Project Management Development – Practice and Perspectives
Third International Scientific Conference on Project Management in the Baltic Countries
April 10-11, 2014, Riga, University of Latvia

CONFERENCE PROCEEDINGS

Conference is organized by the Faculty of Economics and Management, University of Latvia, and the Professional Association of Project Managers, in cooperation with Baltic Controlling Institute, Employers' Confederation of Latvia and Latvian Association of Local and Regional Governments, supported by the "Latvijas Mobilais Telefons" Ltd.

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Professional Association of Project Managers

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Project coordinators: **MSc.proj.mgmt. Silvija Bruņa** and **MSc.proj.mgmt. Emīls Pūlmanis**
Design: **Andra Liepiņa** and **Emīls Pūlmanis**
Layout: **Sandra Neidere** and **Ludis Neiders**

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PREFACE

Ladies and gentlemen, honoured guests, and friends of project management!

This is the third year in a row that the Economics and Management Faculty of the University of Latvia together with the Professional Association of Project Managers organize an international conference for project management, gathering professionals from a number of countries.

In 2013 thirteen countries were represented (Latvia, Estonia, Germany, Spain, Russia, Island, Hungary, Iran, Saudi Arabia, Serbia, Poland, Australia, Chez Republic), and this year several others have joined in.

The conference aims to host a vast exchange of ideas, thoughts, and experience in the benefits of applying project management to resolving practical problems.

Project management has been developing rapidly over the last 30 years and become an important factor in business success. It opens new opportunities for businesses to increase their competitiveness in the market. Project management methods improve project transparency – cash flow tracking, project risk assessment, and risk prevention planning, project stakeholder analysis, project implementation planning and supervision. This is a particularly important aspect for Latvia, since the coming years will bring many large scale projects both in railway reconstruction and big construction objects, such as the new concert hall, as well as various sizeable event organization, for instance Riga-2014 European Capital of Culture year in Riga.

Project management is currently one of the most topical forms of task organization. The necessity for its application is dictated by several factors. The most important among them are the ever increasing complexity of products and services, and market competition. The complexity of products and services causes higher requirements for interdisciplinary knowledge, and the growing competition in markets forces businesses to make better use of their resources, become better and quicker than their competitors, and make swifter changes in their organizations, pursuing their clients' interests. In such conditions project management opens new opportunities for businesses.

An increasing amount of work and tasks are already performed as projects rather than routine work methods. In future, tasks will be more sizeable and, respectively, the demand will grow for qualified project managers, possessing the knowledge and skills to succeed at their job today and tomorrow.

Another result is more emphasis on the theoretical and practical questions of project management as well – how to initialize a project, how to assess it, choose the financially most advantageous projects, and assess project sustainability. Methodical questions of project work, time and resource planning are no less important, along with project risk assessment and monitoring, and selection of project management instruments. IT projects are increasingly using new methods known as the Agile Project Management Methodology. What does its application stand for? In what cases is it the best choice to manage a project? These topics are addressed by many experts and researchers in the conference proceedings.

The Professional Project Managers Association (PVPA) together with the University of Latvia are organizing already the third international conference in project management, giving practical and theoretical specialists from various countries the opportunity to exchange their opinions on practical and theoretical aspects of project management. Such exchange of knowledge and opinions enables us to develop project management as a professional activity not only within an individual country, but on an international level as well.

Evidence to the current importance of project management issues is the fact this year representatives of more than 16 countries have expressed interest in our conference.

I would like to thank our general sponsor "Latvijas mobilais telefons" Ltd. and the many information sponsors for supporting the conference organization.

The conference organizers hope that you will find many interesting discussions in the conference that will provide inspiration for new work.

Prof. Dr. oec. Žaneta Ilmete
Chairman of the board of the Professional
Association of Project Managers

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INTERPLAY OF TANGIBLE AND INTANGIBLE FACTORS IN PROJECT MANAGEMENT: A CASE STUDY OF A MARINE PROJECT

Vivekanand M Bankolli, SJM School of Management, India[1];

Karuna Jain, SJM School of Management, India

Abstract

Project management, a rapidly evolving field, helps organizations achieve pre-set goals. However, despite project managers adopting the latest practices, very few Indian marine projects have been successful, indicating gaps in management practices, which can be attributed to tangible and intangible factors. Although both factors influence project success, the interplay between them has not been examined in detail. Thus, to obtain empirical evidence of this interaction, this study identified gaps in project management via a case study conducted through direct observation and interviews with project participants. It also examined the contribution of intangible factors to project success.

The results showed that the gaps in project management are attributable to intangibles, which act as catalysts for the required interplay between the factors types in achieving project goals. Thus, intangible factors are essential to project management and inclusion of both factors in project management practices will significantly benefit organizations.

Key words: *Project performance, Project success criteria, Intangibles, Project management*

JEL code: M19

1. Introduction

Project management (PM) came into practice during early human civilizations. The earliest known example of PM is apparently on an uncut stone pyramid dating back to 3000 BC, in the city of Caral, Peru. Yet, the practices of PM started gaining importance only in their modern form in the early 1950s, through the systematic application of PM tools and techniques to complex engineering projects in its modern form (Morris, 1997). Businesses began to realize the benefits of PM by the early 1960s, when they began to organize work around projects and recognized the need to communicate with stakeholders and integrate work across multiple departments and professions.

PM is supporting organizations in India to a considerable extent. However, few marine projects in the country have achieved the desired results with respect to schedule, cost, scope, and quality, despite project managers using the latest PM tools, techniques, and processes. A possible reason could be that project managers are incessantly confronted with issues and challenges known as “messes” (Ackoff, 1994) while executing projects, because of which they fail to converge efforts to meet predefined performance criteria. These messes indicate gaps in present PM practices (Kumarswamy & Dissanayaka, 2000; Jugdev & Muller, 2005; Olsena et

[1] Corresponding author – e-mail address: vivekanand.bankolli@iitb.ac.in, telephone: +91 9819379173

al., 2005; Caron et al., 1998; Shenhar & Dvirh, 1996; Soderholm, 1999). Thus, issues affecting PM practices do exist, and they warrant re-evaluation of current practices and their exploration through a different perspective.

The attributes influencing project success can be classified into two major types: tangible and intangible. Tangible factors are those that influence the project directly and can be quantified into units, such as scope, time, cost, and quality. In contrast, intangible factors influence the project indirectly and are difficult to define; they are usually associated with human resources, such as, communication methods, procurement experience, organization culture, team work, leadership, innovation, approach towards resolving issues and conflicts, the organization's approach toward risk, and external and internal environmental factors. This deliberation, since project teams expend their efforts (tangible in nature) to achieve common objective that are cross-functional in nature and a team generally consists of inter- and intra-organization members, performance as an individual and as a team determines project performance. Since teams are often involved in several interactions at various levels in the organization, to meet the desired performance criteria (Eriksson & Westerberg, 2010).

To the best of author's knowledge, studies have not been conducted to determine the contribution of tangible and intangible factors to project performance via a holistic approach; most previous analyses in this regard have been one dimensional (Kumarswamy & Dissanayaka, 2000; Jugdev & Muller, 2005; Olsena et al., 2005; Caron et al., 1998; Shenhar & Dvirh, 1996; Soderholm, 1999). Thus, this paper attempts to identify factors contributing to project performance with a focus on the interplay between tangible and intangible factors. The scope is confined to the Indian marine industry, since research in this area is limited and the author has extensive exposure in this field.

1.1. Objective and Methodology

The study objective is to understand and identify gaps in marine project performance with regard to tangible and intangible factors through exploratory research. The study seeks to answer the following questions: What are the critical success factors in PM and do intangible factors exist and form part of these success factors? What are these tangible and intangible factors and how do they interact and affect project performance? Will introduction of intangible-based management methodology improve project performance?

A literature review was undertaken to identify factors responsible for project success in various approaches. These factors were then examined for their suitability by conducting a case study to obtain empirical evidence.

1.2. Success Criteria

Most organizations focus mainly on the tangible success criteria of cost, time, and scope, known as the "iron triangle" (Atkinson, 1999), which prevents them from realizing additional unexpected advantages from projects and from achieving long-term or strategic goals (Shenhar & Dvirh, 1996). Traditional transaction cost economics in projects mainly focus on competition, which is not favorable under all circumstances. Higher performance can be achieved when PM processes are more flexible and involve information exchange, coordination, knowledge exchange, cooperation and collaborative work, and cooperative procurement procedures. Therefore, these soft parameters need to be included in contracts as success criteria along with the iron triangle. In a collaborative climate, these factors act as mediating or moderating factors, and they are in turn moderated by project characteristics (complexity, customization, uncertainty, value/size, time, etc.), thus improving overall project performance (Eriksson & Westerberg, 2010).

Kumarswamy and Dissanayaka (2000) strongly support the existence of intangibles and acknowledge the growing need for improved project procurement and managerial systems for the client to select the appropriate procurement strategy/option. They developed a knowledge-based advisory system with tangible and intangible variables for decision optimization. On testing the system, they found that only tangible factors as performance criteria were not sufficient and that intangible parameters were also essential for an effective decision support system, to obtain a higher probability of project success.

Client behavior, schedule restriction on milestones, more frequent project status reports, approval delays, micromanagement, and change in scope influence various decisions in complex projects, setting certain limitations and giving rise to conflicts during project implementation (Jugdev & Muller, 2005). Therefore, clients and contractors must consider intangible factors, which will lead to a collaborate climate based on mutual trust. Identification of conflicts and their resolution via a holistic approach by clients and project participants ensures better support from top management, resulting in better project performance.

Current PM success criteria isolate the requirements of customer satisfaction, preventing project team from being more cohesive due to attitude of “that’s not my problem” (Frame, 1994). Project success criteria need to evolve to incorporate client expectations into the project objectives rather than just setting success criteria. As Jugdev and Muller (2005) aptly mention, projects are about managing expectations, and expectations have to do with perceptions of success among agents involved.

Barber (2004) stated that in order to meet client expectations, project managers need to keep abreast with client’s expectations and be flexible and accommodating to new techniques and technologies through benchmarking with best in the industry. This helps them accelerate and manage change by encouraging a culture of continuous improvement (Muir, 2000). Since customers in the present day are more aware and hence demand more, project managers should constantly evaluate customer needs including intangible factors, re-organize the project, and be flexible to handle rapid changes. This will enable them to achieve higher project performance and customer satisfaction.

1.3. Cooperative and Collaborative Interplay

Olsen et al. (2005) stated that contracts and governance mechanisms for handling complex projects need to have different incentive combinations, and they identified authority and trust in contracts as factors governing PM. Their findings showed that project performance was much better when the participants trusted each other and functioned in a collaborative environment. The trust enhanced the participants’ ability to use authority to take calculated risks so as to obtain incentives.

Pesama et al. (2008) claimed that initial consideration of intangible factors during project procurement is crucial since it sets the basis for cooperation between clients and contractors. Traditional procurement practices are competitive, leading to conflicts and adversarial relationships and consequently to poor performance. However, subproject attribute analysis has shown that the right balance of incentives and limited bids is necessary to form a cooperative environment and achieve optimal performance. Caron et al. (1998) further found that inter-phase collaborative intangible factors are necessary for better project performance, specifically, for integration of project phases to respond to the dynamics of site conditions.

1.4. Environmental Factors

Project procurement is affected by various internal and external factors, which are interdependent. In a 2005 study on the defense industry (Navy, part of marine industry), Chase showed that external factors, e.g., the relationship between two countries, regional balance of power, type of threat from other countries, and the procurement policy of other countries, and internal factors, like the political party in power, the authority involved in defense procurement, socioeconomic factors, and inter-service rivalries, both affect defense procurement. Soderholm (2008) stated that project performance is defined by the options considered to deal with unexpected events and other environmental risks triggered during project implementation. The major focus of Soderholm's study was to identify linkages between projects and their environments by outlining different categories of unexpected events as a consequence of environmental changes. Frequent interactions among project participants (client and contractor) within the environment were found to have a positive impact on project conditions and goals. These interactions are categorized into three types: reopening, revisions, and fine tuning. Additionally, Soderholm (2008) noted that empowerment of the project manager and team members encouraged innovative actions, information flow, detachment strategies, negotiation skills, and commitment building among inter- and intra-project team members, all of which improved project performance.

Conservationism is a necessity for current and future project procurement. Hence, Hochsorner and Finnveden (2006) recommended the following tools to minimize environmental risk: simplified life cycle analysis (LCA), also known as material, energy, chemical and others (MECO), and life cycle costing (LCC). They considered it necessary for all participants to perform their roles to seek advantages and ensure successful project implementation to achieve the pre-set objective. For successful implementation and cost effectiveness, it is necessary to gain advantages, and this in turn relies on cooperation, which should be actively sought. However, in interviews, the participants in Hochsorner and Finnveden's study (2006) indicated that they were apprehensive and reluctant to take decisions in favor of LCC or LCA because they had a poor understanding of the environmental risk and its impact on society.

1.5. Contract Formulation

Various factors are involved in contract formulation, and these govern the project life cycle (Yildirim, 2009). In large-scale projects, procurement strategies are governed by Markov's perfect equilibrium theory during commercial finalization. Yildirim (2009) inferred that the interplay of intangible factors dominates the contract negotiation process. These factors are dynamic in nature, and the strategies adopted by the actors during negotiation are administered by rules of game theory and instant environment.

Competition and cost improvisation are carried out on the basis of the phases of the procurement cycle, namely, initial design, development, initial production, and reprocurement (Anton & Yao, 1990). Cost savings cannot be measured at the initial procurement stage, since different tangibles and intangibles eventually affect the project's success. Competitive savings occur only during reprocurement, as competition comes into play only in the subsequent sourcing. Therefore, it is important to formulate contracts such that they include both the intangible and tangible interests of clients as well as contractors at all stages of procurement.

Consideration of intangible factors during contract formulation for a project leads to an alliance between the buyers and suppliers for complex projects. Therefore, Ahola et al. (2008) proposed the theory of value creation for customers. Value creation is based on elements, benefits, and sacrifices: "customer value is the difference between benefits received and sacrifices made by the customer." Turnkey delivery includes a complex combination of tangible and intangible components, which need to be integrated to create a functional offering. Ahola et al.'s (2008) results showed that since value addition is a function of long- or short-term requirements and should include buyer's interest, buyers' purchasing strategy needs to be well understood and executed.

1.6. Taxonomy

Nowadays, managing projects involves much more than planning and executing an interrelated set of activities: it also involves integration of numerous management functions into processes. Creation and execution of the appropriate typology of projects will enable organizations to utilize their resources optimally during program or project execution. Most taxonomies/typologies do not provide decision rules for classifying organizations. Hence, Doty and Glick (1994) outlined criteria for typology by including performance factors, thereby formulating a theory. Similarly, Shenhar and Dvirh (1996) suggested a two-dimensional taxonomy for projects and PM styles, along with organizational attributes. For developing this PM theory, they considered various organizational aspects, and they, too, suggested that intangible factors are necessary to consider while formulating the appropriate taxonomy.

The available literature does indicate gaps in present PM practices attributable to the exclusion of intangible factors, and they influence project performance. The currently accepted success criteria and PM processes are not adequate to ensure project success; success in terms of the iron triangle may be achieved, but the purpose for which the project was undertaken may not be accomplished. This leaves clients and stakeholders less satisfied, making project success temporary and subjective. It is also evident that intangible factors play a critical role in project success, although their contribution needs to be explored thoroughly. These factors also need to be correlated with project typology. Since factors identified in various studies seem independent of each other, they need to be integrated for a better plausibility of project success, as independently they cannot assure project success. Further, few studies evaluate project performance while considering project channel members, and these studies have limited themselves to adjacent channel members.

Therefore, this study is conducted to verify previously reported tangible and intangible factors influencing project performance by inclusion of all channel members in the marine industry. This paper attempts to verify the aptness of the identified tangible factors and focuses on set objectives via a holistic approach.

2. Case study

2.1. Case Study Design

The exploratory case study undertaken here was designed and conducted based on the research methodology suggested by Yin (2003). The data were collected from multiple sources of evidence for data triangulation. Yin (2003) identified four threats to validity that need to be addressed to establish the quality of case study research: construct, external, internal, and reliability validities. All these were checked and mitigatory actions were undertaken to eliminate threats to validity.

In the selected case, the project is the unit of analysis investigated for its performance on primary success factors, "iron triangle", and evaluated according to set objectives. Data were collected from process documents, archival records, interviews with project participants, and direct observation. Process documents were examined to determine inter- and intra-department understanding of the processes being followed. These included policy and procedures, inter- and intra-project documentation, training provided to the project team, presentations given, test cases, communication plans, risk logs, status reports, outcomes of retrospectives held, project-tracking spreadsheets, release plans, pictures of white boards depicting the outcomes of discussions, and weekly showcase presentations made by the project team to the customer.

Interviews were conducted with project participants across all project channel partners; attempts were made to ensure that all roles were represented. Eight participants from each channel totaling 40 members were interviewed, and all organizational levels were represented. The interview duration was fixed at a maximum of one hour each, and selected candidates were informed about the study purpose and about why they were selected. Permission was sought from the participants for their involvement in the study. Participant's identities were recorded in coded form to ensure anonymity, so that unbiased information could be obtained for analysis. The participants were questioned about their background and experience. Subsequent discussions were in the form of a semi-structured interview, with questions focused around the study objective and their related experiences. The output of the discussions was transcribed, and the participants subsequently checked whether their data had been captured appropriately.

Direct observations were carried out by visiting sites, meeting people, and assessing their behavior. The aim was to check for various intangible factors related to the participants as individuals and as team members, in formal and informal settings.

The project selected for analysis was executed by an original equipment manufacturer (OEM) from the oil and gas sector, a segment of the marine industry. The OEM Company is a joint venture between an American and an Indian company. The project considered is of the modified engineering, procurement and management (EPM) type and entails engineering, procurement, manufacturing, on-site testing known as the factory acceptance test (FAT), supervision of installation, and the site acceptance test (SAT) conducted on the platform. The project involved the supply of pedestal-type American Petroleum Institute (API)-monogrammed cranes.

The OEM started operations in mid-2010, and project was received in November, 2011 and the organization is headed by an Executive Chairman with Chief Operating Officer (COO) reporting to him for all the operations. The COO is assisted by a Chief Financial Officer and heads of departments (engineering, procurement, production, quality, project, human resources, administration, and accounts departments). COO and CFO had recently joined the company when the project was accepted, and project department was also newly introduced in the organization.

2.2. Project Details

The project channel members in this case were the end customer (a public sector corporation); an engineering, procurement, construction and installation (EPCI) contractor (main contractor); the OEM; vendors/suppliers; and sub-vendors /sub-suppliers/manufacturers. In this case, the OEM had received a direct order from the EPCI contractor. . The specifications and project details are given in Table 1.

The project was finalized after considerable negotiation between the contractor's team (procurement and project representatives) and the OEM team (Executive Chairman and sales head). Nonetheless, the negotiation process was smooth, and the contract was awarded to the OEM since the company committed to adhering to the schedule mentioned in the contract. Since this was the first direct order for OEM, they accepted all contractual terms and conditions. The contractor had nominated a project coordinator to oversee all project communication. The client's procurement manager was also responsible for overseeing and project deliverables, since the crane was classified as a product.

The OEM has a weak project organization structure (PMPBOK, 2008) with design head nominated as project manager. The project was handed over to the project manager in an internal contract review meeting after issuance of an internal work order (IWO), a document describing the project in detail. Internal participants could refer to this document for the contract requirements. However, in this case, the IWO was not adequately detailed and had too many open-ended statements. The project schedule was based on the letter of intent, with the micro-plan provided by the joint venture partner (JVP) to the project manager. The micro-plan was, however, redundant, since the project manager lacked expertise in the MS Project tool. The project manager was not provided a budget or the contract value, so cost criteria were not monitored or tracked. In addition, the role of the project manager was not well defined, so responsibilities were limited to interacting with the customer. The project status was directly monitored by the Executive Chairman, who held the centralized decision-making authority, decisions focused on cost and factors influencing it, the project organization and interplay of decision is as shown at figure A. The team also reported to functional JVP counterparts in addition to their respective superiors. Project coordination took place at the level of the department head and higher. Thus, roles and responsibilities were unclear, and the PM style was disorganized.

The engineering phase of the project was prolonged because of a rigid approval process, according to which the OEM was responsible only for producing drawings after design by the JVP, and the drawings were to be approved by JVP, because of which the OEM was dependent on the JVP. The procurement department, apart from procurement, vendor development, vendor liaising, expediting, import/export, customs, and excise, was also responsible for management of stores, receipt of all material, and dispatch of the entire crane in the knockdown condition.

The initial procurement phase was complex, as the process involved the engineering, quality, production, and project departments; the OEM's corporate office; and the JVP's design and procurement departments. Further, all import activities were to be routed through the OEM's London office except for placement of the purchase order, which was done by the OEM's procurement department.

Procurement in this case followed two modes: imports and domestic. The list of imported items was provided by the JVP, and the orders were placed by the OEM's procurement department. The imports were further controlled by the OEM's corporate office under direct supervision of the Executive Chairman, to keep cost confidential. Since the contract was a direct order, responsibility for ensuring that the project was executed and completed lay with the OEM. Further, it was the OEM's responsibility to ensure that all raw material and bought-out parts were procured in time. However, the JVP dictated the specifications, which they provided according to a planned schedule, thus making OEM highly dependent on them. The import phase was very critical since items were procured under advance license, to receive customs duty benefits. The major drawback in this process was the lack of expertise in the company; all responsibility lay with the procurement manager, who had very limited knowledge in this domain. Domestic parts were to be procured in India, and procurement was to be undertaken after approval from the JVP, to maintain quality standards and specifications, even though these items were non-critical in nature.

The quality department was responsible for total quality management in the organization, mainly focusing on quality assurance and quality control of the process and product at all stages of the project. The organization had adopted a quality-oriented culture, since the JVP followed this culture globally for API-monogrammed products along with ISO standards. All quality, process, policy, and procedure and project documentation from generation, collation, and distribution (internally and externally) to archiving was the quality department's responsibility.

Production was considered as the most important activity since the project deliverables were dependent on the manufacturing, painting, and assembly of the crane. The service department was responsible for assembly, but for project execution, the organization was restructured, and this department was brought under the production department on an informal basis. This meant that for all service requirements, the service manager had to report to the production head in addition to the COO and business development head. The service manager was thus placed one level below in the organization structure, leading to dissatisfaction in the service team. Further, there was a struggle between the production and service teams for crane assembly, since they competed over incentives like on-the-job training and opportunities to visit the site for re-assembly, installation, and commissioning. Other departments were considered supporting departments to quality and production, which left many team members demotivated.

Although this project was awarded on the basis of commitment and acceptance of the completion date, prior to contract acceptance, the OEM and JVP were not in agreement over the commitment and success criteria, and this disagreement persisted until project completion. Priority conflicts arose since this project was a direct order for the OEM, while another project was also under execution, which was an indirect order (from the JVP).

Table 1

Case Specifications and result

Criteria	Data/ Information	Remarks
Contract	Design, Supply & Commissioning of API monogrammed Crane	
Value	9,75 Crores (02 cranes)	Fixed, variation only for the commissioning of the crane – SAT
Contract form	Turnkey type	
Organization structure	Intra Organization – Weak Matrix	The project coordination was affected due to the confusion of the reporting and the objectives
Number of channel levels	Four(including OEM)	The order was direct on the OEM, hence lesser channel level
Immediate customer	EPCI contractor	For first time the OEM was handling EPCI type contractor hence had lot of project related issues
Project duration	08 months	Fixed duration, except for erection & SAT
Schedule plan date	Crane 1 – 18 May 12	
	Crane 2 – 6 Jun 12	
Actual date of Delivery	Crane 1 – 7 Oct 12	05 months delay
	Crane 2 – 9 Oct 12	04 months delay
Total Delay	05 months	
Channel partners Relationship	Channel partners	Strained between all the channel members
Stakeholders consideration	Not done by Contractor nor OEM	The stake holder analysis was not carried out, focus was more on cost savings than commitment towards the schedule
Stakeholders management	Nil	Only end customer was managed by Contractor. OEM did not manage any stakeholders
Decision Making	Centralized – Controlled by top management in OEM organization	This led delay in decision making, and some time was not an informed decision – Autocratic type
Platform sailing out	15 days, delay due to crane commissioning & trials	The platform was built as per the schedule

Criteria		Data/ Information	Remarks
End result	Cost	08% above the budgeted cost	Excluding 10% LD which is still being negotiated
	Scope	Nil	Scope changes were not accepted by OEM, hence undertaken by Contractor
	Time	Delayed by 62.5% (05 month) against contractual schedule	The delay was too much, and this affected the schedule of the platform
	Strategic difference	1. HR issues – attrition	1. High attrition in OEM organization & team
		2. Inter & Intra conflicts organization conflicts	2. Inter & Intra conflicts very high
		3. Future business	3. Loss of projects due to delay in the present projects
		4. Stress	4. Stress with the participants leading to health problems and accidents
		5. Trust	5. Less trust
		6. Decision making	6. Centralized & less empowerment to OEM project participants. Higher management had the decision making capacity
		7. Channel partners relations	7. Channel partners reluctance to carry out business
		8. Termination of workers and staff	8. Uncertainty and low morale
		9. Joint ventures	9. Joint ventures dissolved and OEM taken over by JVP

3. Results

Interviews with the participants and observations from the case study yielded the following findings. First, the project conception was not appropriate since adequate importance was not given to cash flow and schedule. Further, the project negotiation was undertaken by the OEM with the only motive of getting a direct order.

Poor cash flow and management of cash led to uncertainty among project participants across all channel members. Overall, negative interplay of tangible and intangible factors was observed, leading to poor project performance.

Interviewees reported that the project participants came under tremendous stress during the later stages of the project, since they had to work almost 16–18 hours a day, sometimes even 24 hours. Further, no team-building processes or motivational exercises were conducted. The staff payments were delayed and leave was not sanctioned for many. They were also not provided medical insurance, and logistic arrangements were controlled by local vendors. This led to illness and high attrition rates, causing inter- and intra-department conflicts related to ownership and shirking of responsibilities, which affected project performance; one department had an attrition rate of 100%.

A grand opening was held for a new facility, due to which assembly and testing of the crane was stalled halfway, as all the resources were diverted, causing a delay of almost 25 days. The project was severely delayed for various other reasons as well, as reported by the interviewees and observed by the author. Engineering-related problems occurred, for example, no infrastructure for design checks; inadequate expertise; classification of the vessel as ABS, although ABS (India) had limited experience working on API cranes; delay in availability of design for detail engineering; inter-department conflicts due to project allocation to the engineering manager, resulting in conflicts of interest between the engineering head and engineering manager since both were responsible for different projects; and non-availability of assembly drawings. Similarly, there were problems with procurement, e.g., late availability of material take off; classification agency requirements for material procurement; lone approved vendors; nonstandard terms of payments; non-qualified domestic vendors; non-payment to vendors; and local vendor monopoly.

Poor inter- and intra-organization cooperation was also observed, due to lack of trust among the project participants. Most project participants were working in silos because of poor dissemination of project objectives within the organization. Many conflicts were observed between the OEM and JVP, which snowballed to all levels in the OEM Company. The OEM had a poor relationship with the channel partners because the company was not committed towards the promises made. Because decision making was centralized, the project team followed instructions forced on them, despite being aware of better options. Productivity was low, and poor organizational structure in the OEM created confusion. Project participants from the OEM were de-motivated because of variation in resource requirements, leading to job insecurity, which was exacerbated by the master-servant relationship between the management and workers.

The OEM did not heed the partner's advice and agreed to supply six cranes in one year despite having experience in manufacturing and supplying only one crane under the JVP's supervision. Further, project typology was not given any consideration because of which resources were not appropriately assigned to various projects in the OEM.

Progress reports submitted biweekly to the client were highly optimistic, as directed by the Executive Chairman. Therefore, the client was unaware of the actual delay in the project. Once the project was delayed beyond the risk buffer, the customer stationed an expeditor at the facility, and this ensured factual reporting. Further, the contractor, albeit unwillingly, ensured better cash flow, and no further delays occurred for want of project funds. This project became a critical activity for the contractor, since the only work left on the platform was installation and commissioning of the crane. In the final stages of assembly and testing, the project witnessed a few critical failures, and further delays were caused because of non-availability of the right material.

Most stakeholders, including the JVP, customer, and end customer were enraged about the considerable delay in project completion. The contractor was relatively cooperative despite the delay and wished to finish the project in an amicable way. During FAT, all minor punch points were ignored, and the activities were undertaken at the contractor's yard. On receipt of the cranes at the yard, there were no delays in installation, commissioning, and SAT, and all required procedures were successfully completed according to the classification requirements.

The vendors and sub vendors in the channel members were reluctant to provide the support due to OEM's oppressive approach towards them, Apart from not providing their payments in time their issues and requests were unheard and unattended. Thus OEM having uncooperative relationship with them

All interviewed participants across the channel members confirmed that control of tangibles factors did not allow for proper governance of the intangibles, in addition interplay of intangibles negatively affected project performance. Thus, although tangible factors are prerequisites as business requirements, intangible factors are necessary for project success.

4. Discussion

Undeniably, intangible factors affect all types of projects, and they must be instituted into PM processes. Previous studies in this regard adopted a micro-approach, either towards specific knowledge areas or specific intangibles factors related to project success (Shener, 1996; Kumarswamy, 2000; Jugdev, 2005; Olsen, 2005; Pesamma, 2008; Ericksson, 2010; Caron, 1998; Chase, 2005; Soderholm, 2008; Hochsorner, 2006; Yildrim, 2009; Anton, 1990; Ahola, 2008; Doty, 1994; Dvirh, 1996). These studies evaluated factors responsible for project performance based on models or propositions considering a maximum of two channel members, and each study examined a very specific factor or factors related to specific knowledge areas of PM. Therefore, they failed to conduct a holistic examination of PM, which integrates several knowledge areas and numerous factors that collectively affect project success. The present study, in contrast, considers projects as the units of analysis as a whole, and it evaluates various tangible and intangible factors that contribute to project success. In addition, only identified study about factors affecting PM pertained to the marine industry (Olsen, 2005), and even this study is limited in that it focuses on procurement.

Although researchers have identified numerous intangible factors affecting PM., their results seem mutually exclusive. Therefore, these previously identified intangible factors and the additional ones identified in the present study must be consolidated to fall under the categories of success criteria, cooperative and collaborative interplay, external and internal environment, contract formulation, and taxonomy. The interplay of intangible factors begins from the conception of the project idea and ends with the post-completion phase; yet, most organizations consider only the iron triangle as success criteria, preventing them from gaining long-term benefits.

Effective PM involves informed and timely decision making, mainly by the project manager and participants. Occasionally, decisions contrary to decision models need to be made, since no dynamic intelligent model has been created thus far to take project scenario decisions, which are uncertain, risky, and dynamic. Although decision models do consider intangible factors, they cannot be used blindly; they should ideally act as guides for informed decision making.

The environment is becoming a crucial factor affecting project success, since environmental risks have a very high impact and should be addressed urgently. It is cause for concern that this factor did not come to light in the interviews with project participants in the present study. National and international policies need to be framed in line with LCA and life cycle economic costing, in order to adequately consider environmental risks. Nowadays, business operations are rarely restricted to single countries, and it is a global necessity to consider environmental issues from both the business and social perspectives.

In the case study, it was observed that issues and conflicts were not attended to and addressed appropriately. Key project participants should have identified these conflicts and devised a method of resolution at the early stages, as mentioned by Soderholm (2008), using different approaches such as better communication, consideration of channel member's issues, formal and informal meetings, prioritizing activities, and adopting cultural sensitivity. This would have helped all stakeholders to understand each other's viewpoint and participate in more effective resolution of issues and conflicts.

Intangible factors that guide contract execution and encourage cooperation and collaboration need to be included in contracts, in order to empower project participants. Contract negotiation can be initiated by involving subcontractors during the tender formulation stage. However, caution should be exercised to ensure a threshold among organizations, since over-involvement may lead to business risks, such as subcontractors becoming competitors and loss of expertise.

5. Conclusion

The present study confirmed the contribution of intangible factors to PM in the marine industry and identified gaps in PM in current marine projects attributable to the absence or disregard of the appropriate intangible factors. Both tangible and intangible factors affect projects from conception to the final post-execution stages, and the interplay between these factors as they mediate various project phases is critical for project success. The degrees to which these factors affect project performance depend on the project phase and complexity. Inclusion of the correct intangible factors into processes should be part of the contract for compliance and should be applicable to all channel partners. It should be noted that inclusion of only intangible factors is not sufficient: these factors need to be embedded into processes along with tangible factors and should be practiced properly during contract formulation and execution. Additionally, while attempting a cooperative and collaborative approach to PM, boundaries need to be defined appropriately such that business ethics are not compromised.

In conclusion, the critical success factors that affect projects should include tangibles as the primary requirements and intangibles as the secondary requirements, and projects should focus more on objectives than rigid success criteria. Intangible factors do exist in PM in the marine industry as well, and they play a vital role in achieving pre-set objectives. They act as catalysts for project performance. However, intangible factors by themselves are not adequate to achieve project objectives. Importantly, the interplay of the factors should be recognized and understood by all channel partners, who need to form an alliance and function as one system. This study has limitations in that it included only a single failed project in the case study and examined a small sample. Further research should extrapolate on this study and devise an optimal methodology to examine the interplay of intangibles, which can be adopted by organizations to improve project performance.

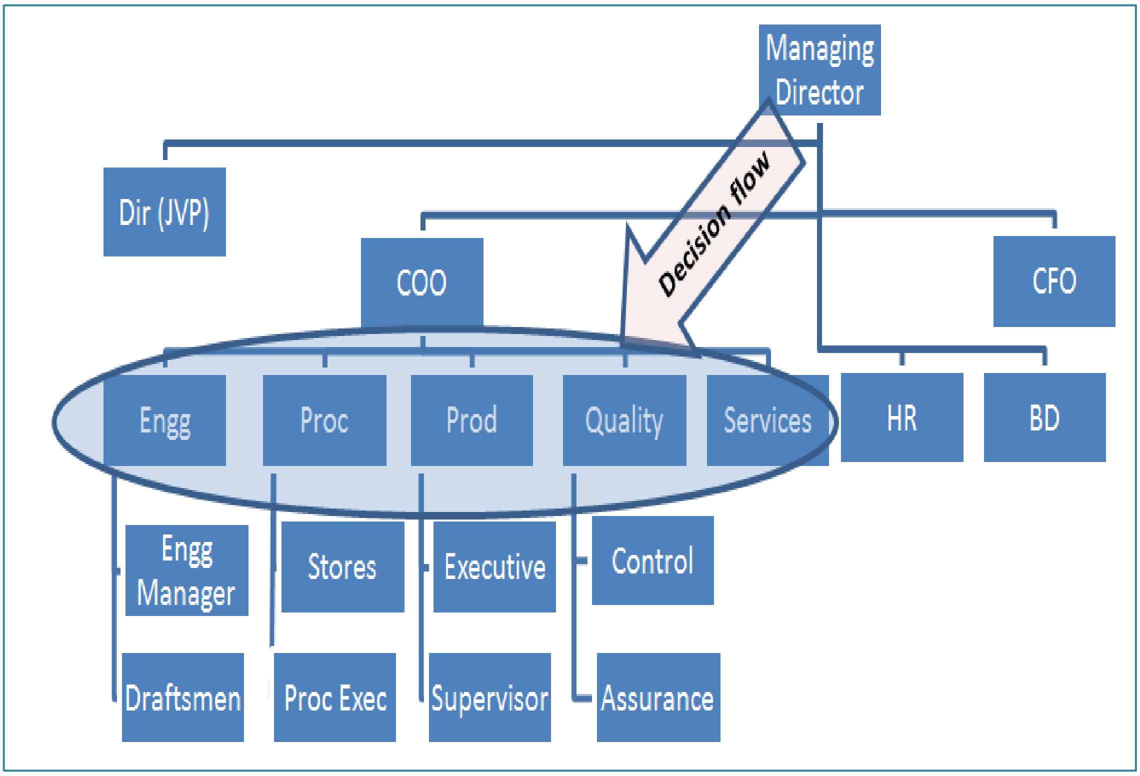

Fig. 1. **Project organization and decision flow**

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PROJECT SCHEDULING METHODS USED UNDER UNCERTAINTY: A NUMERICAL EXAMPLE

Muhammet Deveci, Yildiz Technical University, Turkey[1];

Fatih Canitez, IETT, Public Transport Company in Istanbul, Turkey;

Mehmet Kiliç, IETT, Public Transport Company in Istanbul, Turkey;

Nihan Çetin Demirel, Yildiz Technical University, Turkey

Abstract

Project scheduling is usually employed for many reasons such as investigating the results of possible delays in activities' completion times, checking progress control and allocating the resources over the duration of the project. The methods used for Project Scheduling in the literature generally deal with problems having a deterministic nature. However; in real life situations, the problems requiring scheduling methods often involve uncertain conditions. In this article, the project scheduling methods in the literature are examined with a view to analyzing the project scheduling techniques used under uncertainty. There are many scheduling methods which can be utilized for the projects under uncertain conditions. Among these methods are Stochastic Project Scheduling, Reactive Project Scheduling, Proactive (Robust) Project Scheduling, Sensitivity Analysis and Fuzzy Project Scheduling. These scheduling procedures are used for different kinds of uncertainties. Whereas some of these methods such as Stochastic Project Scheduling require statistical modelling procedures, some scheduling methods such as Fuzzy Project Scheduling include fuzzy conditions. A numerical example is presented in the last part of this article for the purpose of elaborating on the use of Fuzzy Project Scheduling.

Key words: *Project management and scheduling, Scheduling under uncertainty, Parallel kangaroo algorithm, Fuzzy scheduling procedure*

JEL code: C6

1. Introduction

Scheduling is employed to provide a product or service by assigning labor, materials and facilities. There are remarkable differences in how scheduling is used depending on the type of operation. These types include process industries, mass production, projects and job shop production. Among these types, project scheduling involves many decisions and these decisions are often interrelated with each other, PERT and CPM techniques have been developed for this purpose. The main reasons for scheduling are meeting customer demands, minimizing delays, minimizing response and completion time, minimizing overtime, maximizing equipment and labor usage and minimizing idle time (Russell and Taylor, 2011).

[1] Corresponding author – e-mail address: mdeveci@yildiz.edu.tr, telephone: +902 123833031

Most of the planning and scheduling cases include jobs that have precedence relationships between them. For example; for the production of a certain product, there might be some jobs that should be finished before carrying out the next job. These type of scheduling problems require the minimization of the duration for the whole process and at the same time abiding with the precedence constraints. These kind of problems are referred as project planning and scheduling problems. Without labor constraints, the basic project scheduling is quite easy to compute. When the labor constraint should be taken into account; especially in large projects like real estate developments, construction of power generation centers, software developments, computing the optimal solution can sometimes be hard. For these kinds of problems, some special methods should be utilized to facilitate the computation process (Pinedo, 2005).

In the real world, projects are subject to numerous uncertainties at different levels of planning. There are a number of studies in the literature covering the project scheduling problems under uncertainty. Hapke and Slowinski (1996) made a study on the generalization of the priority heuristic method for solving resource-constrained project scheduling problems (RCPS) with uncertain time parameters. This generalization includes handling fuzzy time parameters instead of crisp ones. In order to create priority lists, Hapke and Slowinski proposed a fuzzy ordering procedure. Herroelen and Leus (2005) proposed an article named "Project Scheduling under Uncertainty: Survey and Research Potentials". In this article, they made a review of the fundamental approaches for scheduling under uncertainty: reactive scheduling, stochastic project scheduling, fuzzy project scheduling, robust (proactive) scheduling and sensitivity analysis. They also discussed the potentials of these approaches for scheduling under uncertainty projects with deterministic network evolution structure. Masmoudi and Hait (2013) developed fuzzy modelling and solving techniques for project scheduling problems involving uncertain conditions. They devised a new technique that keeps uncertainty at all steps of the modelling and solving procedure by taking into account a fuzzy modelling of the workload inspired from the fuzzy/ possibilistic approach. Creemers et al., (2008) examined project scheduling with net-present-value objective and exponential activity durations by means of a backward stochastic dynamic programming recursion. They also analyzed the particular setting in which the individual activities carry a risk of failure and in case that an activity fails the whole project also fails. Rahmani and Heydari (2013) analyzed the robust and stable flow shop scheduling with unexpected arrivals of new jobs and uncertain processing times. Bruni et al., (2011) used a heuristic approach for resource constrained project scheduling with uncertain activity durations. Bidot (2005) developed a general framework integrating techniques for scheduling under uncertainty.

In practice, projects may contain many activities. To schedule such projects, under constraints of limited resource and precedence relations, it becomes an NP hard problem. Any exact algorithms will have difficulty solving such problems. In addition, many activities of a project are quite often imprecise and vague due to lack of sufficient information. Fuzzy set theory is the best way to describe such data (Pan and Yeh, 2003). In this study, a parallel kangaroo algorithm approach is developed to handle project scheduling with fuzzy data.

In this article, the focus is on fuzzy time-bound and fuzzy resource-bound project scheduling problem. The remainder of this paper is organized as follows: In the second part, project scheduling under uncertainty and kangaroo algorithm are investigated. In the third part, an example is given for solving fuzzy Project scheduling problems by parallel kangaroo algorithm. Finally in the last section, conclusion is remarked.

2. Project Scheduling Under Uncertainty

In a scheduling environment, it is desirable that realized schedules have high system performance and that they do not deviate significantly from initial schedules. To achieve these objectives and cope with the uncertainty in scheduling processes policies are considered. To deal with uncertainties in project scheduling, Herroelen and Leus (2005) distinguish between five main approaches: stochastics project scheduling, reactive project scheduling, proactive project scheduling, sensitivity analysis and fuzzy project scheduling. The literature on stochastic project scheduling is rather sparse. Most efforts concentrate on the so-called stochastic resource-constrained project scheduling problem. The stochastic resource-constrained project scheduling problem aims at scheduling project activities with uncertain durations in order to minimize the expected project duration subject to zero-lag finish-start precedence constraints and renewable resource constraints. The studies carried out about this subject generally bring different heuristic methods and solution techniques (Koyuncu, 2011).

Reactive scheduling does not directly consider the uncertainty in generating schedules, but revises the schedule when unexpected events or disruptions occur. (In other words, reactive scheduling aims at finding the ways to (ideally) optimally react to disruptions after they occur. The reaction generally takes the form of either modifying the existing initial schedule (repairing), or generating a completely new schedule from scratch (Sabuncuoğlu and Gören, 2009). A new project scheduling is done according to this approach, However, in case that this is done too frequently, there are some concerns that project scheduling becomes extremely reactive. Fort this reason, another approach, namely proactive scheduling, is developed. In proactive scheduling, the main objective is to develop a project scheduling scheme which is least vulnerable to possible setbacks (Çubukçu, 2008). Proactive scheduling, considers future disruptions when generating initial schedules. It is concerned with generating an initial schedule that minimizes the effects of disruptions on the performance measures (Sabuncuoğlu and Gören, 2009). Another important method which is used in project scheduling under uncertainty is sensitivity analysis. As is well known, in sensitivity analysis the results are analysed with respect to their sensitivity to the changes in input. It is quite important to be able to carry out proper sensitivity analysis for questions like whether in what range of a parameter it is possible to preserve the optimality of the result or in case of a new parameter what the optimal result would be and to test the robustness of the model (Cubukcu, 2008). Sensitivity analysis addresses ‘‘What if. . .?’’ types of questions that arise from parameter changes. The authors study polynomially solvable and intractable machine scheduling problems and try to provide answers to a number of fundamental questions such as (a) what are the limits to the change of a parameter such that the solution remains optimal? (b) Given a specific change of a parameter, what is the new optimal cost? etc. Fuzzy project scheduling that the advocates of the fuzzy activity duration approach argue that probability distributions for the activity durations are unknown due to the lack of historical data (Herroelen and Leus, 2005).

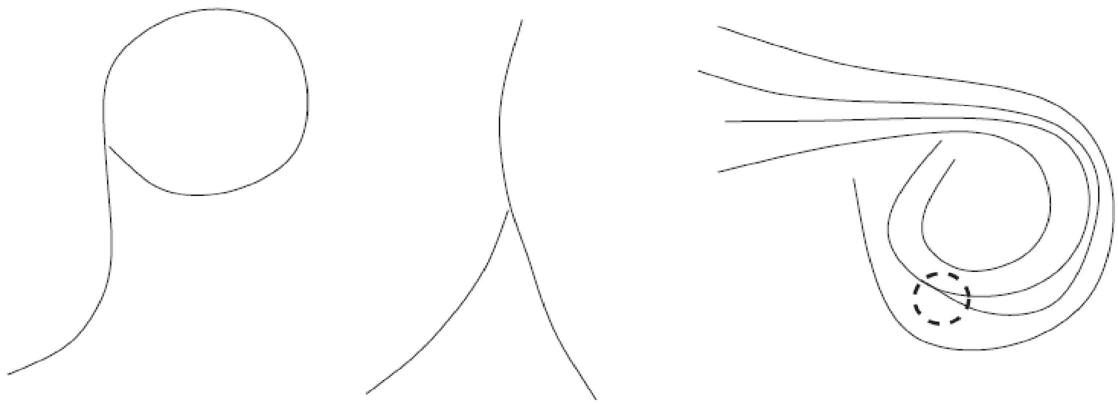
In this paper, a new optimization method based on parallel kangaroo algorithm for solving project scheduling with uncertain activity duration is proposed. Fuzzy set theory is used to represent the uncertainties of activity duration. A searching technique using on parallel kangaroo algorithm is adopted to search for the minimum of fuzzy project makespan. A case with uncertain activity duration is used to illustrate the performance of the proposed method.

2.1. Heuristic Methods

To find an optimal decision for a project scheduling problem with uncertain activity duration times, we need to design some heuristic algorithm. The insufficiency of the amount of problems that can be solved by precise solution methods and the high magnitude of durations prompt the researchers to study on heuristics methods which provide not the optimum but relatively optimal solutions for greater projects. The results of heuristics methods, at the same time, are also important for determining an upper or lower bound for exact solution methods.

2.1.1. Parallel Kangaroo Algorithm (PKA)

It is often stated that kangaroo method is at the same time known as lambda method, but with the popularization of the rho method, rho method is stated as lambda method and these methods are often confused with each other.



(a) (b) (c)

Source: Teske (2003)

Fig. 1. **(a) Rho method; (b) Kangaroo method; and (c) Parallelized rho method**

In rho method that Pollard developed to solve discrete algorithms, a ranking (yk) is composed in G. Inıtial term is chosen y0 Є G, and the following rule is like this: yk+1 = F(yk), k Є N, F: G → G. This periodical ranking, if drawn on a paper, takes the shape of rho in Greek alphabet, beginning with lower corner and ending with a circle (Figure 1 (a)). If the kangaroo method is shown on a paper, domestic kangaroo begins from lower left and wild kangaroo begins from lower right and their paths converge after some time. This figure is the same as the lambda character in Greek alphabet (Figure 1 (b)). In paralellized rho method, different rankings of rho and where these intersect a lambda shape is formed (Figure 1 (c)). This also shows the similarity of the functions (Teske, 2003).

Parallel kangaroo algorithm, as can be understood from its name, includes independently jumping two operators (kangaroos) at the same time interval. Domestic kangaroo makes local leaps with little jumps. On the other hand, wild kangaroo has greater leaps and tries to reach different solution areas. In practice, both kangaroos begin their moves at the same time and with different starting rankings. They continue jumping until they reach the target point or maximum iteration number. After every jump, the objective function is calculated again, and if the result is better than before the calculation continues with new ranking. When maximum iteration number is reached, which kangoroo (domestic or wild) reaches better solution, other kangaroo begins the next iteration group with that ranking. This process continues until reaching target point or maximum iteration number (Baysal et al. 2012).

Kangaroo algorithm, which is an iterative solution improvement method, is developed with inspiration from heuristics like tabu search and simulated annealing. This method is also categorized as neighbour search algorithm. In discrete optimization problems, solution is searched beginning from a certain point and neighbours are searched according to a certain neighbourhood function. This phase is called descent. The beginning solution is called u and at every step neighbouring solutions are investigated (uı). Current optimal solution is called u* and if searched solution is found then this solution set becomes u. Neighbour search methods are used to scan all solution space. In the beginning, alternative solutions are determined among near neighbours among of a known solution. When a certain number of iterations (A) are completed and if there is no improvement in objective function, then second step begins. The second step is called jump in the literature. A different neighbour search technique of jumping is developed to stop the solution point stucking with local optimum. In this step, besides near neighbour search solution set is altered arbitrarily to scan also different points of solution space. Again in the same manner, if there is not any improvement by determined step number, a descent is made to change from the best jumping point to near neighbour search procedure (Erdem and Keskintürk, 2011).

Minzu ve Beldiman (2007), points out that KA application works in the manner of N(u) neighnourhood and with the shift of i and i+1located jobs u' solution set is reached via u. For example, if u = [1 4 3 2 5] then N(u) = { [4 1 3 2 5], [1 3 4 2 5], [1 4 2 3 5], [1 4 3 5 2], [5 4 3 2 1] }.

Parallel Kangoroo Algorithm Steps (Kökçam and Engin (2010))

Step 1: Determine the activities according to precedence relationships
(Activities having no precedent activity or completed activities)

Step 2: Check resource intersections.
a. *If the resource need of activities that can be chosen is greater than available amount of resource, then there is resource intersection.*
b. *If the resource need of activities that can be chosen is equal to or smaller than available amount of resource then there is no resource intersection. Select these activities and go to Step 4.*

Step 3: Determine the activities that can be chosen:
a. *Select a random activity for domestic kangaroo.*
b. *Select randomly an activity that domestic kangaroo has not chosen for the wild kangaroo.*

Step 4: Schedule the selected activities.
Calculate the beginning and ending times according to completion times of precedent activities.

Step 5: Check the algorithm at the end.
a. *If all the activites are scheduled then finish the algorithm.*
b. *If not all activities are scheduled then return to Step 1.*

3. Numerical Example

This example is contributed by Kökçam and Engin (2010) who makes a study on parallel kangaroo. This example consists of 7 activities. Figure 2 and Table 1 presents precedence relationships and resource needs of these activities. The earliest fuzzy beginning time of the project is (1,2,2,2). It is assumed that there is only on resource and the availablity of this resource is 2.

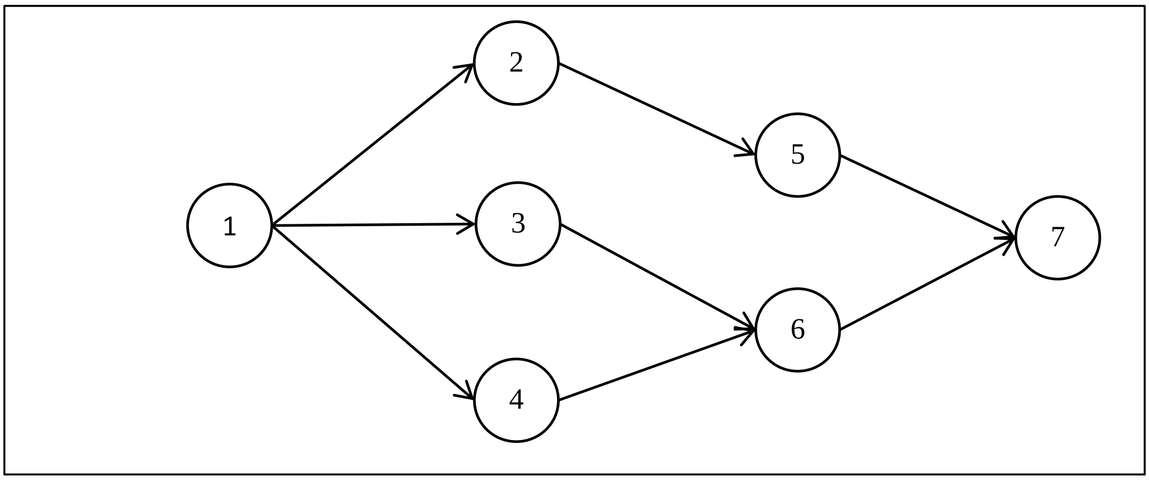


Fig. 2. **Flow diagram of the example**

Table 1

Activity durations and resource needs of the example

Activity	Time	Resource Need
a_1	(3, 5, 7, 8)	1
a_2	(6, 9, 13, 15)	1
a_3	(12, 16, 18, 20)	1
a_4	(7, 11, 16, 23)	1
a_5	(5, 6, 7, 8)	1
a_6	(8, 10, 14, 15)	1
a_7	(23, 26, 29, 30)	1

The only activity that is to be chosen at the beginning is activity a1 which has no precedent. In the second step, a1 is chosen since it has less resource need (1 unit) than the current resource (2 units) and fouth step begins and after that, the scheduling of this activity is done, calculating starting and ending times. In the fifth step, it is seen that not all activities (7 activities) are scheculed, so one returns to the first step. In the second step, activities (a2, a3, a4) are determined again according to the precedence relationships. In the second step, it is seen that resource needs of these activities (3 units) are greater than current resource need (2 units) and one goes to third step. In this step, domestic kangaroo selects randomly an activity (a4) and wild kangaroo randomly selects an activity (a2) that is not selected yet. In the fourth step, the starting times and completion times of the selected activities according to the completion times of the precedent activitities. In the fifth step, it is seen that not all activities (6 activities) are scheduled and again one returns to first step. This process goes on until all the activities are scheduled. According to the results that are found, domestic kangaroo schedules in the order 1-4-3-2-6-5-7, completing the project in time (45, 59, 74, 86) (look at Table 2) and wild kangaroo completes the project in the order 1-2-4-5-3-6-7 and with completion time (54, 70, 86, 98) (look at Table 3).

Table 2

The results obtained from domestic kangaroo

Domestic Kangaroo						
Step	**Alternatives**	**Selected Activity**	**Resource Need**	**Current Resource**	**Starting Time**	**Completion Time**
1	a_1	a_1	1	2	(1, 2, 2, 2)	(4, 7, 9, 10)
2	a_2, a_3, a_4	a_4	3	2	(4, 7, 9, 10)	(11, 18, 25, 33)
3	a_2, a_3	a_3	2	1	(4, 7, 9, 10)	(16, 23, 27, 30)
4	a_2, a_6	a_2	2	1	(11, 18, 25, 33)	(17, 27, 38, 48)
5	a_5, a_6	a_6	2	1	(16, 23, 27, 30)	(24, 33, 41, 45)
6	a_5	a_5	1	1	(17, 27, 38, 48)	(22, 33, 45, 56)
7	a_7	a_7	1	2	(24, 33, 41, 45)	(45, 59, 74, 86)

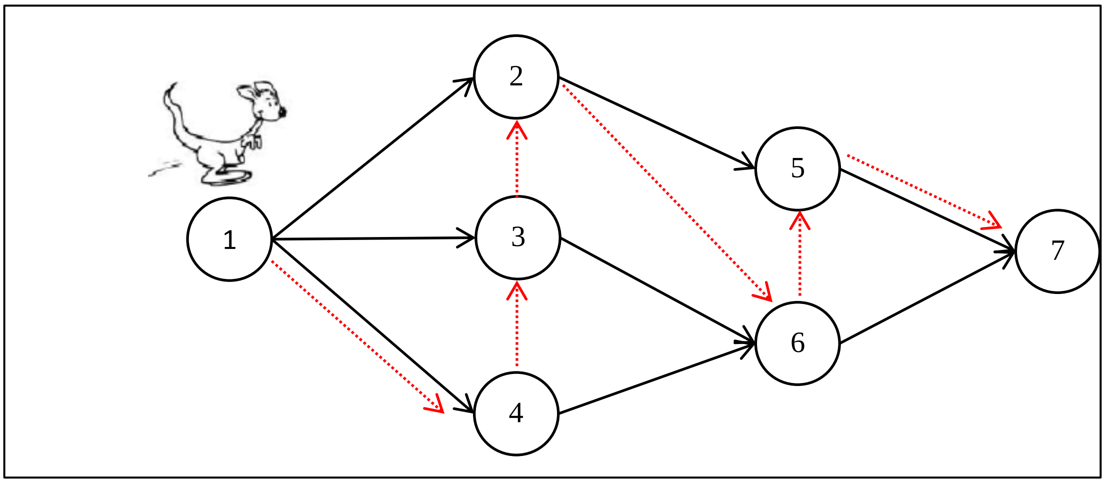


Fig. 3. **Path followed by domestic kangaroo**

It is now possible, with the implementation of the paralel kangaroo algorithm to fuzzy time-bound and fuzyy resource-bound project scheduling, to minimize the likelihood of delay and maximize the minimum satisfaction values of all activities in a very short time. According to the results, it is detected that paralel kangaroo algorithm gives good solutions to fuzzy project scheduling problems.

Table 3

The results obtained from wild kangaroo

Wild Kangaroo						
Step	**Alternatives**	**Selected Activity**	**Resource Need**	**Current Resource**	**Starting Time**	**Completion Time**
1	a_1	a_1	1	2	(1, 2, 2, 2)	(4, 7, 9, 10)
2	a_2, a_3, a_4	a_2	3	2	(4, 7, 9, 10)	(10, 16, 22, 25)
3	a_3, a_4, a_5	a_4	3	1	(4, 7, 9, 10)	(11, 18, 25, 33)
4	a_3, a_5	a_5	2	1	(10, 16, 22, 25)	(15, 22, 29, 33)
5	a_3	a_3	1	1	(11, 18, 25, 33)	(23, 34, 43, 53)
6	a_6	a_6	1	1	(23, 34, 43, 53)	(31, 44, 57, 68)
7	a_7	a_7	1	2	(31, 44, 57, 68)	(54, 70, 86, 98)

4. Conclusion and Discussion

"Fuzzy project scheduling" concept has arisen to solve the uncertainties coming from the nature of projects in project scheduling area and this subject has attracted the attention of researchers due to increasing importance. In fuzzy project scheduling, because of the complexity of the projects and disruptions and delays in the projects, metaheuristic methods provide good solutions in a short time in problems that is hard to be solved by conventional methods. In this research also, kangaroo algorithm, which is developed by inspiration from the jumps of kangaroos in nature, is improved as paralel kangaroo algorithm (PKA) in order to be utilized in solving fuzzy project scheduling problems. Two different jumping techniques, namely setting starting rankings and step magnitudes for domestic and wild kangaroo techniques are used and the optimal values are determined for the problem groups.

In real life, the resources that are to be used in projects which are implemented for the first time are uncertain. This uncertainty can only be resolved by using fuzzy logic techniques. In the literature regarding the solutions about fuzzy project scheduling problems, there are not any metaheuristic methods that give optimum solution. It is hoped that the studies in the future will provide near optimum solutions by using new metaheuristic methods or using the available methods in a combinatorial fashion.

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RESOURCE ALLOCATION IN THE PROJECT PORTFOLIO: A REVIEW OF QUANTITATIVE MODELS

Nomeda Dobrovolskienė, Vilnius Gediminas Technical University, Lithuania[1];

Rima Tamošiūnienė, Vilnius Gediminas Technical University, Lithuania

Abstract

One of the factors that highly influence a project portfolio is available resources. In order for project portfolio management to be fully implemented resources have to be properly allocated across the approved projects. The lack of resource allocation results in more time required for completing or terminating projects. Thus, resource allocation is a vital part of project portfolio management. Numerous analytical techniques from simple weighted scoring to complex mathematical programming approaches have been proposed to solve this problem. The aim of this article is to summarize the literature on quantitative modelling for resource allocation, to emphasize the diversity of existing methods and to present a classification of resource allocation models and methods.

Key words: *project portfolio, project portfolio management, resource allocation*

JEL codes: M21, Q02, Q022

Introduction

At any given moment, most companies are carrying out a number of projects in order to gain competitive advantage and to implement their strategy. Some projects may be related to product development and marketing, whereas others may involve changing the strategy, introducing new IT systems, or modifying work processes. The majority of organizations have more projects than resources necessary to implement these projects. Thus, project portfolio management becomes a necessity. The findings of the studies made by Blichfeldt B. S. and Eskerod P. (2008) suggest that project selection, prioritization, and distribution of resources among the projects are above all. So, the allocation of resources is one of the key elements of project portfolio management.

Current literature on project portfolio management covers a large number of resource allocation methods and techniques. Some of these techniques are not widely used because they are too complex or require too much input data. Over 100 methods and techniques for resource allocation are discussed in the relevant literature (Hall D. and Nauda A., 1990; Dey L. and Pennypacker J. S., 1999), including a thorough analysis of their advantages and disadvantages (Ghasemzadeh F., 1998; Archer N. P. and Ghasemzadeh F., 1999b; Graves S. B. and Rinquest J. L., 2003).

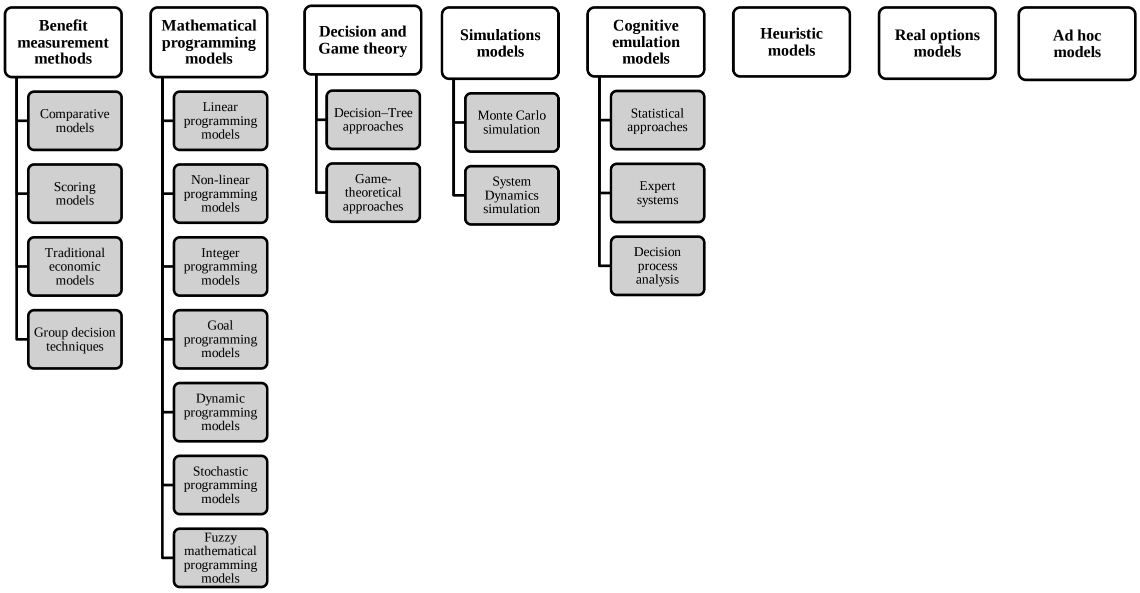
The aim of this paper is to summarize the literature on quantitative modelling for resource allocation, to highlight the variety of existing methods and to present a classification of resource allocation methods and models.

[1] Corresponding author – e-mail address: nomeda.dobrovolskiene@gmail.com, telephone: +370 68632223

Methods of research: analysis of scientific literature and other sources of information.

Resource allocation in the project portfolio: a literature review

There are several classifications of resource allocation models and methods. Our classification is an update and synthesis of previous classifications (e.g. Baker N. R., 1974; Hall D. and Nauda A., 1990; Martino J. P., 1995; Heidenberger H. and Stummer Ch., 1999; Iamratanakul S., *et al*., 2008). It divides resource allocation methods and models into 8 groups, namely benefit measurement methods, mathematical programming methods, decision and game theory, simulation, heuristics, cognitive emulation, real options and ad hoc models (Fig. 1).



Source: prepared by authors

Fig. 1. **Resource allocation models and methods in the project portfolio**

Benefit measurement methods used in resource allocation

Benefit measurement methods help to determine the benefits of each doubtful project. Consequently, projects that are most beneficial are selected taking into account the overall budget limits. Benefit measurement methods are divided into comparative models, scoring models, traditional economic models and group decision techniques.

Comparative models. Comparative models are used in order to evaluate a group of projects linking one project offer to another project offer or several alternative project offers (Martino J. P., 2003). Models also depend on group project evaluations, when respondents have to compare one offer with another. An offer can be added or removed from the group under consideration at any time, and the entire process has to be repeated. The *Q-sort* method is the least formal of all comparative methods. It is a psychometric method aimed at classifying a group of things based on the discretion of the deciding group (Souder W. E., 1978; Souder W. E. and Mandakovic T., 1986). Analytic hierarchy processes allow the decision maker to formulate a complex multi-project evaluation in a hierarchical form, with projects being at the bottom and various targets at respectively higher levels (Kuei C. H., *et al*., 1994; Suh C. K., *et al*., 1994; Elahi M. and Najafizadeh N. S., 2012).

Scoring models. Scoring models are methods aimed at classifying interrelated candidate projects. When scoring models are applied, respondents have to indicate the benefits of each offer according to the established criteria. Cooper R. G. (1981) assessed that scoring models are often viewed as too simplistic, since their application makes complex decision-making less complex, a simple equation is used instead which produces a mixed result. Scoring models are divided into a checklist method, traditional scoring models and multi-attribute utility analysis. A checklist method helps to check whether certain project requirements are ensured, and enables a concise presentation of results in a figure form. (Sounder W. E. and Mandakovic T., 1986). Traditional scoring methods are often regarded as merely scoring models suitable for overcoming certain above-listed problems relating to a checklist. Traditional scoring models were introduced by Krawiec F. (1984), Paolini A. and Glaster M. A. (1977), Ulvila J. W. and Chinnis J. O. (1992), Murray S., *et al.* (2010). Multi-attribute utility analysis is an evaluation method created on the axiom principle.

Traditional economic models. Traditional economic models are designed to perform cost-benefit analysis and/or assess the financial risk of a project. They are based on cash-handling methods and are closely interrelated or related to extensions of traditional methods used in capital budgeting. The first group of traditional economic models is based on indexes. Silverman B. G. (1681) introduced an index-based economic model called PAM (project appraisal methodology). More examples can be found in the works by Gupta S. K. and Mandakovic T., 1992; Pearson (1972) and others. In the context of projects, investment valuation procedures of discounted cash flows are also applied. Discounted cash flow models are described in the works of Augood D. R. (1975) or Ramsey J. E. (1981).

Group decision techniques. The use of group decision techniques allows for a systematic collection and collation of knowledge and evaluations of specialists in specific areas of expertise. Therefore, this method is regarded as appropriate in the performance of practical operations or at least as a means of verification for the purpose of receipt of data necessary for the development of a more complex model (Khorramshahgol R., *et al.*, 1998). The Delphi method is a widely used group decision technique. Other group decision techniques include the nominal interaction process and the impact and ordinal intersection methods. Souder W. E. (1975) proposed the impact method, while the ordinal method was proposed by Cook W. D. and Seiford L. M. (1982).

Mathematical programming methods used in resource allocation

Mathematical programming models allow optimizing certain target functions taking into consideration constraints relating to resources, strategy, project logic, technology, project dynamics, etc. Mathematical programming models are divided into linear programming, non-linear programming, integer programming, goal programming, dynamic programming, stochastic programming and fuzzy mathematical programming models.

Linear programming models. One of the fundamental quantitative tools used in selecting an appropriate project and resource allocation is linear programming. It allows increasing the expected benefits likely to be gained if the respective project is selected, in the context of the limits of available resources. Linear programming models show that the scope of each project is infinitely divisible, both benefits and resource input on a linear scale depend on the project scope; the underlying efficiency function is linear, expected values are most uncertain, projects are not interdependent. A linear model was introduced by Asher D. T. (1962), Wang Y., *et al*., (2002) and others. The model introduced by Wang Y., *et al*. (2002) essentially runs as follows:

Maximize

$$maxY = 1/T$$

subject to

$$Y \leq \sum_{r=1}^{R} \frac{\beta_{\alpha,r} \cdot \mu_{\alpha,r}}{\omega_{\alpha}} \; for \; \alpha = 1,2, \dots, A$$

and

$$\sum_{\alpha=1}^{A} \beta_{\alpha,r} \leq 1 \; for \; r = 1,2, \dots, R \quad (1)$$

where *A* is the number of activities, and *R* is the number of resources.

Non-linear programming models. In practice the majority of problems related to decision-making are non-linear by nature. Non-linear approaches are the most complex, but they allow treating a variety of constraints. These mathematical programming methods are conceptually attractive because they optimize specific quantitative measurements (e.g. productivity), subject to budget and organizational constrains; however, surveys have not shown any widespread utilization of these techniques. There are examples when the models obtained can be transformed into linear programming models by the Piecewise function. The classical non-linear programming model, the Piecewise function and integer programming were described in Souder's W. E. works (1973).

Integer programming models. Integer programming models facilitate the understanding of contingent projects, mutually exclusive projects, parallel projects and all project interactions in a programme, for example, those which are expressed through common resources, common technologies, strategic importance, result interactions, etc. Integer programming models can be divided into linear and non-linear. The latter group includes models proposed by Ghandforoush P., *et al.* (1992), Lootsma F. A., *et al.* (1990), Mehrez A. and Sinuany-Stern Z. (1983). The other group includes models proposed by Bard J. F., *et al*. (1988), Fox G. E., *et al.* (1984), Madey G. R. and Dean B. V. (1992), Schmidt R. L. (1993).

Goal programming models. Goal programming was first used to address more than one objective. This technique sets certain target levels or goals for each objective, then minimizes deviations from these goals. Goal programming models derive from the fact that the decision maker usually sets targets in his real life. This is a method allowing the decision maker to get to his set target as close as possible. The prioritization of various targets by the decision maker is expressed through cardinal target-related values. Two goal programming schools can be distinguished and both of them are important in resource allocation. The first is described as lexicographic goal programming. This is possible only when goals at higher priority levels are met to the extent that goals at lower levels can be considered. By comparison, the second school expresses the goal function as a weighed combination of directly related deviation variables. An example of a goal programming model in resource allocation was given by Winkofsky E. P., *et al*. (1981), Lee J. W. and Kim S. H. (2000).

The model can be expressed as follows (Lee J. W. and Kim S. H., 2000):

Minimize

$$Z = P_k(w_j d_i^+, w_j d_i^-)$$

subject to

$$a_{ij}x_j + d_i^- - d_i^+ \leq i \text{ for } i = 1, 2, ..., m, j = 1, 2, ..., n$$
$$x_j + d_i^- = 1 \text{ for } i = m + 1, m + 2, ..., m + n, j = 1, 2, ..., n$$
$$x_j = 0 \text{ or } 1 \text{ for } \forall j, \tag{2}$$

where m = the number of IS project goals to be considered in the model, n = the pool of IS projects from which the optimal set will be selected, w_j = the ANP mathematical weight on the j = 1, 2, ..., n IS projects, P_k = some K priority pre-emptive priority ($P_1 > P_2 > \ldots > P_k$), for i = 1, 2, ..., m IS projects goals, d_i^+, d_i^- = the *i*-th positive and negative deviation variables for i = 1, 2, ..., m IS projects goals, x_j = 1, then select the *j*-th IS project or when x_j = 0, then do not select the *j*-th IS project, a_{ij} = the *j*-th IS project usage parameter of the *i*-th resources, and b_i = the *i*-th available resource or limitation factors that must be considered in the selection decision.

Dynamic programming models. Top level managers usually do not discuss each technical project at a strategic business unit level, but instead they allocate resources for all product lines. Resource allocation in any product line will be different depending on the expected profitability. A dynamic programming model can be a response to this practice (Iamratanakul S., *et al.*, 2008). Generally speaking, a dynamic programming model is an iterative mathematical method which may be used to find the optimal trajectory of actions for a group of sequential decisions. It is appropriate in those situations when a decision made in one programme stage has an impact on the environment, for example, on the probability of technical success, as illustrated in the Jackson's model (1983). However, DPM is inadequate as only a single resource constraint can be used, e.g. total cost. Another dynamic programming model was presented by Silva L. C. and Costa A. P. C. S. (2013).

Stochastic programming models. In stochastic programming models, at least one type of input data is indefinite and varying. Only a few models have been published, the majority of them use limited stochastic programming. In the context of this system, resource constraints are random variables rather than constant parameters; moreover, test plans may be developed that could identify winning probability. Such plans have to be reviewed in the short and long run establishing financing models in research activities. Stochastic programming models were introduced by Allen B. (1991), Czajkowski A. F. and Jones S. (1986), Solak S., *et al.* (2010), Rafiee M., *et al*. (2013) and others. The model introduced by Rafiee M., *et al*. (2013) can be written as follows:

$$MaxE\left\{\sum_{i=1}^{I}\sum_{j=1}^{J_i}\sum_{t=1}^{T}P_{ijt}X_{ijt}\right\}$$

subject to

$$d_{ij}X_{i(\,j+1)t} \leq \sum_{l=1}^{t-1}(t-i)(X_{ijl});\ \forall ij, \forall t > 1$$

$$\sum_{l=1}^{t}X_{ijl} \leq 1;\ \forall it, \qquad \forall j = 1,2,\dots,J_i$$

$$\sum_{i=1}^{I}\sum_{j=1}^{J_i}r_{ijkt}\sum_{l=max\{0,t-d_{ij}+1\}}^{t}X_{ijl\leq R_{kt}}\ \forall k = 1, t = 1,\dots,T$$

$$X_{ijt} \in \{0,1\};\ \forall i,t,\forall j = 1,\dots,J_i$$

$$X_{ijt}\text{is measurable } w{:}r{:}t\sigma(\varepsilon_1,\varepsilon_2 \dots,\varepsilon_t\,), \tag{3}$$

Fuzzy mathematical programming models. Input data for project selection and resource allocation models can be very fuzzy, i.e. technical perspective of success can be measured as "poor", "unforeseen", "neutral" or "high". Such data can be used in the application of a particular fuzzy mathematical programming method proposed by Weber R., *et al.* (1990), Bhattacharyya R., et al. (2011), Rebiasz B. (2013), Chen C. T. and Cheng H. L. (2009), Ghapanchi A. H., *et al*. (2012) and others. The model introduced by Bhattacharyya R., *et al*. (2011) is constructed as follows:

$$\begin{cases} max\{R^L(x,a), R^U(x,a), S^L(x,a), S^L(x,a)\} \\ min\left\{\delta^{2^L}(x,a), \delta^{2^U}(x,a)\right\} \\ subject\ to \\ R_{st}(x) \geq c, R_{lt}(x) \geq \tau, L(x) \geq l, D(x) \geq d, \\ \sum_{i=1}^{n} x_i = 1, x_i \geq 0, i = 1,2,\dots,n, a, \in [0,1], \end{cases} \tag{4}$$

Decision and game theory used in resource allocation

Both decision and game theory methods clearly emphasize possible future events or reactions of the company environment that are undefined in their scope. The difference between these methods is that decision-making theory states that environmental changes do not depend on the company's actions, whereas game theory clearly emphasizes rational competitors (Heidenberger K. and Stummer Ch., 1999). Decision-making and game theory models are divided into decision tree methods and game-theoretical models.

Decision tree methods. Decision tree analysis can deal with individual decision problems. It allows analysing the expected values of a project at each event node to choose the case with the maximum value (Sao T. & Hirao M., 2012). In general terms, a decision tree is made up of two types of nodes, namely nodes of classical probabilistic events and decision nodes. Heidenberger K. (1996) introduced the third type of node, the "computed chance". The use of decision tree methods in selecting a project and allocating resources was proposed by Granot D. and Zuckerman D. (1991), Hess S. W. (1993), Stonebraker J. S. and Kirkwood C. W. (1997) and others.

Game-theoretical methods. Game-theoretical models are useful in evaluating resource allocation strategies, taking into consideration rationally operating competitors. Most game-theoretical methods are limited in that they emphasize duopoly competition in two-stage race for patents, where the second stage starts only after the successful completion of the first one. Game-theoretical methods were proposed by Ali A., *et al.* (1993), Gruver G. W. (1991) and others.

Simulation models used in resource allocation

Simulation models allow for a much more detailed expression of real systems as compared to optimization models, while during modelling only "what-if" type of questions have to be answered. They are used in cases where experiments in reality are inappropriate, too expensive or take too long, and the performance of complex analytical procedures is impossible or they cannot be applied without exceeding permissible costs or taking too long (Heidenberger K. and Stummer Ch., 1999). Most simulation methods can be observed in project selection and resource allocation.

In *Monte Carlo simulation*, probability distributions of all probabilistic elements are used in the programme in order to calculate the overall distribution of the target values and probability of the used values. In their example, Versapalainen A. P. J. and Lauro G. L. (1988) apply Monte Carlo simulation to evaluate the portfolio balance effect and competitor strategies for the company in order to secure probabilistic and expected return on investment.

Systemic dynamics simulation creates feedback cycles so that analyses could be expanded based on a certain scenario, for example, considering consequences and reactions in certain markets after the presentation of a certain new product (Milling P. M., 1996). Fox G. E. and Baker N. R. (1985) developed a model for process descriptions which was not sufficiently detailed to perform an analysis of a particular strategy. This model consists of three key components: profitability model based on the net present value, project generation module related to the time-dependent product innovation and process innovation combination, as it is known based on the model proposed by Utterbach J. M. and Abernathy W. J. (1975).

Cognitive emulation used in resource allocation

Cognitive emulation methods are designed for the development of a model of actual decision-making process within an organization (Hall D. and Nauda A., 1990). They are based on the previous experience acquired under similar circumstances where, given the possible data, drawing conclusions seems reasonable. However, these conditions are possible only in making tactic decisions (Rosenhead J., 1989). Cognitive emulation models can be divided into statistical methods, expert systems and decision process analyses.

Statistical methods. There are models employing statistical methods in order to determine factors affecting project implementation in a programme. Those factors can be ensured by statistical methods, such as discriminant, regression and cluster analysis (Iamratanakul S., *et al*., 2008). Discriminant analysis involves the classification of certain factors reflecting a particular project characteristic which subsequently may be associated with categories of a project based on threshold values. Regression analysis is aimed at determining relationships. Martino J. P. (1995) showed that regression may help capture the thinking of a particular person or group, as the inputs thereof match the mental model of the decision maker. Stahl M. J. and Harrell M. A. (1983), Cooper R. G. (1981) also apply regression analysis in project selection and resource allocation. Cluster analysis groups make sets of objects which are divided into homogeneous subsets presenting the maximum distance between subsets (Mathieu R. G. and Gibson J. E., 1993).

Expert systems. An expert system is aimed at repeating the manager's decision-making process when decision-making projects are analysed to a certain degree (Hall D. and Nauda A., 1990). An expert system is a computer programme designed to replicate conclusion-drawing process used by specialists (Heidenberger K. and Stummer Ch., 1999).

Decision process analysis. The aim of decision process analysis is to improve the understanding of general managerial principles and reflect a hierarchical organization where manifold groups operate, including the selection process. The work of Schmidt R. L. and Freeland J. R. (1992) introduces essential changes when decision-making cases lead to decision-making processes. Winkofsky E. P., *et al.* (1981) describe the resource allocation process covering various units at three hierarchical levels. In their work, Baker N. R., *et al*. (1976) emphasize the budget allocation process in a large hierarchical organization.

Heuristic model used in resource allocation

Heuristic modelling is designed for finding acceptable although not necessarily optimal decisions. A model which is intended for project selection and resource allocation and includes a heuristic procedure was proposed by Mandakovic T. and Sounder W. E. (1985). Heuristics was used by Coffin M. D. and Taylor B. W. (1996), Oral M., *et al*. (1991), Carazo A. F., *et al*. (2010) and others.

Modelling methods for real options analysis

For the strategy to be successful, real options are necessary when applying evaluation methods in relation to projects combining uncertainties in business and active decision-making. Real options start with drawing an investment opportunity, taking into account an option. To make this possible, variables have to be determined that allow defining project characteristics and the value of a simple option. A model using a real options approach was proposed by Rogers M. J., *et al.* (2002).

Ad hoc modelling approaches

Ad hoc models are models of a different type, they are unstructured and developed for specific purposes (Iamrantanakul, S., *et al*., 2008). These methods include "top-down" approach to project selection and resource allocation. One usually successful method is a technique which is referred as a "genius award" method (Cooper, M. J., 1978) that simply provides funding to proven researchers to work on any project of their choice. This technique is often as successful as complex analytical approaches (Hall D. and Nauda A., 1990).

Conclusions

The review has revealed that literature on project portfolio management covers a large number of resource allocation methods and techniques. We updated previous classifications and divided methods into 8 groups, namely benefit measurement methods, mathematical programming approaches, decision and game theory, simulation, heuristics, cognitive emulation, real options and ad hoc models.

Each model may be appropriate and practical, depending on its application. For example, decision tree analysis can address individual decision problems. It enables analysis on the expected values of a project at each event node to choose the case with the maximum value. However, it cannot address decision problems of a continuous type. If we try to apply it to a large number of activities, the tree branches would rapidly grow to an impractical degree of complexity. Another example can be Analytical Hierarchy Process (AHP) which is relatively simple in terms of on its procedure. It can present a complex decision problem as graphical hierarchical structures. However, AHP is subjective in nature. Different decision makers can attribute different levels of importance to the same criteria. As the number of criteria increases, the tabulation and calculations become too complex.

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BENCHMARKING LABOR PRODUCTIVITY IN PERFORMING ON-SITE ACTIVITIES: LESSONS FOR CONSTRUCTION PROJECT MANAGERS

Parviz Ghoddousi, Iran University of Science and Technology, Iran;

Behzad T. Alizadeh, Iran University of Science and Technology, Iran;

M. Reza Hosseini, University of South Australia, Australia[1];

Nicholas Chileshe, University of South Australia, Australia

Abstract

Labour productivity is one of the main determinants of success for any construction project. As a result, project managers should draw upon effective methods to gauge productivity on their sites in order to compare it against acceptable baselines. This would be the first step towards controlling and eventually improving labour productivity on construction sites. This paper considers the Theoretical Model of International Benchmarking for Labour Productivity (TMIBLP) as one of the most popular methods to measure the productivity of labour in performing on-site activities. Drawing upon a critical review of the literature this study presents a framework to improve the effectiveness of TMIBLP. Afterwards, the study describes the procedure for benchmarking on-site construction activities deploying the proposed framework. The data were collected from steel structures erecting activities in six building projects in Tehran, Iran. The discussions will present practical guidelines for construction project managers regarding benchmarking labour productivity. The paper concludes with putting forward some suggestions for future research opportunities.

Key words: *benchmarking, productivity, labour, construction industry, steel structure*

JEL code: J240

Introduction

Construction projects largely entail labour-intensive activities, thus enhancing the labour productivity of construction activities would immensely be advantageous for the economy of any country in micro and macro levels. This is because higher level of productivity facilitates utilising the available resources more efficiently (Duncan, 2002). Apart from the national level, higher labour productivity in a construction company makes the company more competitive in the market (Horta et al., 2013). Likewise, a plethora of studies in construction context has attempted to improve labour productivity through trying a wide range of available avenues (Yi & Chan, 2013). The attempts have involved conducting studies focused on comparing labour productivity in one organisation to that of others particularly leading corporations (Song &

[1] Corresponding author – e-mail address: Mohammad.Hosseini@unisa.edu.au, telephone: +0061 8 302 177

AbouRizk, 2008). The foregoing strategy titled as *Benchmarking* is a logical and systematic tool extensively deployed to measure, compare and eventually increase the level of productivity in the construction industry in project, corporate (Presley & Meade, 2010), and activity levels.

As a developing country, Iranian construction industry has always suffered from poor levels of productivity ending up in frequent delays and budget overruns (Zakeri et al., 1996; Ghoddousi & Hosseini, 2012). In this context and as acknowledged by the relevant literature in other countries, utilising benchmarking methods for enhancing labour productivity would bring about many advantages for the Iranian construction industry. Nevertheless, there is no evidence of utilising the forgoing methods in Iran. The paucity of research on benchmarking labour productivity in Iran is the main driving force for conducting a research study as the first one utilising benchmarking at the activity level in construction projects.

On the other hand, previous studies using TMIBLP are fraught with serious shortcomings as per the findings of the review of the literature. To avoid the drawbacks of previous studies, the paper will propose a framework that enhances the level of reliability of the results of TMIBLP by meeting the basic requirements of the benchmarking concept. Subsequently, deploying the foregoing framework, the study present the results of an investigation on labour productivity at activity level in 6 construction projects considering erecting steel structures as the activity. Authors are of the view that this study will contribute to the sphere by promoting using TMIBLP for benchmarking activities within the construction context in Iran and other countries.

Literature Review

Benchmarking is geared towards identifying if any gap exists between the performance of an entity to that of the competitors or the leading ones (Liao, Liu & Pi, 2011). Most of the studies in construction context have used benchmarking to enhance the construction labour productivity building on the concept of the productivity baseline. In this spirit, baseline has been defined in different ways as some authors have considered it as the best level of the labour productivity one contractor can achieve in one project (Thomas, H.R. & Završki, 1999a, 1999b; Thomas, H. R & Sanvido, 2000). From another perspective, baseline is described as the level of the labour productivity manifesting the normal operating performance of a contractor (Gulezian & Samelian, 2003).

A wide range of methods including Data Envelopment Analysis (DEA), K-means clustering method, and control charts have been developed for measuring the baseline labour productivity level (Yi & Chan, 2013). In this regard, Thomas and Zavrski (1999a) introduced a benchmarking procedure titled as *Theoretical Model for International Benchmarking of Labour Productivity* (TMIBLP) for certain construction activities. TMIBLP is one of the most recognised methods within construction context and has been utilised in many studies from a wide range of countries as illustrated in Table 1.

Table 1

Previous studies utilizing TMIBLP

Authors, year	**Considering Work Content (WC)**	**Method for calculating Baseline in one project**	**Method for calculating expected Baseline for the activity**
(Idiake & Bala, 2012)	No	Average of baseline set for each project	Average baseline productivity of all the projects studied
(Odysseus, 2011)	No	Not defined	Not defined
(Sweis et al., 2008)	Yes	Median of baseline set for each project	Linear regression model
(Enshassi et al., 2007)	No	Average of baseline set for each project	Average baseline productivity of all the projects studied
(Abdel-Razek, Abd Elshakour M. & Abdel-Hamid, 2007)	No	Average of baseline set for each project	Average baseline productivity of all the projects studied
(Thomas, H.R. & Završki, 1999b)	Yes	Median of baseline set for each project	Linear regression model

TMIBLP is practically a 8-stage procedure comprising the steps briefly illustrated in Figure 1 as recommended in (Thomas, H.R. & Završki, 1999b).

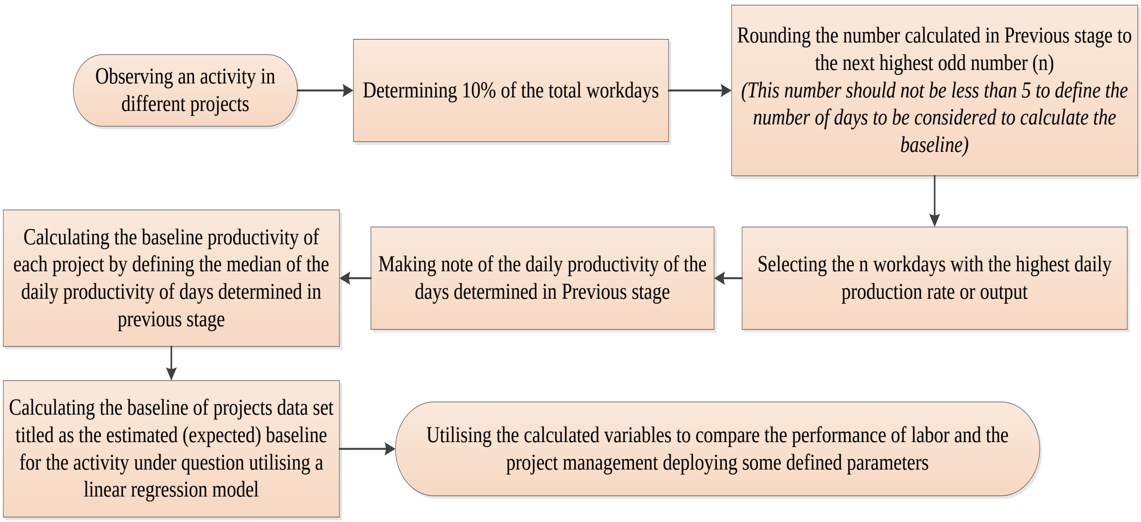

Fig. 1. **Process to undertake TMIBLP for projects**

As depicted in Figure 1, the process to conduct TMIBLP method seems straightforward and offers a convenience method to be utilised by practitioners and project managers. However, some aspects of the methods are central to validity of the results as will be explained in view of the existing studies concerning TMIBLP.

Thomas and Završki (1999b) deployed the concept of Work Content (WC) representing the complexity of the activity in hand in TMIBLP method. Incorporating WC is essential in terms of confining the application of TMIBLP to the working conditions in which all the factors affecting completing activities in different projects are analogous (including WC). Yet, the literature review uncovered that some studies drawing upon the study of Thomas, H.R. and Završki (1999a) have neglected WC concept (see Table 1). It also became apparent that previous studies largely have overlooked the crucial role of considering analogous conditions as a prerequisite for making any comparisons as a fundamental principle for benchmarking. This obvious pitfall in benchmarking has been termed as the "*lack of comparable objectivity*" in (Barber, 2004). As a result, selected projects to be compared in any benchmarking study should be similar in every aspect to be eligible for making comparisons. It includes the complexity of the design (WC), the weather, the type and objectives of clients and the environments of the project such as the authority delegated to the project management as postulated by Barber (2004). In the same vein, as stated by Clarke (1999), many factors affecting the labour productivity in projects might be literally outside the control of the project manager. Therefore, benchmarking the performance of project management of a project merely drawing upon the outcomes of the project could end up in misleading conclusions. On top of that, TMIBLP takes having two databases of quantitative and qualitative nature (Thomas, H.R. & Završki, 1999b) to make sure all the conditions are similar. The studies in table 1 expect the former one lack this aspect.

Subsequently, it could be inferred that most of the previous studies using TMIBLP have failed to compare "apples and apples" (Barber, 2004, p. 6), which is the cornerstone of the benchmarking concept. In regards to Iranian construction industry, authors did not find any study geared towards using benchmarking at activity level in the construction industry. Therefore, taking into account the lifelong issues of Iranian construction industry in terms of labour productivity (Ghoddousi & Hosseini, 2012), conducting studies in Iran using the TMIBLP after resolving the issues as drawbacks and pitfalls of the body of knowledge on the subject of interest seems relevant and would facilitate establishing the field.

Research Methods

Developing a framework for conducting this research deemed necessary to avoid the drawbacks of previous studies as discussed in previous sections. Building upon the fundamental aspects of the benchmarking method stated by Barber (2004) the main objective of this framework should be to steer away from any dissimilarity between the selected projects. This would enhance the level of reliability of TMIBLP results. The framework developed for the aforementioned purposes is illustrated in Figure 2.

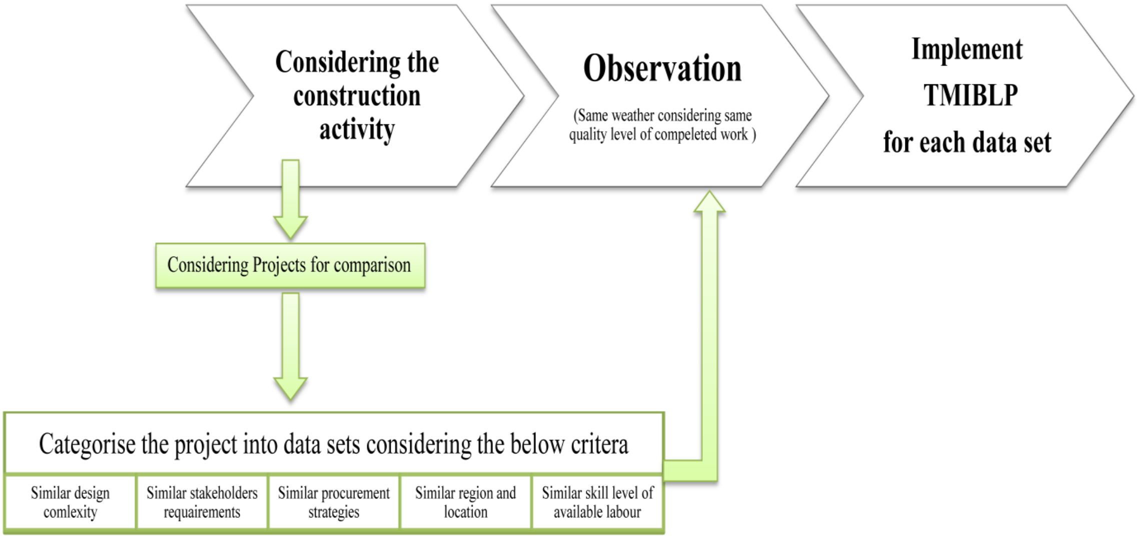

Fig. 2. **Developed framework for implementing TMIBLP in construction projects**

The definitions of the elements of the TMIBLP are considered as the following (Thomas, H.R. & Završki, 1999b; Sweis et al., 2008):

(1) Total work hours: sum of daily working hours in each project.
(2) Total quantities: sum of the quantities of completed activities daily in each project.
(3) Cumulative productivity: the measure of the inclusive effort necessary to install the work calculated as:
Cumulative productivity (hrs/ton) = Total work hours (hrs)/Total quantities completed (ton);
Other parameters are calculated based on the 5 steps depicted in figure 2 and described in section 2-2.
(4) Baseline productivity: the highest performance rate a contractor can achieve for a specific design under the certain circumstances.
(5) Number of abnormal workdays: The variability range of daily productivity values should be limited to twice the average baseline productivity of all projects in any data set. Any day falling off this range is an abnormal day.
(6) Disruption index (DI): One metric for benchmarking labour productivity is the disruption index (DI). Equation (1) illustrate the simplest form of DI:

$$DI = \frac{Number\ of\ Abnormal\ (Disrupted)\ Work\ Days}{Total\ Number\ of\ Work\ Days} \quad (1)$$

(7) Performance ratio (PR): The performance ratio (PR) is calculated by dividing the actual cumulative productivity by the expected (estimated) baseline productivity that is the average of values of baselines for all projects according to equation (2):

$$PR = \frac{Cumulative\ productivity}{Expected\ baseline\ productivity} \tag{2}$$

(8) Project management index (PMI): This concept is a parameter (dimensionless) which reflects the project management contribution to the cumulative labour performance of the project. Logically, lower PMI values imply better project management's influence on overall performance. Equation (3) illustrates PMI calculation details.

$$PMI = \frac{Cumulative\ Productivity - Baseline\ Productivity}{Expected\ Baseline\ productivity} \tag{3}$$

TMIBLP Implementation

In order to have a common basis for making comparisons, all the productivity data need to be prepared and calculated deploying a standard procedure such as the one developed by Thomas and Kramer (1988). Hence, productivities for subtasks of an activity have to be derived individually. One way to do this is via a multiple regression model without a constant term (Thomas, H. R & Sanvido, 2000). In the regression model, the daily work hours serve as the dependent variable and the daily quantities of the subtasks serve as the independent variables. The calculated model coefficients are the unit rates of the independent variables. Then conversion factors are deployed for adapting dissimilar units of work into an equivalent quantity of a basic or standard unit (Thomas, H.R. & Napolitan, 1995). As an example applicable to structural steel erection activity, erecting one ton of column is considered equivalent to erecting 0.65 ton of beam. Based on the framework developed, data were collected from 6 construction projects in Tehran. The goal was to measure the labour productivity for steel structure erection activity. The targeted projects included 3 residential, 2 commercial and 1 administrative building. The design and construction method complexity of all of the projects were the same. The methods for material handling were also similar. In addition, the financial strategies towards suppliers and workers labour rates in charge of the activities in question were alike which assured the similarity between the skills of deployed workers in all the projects. Table 2 captures the results of a typical data gathering in one of the projects.

Table 2

Data collected from one of the projects

(1)	(2)	(3)	(4)**	(5)	(6)	(7)
Work days	**Weight of erected structure (ton)**		**Total quantity (beam as standard item)**	**Work hours**	**Daily productivity**	**Baseline subset**
No.	**Columns**	**Beams**	**Ton**	**hr**	**hr/ton**	*
1	**11**	**25**	30.21	84	2.78	*
2	10	7	11.73	80	6.82	
3	26	11	23.31	80	3.43	
4	9	13	17.26	88	5.10	
5	20	19	28.47	114	4.00	
6	0	25	25.00	82	3.28	
7	18	7	15.52	82	5.28	
8	17	5	13.05	88	6.74	
9	0	13	13.00	84	6.46	
10	0	15	15.00	56	3.73	
11	14	14	20.63	88	4.27	
12	**55**	**18**	44.04	88	2.00	*
13	**27**	**16**	28.78	80	2.78	*
14	10	14	18.73	86	4.59	
15	**0**	**57**	57.00	86	1.51	*
16	0	15	15.00	80	5.33	
17	19	13	21.99	72	3.27	
18	0	27	27.00	78	2.89	
19	11	12	17.21	78	4.53	
20	**42**	**24**	43.88	80	1.82	*
21	10	19	23.73	80	3.37	
22	0	19	19.00	80	4.21	
23	0	24	24.00	78	3.25	
24	0	26	26.00	82	3.15	
25	0	19	19.00	78	4.11	
26	0	19	19.00	82	4.32	
Baseline					**2.00**	

* Bold faces indicates baseline subset members
****** According to Regression model: (5)=1.3870(2)+2.9296(3), then CF=1.3870/2.9296=0.4734 so (4) = 0.4734*(2)+(3)

Results and Discussions

Daily labour productivity rates were calculated. The highest values for production rates were used to determine the baseline subset. Likewise, the median of foregoing values represented the baseline productivity in the project. As an example for Project 1, the values of labour daily productivity corresponding to the maximum output were as 2.78, 2.00, 2.78, 1.51

and 1.82. Thus, the baseline productivity of the aforementioned project as the median of mentioned 5 numbers is 2.00, as shown in Table 2, and Figure 3.

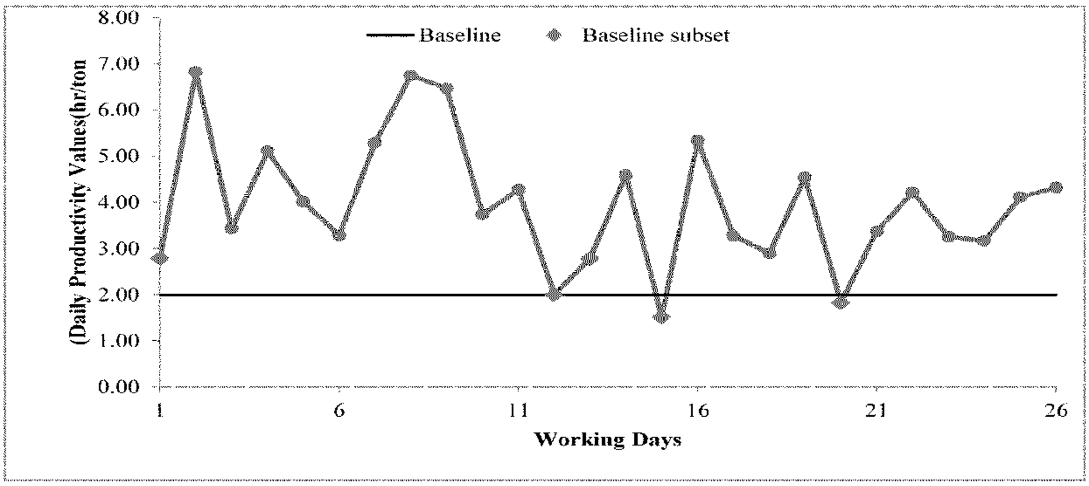

Fig. 3. **Daily productivity and baseline for Project No 1**

The average baseline productivity for the six projects under investigation was calculated and equalled 2.07. The daily productivity levels exceeding twice the former amount (2.07*2 = 4.14) were considered as representing abnormal days. Hence, daily productivity values were compared against the calculated value (4.14) to identify the abnormal days. The results are illustrated in Table 3.

Table 3

Project attribute for studied projects

Project No.	No. of work days	Total work hours	Total quantities (ton) (Beam equivalent)	Cumulative productivity	Baseline productivity	No. of abnormal days	% of abnormal days
1	26	2134	617.55	3.46	2.00	11	42%
2	26	1600	458.68	3.49	2.15	8	31%
3	21	932	325.02	2.87	2.00	5	24%
4	15	652	207.47	3.14	2.15	4	27%
5	20	872	311.05	2.80	1.79	5	25%
6	16	648	204.38	3.17	2.33	4	25%

DI values range from 0.0 to 1.0 while higher values of DI reflect the fact that project has experienced days that are more abnormal. As an example, projects 1 had a DI value of 0.42. Presumably, the former project had experienced many disruptions. Table 4 illustrates the performance ratios of all six projects, the lower the PR the better the project performance. It could be noticed that all projects have performance ratios of greater than 1.0. However, it should be noted that a PR with a value greater than 1.0 necessarily does not represent a poorly performing project. In fact, it is merely a comparison against the best overall performance of the projects in the data set. Among all studied projects, project 1 experience high DI and PR simultaneously. Therefore, it can be concluded that this project has had poor performance.

Table 4

Performance ratios of studies projects

No. of projects	Cumulative productivity (hr/ton)	Expected productivity (hr/ton)	Performance ratio (PR) (hr/ton)
1	3.46	2.07	1.6694
2	3.49	2.07	1.6852
3	2.87	2.07	1.3853
4	3.14	2.07	1.5182
5	2.80	2.07	1.3543
6	3.17	2.07	1.5317

PMI concept represents the contribution of the project management to the cumulative labour performance. Lower values of PMI show that project management's influence on the overall performance has been greater. PMI values for the six projects are presented in Table 5. It could be concluded from Table 5 that no project has a PMI less than 0.4 that is as an indication of reasonably acceptable performance. Projects 1 and 2 with PMI values 0.7032 and 0.6465 respectively had performed poorly because of their PMIs greater than 0.5.

Table 5

Project management indices of studied projects

No. of projects	Cumulative productivity (hr/ton)	Baseline productivity (hr/ton)	Expected productivity (hr/ton)	PMI
1	3.46	2	2.07	0.7032
2	3.49	2.15	2.07	0.6465
3	2.87	2	2.07	0.4191
4	3.14	2.15	2.07	0.4795
5	2.80	1.79	2.07	0.4896
6	3.17	2.33	2.07	0.4061

The results obtained for PMI and DI show the existing correlation between these two indices. To clarify, the worst PMI value (i.e. the highest value obtained) amongst all six projects was for project 1(0.7032). This was attributed to the higher number of abnormal days (11 days out of 26 total actual working days were abnormal and thus gave rise to the highest value of disruption index i.e. 11/26=0.42). The results denote the conclusions of previous studies (Abdel-Razek, Abd Elshakour M & Abdel-Hamid, 2007) concerning the correlation between PMI and DI. More number of abnormal days in a project could be the symptom of a poorly managed project and low levels of labour productivity. Higher values of DI and PMI show unacceptable labour performance and poor management. Presumably, as the PMI value increases, more abnormal days or disruptions are expectable and accordingly the DI value increases as well.

Conclusions, proposals, recommendations

Through spotting the drawbacks of previous studies, a framework for utilising TMIBLP for construction activities was developed. Applying the developed framework, the boundaries of TMIBLP method will be confined merely to projects located in one region affected by the very similar surrounding environment conditions. However, the reliability of results will not be compromised against the variety of projects. By utilising the guidelines of the framework, project managers will make sure that the results reflect the contribution of project management and are not affected by parameters out of the control of the project manager.

A practical implementation of the TMIBLP method was presented to address the lack of research in Iran and to show the feasibility of using the framework developed. As a snapshot of the conditions in Iran, the values calculated could give an approximate baseline for similar projects in the country particularly for Tehran. However, any conclusion and judgment should incorporate the discrepancies between the characteristics of the projects as opposed to our samples. The results of the paper indicate a necessity of taking immediate actions to improve the current trend of construction project management in Iran, considering the low level of productivities witnessed in the capital city. It shows a fertile ground for future researchers to identify the in-detailed reasons behind the dominance of low productivity in Iranian construction industry.

On top of that, developing countries such as Iran suffer from the ineffectiveness and absence of documentation in construction projects. Establishing frameworks integrating TMIBLP with effective documentation systems seems a necessity in the context of developing countries. Likewise, TMIBLP could be the source of identifying the main reason behind low level of productivity, delays, and cost and budget overruns in construction projects building upon the documents and lessons learnt from previous projects or meta-analysis studies. Investigating the foregoing grounds would enable the future researchers of making great contributions to the construction context specifically in developing countries. Furthermore, calculating the same activities by different corporations should yield establishing communities of practice aimed at resolving the rampant issues with low productivity in executing different activities as a necessary element of managing knowledge in Iranian construction context.

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Project Management Development – Practice and Perspectives
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SOCIAL-STATISTICAL PROJECT MANAGEMENT WITH USING MS PROJECT

Maia Giorgobiani, Ivane Javakhishvili Tbilisi State University, Georgia[1];

Mzia Tikishvili, Ivane Javakhishvili Tbilisi State University, Georgia

Abstract

Problem Defining. The current article "Social-statistical project management with using MS Project" is discussed on example of Automation Population Census. As this task requires a lot of work, time and costs, it is very difficult for working and planning, implementation timeframes and control of costs resources without software tools. Today in the severe competition conditions for realization of the correct managerial activities the huge role takes using and implementation of information technology as unconditional priority over.

Purpose. 1. To show advantage of realization social-statistical project management on the example of Automation Population Census using information technologies, essentially with Ms Project and get statistical view within this program, as far as statistics help us to make the conclusions about the data in this project. Using statistical conclusions any manager of company will be in a better position for making best solutions. MS Project shows how to manage social statistical projects efficiently and effectively.

2. Clearly presentation the set of conceivable tasks, required for complete this project, duration of the each task, assignment material and labor resources for them. The project includes tasks within the regional and on regional level. A key feature of the project management is the "Triple constraint": the project limits, time limits and the cost, which allows us make control of them. There is shown the main advantage of using Ms Project for automated Population Census, that allows us to get quite necessary information and make analysis.

Methodology. In this research were used**:** analysis, synthesis, economic-mathematical modeling, system analysis and comparison methods. Were considered such indexes, as: Growth Competitiveness Index, Business Competitiveness Index – BCI, Global Competitiveness Index – GCI, New Global Competitiveness Index – New GCI.

Results. With using Ms Project for managing social-statistical projects on example of Automation Population Census we check the following points important for the flow of the project.

- Dates: comparison between planned and actual performance, variance analysis. What were the typical reasons for delays?
- Resource assessment. Where are narrow places?
- Costs: What are the real costs? What factors contributed to the excess of the cost?
- We can get visual representation of data through Gant chart.

At last, we create a model – display and displacement of an object by some parameters that gives new information. Creating a project as a whole – the end result which will be basis for the subsequent implementation.

Key words: *Management, MS Project, Task, summary task, Population, Optimization Resources, assignments, Statistic, Gant Chart*

JEL codes: J10, M15, Z13

[1] Corresponding author – e-mail address: giorgobianimaka@ymail.com, telephone: +599 577 254430

Introduction

The main question of the presents Automation of Population Census in Georgia by programm MS Project. The role of population census in development of science and research is tremendous as all social studies use its data and materials. Population census provides complete information about social, demographic and economic status of the population. Materials obtained through population census are used by authorities and local municipalities for efficient management of the country's economy and social-economic planning. Population census is the significant source of statistical data and scientifically organized important state event. Demographic and statistical material obtained through population census is essential for a nation. Statistical and demographical data provides the history of population growth. To understand the economic condition of a country, it is important to determine population growth rate and immigration pattern. The government uses demographical information to determine the total resources needed to satisfy the demand of the total population.

Population census is labor-consuming process with financial and material costs. in addition this process is influenced by different factors and it has specified demands. Modeling and automation of population census with MS Project simplifies implementation of the organizational work and provides possibility of controlling financial, material, labor and time resources. It presents a new management culture leading to deliberate planning. Project management implies activity for efficient achievement of results of the project within the framework of time, affirmed/approved budget and specified quality.

Population census is a subject of social statistics research. Social projecting is widely used today. Social projecting is designing of social objects, social qualities, social processes and relations aiming achieving socially significant goals and localized according to location, time and resources. Social projecting/planning inherently envisages specified social changes and activity.

Characteristic feature of Project Planning is so called **"Triple constraint"** – project limits, time limit and cost/budget. Project is sufficient if these three components are balanced. Or, otherwise, project requirements – product, service and outcome is accomplished in given scope, time and budget/costs. Relationship between these three factors is so close that if one of these factors changes it will impact the two others as well.

Among the Information technologies of Project Management successfully operates MS Project. MS Project software belongs to MS Office program family and it can be installed as the separate program or as with the MS Office package and it does not require additional cost for software installation.

MS Project is information technology which provides planning, scheduling and controlling. By means of this software application we efficiently and effectively use time, money and resources. Since the goal is defined, Project schedules out each task needed for completion, and identifies teams and resources. By controlling, managers need to revise or change plans by monitoring resources, cost, and quality. Lastly, scheduling involves sequencing and allotting time to all project activities. This is where time and resources come in to see how much time is needed to complete, the people to work, and materials needed for the project.

Microsoft Project creates schedule of all working process. Schedules can be composed taking in account used resources. Chain will be visualized by Gant diagram.

MS Project provides:

- Manage our project plans more efficiently;
- Create tasks, assign resources, and allocate project resources;
- Use techniques to track critical paths, milestones, and project baselines;
- Become more productive by learning how to customize our project work space;
- Track our project finances.

Calendar and schedule tasks as well as customize different project views.

All the information about the Project is kept in data base. Due to mechanism of data base it is possible to present data in different tables/schemes. Conditionally we can say that data base consists of two massive tables: table of tasks and table of resources. Structure of their fields makes possible to create/compose a project of any complexity.

Within the MS Project is being processed the metrics and then specific attitude to statistical data. These materials are used for country and regions. In addition all these trends at the long run presents total general and integrated information about social life, trends of development the community.

Discussion

Actuality of this article presents automation census population by information technology MS Project. In the earlier census population of Georgia the organization and managing of all workings were planning on the paper. However, the final data for statistical processing was working in Excel by the Statistical Department of Georgia. It was difficult watching all the process of describing and controlling.

Census population in Georgia is carried out from time to time, generally once in ten years. Population census, its organization and technology in Georgia has a long history. The organization of population census was governed by state legislation. The population census regulation/procedure was a part of Kartli King Vakhtang VI “Dasturlama”. Every population census was carried out under king’s order/decree and special guidelines describing organizers of the census and categories of population.

The first national population census in independent Georgia was carried out with the help of UN Population Fund in 2002. Georgian population that time was 4.300.000 people. Population census was not carried out for last ten years while information about real population size is very significant for Georgia for sufficiently planning strategies of country’s development.

In July, 2005 UN Economic and Social Council adopted a resolution that appeals to member countries carry out and submit to UN and other interested multilateral agencies population and housing habitation censuses as the paramount source of information for development of planning in municipal, regional, national and international levels for supporting population, environmental and social and economic programs.

On April, 2013, Governmental Commission of Georgian Population Census Coordination sitting considered and adopted 2014 year’s Program of population census submitted by National Statistic Service (Sakstat). According to this Program the following population census in Georgia, as well as in many other countries, will be carried out during 5-19 November, 2014 with the financial and technical support of **UNFPA.** Among East European countries Georgia is the last country that will carry out population census behind 10 year schedule.

During population census (November 5-19) for the optimal utilization of resources and manpower Governmental Coordination Commission envisaged agriculture household census. As a result, together with social and demographic data will be collected information about agricultural activity as agricultural activity and production in Georgia, generally, is carried out in household sector. The existing database of agricultural household sector production is out-of-date and needs renovation. Inclusion of agricultural module in population census will improve the quality of census. For preparation of preliminary agricultural lists will be used digital cartographic material. It should be noted that Georgia is the first country in South Caucasus that will use geographic information systems in population census. The population census person will visit any household with a satellite map. The main goal of the interviewer visit all the premises marked on the map and give the household a special code and collect information about this family and household. The map cannot represent some newly constructed building. In such case the interviewers are obliged to mark this building on the map for the subsequent correction. On this basis will be corrected cartographic materials.

Selection of population census date is a significant organizational activity. Every country chooses population census date according to its social, economic, natural and climate conditions. Definition of critical moment allows to determine population status. It is the propitious moment when we register the data of our interest about population. As the following population census will be carried out in November 5-19, 2014, calculation will start according to the situation of midnight November 5th. Status of population should be recorded as follows: newborns since midnight (24 hours) will not be registered/recorded as they did not exist by that moment. Dead people after midnight (24 hours) will be registered/recorded as alive as it corresponds with their status by the critical moment. Correspondingly, registering/recording data according to critical moment will provide a precise picture of population, let’s say the picture of population in delayed/stopped position. All the data obtained through population census should be corresponding to given moment. Population census starts on the following day of critical moment.

During the population census according to program registration should occur on two categories:

1. Permanent population – community of people that permanently resides on the given place during 12 months and more notwithstanding the place/locality where he was in the moment of population census. The permanent population who was out of the place of residency in critical moment will be registered as temporarily absent population if his absence does not exceed 12 months.

   Permanent population = present population – permanently residing/living + temporarily absent.
2. Present population consists of population permanently or temporarily residing on the given place.

   Present population = permanent population + temporarily residing/living and temporarily absent.

Temporarily absent persons will be registered at the place where they found themselves at the moment of population census and they will be registered as temporarily residing persons if their stay at the given place does not exceed 12 months. Otherwise, if they staid more than 12 months they will be registered as permanent population.

The duration of population census is determined considering the following factors:

1. Complexity of census program and perfection of program questions.
2. Selection of sufficient personnel and rate/quality of their training.
3. Volume of population and proportion of urban and rural population.
4. Country's area/territory and complexity of landscape.
5. Level of development of transport and communications.
6. Connection/liaison of r researches.

During the project management especial meaning should be given to safeguarding of obtained data. Individual data about respondents are kept in accord to Georgian legislation. Individual data is only disseminated as the whole and in generalized form.

In the course of automation of population census especial attention should be paid to selection of good personnel for organization workings. It should be accomplished with the inclusion of IT manager among organizers who are well aware of performance capabilities of MS Project and have experience of the work with it.

Population census according to age groups provides calculate and receive such data as:

- able-bodied among young people;
- older than able-bodied population.

For the denoted group UN Statistic Commission recommends the following age rates:

- younger than able-bodied population – from 4 to 14 years;
- able-bodied population age – from 15 to 64 years.

Based on mentioned age group is calculated the following:

1. Coefficient of substitution of manpower. It presents part of young people in able-bodied population:
2. Pensionable load coefficient. It is calculated for the rate of older than able-bodied people in the able-bodies population.
3. Coefficient of general load. It presents total of younger and older of able-bodied population in comparison with able-bodied population.

Coefficients of manpower substitution, pensionable and general loads are calculated per thousands and characterize how many younger or older of able-bodied age (or both) are on 1000 able-bodied people. This information is used for social welfare and working out measures for rational utilization of resources.

In recent years continues process of aging of planet's population. Size of people older than able-bodied exceeds size of population younger than able-bodied people. In some countries with the growth of older than able-bodied people decrease growth of the people younger than able-bodied group (Japan, Hungary, Bulgaria, Great Britain, France, Canada, Sweden). Decrease of the people younger than able-bodied age is basically associated with the decrease of birth rate in the most countries.

Effect of live labor utilization is studied with the help of data/rate of manpower utilization. To this belong rate of activity, employment and unemployment indicators. There are two kinds of calculation of economic activity coefficient:

1. **Coefficient of economic activity=size of economically active population/size of able-bodied population.**
2. **Coefficient of economic activity=size of economically active population/total size of population.**

The first index characterizes not the activity of total population but only its active part, e.g. able-bodied population. Coefficient of economic activity is characterized by significant alterations according to the country. This rate is higher in economically developed countries that can be explained by high activity of women. **Coefficient of population's employment=size of employed population/size of total population.**

This coefficient characterizes level of involvement of population in social production. It is very general indicator as it covers total population without taking into account differentiation according to age, health state, etc. As the result of processing population census materials we obtain rates of unemployment. According to preliminary census of the population in 2013 year amounted to 4483.8 thousand people. Among them number population in town is 2410.8 thousand, in villages 2073 thousand. We built forecast trend line (Figure 1) for next three years (2014, 2015 and 2016) based on numeric indices taken from the National Statistic Service (Sakstat)[2].

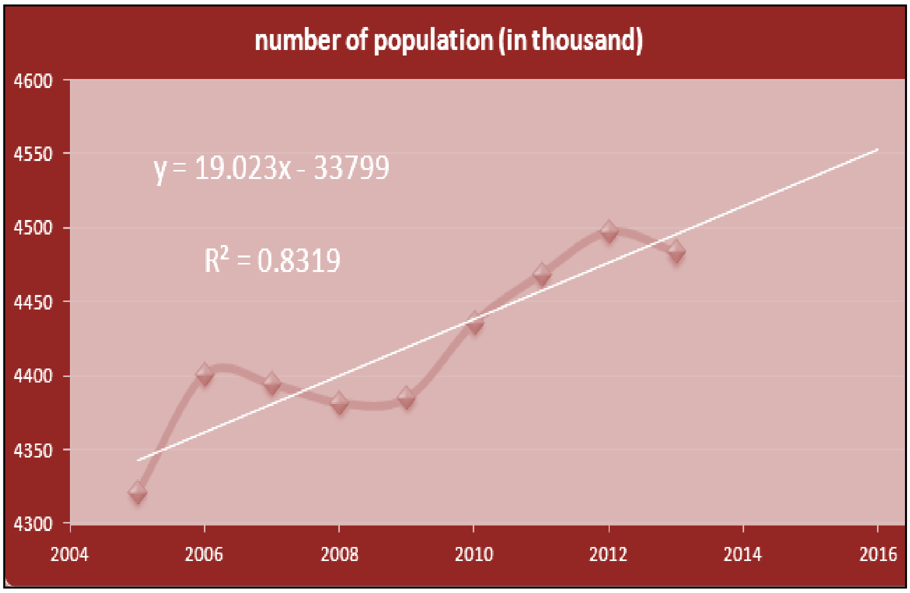

Fig. 1. **Trendline of number population**

Methodology. Within the MS Project and through the also Office program – Excel we use the appropriate statistical methods for analyze our data and draw conclusions, because without using statistics it is very difficult to make decisions based on the data collected from a research project. Using statistical conclusions any manager of company will be in a better position for making best solutions. Statistics refer to the range of procedures used for drawing conclusions about the data in the project. Popular techniques include using descriptive statistics, tests of statistical significance, analysis of variance, factor analysis and linear regression. Statistical methods will help us in answering questions of the project. Descriptive statistics summarize and describe our data with a few basic measures. Key descriptive statistics include

[2] http://www.geostat.ge/?action=page&p_id=151&lang=geo

the mean (the arithmetic average) and the standard deviation (the amount of dispersion in the measures of a particular variable). We use descriptive statistics for summarizing data, such as: size of population according to electoral district and whole Georgia according to age, birth rate, mortality rate, etc. For identification of average rate of growth of population, obtaining statistical data of agricultural record: agricultural lands, farmer enterprises and etc. After statistical processing of data for statistical analyze we obtain different graphs and tables. Tables display information in greater detail, while graphs, such as bar charts and line graphs, are easier to interpret, have greater visual impact and help viewers of our project understand the most important points.

MS Project system is based on web planning and projecting management methods. These methods ensure realization of basic phases of the Project:

- Project initiation;
- Planning – scheduling and distribution of resources;
- Control of plan accomplishment and Project management;
- Completion of the Project.

For statistical research of structure of population are used a method of grouping, graphs and tables for data representation, rates of generic values, etc. The most prevailing is the method of grouping as it is the base of structural composition of population.

In the most group methods urban and rural population are separated and it represents one of the most dynamic and informational indicator. It reacts/responds to any social, economic or political occurrence and process.

One of the significant grouping method is grouping of people/population according to sex and age. As a rule, age intervals are presented by one year, five or ten year intervals. Besides grouping method for characterizing population structure are utilized absolute and comparative/relative indexes.

Population's age composition/structure is also characterized by generic indexes such are medium/middle, mode and median. They are calculated as for the total population as for separate categories. E.g. calculation of medium age of able-bodies population, medium age of people of different professions, etc. Significant aspect of farmer enterprises statistical analyze structure is study of its dynamics. In this indicators are calculated, rates of growth in the specified period. Also are calculated medium level, medium absolute growth and, medium speed/rate.

Project planning: Each project requires planning as it provides possibility to avoid problems: over expenditure of budget, lack of resources, incorrect definition of project objectives, difficulties associated with accomplishment of the project in defined time, etc. Gant Diagram and web graph are used for graphic presentation of task parameters. For presentation of resource parameters is used a type of graph called resource graph. The latter graph has 10 different formats corresponding to aspects of resource planning and analyze.

Calendar can be considered an isolated case of graph. It provides possibility to review/observe utilization of tasks and resources in accord to the time of accomplishment/their use. Operating on time we can obtain precise data about the tasks and resources for those tasks and if needed, apply changes/corrections.

Project duration, its cost and other parameters are calculated on the basis of automatically introduced data.

		Task Name	Duration	St	Finis	Pr	Resource Names
0		Population Census in Georgia	683.33 days	/24/14	ed 9/7/16		
1		1. The preparatory works	171 days	1/24/14	Fri 9/19/14		chief manager[5%]
2		1.1 Preparation Questionnaires and instructions	40 days	Fri 1/24/14	Thu 3/20/14		stationery[300 pack],developer,operato
3		1.2 Divide territory of Georgia into registration areas	21 days	Fri 3/21/14	Fri 4/18/14	2	komputer[50 piece],Organizer[300%],stationery[20 p
4		1.3 Field personnel selection for making list of buildings with their residents and households	45 days	Mon 4/21/14	Fri 6/20/14	3	Organizer[3,000%],komputer[30 piece],printer[30 piece],scaner[10
5		1.4 Advertising Company	15 days	5/23/14	Fri 7/11/14	4	manager,Creator adverts[1,000%],deve
6		1.5 Personnel Training for registration buildings and housholdes	43 days	Mon 7/14/14	Wed 9/10/14	5	teachers for trening[200%],komputer[1 piece],printer[1 piece]
7		1.6 Make a list of numbering buildings and hou	7 days	9/11/14	Fri 9/19/14	6	rent for transportation[1 piece],manage
8		2. Field workings for preparation stage	165 days	9/22/14	Fri 5/8/15		chief manager[5%],electricity
9		2.1 The preliminary estimate number of the population and households	41 days	Mon 9/22/14	Mon 11/17/14	7	komputer[3 piece],stationery[1 pack],Organizer,rent for transportation[
10		2.2 Create database	40 days	1/18/14	lon 1/12/15	9	developer,IT woker,operator,komputer[:
11		2.3 Correcting cartographic material	42 days	1/13/15	'ed 3/11/15	1(	developer,komputer[1 piece],IT woker,s
12		2.4 Preparation of describing docunmentation and printing	42 days	Thu 3/12/15	Fri 5/8/15	11	operator,IT woker,developer,stationery[pack],rent for transportation[1
13		3. Implementation of the first phase of fieldv	79 days	5/11/15	hu 8/27/15		
14		3.1 Description of the population in Adjara and Guria	10 days	Mon 5/11/15	Fri 5/22/15	12	chief manager[5%],manager,developer,kompı
15		3.2 Description of the population in Kakheti	10 days	5/25/15	Fri 6/5/15	14	chief manager[5%],manager,developer,
16		3.3 Description of the population in Samegrelo	25 days	6/8/15	Fri 7/10/15	1!	chief manager[5%],developer,IT woker,
17		3.4 Description of the population in Kartli and Imereti	11 days	Mon 7/13/15	Mon 7/27/15	1(	chief manager[5%],manager,developer, woker,komputer[4 piece],printer[4
18		3.5 Description of the population in Tbilisi	12 days	7/28/15	'ed 8/12/15	1i	chief manager[10%],manager,komputer
19		4. Census population	11 days	3/13/15	hu 8/27/15		
20		4.1 Cenus population for described date	11 days	3/13/15	hu 8/27/15	1{	komputer[6 piece],IT woker,manager,re
21		5. Census results	53.33 days	3/28/15	d 11/11/15		
22		5.1 Getting the reports in various indicators	29.33 days	3/28/15	hu 10/8/15	2(	editor,developer,printer[1 piece],komput
23		5.2 Printing described documentation, publishing and spread	24 days	Thu 10/8/15	Wed 11/11/15	22	editor,komputer[1 piece],manager,operator,printer[1
24		6. Data processing	215 days	1/11/15	Ved 9/7/16		
25		6.1 Field personnel selection for making list of buildings with their residents and households	84 days	Wed 1/11/15	Tue 3/8/16	2:	editor,operator,manager,stationery[10 pack],komputer[1 piece],printer[5 piece]
26		6.2 Statistical data processing	131 days	3/8/16	Ved 9/7/16	2!	editor,komputer[1 piece],manager,printe

Fig. 2. **Projecting tasks with assignment resources**

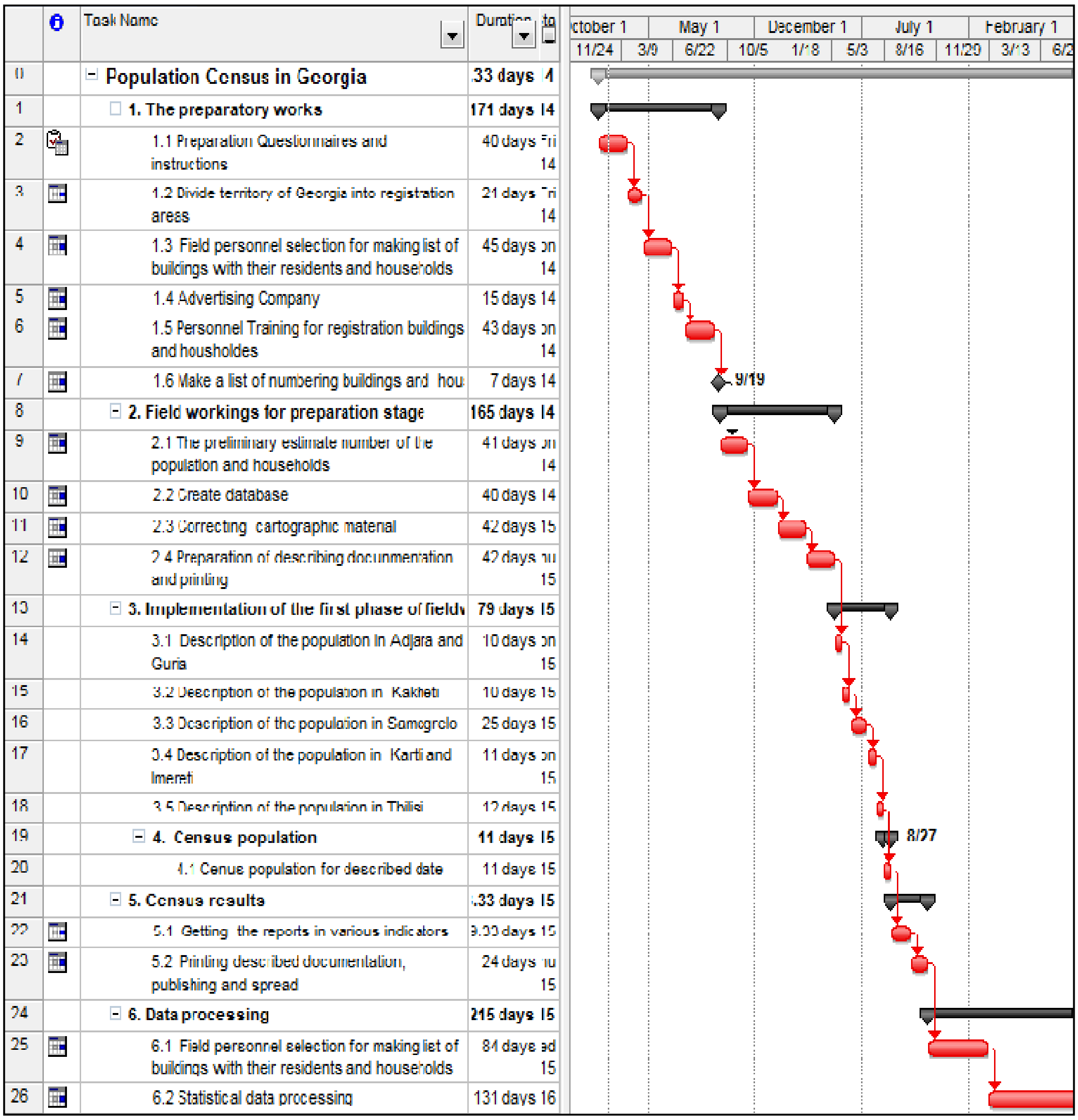

Fig. 3. **Critical way**

The Project goal is population census in tightened period of time with the help of MS Project software for obtaining possibly precise picture about size of population: birth rate, morbidity, marriage, divorce, migration, data about rural appraisal, etc. Statistical processing of these data allows study and analyze social problems – trends of unemployment, social differentiation, trends of development of standards of life of population, level of healthcare, etc. that hampers long term economic development of the country.

Range of time – should be accomplished in specified time. The basic parameters of the Project are volume of work, time of implementation/accomplishment and cost.

The program needs to include information about tasks, their links/relationship, constraints/limitations, implementation dates, resources and costs. Since the information is included the program composes schedule that, according to the team decision, can be optimized for obtaining really feasible and best results.

The Project consists of defined actions called tasks. Tasks are units of the Project. Their generality present content of the Project. The solution of these tasks presents the basic part of the Project implementation. They have succession, times of fulfillment and resources. When we describe tasks, we also make assigning resources to them. In our case content of the Project with pointing starting and finishing date and assigning resources are shown on Figure 2.

We find Critical Path Analysis (CPA), that helps us to lay out all tasks that must be completed as part of a project. As part of a project and to identify the minimum length of time needed to complete a project.

The critical way is shown on Figure 3.

The most data of the separate task and subtasks during performing describing process are working trough Excel and data base Access. Because the census population for 2014 year is not over yet, we have not the filled Report forms.

Conclusions

- Management of social and statistical project of population census using MS Project will simplify monitoring and control of this process to Department of Statistics and organizers.
- MS project shows how to manage social statistical projects efficiently and effectively. provides possibility to control every task accomplishment any time, review the information about the time of its accomplishment, monitor resources assigned to it, we have possibility to reveal narrow parts of the Project and make corrections. Project duration, project cost and other parameters are calculated automatically, on the basis of information included previously.
- Besides economy of time and financial expanses, MS Project makes possible to demonstrably and according to stages present accomplishment of all tasks where the main task will be separated with its secondary tasks with dates of accomplishment/realization, defined interrelations between tasks and indication of time of start and completion, distribution of resources, executing officer of the given task, financial resources dedicated and, simultaneous applying corrections for plan optimization.
- It is possible to present data graphically detectably in Gant Diagram.
- Obtaining different report providing precise picture of population or gathering such quantitative data as: **number of population** (according to urban and rural population), **birth rate, mortality** according to age, sex and nationality; **marriage, divorce, employment, unemployment, income, migration** (according to sex, age and residency); also **information about agricultural and peasant farms**. We must note, that the result forms will be filled after registration population, in April of 2014 year. One of them is shown on Figure 4.

Results according to describing districts							
	Birth	**Death**	**Marriage**	**Divorce**	**Employment**	**Unemployment**	**Migration**
GEORGIA							
Tbilisi							
Abkhazia							
Guria							
Imereti							
Kakheti							
Mtskheta-Mtianeti							
Racha-Lechkhumi and Lower-Svaneti							
Samegrelo and Upper Svaneti							
Samtskeha-Javakheti							
Kvemo Kartli							
Shida Kartli							

Fig. 4. **The face of the result form**

- Obtained quantitative rates/data provides possibility to study social problems – growth of unemployment, growth of social differentiation, worsening/deterioration of standard of living, etc., that hampers long term economic development of the country.
- After processing the population census data utilizing mathematical and statistical modeling methods we can:
  1. Predict/forecast for following years.
  2. Analyze factors impacting/influencing formation of farmer enterprises.
  3. Study interrelation between different demographic and social processes and farmer enterprises.
- For the optimization of budget we can carry out the following activities:
  1. Reveal tasks that caused budget surcharge.
  2. Define time reserves for those tasks that cannot go into budget.
  3. Change structure and distribution of resources for the reduction of costs.
  4. Save copy of the plan.

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A SCENARIO BASED STOCHASTIC MULTI-OBJECTIVE MODELING FOR TIME-COST-QUALITY TRADE-OFF PROBLEM

Hêriş Golpîra, Islamic Azad University Sanandaj Branch, Iran[1];

Shamila Hejazi, Islamic Azad University Sanandaj Branch, Iran

Abstract

Projects are often affected by several sources of uncertainties. So it is essential to have schedules that are less vulnerable to disruptions caused by these noises. In this study we investigate the stochastic time-cost-quality trade-off problem over a multi-objective approach. The model is scenario based and its basic assumption is that the probability of each scenario is available. The model is constructed and a numerical example is modeled and solved according to the proposed approach. The results show the applicability and usefulness of the method which are illustrated at the end of the paper.

Key words: *Stochastic programming, Uncertainty, Time-cost-quality trade off*

JEL code: C61

Introduction

However, in traditional project scheduling problems, only the time and cost are considered without the quality parameters, quality is the other most crucial dimension which is significantly affects a project success (Golpîra, 2012). So, balancing among these key factors has been introduced as a focus of researchers and projects managers since 1990s. El-Rayes and Kandil (2005) and Sonmez and Bettemir (2010) use a genetic algorithm to solve the time-cost-quality trade-off problem (TCTP). Tareghian and Taheri (2007) introduce electromagnetic scatter search as a solution procedure for the discrete TCTP. Huang (2008) proposes a modified ant colony algorithm; Yang (2009) suggests improved particle swarm optimization (PSO) algorithm and Zhang and Xing (2010) apply the same algorithm in fuzzy environment to deal with the problem. Shrivastava, Singh and Dubey (2012) reveal that multi colony ant algorithm is a good method to solve the problem; Shahsavari Pour, Modarres and Tavakkoli Moghadam (2012) introduce linguistic variable for the problem; Mungle et al. (2013) use a fuzzy clustering based genetic algorithm approach and Zhang (2014) studies the fuzzy time-cost-quality-environment-trade-off problem of construction project and establishes a decision making model with multiple modes under resource-constrained environment.

The existing studies generally assume complete information and deterministic environment. Nevertheless, in practice, projects are often subject to some uncertainties. Therefore, it is vital to have effective approaches to make project schedules, which are less vulnerable to disruptions caused by these noise factors. To the best our knowledge, However

[1] Corresponding author – e-mail address: H_Golpira@iausdj.ac.Ir, telephone: +988 713246248

Klerides and Hadjiconstantinou (2010) address uncertainty on problem, using stochastic programming and Salmasnia, Mokhtari and Nakhai Kamal Abadi (2011) introduce the robust model to deal with TCTP; but they are not in multi-objective approach which is addressed in this study. So in this paper we suggest a new stochastic TCTP using goal programming (GP) as the well-known multi-objective decision making (MODM) method on stochastic parameters which is not addressed in the literature. To do this, in the following chapter the method and its attributes are defined, then the model is applied to an example and finally the results are revealed to show the applicability of the method.

Time-cost-quality trade-off problem under uncertainty

Stochastic programming (SP) is a well-known optimization attitude under uncertainty. SP applies probabilistic models to deal with uncertain data in terms of probability distributions. When accurate distributional information is available, stochastic programming has the advantage of incorporating this available distributional data; however, stochastic programming models are usually computationally more demanding (Hazir, Haouari and Erel, 2010).

A scenario based stochastic multi-objective modeling for TCTP is as follows:

$$Minimiz\ z = \sum_{s=1}^{s} \sum_{i=1}^{i} p_s \left(d_{si}^{+} + d_{si}^{-}\right) \tag{1}$$

S.t.: $$\sum_{p=1}^{p} x_{sp} - d_{si}^{+} + d_{si}^{-} = T_s,\ (s = 1, \ldots s),\ (i = 1, \ldots i) \tag{2}$$

$$\sum_{p=1}^{p} c_{sp} x_{sp} - d_{si}^{+} + d_{si}^{-} = TC_s,\ (s = 1, \ldots s),\ (i = 1, \ldots i) \tag{3}$$

$$\sum_{p=1}^{p} l_{sp} x_{sp} - d_{si}^{+} + d_{si}^{-} = Q_s,\ (s = 1, \ldots s),\ (i = 1, \ldots i) \tag{4}$$

$$\sum_{p=1}^{p} a_{sp} x_{sp} \le LMC_s,\ (s = 1, \ldots s),\ (i = 1, \ldots i) \tag{5}$$

$$1 \le x_{sp},\ d_{si}^{+}, d_{si}^{-} \ge 0,\ (i = 1, \ldots i),\ (p = 1, \ldots p),\ (s = 1, \ldots s) \tag{6}$$

Where s is the scenario number, i is the constraint number and p is the project phase number. p_s is the probability of the scenario s and d_{si}^{+}, d_{si}^{-} are respectively the under-achievement and over-achievement of the i^{th} goal for the s^{th} scenario. x_{sp} is duration of phase p over scenario s. T_s is total time of the project over scenario s; TC_s is total cost of the project over scenario s; Q_s is total quality achieved over scenario s and LMC_s is total labor and material cost for the project over scenario s. a_{sp} labor and material cost coefficient for phase p over scenario s of the project.

Simulation and results

To illustrate usefulness and practicability of the proposed approach, an empirical study considering a real project consisting three phases- planning, scheduling and controlling- is given as a sample of construction projects. The data for this study are collected in winter 2013 in Kurdistan. The data of the problem is illustrated in Table 1 and Table 2. Besides, Some assumptions are considered in this problem: (1) there are three scenarios extracting from the real world which have the predefined probabilities as shown in Table 1; (2) each scenario has the predefined unique data as shown in Table 1 and Table 2; (3) cost of quality for each scenario is defined by unique fixed ratio of the total cost of the project which is shown in Table 1.

Table 1

Problem data of each scenario over each scenario

Scenario	Probability of Sc.	Phases	Phases name	Human recourses monthly cost	Other monthly costs	Monthly cost of quality
1	0.40	1	Plan	16	20	30
		2	Scheduling	18	26	5
		3	Control	25	30	20
2	0.35	1	Plan	10	20	24
		2	Scheduling	12	18	4
		3	Control	22	25	16
3	0.25	1	Plan	20	18	22.5
		2	Scheduling	16	20	3.75
		3	Control	30	40	15

Table 2

Problem data of the total project

Scenario	Total cost of human recourses and material	Total cost of project	Time table of the project	Total cost of quality of the project
1	800	1000	36	3.5
2	500	800	30	3
3	400	750	24	4

According to data from Table 1 and Table 2, considering the proposed method predefined by Eq. (1) to Eq. (6), the problem is modeled as follows:

$$Min\ Z = 0.4(d_{11}^{+} + d_{11}^{-} + d_{12}^{+} + d_{12}^{-} + d_{13}^{+} + d_{13}^{-}) + 0.35(d_{21}^{+} + d_{21}^{-} + d_{22}^{+} + d_{22}^{-} + d_{23}^{+} + d_{23}^{-}) + 0.25(d_{31}^{+} + d_{31}^{-} + d_{32}^{+} + d_{32}^{-} + d_{33}^{+} + d_{33}^{-})$$

$$\begin{aligned}
s.t.:\quad & x_{11} + x_{12} + x_{13} + d_{11}^{-} - d_{11}^{+} = 36\\
& 20x_{11} + 26x_{12} + 30x_{13} + d_{12}^{-} - d_{12}^{+} = 1000\\
& 0.03x_{11} + 0.2x_{12} + 0.05x_{13} + d_{13}^{-} - d_{13}^{+} = 3.5\\
& 16x_{11} + 18x_{12} + 25x_{13} \le 800\\
& x_{21} + x_{22} + x_{23} + d_{21}^{-} - d_{21}^{+} = 30\\
& 20x_{21} + 18x_{22} + 25x_{23} + d_{22}^{-} - d_{22}^{+} = 800\\
& 0.04x_{21} + 0.25x_{22} + 0.06x_{23} + d_{23}^{-} - d_{23}^{+} = 3\\
& 10x_{21} + 12x_{22} + 22x_{23} \le 500\\
& x_{31} + x_{32} + x_{33} + d_{31}^{-} - d_{31}^{+} = 24\\
& 18x_{31} + 20x_{32} + 40x_{33} + d_{32}^{-} - d_{32}^{+} = 750\\
& 0.04x_{31} + 0.26x_{32} + 0.06x_{33} + d_{33}^{-} - d_{33}^{+} = 4\\
& 20x_{31} + 16x_{32} + 30x_{33} \le 400
\end{aligned}$$

$$x_{11}, x_{12}, x_{13}, x_{21}, x_{22}, x_{23}, x_{31}, x_{32}, x_{33} \ge 1,$$
$$d_{11}^{+}, d_{11}^{-}, d_{12}^{+}, d_{12}^{-}, d_{13}^{+}, d_{13}^{-}, d_{21}^{+}, d_{21}^{-}, d_{22}^{+}, d_{22}^{-}, d_{23}^{+}, d_{23}^{-}, d_{31}^{+}, d_{31}^{-}, d_{32}^{+}, d_{32}^{-}, d_{33}^{+}, d_{33}^{-} \ge 0$$

The problem is a linear stochastic goal programming which is simply solvable by Lingo software. The results are shown in Table 3.

Table 3

Solution data of the empirical example

Scenario	Variable /Underachievement of goal	Value	Variable /Overachievement of goal	Value	Decision Variable	Value
1	d_{11}^{-}	0	d_{11}^{+}	0	X_{11}	3.29
	d_{12}^{-}	0	d_{12}^{+}	0	X_{12}	11.77
	d_{13}^{-}	0	d_{13}^{+}	0	X_{13}	20.93
2	d_{21}^{-}	0	d_{21}^{+}	7.54	X_{21}	26.33
	d_{22}^{-}	0	d_{22}^{+}	0	X_{22}	1
	d_{23}^{-}	1.08	d_{23}^{+}	0	X_{23}	10.21
3	d_{31}^{-}	9.86	d_{31}^{+}	0	X_{31}	1
	d_{32}^{-}	226.66	d_{32}^{+}	0	X_{32}	1
	d_{33}^{-}	3.29	d_{33}^{+}	0	X_{33}	12.13

As you one can see in Table 3, if manager has no propensity to any tradeoff between time, cost and quality, he should plan the project using scenario 1. In other words, if the manager selects the scenario 1, the tradeoff is not needed and the project may be finished exactly. But if the scenario 2 is taking place, a manager may expense 7.54 time units (21%) rather than the scheduled time of the project, in order to achieve 36% fewer cost of quality. If scenario 3 is taking place, because the lower bound of the all x_{ij}s, the project may finished at 9.86 time units (41%) rather than the scheduled time of the project and 226.66 units of cost (30%) rather than the basic scheduled total cost in order to achieve 3.29 units of cost of quality (82%) fewer than what is been scheduled.

Conclusion

In this paper we consider the time-cost-quality trade-off problem in the field of project management under stochastic manner to handle the uncertainty of the real world projects environments. To deal with this uncertainty, we adopt the scenario approach. As one can see, the model exactly helps the decision maker to have a better solution if each scenario is happened and in this decision making helps him/her to make better optimal tradeoff between all the critical factors of project. In addition to handling uncertainty, the variety of scenarios that can be considered, numerous constraints that may be indicated in the model and its simplicity and solvability are making the model more flexible and practical in real worlds.

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ON SUPPLY CHAIN NETWORK RISK MANAGEMENT, USING TAGUCHI METHOD

Hêriş Golpîra, Islamic Azad University Sanandaj Branch, Iran[1];

Abbas Saghaei, Islamic Azad University, Iran

Abstract

Robustness of Supply chain network is a growing subject in recent decades. It is essentially multi-dimensional topic which needs some comprehensive approach to deal with. In this paper, a new method is introduced in order to quantitatively manage supply chain network risk (SCNR) and achieving higher level of robustness. The method is based on Taguchi method (Tm) as a statistical design of experiments (SDOE) methods. A set of risk factors divided to internal and external factors are built. Most important ones are extracted and the Tm is designed based on these selected factors. The factors are presented to some experts to have some conceptual judgments about the risk level of each state and the results are added up and analyzed. Finally, the method is practically tested in Iran Tractor manufacturing supply chain network and the results are illustrated in the following paragraphs.

Key words: *Supply chain management, Network risk management, Robustness, Taguchi method, Uncertainty*

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1. Introduction

Now a days globalization, unpredictable demand, cost pressures, increasing use of outsourcing, are some of drivers to make higher levels of uncertainty for enterprises in supply chain networks (Shin et al., 2012). In addition, poor execution and lack of contingency plans may result in many failures in business (Wu, Blackhurst and Chidambaram, 2006). Pfohl, Kohler and Thomas (2010) and Shin et al. (2012) suggest that the lean supply networks, applied to cope with the uncertainty, significantly result in higher levels of vulnerability in the field of disturbances but these may have negative effects on robustness of supply chain networks. Therefore, Pfohl, Kohler and Thomas (2010) introduce SCNR management (SCNRM) as an effective success factor for supply chain network management (SCNM) which is increasingly amplified in recent years.

Uncertainty may exist due to many elements as scholars mentioned (Chopra and Sodhi 2004). Stewart (2005) illustrate that uncertainty leads to risk (Klibi, Martel and Guitouni, 2010). Kiser and Cantrell (2006) summarize SCNR factors in internal and external classes similar to Wu, Blackhurst and Chidambaram (2006) who identify them in inbound and outbound factors. In the field of research methods to manage SCNR, there are two classes of methodologies: qualitative and quantitative studies (Pfohl, Kohler and Thomas, 2010) and qualitative methods are more usual than quantitative ones (Tang and Nurmaya, 2011). A challenge in using

[1] Corresponding author – e-mail address: H_Golpira@iausdj.ac.Ir, telephone: +988 713246248

quantitative methods is to find the suitable information to quantify the risk measures (Knemeyer, Zinna and Eroglu, 2009). (Klibi, Martel and Guitouni, 2010) reveal that the concept of robustness has raised a lot of discussion in the literature on decision-making under uncertainty.

Although there is the widespread literature on robust or strategic supply chain network design (SSCND), they are not holly consider the network exhaustively. These weaknesses may be more critical, in view of these facts that mitigating one risk can aggravate the exposure to another risk (Miller, 1992; Chopra and Sodhi, 2004) and mitigation plan of the one firm in the supply chain network may create a new risk for other its members Chopra and Sodhi (2004). So, it is not expected that a set of independent approaches or action plans can lead the supply chain network to be robust. Therefore, it is necessary to establish the good SCNR strategic plan to deal with uncertainties and their variety and provides robustness and resilience for the entire supply chain network (Gaonkar, and Viswanadham, 2007; Pfohl, Kohler and Thomas, 2010; Shin et al., 2012). But according to Gaonkar, and Viswanadham, (2007), the previous methods are introduced to increase efficiency of a SCN and not for achieving its robustness and resilience under uncertainty.

The aim of this paper is to introduce a new quantitative model to obtain a robust plan not for one side or one component of the SCN, but for the entire network. But, there are so many risk drivers when we talk about the entire SCN with some suppliers, focal company and customers which may belong to controllable, incontrollable, internal or external/environmental ones. Thus, the Tm is used to make economical design of experiments in order to have robust SCN with any types of risk drivers. The reminder of this paper is structured as follows: in section 2 the conceptual framework for Taguchi method is derived. Section 3 presents the corresponding model for SCNRM model. General application and robustness achieving of the model are highlighted in section 4 and the conclusion is provided in section 5.

2. Theoretical Background and the Concept of the Taguchi method

Genichi Taguchi is a Japanese engineer who has proposed both philosophy and methodology of Taguchi method (Tm) as the statistical design of experiments (SDOE) in early 1980s (Maghsoodloo et al., 2004; Antony and Antony, 2001). Taguchi (1986) defines quality as "The loss a product causes to society after being shipped, other than any losses caused by its intrinsic functions". Many scholars till date have focused on the Tm applications in service and manufacturing industries. few researchers had applied Taguchi‘s Design-of-Experiment in managing software projects. Rawlands, Antony and Knowles (2000) and Antony and Antony (2001) summarize some of Tm's applications; Tsai, Moskowitz, and Lee (2003) integrate orthogonal array (OA) with critical resource diagram (CRD) to allocate the appropriate human resources (developers) for the proper task. Salem, Rekabb and Whittaker (2004) have applied Taguchi‘s OA to develop a logistic regression model and Maghsoodloo et al. (2004) introduce the essential and literature of the method in a good manner. Zeng, Yao and He (2009) introduce an optimal scheduling model for centralized SCNM including both discrete events and continuous-time dynamics using a hybrid systems method. Tseng and Liu (2011) present a hybrid Taguchi-genetic algorithm for selecting and scheduling a balanced project portfolio and Shi, Wang and Qi (2012) introduce a hybrid genetic algorithm for scheduling and selecting a project portfolio. Sadeghi (2012) presents a project scheduling non-linear bi-objective model to minimize cost and time of projects and Zoraghi, Najafi and Niaki (2012) propose an integrated model of project scheduling and material ordering to minimize the total material holding and ordering costs. In the both methods, Tm is used for tuning parameters of the algorithm to increase its performance.

The process of performing a Tm is as follows: (1) Full understanding and formulating the nature of the problem, (2) Identifying the most relevant output performance features, (3) Full identifying of control factors – that can be controlled under normal conditions –, noise factors – which are too difficult to control in normal conditions – and signal factors – which affect the performance of the process, (4) Defining factor levels, their interactions and degrees of freedom, (5) Selecting/designing an appropriate (OA) – that provide an alternative to standard factorial designs, (6) Preparing the experiment, (7) Collecting data and running the experiment, (8) Analyzing the results (Antony and Antony, 2001; Maghsoodloo et al. 2004). Selecting an appropriate lose function is a basic subject to prepare the statistical analysis based on the Tm. There are three types of lose functions which are used in the Tm: (1) nominal the best, (2) smaller the best and (3) larger the best. *S/N* ratio as a class of statistics which can be applied in order to measure the effect of the noise factors on the process performance is used instead of the lose function, regarding to its type. Taguchi introduced that by maximizing the *S/N* ratio, the loss function is minimized. After the *S/N* ratios calculation, the effect rang of each factor can be calculated to have a comparison among the effect of the factors.

This ratio regarding to the smallest the better lose function is as follows which must be maximized:

$$S/N_s = -10\log\frac{1}{n}\sum_{i=1}^{n} y_i^2\,, \qquad \bar{y}_i = \frac{1}{r}\sum_{j=1}^{r} y_{ij} \tag{1}$$

Index s refers to the type of the lose function; $\bar{y}_i$ is the integrated output of the i^{th} experiment; y_{ij} is the output of the j^{th} times of the i^{th} experiment, and n is the number of experiments defined by OA. Noise factors are factors which influence the output of a process, but cannot be controlled, economically (Roy, 1990).

3. Proposed SCNRM model, Empirical Study and Results

For the purpose of this study, the Taguchi method is applied in order to introduce a comprehensive quantitative robust SCRM method. The method is designed to cope with all the SCR factors which are categorized into two controllable and uncontrollable classes. Table 1 contains of 62 risk factors which are regulated based on the Pareto method (for simplification, we suppose that the correlation between the factors is equal to zero). For this purpose, the factors are presented to some experts to be evaluated conceptually in five levels of importance (The qualitative evaluation is quantified using five-point-Likert method). Suitable factors level is defined and the output factor is featured based on the level of overall risk in each statement which is designed by appropriate Taguchi's OA. The levels are prepared according to experts integrated ideas which are quantified either by five-point-Likert. Recall that the study is about the risk, so it is obvious that the appropriate function is the smaller the better lose function, so, the *S/N* ratio is calculated by Eq. (1). Analysis of variance (ANOVA) is performed to identify the most crucial risk factors and the effect of the risk factors. Finally, response curve analysis is done to determine influential parameters.

Table 1

SCR factors classification (Wu, Blackhurst and Chidambaram, 2006; Williams, Lueg and LeMay 2008; McFadden and Arnold, 2010)

F. classification		Type	Factors	Sub-factors
Controllable risk factors	Full controllable factors	Internal	Quality	Customer reputation
			Cost	Cost model
			On-time delivery	Logistic (1), Non-delivery loses (2)
			Engineering/ Production capability	Design, Manufacturability, Production capabilities and limitations, Capacity utilization, Production capability, Buffering capacity
			Product flexibility	Product and process changes, Nature of product, Change in production volume and mix (4), Substitution policies, Entry barrier, Inability to change
			Technical/ knowledge resources	Incompatible knowledge system, Knowledge management, Training, Changes in technology, Supplier risk awareness (3)
			Financial & insurance	Financial health, Multi-factor business, Non completed risk coverage
			Management related	Management vision, Make-buy opportunity, Break-even stability
		Ext.	2nd tier supplier	Same 2nd tier supplier
	Partially controllable factors	Internal	Accidents	Fire accidents, Employee accidents, Accidents in transportations
			Market strength	Supplier Market strength, Possibility of the suppliers becoming a competitor for the focal company
			Internal legal issues	Labor union, Labor strikes
			Continuity of supply	Supply availability, Unpredictable cycle time, Supplier backing up
		External	External legal issues	Legal claims by customers (5), Legal status of product/services
			Demand	Demand loss, Expected demand growth
			Security	Maritime pirate attack, High-way theft
Full Uncontrollable risk factors		External	Natural/man-made disaster	Earthquake, Volcano, Flood, Communal riots, Terrorism, Sabotage, Counterfeiting
			Politics/ economics stability	Economy down-turn (6), New government, Rules/regulation changes, Actions and sanctions of governments
			Market characteristics	Raw material cost trend, Loss of contract, Low profit margin, Market growth, Market size
			Competitive	Uncertainty about competitors' actions

As an empirical study, the Iran tractor manufacturing supply chain (ITMSC) is proposed to demonstrate usefulness and validity of the proposed method. The data for this study were collected in winter 2013 in Iran. A group of four top manager of the ITMSC is asked to choose the most important risk factors which are classified into two external and internal classes as shown in Table 1. Subsequently there are four internal factors and two external ones which are become distinguished numerically in Table 1, are selected.

The mixed orthogonal array shown in Table 2 is selected for the experimental investigation. "smaller-the-better" is being taken as a quality characteristic, since objective function is to minimize the risk of the Supply chain. Those top managers are asked together to fulfill the table subjectively. Their judgments are shown in Table 2.

The average risk levels and S/N ratios are calculated for each experiment and the ANOVA is performed to recognize the most important risk factors as shown in Table 1.

Table 2

Taguchi layout and results

#	Internal variables				Ex. Var.	Overall risk level				$\bar{y}_i$	*S/N*
	(1)	(2)	(3)	(4)	(5)	2	1	1	2		
					(6)	1	2	1	2		
1	1	1	1	1		1,1,2,1	1,1,2,1	1,1,1,1	4,5,4,4	1.9375	-5.7448
2	2	2	1	1		2,3,4,4	3,2,3,2	4,1,2,1	6,6,5,5	3.3125	-10.4031
3	2	1	2	1		3,2,4,4	3,7,3,3	5,4,4,5	8,8,6,8	4.8125	-13.6474
4	1	2	2	1		5,4,4,5	4,6,3,4	4,5,5,6	10,9,7,9	5.625	-15.0025
5	2	1	1	2		5,4,5,6	1,4,3,2	5,5,4,5	6,4,5,6	4.375	-12.8196
6	1	2	1	2		5,4,7,6	4,4,4,4	3,4,5,3	7,5,6,8	4.9375	-13.8701
7	1	1	2	2		5,6,6,5	6,5,6,6	1,1,3,3	5,5,7,5	4.6875	-13.4188
8	2	2	2	2		6,7,6,7	4,5,6,6	1,3,4,2	9,7,10,10	5.8125	-15.2873

Table 3

The ANOVA results

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	52.141	3	17.380	6.714	.001
Within Groups	72.484	28	2.589		
Total	124.625	31			

The results are laying stress on the significant effect of the risk factors. The average of S/N ratios is calculated at each factor level in order to have the response curves as shown in Table 4.

Table 4

The parametric effects of factors

Factors	Level 1	Level 2	(Level 2 - Level 1)
(1)	-48.0362525466408	-52.1573530543553	-4.12110050771447
(2)	-45.6306358357802	-54.5629697652158	-8.93233392943559
(3)	-42.8376552823212	-57.3559503186749	-14.5182950363536
(4)	-44.7978173484634	-55.3957882525327	-10.5979709040693

The greater difference between the levels, the parametric effect will be much. This effect is shown not only in Table 4, but in Fig. 1. In this figure the slope of each line, introduces the effect of that factor. So the 3rd risk factor – supplier risk awareness – has a higher parametric effect and “change in production volume and mix”, “non-delivery loses” and “logistic” are in the latter levels of effect.

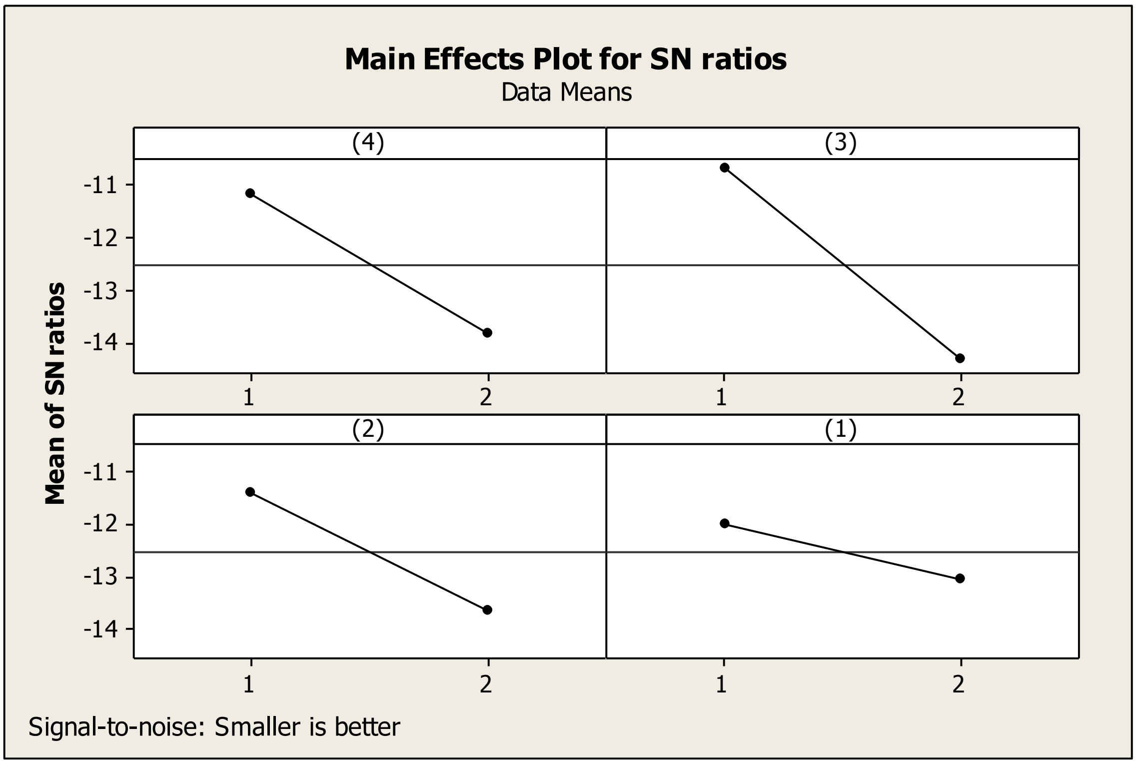

Fig. 1. **The response curves**

As you see in Table 2, the better state for the ITMSC is the state that internal and environmental risk factors are in their lower level. This table not only shows the better state of the ITMSC, but the better state for any condition of the supply chain in any level of its internal risks, according to dependency of the external risk factors. For instance, one can see that if all of the external risk factors are in their higher levels, and the 2nd risk factor – non-delivery loses – is either in its higher level, the better condition is occurred in raw 2 which says that in this statement, the ITMSC most try to being in lower level of the 3rd and 4rd risk factors and the 1st risk factor can be in its higher level and it is because of their interactions and interdependencies.

4. Conclusion

In this paper, we consider the supply chain under the effect of internal and external risk factors. To handle the uncertainties of the various risk factors and to achieve the high level of robustness, we adopt the Taguchi method. The basic major superiority of the method is its ability to explain a strategic plan for the supply chain as a combined interrelated network to achieve robustness. The method is successfully installed in ITMSC and the results illustrate the applicability and validity of it.

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Project Management Development – Practice and Perspectives
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A DISCOURSE ON VIRTUALITY OF TEAMS FOR CONSTRUCTION PROJECT MANAGERS

M. Reza Hosseini, University of South Australia, Australia[1];

Nicholas Chileshe, University of South Australia, Australia;

Jian Zuo, University of South Australia, Australia;

Bassam Baroudi, University of South Australia, Australia

Abstract

The construction industry has observed the emergence of innovations such as Building Information Modelling (BIM) in which most of the operations should take place in virtual teams. Likewise, adopting distributed teams has been regarded as a remedial solution for the problems confronting the construction context. Against this backdrop, a major part of teams deployed nowadays in construction projects stand somewhere along a continuum between face-to-face and purely virtual, thus could be deemed partially virtual. There is evidence indicating that managerial styles and policies for leading teams with virtuality are different from those of face-to-face teams. Hence, awareness of the nature and effects associated with virtuality in teams is becoming a prerequisite for effectively designing and managing teams within the construction industry. This makes having a deep appreciation of the constructs and variables contributing to the virtuality of teams relevant and urgent for construction project managers. Nevertheless, virtuality and its associated factors have been overlooked by academia in the construction industry. In response to this, the current paper draws upon a qualitative meta-analysis method to ascertain the main determinants of virtuality from the literature. The paper presents the theoretical background resulting in developing a conceptual framework for clarifying virtuality of teams within the construction context. The discussions presented and the conceptual framework would provide the practitioner in the construction industry with some insight about the major aspects of virtuality of teams. Additionally, it would add fresh impetus to the field for conducting further inquiries on the subject.

Key words: *Virtuality, Virtual teams, Discontinuities, Project Management, Construction Industry*

JEL code: O33

Introduction

Research studies on virtual teams in the construction industry have postulated that construction practitioners should embark on using virtual teams as an effective remedy to tackle the fierce competition in today's business environment (Chinowsky & Rojas, 2003; Chen & Messner, 2010). As such, most of the construction project teams nowadays operate virtually (Zhang et al., 2007). In this context, construction project managers should increasingly deal with teams that are not explicitly traditional or completely virtual and

[1] Corresponding author – e-mail address: Mohammad.Hosseini@unisa.edu.au, telephone: +61 404724858

mostly could be considered to be somewhere between the two aforementioned extremes (Hosseini & Chileshe, 2013).

It is in this context that establishing and disentangling the concept of virtuality is of utmost importance for two main reasons. Firstly, strategies that are advantageous for conventional project teams are deemed to be ineffective as teams shift further towards operating virtually (Chen & Messner, 2010). Hence, project managers should design and manage their teams taking into account the far-reaching effects of virtuality as pointed out in (Arling & Subramani, 2011). Secondly, there is a plethora of statements attesting to the immaturity of the body of knowledge on many aspects of working in virtual teams (Schweitzer & Duxbury, 2010; Martins & Schilpzand, 2011; Hosseini et al., 2013). However, achieving a comprehensive understanding of virtual teams requires agreement on a common definition by researchers as a prerequisite for further investigations. Particularly, a construction-oriented definition for the construction industry is a perquisite for future inquiries (Hosseini & Chileshe, 2013). Such a definition should draw upon the phenomenon of virtuality (Martins et al., 2004). As maintained by (Joy-Matthews & Gladstone, 2000, p. 25), in order to investigate virtual teams rigorously, the concern should be to clarify 'what happens along the continuum between proximate and wholly virtual teams'. Nonetheless, a common definition of virtuality has yet to emerge in the literature (Hosseini & Chileshe, 2013).

This paper addresses the above-mentioned issues through building a conceptual model that could shed some light on the phenomenon of virtuality in contemporary teams. The objective is based on the assumption that presenting a conceptual framework or intermediate theory would link the existing and future studies and provide a sound basis for further inquiries.

Research Methods

As stated in the above, the overarching aim of this study could be expressed as providing the foundations, grounds and directions for future theory building attempts in order to create knowledge on virtuality as an overlooked area in construction field. Nevertheless, knowledge creation is merely possible by building new theories, extending existing theories and discarding the theories or the thereof elements rejected in empirical studies. Yet, any attempt for building theories should follow a scientific process and provide the basic elements necessary for building theories for creating knowledge (Meredith, 1993). On the other hand, literature review plays a crucial role in all stages of theory building journey. As stated by Wacker (1998) assuring that all the requirements of building a good theory has been met takes conducting exhaustive literature reviews. In addition, as stated in (Torraco, 2005), the novelty of a field justifies undertaking studies to synthesise the findings of previous studies. Hence, conducting an integrative literature review becomes relevant in constructing a conceptual model for conceptualising virtuality.

The protocol to conduct review of the literature in this study conformed to the procedure followed in the recent study by Hosseini and Chileshe (2013). Therefore, review of literature in this study covered all the databases mentioned in the former study. The titles and labels used in the papers by Martins and Schilpzand (2011) and Hosseini et al. (2013) were deployed to search the databases. This resulted in the identification of 410 treatises pertaining to different aspects of virtual teams. Accordingly, the researchers reviewed the databases and singled out any publications focusing on virtuality. This yielded 32 major studies on virtuality.

Advantages of adopting virtual teams

Main achievements of using virtual teams include the ability of to cross over spatial and time borders (Fuller et al., 2012), cost saving due to relatively lower wages (Hunsaker & Hunsaker, 2008), the savings by lower office space rent and expenses, reducing travel expenses (Schweitzer & Duxbury, 2010), enhanced productivity (Chinowsky & Rojas, 2003; Chen & Messner, 2010), timeliness and faster response (Gressgård, 2011), and higher quality of the products or services (Gignac, 2004). Besides, increasing the competitiveness ability of organisations in the globalised working environment is another positive aspect of adopting virtual teams (Mawanda, 2012). As such, some scholars have enunciated that adopting virtual teams for an organisation means shifting from failure to success (Duarte & Snyder, 2006). Consequently, there is evidence stating that virtual teams will be adopted increasingly within a wide range of industries including the construction industry (Hosseini & Chileshe, 2013). As a result, understanding the nature and major aspects of virtual teams is a necessity for construction project managers due to the popularity of this phenomenon in the industry.

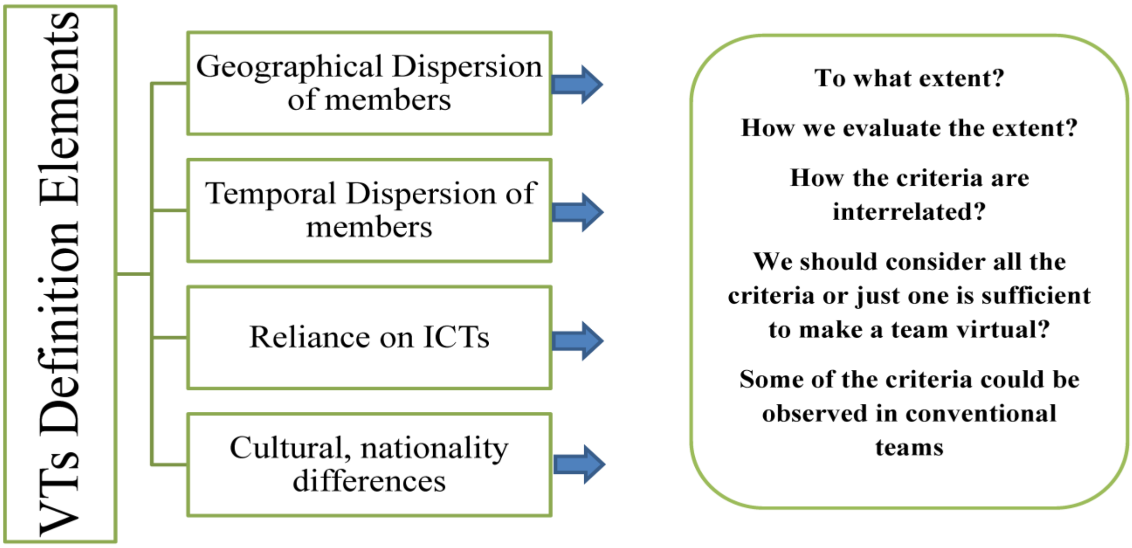
Conceptual Definition of virtual teams

There is little consistency regarding the constructs and the attributes of virtual teams within the extant literature (Hosseini & Chileshe, 2013). Besides, the conceptual definition of virtual teams is still subject to change and evolution. Consequently, the literature has not hitherto come up with a fixed terminology (Martins & Schilpzand, 2011). Due to the continually evolving concept of virtual teams, one can hardly come across a unified definition for the virtual teams agreed upon within the published documents (Chen & Messner, 2010; Schweitzer & Duxbury, 2010; Martins & Schilpzand, 2011). In general, two main approached for defining virtual teams has prevailed the field as discussed in below.

Dichotomy approach

Review of literature showed that most of the published works on virtual teams have focused to define them as the dichotomous alternative of conventional teams. This represents the traditional approach to define virtual teams according to which teams are defined on one side of two extremes i.e. face-to-face or virtual. As an example for this approach, Peters and Manz (2007) opined that virtual teams are comprised of members who might be located in more than one geographical positions working extensively with computer-mediated tools as the main channel of communications. Such definition downplays the disparity feature of virtual teams. Besides, it is not well-defined how dependent should team members be on communication technologies. Similarly, Lipnack and Stamps (1997) introduced virtual teams as people who interact for completion of interdependent tasks guided by common purpose while working remotely, in different time zones and organisations with links strengthened by communication tools.

Dichotomy approach seems to be an obsolete approach for defining virtual teams. This is because, contemporary teams are no more explicitly traditional or completely virtual (Gibson & Gibbs, 2006). Moreover, most of the definitions in the dichotomy approach have drawn upon vague criteria as the basis to regard a team as virtual or otherwise. The main criteria of definitions in dichotomy approach and the ambiguities of such definitions are captured in Figure 1.



Source: authors based on (Schweitzer & Duxbury, 2010)

Fig. 1. **Vagueness of elements based on the traditional approach to conceptual definition of VTs**

Accordingly, researchers have attempted to define virtual teams and clarify their nature and attributes based on virtuality concept as will be discussed in the following section.

Virtuality approach

With the advancements in communication technology and the escalation of using technologies by proximate teams along with the trend of decentralisation of organisations, more and more investigators regarded the traditional dichotomy as an oversimplification of the reality e.g. (Gibson & Cohen, 2003). The simplicity of the dichotomy approach could be misleading in interpreting the nature, the processes and the envisaged outcomes of virtual teams. Hence, the field has witnessed a shift from the dichotomy approach towards attempting to define virtual teams the concept of virtuality as will be discussed in the following sections.

Previous studies on virtuality

Five broad dimensions to measure the degree of virtuality has been commonplace within the extant literature. These include the distance between the members, the proportion of time working face-to-face, the level of work asynchronously, the layout of team members and the level of reliance on communication technologies (Schweitzer & Duxbury, 2010). Likewise, Gibson and Cohen (2003) regarded differences in terms of nationality, business sector, function , background, and culture as other measures of virtuality. Nationality was emphasised later by Gibson and Gibbs (2006) as a primary contributor to virtuality. From another perspective, distribution of the team, tasks diversity, and mobility of workplace were the three dimensions used by Chudoba et al. (2005). Kirkman et al. (2002) proposed a three dimensional model to evaluate virtuality based on the proportion of the members of the team that work virtually along with the proportion of the time dedicated to virtual working and the percentage of workdays members allocate to the a particulate team. Later, Kirkman and Mathieu (2005) argued that the geographical dispersion of a team was not a perquisite to have a virtual team. They defined "team virtuality" as a phenomenon with three fundamental dimensions comprising (1) the level of using virtual tools of communication, (2) the value of the information produced and (3) the member activities synchronicity level. Generally, they maintained that teams are less virtual correlated with the extent that their members contacts resemble the contacts that would occur eliminating communication tools from the scene.

The thrust of the paper by O'Leary and Cummings (2007) was somehow in contrast to the proposition of Kirkman and Mathieu (2005) regarding downplaying dispersion dimensions. The authors of the paper stated that all three i.e. spatial, temporal, and dimensions of configuration have their own different effects on the outcome of teams. They developed equations to gauge virtuality mathematically. Yet, as stated by the authors of the former study, organisational, structural and technological variables strongly affect the perceptions and viewpoints of people about dispersion of teams. Apparently, former aspects do not correlate directly and linearly with mileages between the members or the available hours for working synchronously.

Another work oriented by the concept of virtuality of teams is the study conducted by Schweitzer and Duxbury (2010). They gathered the six well-known virtuality criteria through a review of the literature (i.e. geographic, temporal, organisational boundaries dispersion along with being dependent on information tools, lifespan and cultural/nationality issues). Afterwards, the study involved delineating those virtuality conditions (out of the six) that could be sufficient to make a team virtual on its own. Finally the abovementioned paper developed a three dimensional degree of virtuality metrics comprised: (1) the proportion of time team members worked virtually (titled as WV), (2) the proportion of the time members worked apart from each other (termed as MV), and (3) the configuration of the team in terms of the degree of separation (DV). The results were calculated separately for each construct which were consistent with some previous works in terms of emphasising on separate different effects of each dimension on virtuality of teams (Gibson & Gibbs, 2006; O'Leary & Cummings, 2007). Nevertheless, looking at virtuality through the lenses of mathematical equations is not an effective approach, since the concept is not purely objective concept as postulated by Siebdrat et al. (2013).

Salience of defining virtuality for construction project managers

The primacy of clarifying virtuality comes from the vital role of performance of teams for practitioners in the industry. Likewise, there is a plethora of published works focused on the team performance because it has long been argued that the philosophy behind establishing a team is to produce more useful outcomes for an organisation (Mathieu et al., 2008). Likewise, teams with any virtuality are after all a subset of teams within any kind of organisation (Schweitzer & Duxbury, 2010). As far as it concerns teams, a sizable amount of research on team working have struggled to identify the factors and variables leading the teams to be effective and with higher performance (Paris et al., 2000). As the subset of overarching concept of teams, this has been the case for VTs. It is confirmed by the high volume of research dedicated to elicit the variables affecting the performance and effectiveness of VTs (Lin et al., 2008).

The degree of virtuality is an important variable when it comes to investigating the performance and effectiveness of VTs. This is because, many aspects and dimensions of virtuality greatly affect the performance and effectiveness of teams (Gibson & Cohen, 2003; Chudoba et al., 2005; Gibson & Gibbs, 2006; Schweitzer & Duxbury, 2010). However, the effects are different in terms of the nature and the strength (Ortiz de Guinea et al., 2012) and rest on the level of virtuality of a team. In addition, virtual teams and purely face-to-face teams have noticeable discrepancies (Schweitzer & Duxbury, 2010). Hence, leadership and management policies designed for face-to-face teams are not necessarily applicable to teams with degrees of virtuality (Hosseini & Chileshe, 2013).

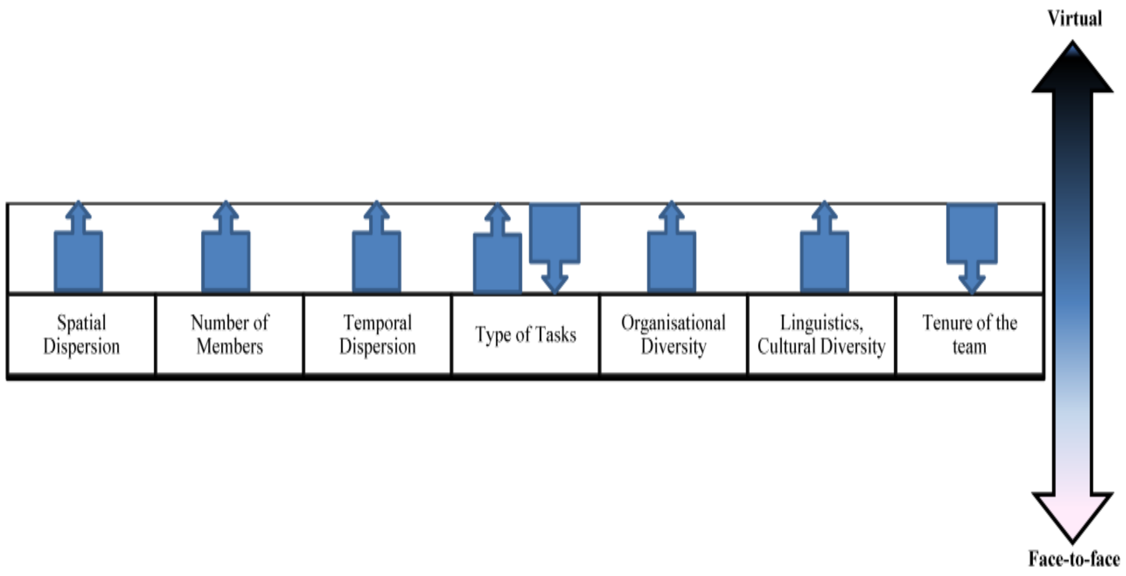
As such, determining virtuality is of vital importance for coming up with the appropriate strategies and approaches for managing and leading contemporary teams. In other words, policies associated with management and leadership of teams contingent upon the degree of the virtuality of teams and the relative distance of the team from face-to-face team working. Above all, due to the effects of higher virtuality degrees on the performance and effectiveness of teams, awareness of the degree of virtuality of teams is essential for any manager when it comes to designing the team and allocation optimised locations and positions to its members (Arling & Subramani, 2011). As a result, construction projects managers should possess a deep appreciation of the concept of virtuality in teams.

Conceptualising virtuality

Teams become virtual due to the limitations dictated by the conditions stemmed from requirements of the stakeholders. As postulated by Schweitzer and Duxbury (2010, p. 13), “If the companies had unlimited travel budgets and teams had endless amounts of time, then face-to-face meetings would be the best way to work, right?”. Presumably, construction organisations require the success of their virtual teams. On the other hand successfulness of activities in virtual teams takes effectiveness of individuals as the members (Saunders & Ahuja, 2006). Likewise, effectiveness of members relies on the success of interactions and information exchanges between the members (Cramton, 2001). As per stated by the social network theory, the benefits envisaged for using network of people is to facilitate having improved accesses and faster contacts with the resources (Burt, 1992).

Hence, success and effectiveness of any team with any virtuality is literally the only aspect of the team that matters to all the stakeholders in the construction context. Based on all the above statements, a correlation between the effectiveness of a team and how easy and effective members of the team can contact each other and exchange information is identifiable. In other words, any factor adversely affecting the ease and quality of information exchange will make the team different from face-to-face teams by increasing the virtuality and should be deemed a contributor to virtuality. Based on the integrated review of literature, the major constructs contributing to virtuality are illustrated in Figure 2. As per the abovementioned discussions, virtuality of any team could be defined as:

A holistic phenomenon as the collective effects of constructs of virtuality that reflects how effectively and risk-free all the team members can cooperate and exchange information in comparison to a team in which all members work face-to-face.



Source: authors

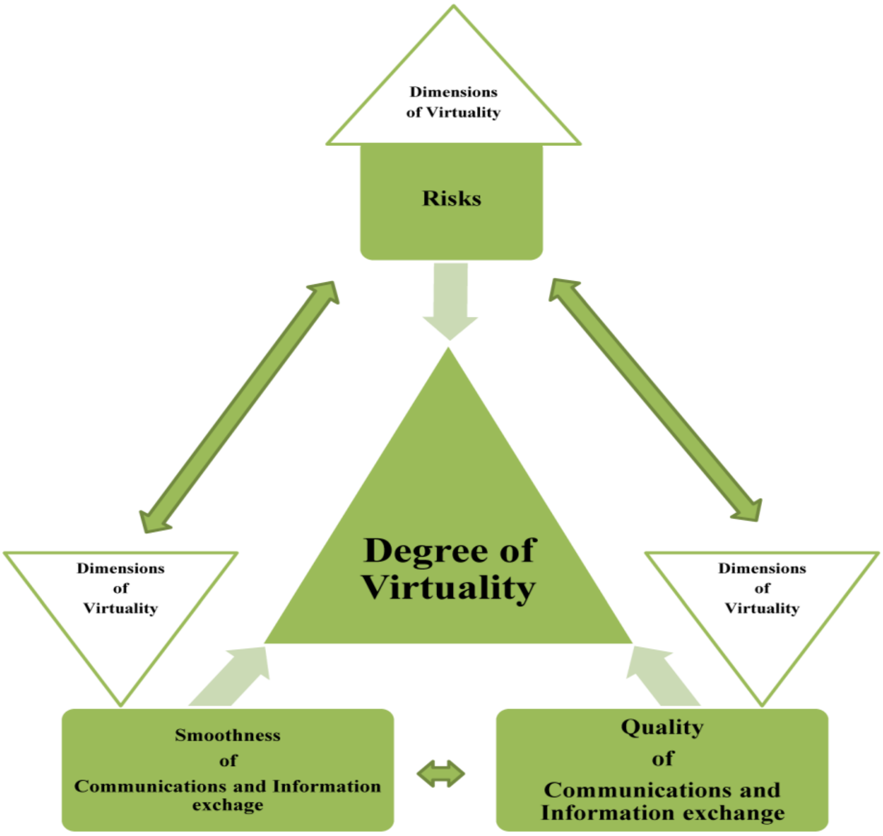
Fig. 2. **Main contributors to virtuality in teams**

Thus, virtuality is the aggregated perceptions of all the team members regarding the simplicity, and quality of information exchange with other members of the team. Besides, it reflects the degree of risks associated with the virtual team working processes due to its virtuality attributes. It should be noted that such definition is not correlated with any specific construct of virtuality. It is actually affected by the collective effect of all the constructs of virtuality and the very context in which the team is active. Hence, degree of virtuality should be based on a holistic approach taking into account the context and all the conditions dominant in any team.

Conceptual model of virtuality

As per the philosophical conceptualisation discussions presented in previous section, three constructs affecting the virtuality of teams were identified as the following:

I. The risks associated with virtual working (Risk).
II. The quality of communications and information exchange (QCI).
III. Smoothness of communications and information exchange in virtual team (SCI).



Source: authors

Fig. 3. **Conceptual model for defining virtuality**

Any of the above fundamental constructs can contribute to the degree of virtuality individually. However, each one of foregoing three constructs is altered under the combined effect of virtuality dimensions. Figure 3 illustrates how three major constructs affect the degree of virtuality while being affected by the collective effects of various dimensions of virtuality. We should note several caveats now. Firstly, as illustrated in Figure 3 constructs can affect each other. Obviously, by reduction in the quality and smoothness of communication, risk will increase. Secondly, communications smoothness and quality represent different concepts. It is because team members can experience high quality communications with extra effort namely lower smoothness. In other words, smoothness indicates the effort to keep acceptable communication channels open while communication quality represents the potential for having high quality communications within the very conditions of the team.

Conclusions, proposals, recommendations

The construction industry is moving from face-to-face teams to teams showing degrees of virtuality while the field is still suffering from paucity of knowledge about the nature of virtuality in teams in many aspects. This includes the lack of a unified definition and conceptual frameworks for incorporating all the affecting elements, which are literally the foundations for building theories, and creating knowledge. This paper contributes to the body of knowledge by presenting a conceptual theory attempting to fulfil these requirements namely building the foundation of further research on the subject. As such, the construction industry requires further research on virtuality considering the paucity of research in the field and the dire need of innovation diffusion and radical changes in every aspect of it to keep pace with the globalisation trend. The framework provided could be the initial stage for future researchers to expound on the concept of virtuality and its undeniable effects on the performance of construction teams.

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THE MOST COMMON MISTAKES IN EUROPEAN UNION FUNDS PROJECTS IN LATVIA

Olita Janberga, University of Latvia, Latvia[1]

Silvija Bruņa, University of Latvia, Latvia

Abstract

Latvia as a European Union (EU) Member State has an opportunity to use EU financial assistance that is provided by the EU funds. The introduction of EU funds in Latvia started in 2004-2006 planning period, it continues currently in the 2007-2013 planning period and is expected to continue into 2014-2020 planning period, resulting in funding being a major source of investment and development.

One of the prerequisites in order to ensure successful and efficient management of EU funds projects is establishing a management and control system that is able to react and prevent or minimize in a timely manner the risks that endanger implementation of EU funds, as one of the European Commission's requirements are adequate EU funds management and control system. Controls set up in line with the management and control system checks (carried out by responsible institutions and cooperation institutions), audits of operations, and on-the-spot checks have to provide assurance to the European Commission on the operational effectiveness of EU funds management and control system and the legality and regularity of declared expenditures.

The levels of EU Funds control system are, firstly, the Audit Authority at the national level, providing an opinion on the management and control systems, including the annual level of error. Next step is for the European Commission to carry out controls in the Member States and give confidence to the European Court of Auditors to submit to Parliament an annual report for the previous financial year.

Investigations of errors in fund projects fall into three major groups. Firstly they are errors in project management. Then follow errors in procurement, especially in public procurement, that make major financial impact. The third huge group is errors in accounting. Early error detection and prevention reduces the negative impact on the state budget by means of financial corrections.

Keywords: *EU funds, project management*

JEL codes: O22

Introduction

For general insight – the total EU fund financing provided to Latvia in the current planning period, i.e. 2007-2013, is 4 bn LVL or 5.7 bn EUR, which is one third of the state budget. The slide shows distribution of the financing by field – most emphasis being on transportation, followed by agriculture and fish industry, then by environment, and so on. Respectively, the financial extent of mistakes follows the same order, but the number of mistakes is inversely proportional.

[1] Corresponding author – e-mail address: olita.janberga@gmail.com

The distribution and role of the multiple layers of institutions involved in the EU fund administration is shown on the next slide – beginning with the recipients of financing, who actually receive the money, on to the cooperation institutions, which ensure selection and assessment, supervision and control of implementation of the potential financing recipients' projects. Cooperation institutions are subordinate to the Responsible institutions – which basically develop the criteria for assessment of fund project submissions, analyse problems in implementation of fund activities and projects, and submit proposals to improve project implementation to the Managing authority. The managing authority in its turn performs supervision and the Responsible and Cooperation Institutions, and it is the Managing authority that is responsible for the operation of the whole management and control system. At the top of this pyramid is the Payment and Certification Institution, which prepares expense declarations and payment applications and submits them to the European Commission.

The purpose of the article is to study of the most essential mistakes in the projects financed by the European Union in Latvia in the planning period of 2007-2013, based on the audits and revisions of institutions involved in the EU fund management carried out over the current planning period of 2007-2013.

The methodological basis for the article is made up of the guidelines of the EU and the Republic of Latvia as well as works of foreign authors, and research carried out by the authors.

The listing of literature provides references to works of foreign authors, standards and sources of publicly available information.

European Union funds projects in Latvia

Project management is the skills, tools and management processes required to under-take a project successfully (Westland, 2007).

The main financial instruments indicated were the European Union structural funds, such as the European Social Fund (94%), European Regional Development Fund (96%), European Agriculture Fund for Rural Development (72%), and the Climate Change Financial Instrument (68%), which can be explained by the fact that the available amounts of these financial instruments are great – more than 4.5 billion euro for the planning period of 2007-2013 (Draft National Strategic .., 2007).

The EU structural funds are financial tools created in the European Union for the purpose of mitigating the differences in development levels of various regions. The objective of the structural funds is to use long-term financing to even out both the social and economic inequality among the EU member countries.

Hundreds of thousands of projects throughout the EU have benefited from investment from regional policy over the years. For the 2007–13 period, Latvia has been allocated around € 4.6 billion in total, €4.5 billion under the Convergence Objective. This is nearly four times more than for the previous programming period, 2004–06.Latvia has three programmes: two supported by the ERDF and Cohesion Fund: ‘Entrepreneurship and Innovations’ and ‘Infrastructure and Services’, and one supported by the ESF: ‘Human Resources and Employment’. All three programmes cover the entire territory of Latvia.

The financing available to the National and Regional Scale Development Centre Growth Promotion for Balanced State Development activity of the event Support for Sustainable Urban Environment and Urban Region Development of the supplemental priority

Polycentric Development of the program Infrastructure and Services in the 2007–2013 planning period makes up LVL 209,216,720, including ERAF co-financing of LVL 177,834,211 and national public co-financing of LVL 31,382,509 (State budget grant), and as a consequence the **reception and efficient administration of financial resources have become topical issues.**

Table 1

Distribution of 4bn LVL of EU funds across fields

Field	Financing, LVL	%
Transportation	950 477 129	23.7%
Agriculture and fish industry	828 897 354	20.7%
Environment	552 563 821	13.8%
Business and innovation	370 456 229	9.2%
Education	312 894 470	7.8%
Employment	203 617 460	5.1%
City environment	192 923 990	4.8%
Science	188 199 785	4.7%
Healthcare	159 446 957	4.0%
Energy, culture, tourism, support	253 436 878	6.3%

Authors' research on most essential mistakes in the projects financed by the European Union in Latvia

The European Commission has stipulated that in project management should use the project life cycle method if the European Union Structural funds resources are utilized; however, the authors' research proves that the project implementers do not always apply the appropriate project management methods and tools, thus failing to ensure maximum project efficiency and investment of financial means.

The study of mistakes in funded projects reveals that they can be subdivided into three major groups based on their influence on the mistakes:

- **Project management;**
- **Procurement;**
- **Accounting.**

Most typical mistakes in project management:

- Incorrectly calculated resource needs on the project – financing, deadlines, people;
- Missed project deadlines;
- Uncoordinated extension of delivery deadlines;
- Insufficient care taken to select cooperation partners;
- Poorly planned cash flow;

- Contractual terms not read and observed;
- Expenses not matching estimates;
- Contractual publicity requirements not observed;
- Procurement from related persons;
- No certainty of the economic advantage of chosen proposal;
- Setting project goals that are not actually planned to be achieved during project;
- Diverting from project goals during execution;
- Lacking or only formal equal opportunities for the handicapped;
- No price control;
- No control over suppliers' promised deadlines, contractual penalties not applied.

Most typical mistakes in procurement:
- Insufficient preliminary research, and resulting poor technical specifications;
- No market research, and as a consequence inappropriate price;
- Insufficient assessment of the potential of unforeseeable expenses;
- Exceedingly limiting requirements for candidates;
- Equal competition and equal opportunities not ensured;
- No opportunities for newcomers to enter the market;
- Insufficient time allowed to prepare the proposals;

Most typical mistakes in construction projects:
- Low quality projects;
- Insufficient care taken in preliminary research;
- Not all work foreseen – especially in renovation and reconstruction of old constructions;
- Poor construction supervision;
- Insufficient care taken in filling construction supervision logs;
- Contracts favour supplier, project manager has no right to apply sanctions in case of contractual delays or non-performance.

Most typical mistakes in accounting:
- Accounting methods do not describe project accounting procedures, which makes tracing and control more difficult;
- Accounting does not comply with laws and regulations effective in Latvia – accounting principles, document formatting, business legality;
- No information stored on requests for payment (RFP) preparation details;
- RFP include data that does not comply with accounting procedure;
- Project-related documentation does not indicate contract/project No. (double financing risk);
- No confirmation that the project manager control project execution and financing;
- Documents are not stored in accordance with requirements of regulations and contract conditions (deadline, document nomenclature, storage place, registers);
- Document nomenclature does not foresee a required document storage time.

Non-conformant expenses are ones that cannot be withheld from the current payment. In other words, these expenses are paid to the recipient of the financing and respectively the non-conformant expenses are taken from the next payment, or recovered otherwise.

Losses to the state budget by non-conformant expenses and non-conformances found in the projects of direct or indirect state administration institutions, derived public entities, or other state institutions, are recovered by withholding them from the current/next payment, by writing them off, recovering and reporting the Cabinet of Ministers. Additional losses to the state budget are caused by non-conformant expenses found in the projects implemented by businesses and non-governmental organizations, and these cannot be recovered.

All in all, it can be concluded that the most significant reasons for non-conformance continue to be violations in the public procurement procedures, lack of operational activity by the recipients of the financing, and failure to implement the activities or comply with project conditions, which includes the indicators planned in a project being practically out of reach or impossible to measure.

EU funded project management experts have indicated the poor project implementation and control system in municipalities as the flaw, rather than the project planning process, emphasising in particular the issues in construction project implementation because:

- municipalities are incapable of providing for a construction board in its own territory – the institution necessary for the construction process – which leads to a situation where several regions share a single construction inspector, who cannot ensure a sufficient quality construction control in his/her municipality,
- lack independence for the inspector, which is especially pronounced in construction of the projects co-financed by the municipality; in some cases the construction inspectors do not have any legal support,
- insufficiently optimal construction project implementation control system and relatively low level of competence among the construction inspectors,
- the level of project specialists' competence and professional knowledge in technical processes, especially in implementation of large scale infrastructure projects (Pūlmanis, Bruņa, 2013).

Conclusion

Consequences of mistakes – non-conformance or financial corrections; withheld financing; penalties for Latvia. The project budget will only function effectively on the three levels if decision making and project management systems and processes are performance-oriented. Weaknesses that undermine public sector performance include:

- Poor project planning;
- No links between policy making, planning and budgeting (political influence);
- Poor expenditure control at municipality level;
- Lack of professional and skilled project managers;
- Poor construction quality.

How to mitigate:

- Simplify government control system by reducing administrative burden;
- Encourage unified approach;
- Impose preventive project control.

Currently the keyword in Latvia is efficiency, which is decisive in renewal of global competitiveness. Unfortunately, politicians and officials often understand and interpret this word incorrectly or its application becomes a standard buzzword that everyone attempts to follow in speech. In practice, sadly, it is quite different.

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INFORMATION SYSTEM DEVELOPMENT FOR THE ASSESSMENT AND ADMINISTRATION OF ACADEMIC PROCESSES OF HIGHER EDUCATION

Tzira Japiashvili, Ivane Javaxishvili Tbilisi State University, Georgia[1]

Abstract

The main aim of the project was to develop information system that would guide, administer and assess the learning processes of Master's Degree students at Ivane Javaxishvili Tbilisi State University. The information system's task was threefold and it consisted of collecting the following information:

1. The academic plan and faculty responsibilities;
2. The academic career of Master's degree students;
3. The delivery of Master's Degree Diplomas. All of these elements of the information system share one database. The users of this information system can be university employees or students who are interested in the information available through the database.

Within the information system there is a collection of tasks that are carried out one by one. Their mission is to create initial charts, requests, forms and accounts. All tasks within the information systems network are interconnected; moreover, their connection is reflected in algorithmic actions – calculation, logical evaluation, selection and assessment of new data. Solving one problem means solving another and such a structure creates a unified database.

The final stage of creation of information system is the construction of an interphase. For database management we use MS Access and SQL Server software, for the system administration - MS Project.

After defining the goal of the project, the next step was to describe the detailed plan. At this stage, after defining the calendar for the tasks, we identified the resources required, the timetable for using the materials, and the budget, thus identifying the base plan. Since the timetable to carry out the tasks was pre-established and would not change, we used Gant diagram for defining the direction of the project, which meant that we choose those tasks based on the time needed to complete the project. The starting date of the project was determined by the initial task, but the dates for other tasks were not concrete and could be easily modified. In some cases, however, the project also required that we set the date for the final task (this could be the date of final examinations, the end of semester, or the tuition payment deadline). Particular attention was paid to planning resources. We created risk factors registry and a plan of action for each risk factor. Knowing how to handle risky situations and designing a plan of action was our priority. To analyse the progress performance of tasks tracking tools were used. Track deviation from baseline plan after you make changes to the plan for the various indicators.

In the end, the creation of the information system allowed us to achieve optimal correlation between the amount of required work, timeframe, and costs involved.

Key words: *Information Technology, Information System, Academic processes, Project management*

JEL code: I230

[1] Corresponding author – e-mail address: tzira@rocketmail.com, telephone: +995 577 502398

Introduction

Now the effectiveness of information systems of accounting and control of teaching process in higher education is not in doubt. Such systems allow as soon as possible to inform both the administration and the students; stimulate interest in learning; organize and oblige them to take up their duties.

In designing the information systems (IS) last word belongs to the project management. This method is widely used in all areas of design. Project management has emerged as a new culture of management and related business cooperation of countries with different traditions, economy and culture. Project management methods and tools to help monitor the design process not only, but also to optimize the allocation of project resources.

Here is a design of information system of accounting and control of learning processes of Master's Degree students at Ivane Javaxishvili Tbilisi State University.

Defining the Goals and Tasks of the "Higher Education" system

The main aim of the project was to develop information system "Higher Education" that would guide, administer and assess the learning processes of Master's Degree students at Ivane Javaxishvili Tbilisi State University. The information system's task was threefold and it consisted of collecting the following information:

1. The academic plan and faculty responsibilities;
2. The academic career of Master's degree students;
3. The delivery of Master's Degree Diplomas.

All of these elements of the information system share one database. The users of this information system can be university employees or students who are interested in the information available through the database.

Within the information system there is a collection of tasks that are carried out one by one. Their mission is to create initial charts, requests, forms and accounts. All tasks within the information systems network are interconnected; moreover, their connection is reflected in algorithmic actions – calculation, logical evaluation, selection and assessment of new data. Solving one problem means solving another and such a structure creates a unified database.

The final stage of creation of information system is the construction of an interphase.

The system consists of several databases for each semester. There is also a combined database for every semester.

Data processing technology of subject area ranging from data entry into the database and management, to the solution of the tasks is represented by a hierarchical system of the switchboard (Fig. 1).

Main switchboard form, which opens when you call the system, represents the database menu and contains the buttons, which provide shortcuts to the dependent switchboard. This form contains the main complexes: the planning of training, data entry into the database, the process of learning and getting the unified data base**.** The buttons *Training Plans* opens the dependent form with same name. On the form controls can be requested after curriculum and various reports of the teachers' workloads.

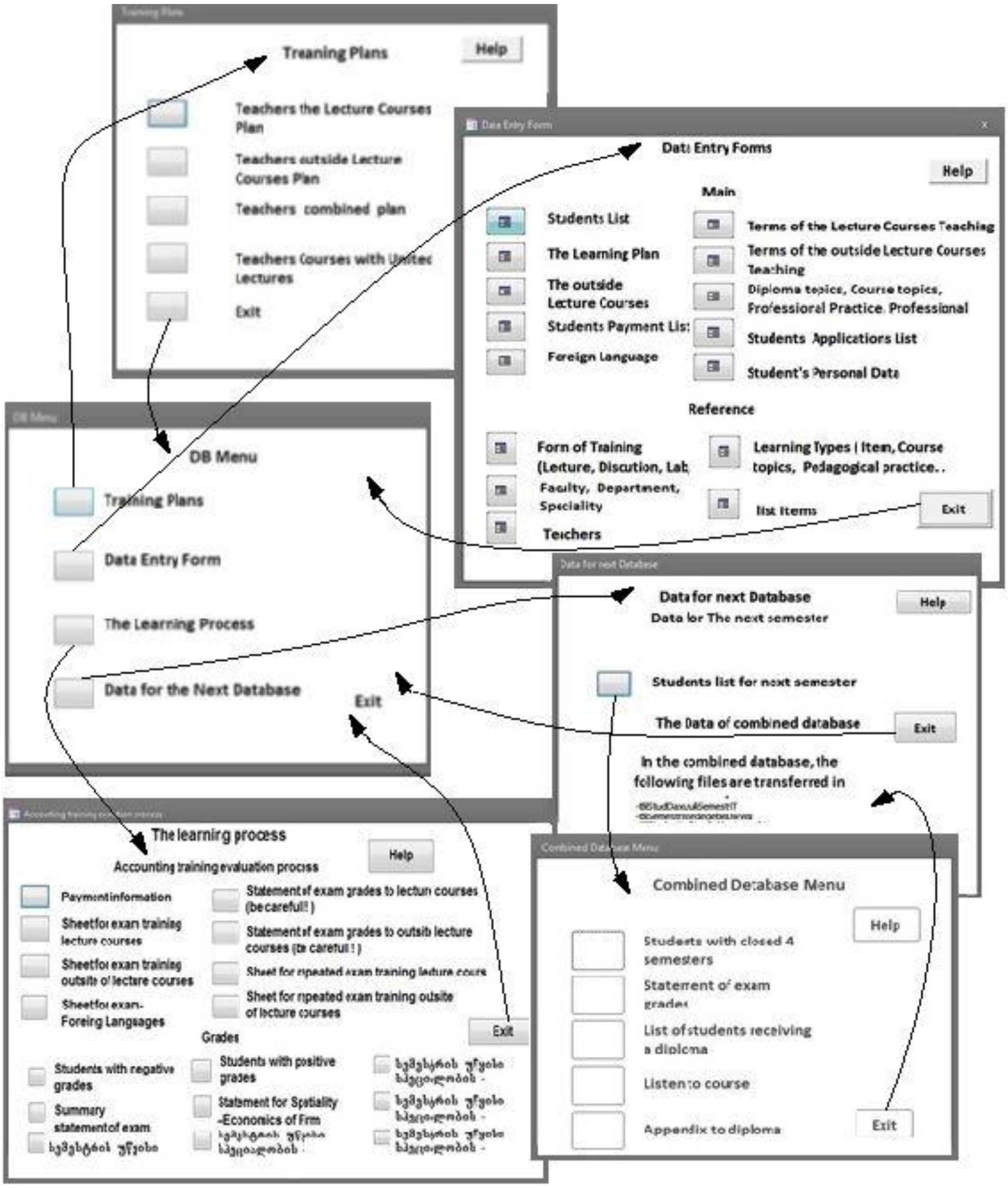


Fig. 1. **Collection of tasks represented by a hierarchical system of the switchboard**

The second switchboard form – *Data Entry Form* contains the list of those *Forms*, from which the source data is entered. Here the form is divided into two parts: *Main and Reference*.

On the Main Data form the operational information forms are represented. They can be called requested by clicking buttons that are available at the Main Data form. The second part contains the controls open a form with the reference and conditionally constant information.

Two groups represent the next subordinate form – *The learning process*. Each has its own button. The first group Accounting Training Evaluation Process opens sheets for exam and pre-examination documents. The second group Grades – represents the Statements of estimates.

The last dependent switchboard is Data for the Next Database. This form creates two databases: one for the subsequent semester, for which a list of students whose scores are positive. The second is the combined database where students' positive evaluation information is gathered during the four semester period.

The combined database is created to collect data, to create applications to the diploma for Master's Degree students. The database consist of all semester student training information. At the opening of a unified database on the screen of computer appears the switchboard, that is diferent from switchboard of the academic term databases.

And one more requirement to perform is – division of the system in two parts: Server and Client. Back end database is placed on the server and on the user's computer is loaded design division. If desired, the customer can be divided into separate complexes of project tasks.

Having considered the task of object design, solutions, formed the issues relating to the creation of an automated information system, can move to the design and management of the design process.

For database management we use Access and SQL Server software and for the system administration – MS Project.

Project "Higher Education" management

Creation a schedule

After determined the goals of what the project "Higher Education" is and the tasks that will have to decide, one should set the following indicators: date, when a new project should be developed, what is the budget, what kind of the technical resources available for the customer and the designers, what technology use for the development [1].

Two month was assigned for the project. At the beginning of the project the basis of the database technology was adopted to create the databases on the mandatory use of the server for multi-user operation databases. The budget was determined approximately on condition that after the establishment of a specific work plan and by determining the value of individual work cots the total cost of the project would be determined. The method "bottom-up" was used. It was decided to automatically ensure the data entry, management and execution of the project.

The Technical Assignment was used as a functional document. Based on this document the project plan was approved. After assigned the information about the project in the Entry Data (Start Data) and planning from the beginning of the project, we moved towards project works. During the project work planning the main stages of the project were identified – stages; assignments for each stage; sequence of each stage (Fig. 2).

File Task Resource Project View Developer Acrobat Format

Gantt Chart

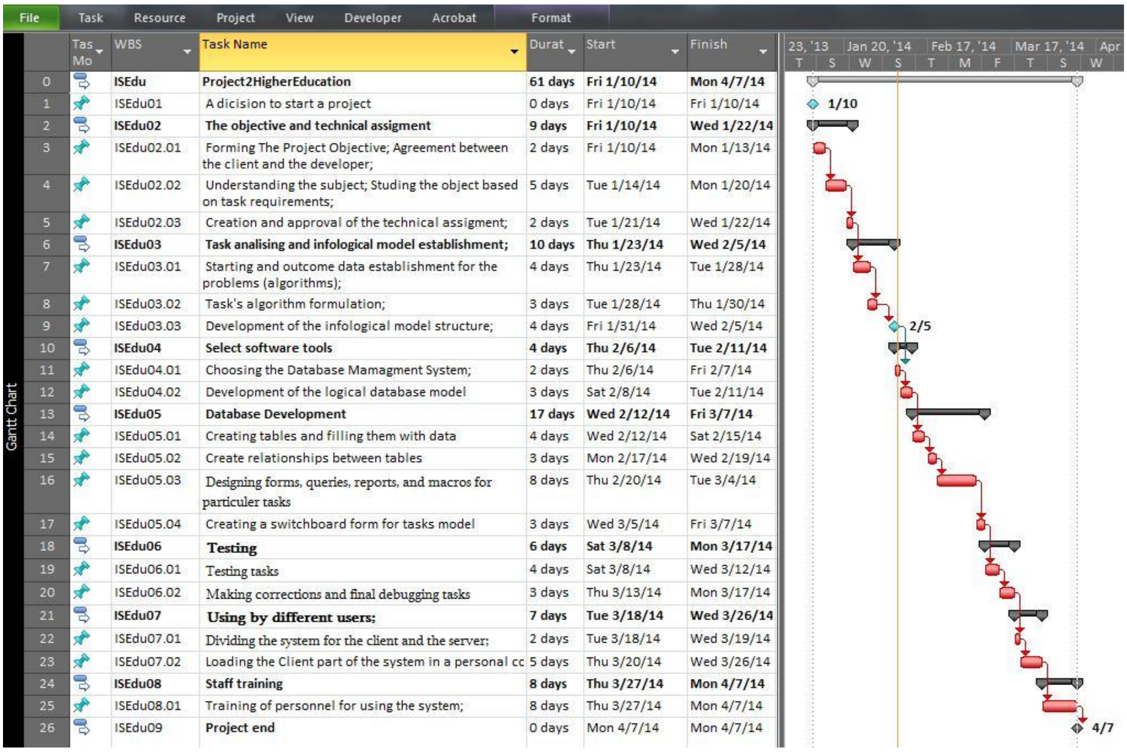
	Tas Mo	WBS	Task Name	Durat	Start	Finish
0		**ISEdu**	**Project2HigherEducation**	**61 days**	**Fri 1/10/14**	**Mon 4/7/14**
1		ISEdu01	A dicision to start a project	0 days	Fri 1/10/14	Fri 1/10/14
2		**ISEdu02**	**The objective and technical assigment**	**9 days**	**Fri 1/10/14**	**Wed 1/22/14**
3		ISEdu02.01	Forming The Project Objective; Agreement between the client and the developer;	2 days	Fri 1/10/14	Mon 1/13/14
4		ISEdu02.02	Understanding the subject; Studing the object based on task requirements;	5 days	Tue 1/14/14	Mon 1/20/14
5		ISEdu02.03	Creation and approval of the technical assigment;	2 days	Tue 1/21/14	Wed 1/22/14
6		**ISEdu03**	**Task analising and infological model establishment;**	**10 days**	**Thu 1/23/14**	**Wed 2/5/14**
7		ISEdu03.01	Starting and outcome data establishment for the problems (algorithms);	4 days	Thu 1/23/14	Tue 1/28/14
8		ISEdu03.02	Task's algorithm formulation;	3 days	Tue 1/28/14	Thu 1/30/14
9		ISEdu03.03	Development of the infological model structure;	4 days	Fri 1/31/14	Wed 2/5/14
10		**ISEdu04**	**Select software tools**	**4 days**	**Thu 2/6/14**	**Tue 2/11/14**
11		ISEdu04.01	Choosing the Database Mamagment System;	2 days	Thu 2/6/14	Fri 2/7/14
12		ISEdu04.02	Development of the logical database model	3 days	Sat 2/8/14	Tue 2/11/14
13		**ISEdu05**	**Database Development**	**17 days**	**Wed 2/12/14**	**Fri 3/7/14**
14		ISEdu05.01	Creating tables and filling them with data	4 days	Wed 2/12/14	Sat 2/15/14
15		ISEdu05.02	Create relationships between tables	3 days	Mon 2/17/14	Wed 2/19/14
16		ISEdu05.03	Designing forms, queries, reports, and macros for particuler tasks	8 days	Thu 2/20/14	Tue 3/4/14
17		ISEdu05.04	Creating a switchboard form for tasks model	3 days	Wed 3/5/14	Fri 3/7/14
18		**ISEdu06**	**Testing**	**6 days**	**Sat 3/8/14**	**Mon 3/17/14**
19		ISEdu06.01	Testing tasks	4 days	Sat 3/8/14	Wed 3/12/14
20		ISEdu06.02	Making corrections and final debugging tasks	3 days	Thu 3/13/14	Mon 3/17/14
21		**ISEdu07**	**Using by different users;**	**7 days**	**Tue 3/18/14**	**Wed 3/26/14**
22		ISEdu07.01	Dividing the system for the client and the server;	2 days	Tue 3/18/14	Wed 3/19/14
23		ISEdu07.02	Loading the Client part of the system in a personal cc	5 days	Thu 3/20/14	Wed 3/26/14
24		**ISEdu08**	**Staff training**	**8 days**	**Thu 3/27/14**	**Mon 4/7/14**
25		ISEdu08.01	Training of personnel for using the system;	8 days	Thu 3/27/14	Mon 4/7/14
26		ISEdu09	**Project end**	0 days	Mon 4/7/14	Mon 4/7/14

Fig. 2. **Structured list of tasks with a start and end data**

The stages in the project are marked as summary of the tasks, which consist of several sub tasks. For stages automatic planning was used, for assignments – manual. After the analyses of the management and project planning the duration of the assignment was determined. Summary tasks were marked as milestones, as a finishing stage.

For the project the schedule was assigned. The default (existing) “Calendar MS Project” is used as a base for the project I am presenting. The schedule in default starts from 8 o’clock till 5 o’clock, with break time during 12:00 – 13:00 o’clock. But I have changed the times. The working hours in presented project start from 9 o’clock and finish at 18:00 o’clock, 13:00-14:00 o’clock. I have excluded weekends (Saturday, Sunday), official holidays;

Further tasks were linked using link types Finish-to-Start, Start-to-Start. For the tasks execution were used for flexible constraints As Soon As Possible, As Late As Possible, after which was determined the critical path (Fig. 3).



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5	ISEdu02.03	Creation and approval of the technical assigment;	2 days	Tue 1/21/14	Wed 1/22/14
6	ISEdu03	Task analising and infological model establishment;	10 days	Thu 1/23/14	Wed 2/5/14
7	ISEdu03.01	Starting and outcome data establishment for the problems (algorithms);	4 days	Thu 1/23/14	Tue 1/28/14
8	ISEdu03.02	Task's algorithm formulation;	3 days	Tue 1/28/14	Thu 1/30/14
9	ISEdu03.03	Development of the infological model structure;	4 days	Fri 1/31/14	Wed 2/5/14
10	ISEdu04	Select software tools	4 days	Thu 2/6/14	Tue 2/11/14
11	ISEdu04.01	Choosing the Database Mamagment System;	2 days	Thu 2/6/14	Fri 2/7/14
12	ISEdu04.02	Development of the logical database model	3 days	Sat 2/8/14	Tue 2/11/14
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19	ISEdu06.01	Testing tasks	4 days	Sat 3/8/14	Wed 3/12/14
20	ISEdu06.02	Making corrections and final debugging tasks	3 days	Thu 3/13/14	Mon 3/17/14
21	ISEdu07	Using by different users;	7 days	Tue 3/18/14	Wed 3/26/14
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26	ISEdu09	Project end	0 days	Mon 4/7/14	Mon 4/7/14

Fig. 3. **Gantt Chart critical path**

In the figure 3 right MS Project is represented by a red light as a task in a critical path; it determines the length of the project.

Tracking the cost

For the project the list of resources were assigned: working, material and costs. For each recourse a group was created; each groups was created by the type and being in the list of resources. (Resource Sheet, Fig. 4).

As you can see from the List of resources cost of work resources are displayed in hours - time-based payment system is used in planning the costs of labor. When you assign resources, attention should be given to the appointment of administrative resources. The project management costs are assigned to summary tasks with the allocation in 5%. Issuing laptop designers lead at the beginning of the project and are a resource of type costs. Link resources to tasks in the project are well seen in the diagram fragment (Fig. 5).

	Resource Name	Type	Work	Ma Lab	Init	Group	Max. Units	Std. Rate	Ovt. Rate	Cost/Use	Accrue At
	Type: Cost	**Cost**									**Start**
	Group: technique	**Cost**				**technique**					**Start**
9	Notebook	Cost			N	technique					Start
	Type: Material	**Material**								**0.00 Lari**	
	Group: materials	**Material**				**materials**				**0.00 Lari**	**Prorated**
4	Paper	Material	3 pack	pack	P	materials		10.00 Lari		0.00 Lari	Prorated
	Group: technique	**Material**				**technique**				**0.00 Lari**	**Prorated**
10	Cartridge	Material	2 piece	piece	C	technique		140.00 Lari		0.00 Lari	Prorated
	Type: Work	**Work**	**780.8 hrs**				**7.3**			**0.00 Lari**	
	Group: administrator	**Work**	**12.8 hrs**			**administrator**	**0.3**			**0.00 Lari**	**Prorated**
1	Khomeriki Giorgi	Work	12.8 hrs		KG	administrator	0.3	15.00 Lari/hr	20.00 Lari/hr	0.00 Lari	Prorated
	Group: developer	**Work**	**376 hrs**			**developer**	**3**			**0.00 Lari**	
2	Dondua Kote	Work	192 hrs		DK	developer	1	7.00 Lari/hr	8.00 Lari/hr	0.00 Lari	Prorated
3	Dekanoidze Nina	Work	184 hrs		DN	developer	1	8.00 Lari/hr	9.00 Lari/hr	0.00 Lari	Prorated
11	Gogia Rezo	Work	0 hrs		GR	developer	1	7.00 Lari/hr	8.00 Lari/hr	0.00 Lari	Prorated
	Group: manager	**Work**	**104 hrs**			**manager**	**1**			**0.00 Lari**	**Prorated**
5	Dumbadze Levan	Work	104 hrs		D	manager	1	8.00 Lari/hr	10.00 Lari/hr	0.00 Lari	Prorated
	Group: operator	**Work**	**232 hrs**			**operator**	**2**			**0.00 Lari**	
6	Mania Iosif	Work	88 hrs		M	operator	1	5.00 Lari/hr	6.50 Lari/hr	0.00 Lari	Prorated
7	Kodua Neli	Work	144 hrs		KN	operator	1	5.00 Lari/hr	6.50 Lari/hr	0.00 Lari	Prorated
	Group: systems programme	**Work**	**56 hrs**			**systems programmer**	**1**			**0.00 Lari**	**Prorated**
8	Salia Vano	Work	56 hrs		SV	systems programmer	1	7.00 Lari/hr	8.00 Lari/hr	0.00 Lari	Prorated

Fig. 4. **List of grouped resources**

File Task Resource Project View Developer Acrobat Format

Gantt Chart

	WBS	Task Name	Durat	Start	Finish	Resource Names
10	**ISEdu04**	**Select software tools**	**4 days**	**Thu 2/6/14**	**Tue 2/11/14**	
11	ISEdu04.01	Choosing the Database Mamagment System;	2 days	Thu 2/6/14	Fri 2/7/14	Salia Vano,Dekanoidze Nana[0.5],Dondua Kote[0.5],Notebook[2,0
12	ISEdu04.02	Development of the logical database model	3 days	Sat 2/8/14	Tue 2/11/14	Dekanoidze Nana[0.5],Dondua Kote[0.5]
13	**ISEdu05**	**Database Development**	**17 days**	**Wed 2/12/14**	**Fri 3/7/14**	
14	ISEdu05.01	Creating tables and filling them with data	4 days	Wed 2/12/14	Sat 2/15/14	Dekanoidze Nana[0.5],Dondua Kote[0.5],Kodua Neli,Mania Iocif,(
15	ISEdu05.02	Create relationships between tables	3 days	Mon 2/17/14	Wed 2/19/14	Dekanoidze Nana[0.5],Dondua Kote[0.5]
16	ISEdu05.03	Designing forms, queries, reports, and macros for particuler tasks	8 days	Thu 2/20/14	Tue 3/4/14	Dekanoidze Nana[0.5],Dondua Kote[0.5]
17	ISEdu05.04	Creating a switchboard form for tasks model	3 days	Wed 3/5/14	Fri 3/7/14	Dekanoidze Nana[0.5],Dondua Kote[0.5]
18	**ISEdu06**	**Testing**	**6 days**	**Sat 3/8/14**	**Mon 3/17/14**	
19	ISEdu06.01	Testing tasks	4 days	Sat 3/8/14	Wed 3/12/14	Dekanoidze Nana[0.5],Dondua Kote[0.5],Paper[1 pack],Cartridge[
20	ISEdu06.02	Making corrections and final debugging tasks	3 days	Thu 3/13/14	Mon 3/17/14	Dekanoidze Nana[0.5],Dondua Kote[0.5],Gogia Rezo[0.5]
9	ISEdu03.03	Development of the infological model structure;	4 days	Fri 1/31/14	Wed 2/5/14	Dekanoidze Nana[0.5],Dumbadze Levan[0.5]

Fig. 5. **Link resources to tasks (fragment)**

In the column named *Resource Names* resources for each tasks are assigned. Linking resources to tasks we have started analyses the plan. For some employees the available resources exceeded. This showed up in the Gantt chart and Resource Sheet in the indicators column with the red mark (Fig. 5). On the figure 10, Resource Dekanoidze, linked to third assignment, is marked by red. By changing the working hours – adding Saturday as a working day – the exceeding availability was corrected. This caused the need to recalculate the presented project, because some of the tasks were essensial. It either had to increase the time to implement them, or to enter additional resources. Have corrected a critical path (used the method Level Resource, Respect Links-Calculate Project), have received a complete list of tasks, their sequence, timing (beginning-end of project), work in hours (hrs.), the costs, the list of resources and their location [1]. This plan became the basis for the baseline (Baseline).

Managing unseen problems (risks)

It should be noted that Baseline formed the basis of the first working plan. The initial baseline fixed tasks and their parameters on the basis of the approved in the Technical Assignment (TK) number duration = 60 days. But the project administrator, after consultation with experts, noted that, given the amount of work and the circumstances of their design, the project could be completed in 30 days by increasing the workload of resources. The plan was revised (Fig. 6) and received Baseline1.

Plan of correction was performed one more time, when commenced a summary task of designing database (Database Development). It turned out that the designers do not fit in time and require either extending or selecting another designer or/and increase work. It was agreed to increase the resources for the task *Creating tables and filling them with data* and *Designing forms, queries, reports and macros for particular tasks* (Database Development) and *Testing tasks* and *Making corrections and final debagging tasks* (Testing). Just 80 hours were added (Fig. 7). The result is another baseline – Baseline 2. It was a risky situation, but it should be noted that this risk was foreseen. In the list of resources another project designer was assigned, who could have been replaced by the existing one or could have assigned extra work if needed.

File Task Resource Project View Developer Acrobat Format

	Tas Mo	WBS	Task Name	Durat	Work	Cost	Start	Finish	Resource Names
0		ISEdu	**Project2HigherEducation**	32 days	812.8 hrs	11,734.00 Lari	Fri 1/10/14	Mon 2/24/14	
1		ISEdu01	A dicision to start a project	0 days	0 hrs	0.00 Lari	Fri 1/10/14	Fri 1/10/14	
2		ISEdu02	**The objective and technical assigment**	6 days	162.4 hrs	5,228.00 Lari	Fri 1/10/14	Fri 1/17/14	Khomeriki Giorgi[0.05]
3		ISEdu02.01	Forming The Project Objective; Agreement between the client and the developer;	2 days	32 hrs	2,392.00 Lari	Fri 1/10/14	Mon 1/13/14	Dondua Kote[0.5],Dumbadze Levan[0.5],Notebook[2,000.00 Lari],Paper[2 pack],Cartridge[1 piece],Dekanoidze Nana[0.5]
4		ISEdu02.02	Understanding the subject; Studing the object based on task requirements;	3 days	120 hrs	2,744.00 Lari	Tue 1/14/14	Thu 1/16/14	Dondua Kote,Kodua Neli,Notebook[2,000.00
5		ISEdu02.03	Creation and approval of the technical assigment;	1 day	8 hrs	56.00 Lari	Fri 1/17/14	Fri 1/17/14	Dondua Kote[0.5],Dekanoidze Nar
6		ISEdu03	**Task analising and infological model establishment;**	6 days	82.4 hrs	580.00 Lari	Mon 1/20/14	Mon 1/27/14	Khomeriki Giorgi[0.05]
7		ISEdu03.01	Starting and outcome data establishment for the problems (algorithms);	2 days	32 hrs	192.00 Lari	Mon 1/20/14	Tue 1/21/14	Dondua Kote,Mania Iocif
8		ISEdu03.02	Task's algorithm formulation;	1 day	16 hrs	112.00 Lari	Thu 1/23/14	Thu 1/23/14	Dondua Kote,Dekanoidze Nana
9		ISEdu03.03	Development of the infological model structure;	2 days	32 hrs	240.00 Lari	Fri 1/24/14	Mon 1/27/14	Dumbadze Levan,Dekanoidze Nan

Fig. 6. **Revised plan (Baseline1, fragment)**

File Task Resource Project View Developer Acrobat Format

		Ta M	Task Name	Durat	Work	Cost	Start	Finish	Resource Names
0			**Project2HigherEducation**	32 days	892.8 hrs	12,214.00 Lari	Fri 1/10/14	Mon 2/24/14	
1			A dicision to start a proj	0 days	0 hrs	0.00 Lari	Fri 1/10/14	Fri 1/10/14	
2			**The objective and techni**	6 days	162.4 hrs	5,228.00 Lari	Fri 1/10/14	Fri 1/17/14	Khomeriki Giorgi[0.05]
3			Forming The Project Objective; Agreement	2 days	32 hrs	2,392.00 Lari	Fri 1/10/14	Mon 1/13/14	Dondua Kote[0.5],Dumbadze Levan[0.5],Notebook[2,000.00 Lari],Paper[2 pack],Cartridge[1 piece],Dekanoidze Nana[0.5]
4			Understanding the subject; Studing the	3 days	120 hrs	2,744.00 Lari	Tue 1/14/14	Thu 1/16/14	Dondua Kote,Kodua Neli,Notebook[2,000.00 Lari],Salia Vano,Dekanoidze Nana,Mania Iocif
5			Creation and approva	1 day	8 hrs	56.00 Lari	Fri 1/17/14	Fri 1/17/14	Dondua Kote[0.5],Dekanoidze Nana[0.5]
6			**Task analising and infolog**	6 days	82.4 hrs	580.00 Lari	Mon 1/20/1	Mon 1/27/14	Khomeriki Giorgi[0.05]
7			Starting and outcome	2 days	32 hrs	192.00 Lari	Mon 1/20/1	Tue 1/21/14	Dondua Kote,Mania Iocif
8			Task's algorithm form	1 day	16 hrs	112.00 Lari	Thu 1/23/14	Thu 1/23/14	Dondua Kote,Dekanoidze Nana
9			Development of the ir	2 days	32 hrs	240.00 Lari	Fri 1/24/14	Mon 1/27/14	Dumbadze Levan,Dekanoidze Nana

Fig. 7. **The second revised plan (Baseline2, fragment)**

For visualization, use multiple plans Baseline Gantt. Figure 8 represents the costs of all three baselines. As you can see from Figure 13 the most distinguish among them is the third baseline (Baseline1 Cost), which was ordinary, since the work resources had been added to the summary tasks Database development and Testing in Baseline2.

File Task Resource Project View Developer Acrobat Format

	Task Mode	WBS	Task Name	Baseline Cost	Baseline1 Cost	Baseline2 Cost
0		**ISEdu**	**Project2HigherEducation**	**11,728.00 Lari**	**11,734.00 Lari**	**12,214.00 Lari**
1		ISEdu01	A dicision to start a project	0.00 Lari	0.00 Lari	0.00 Lari
2		**ISEdu02**	**The objective and technical assigment**	**5,264.00 Lari**	**5,228.00 Lari**	**5,228.00 Lari**
3		ISEdu02.01	Forming The Project Objective; Agreement between the client and the developer;	2,336.00 Lari	2,392.00 Lari	2,392.00 Lari
13		**ISEdu05**	**Database Development**	**1,590.00 Lari**	**1,670.00 Lari**	**2,150.00 Lari**
14		ISEdu05.01	Creating tables and filling them with data	694.00 Lari	534.00 Lari	534.00 Lari
15		ISEdu05.02	Create relationships between tables	168.00 Lari	56.00 Lari	56.00 Lari

Fig. 8. **Multiple Baseline Gantt (fragment)**

The practice of design, to avoid such situations (such situations may even lead to the failure of the project), a study should be undertaken on the foreseen risks [3]. There are methods that involve the study of the analysis and identification of risks and their impact on the project. One of them is used to assess the real terms of tasks, which are 3 versions of the project: optimistic, pessimistic, most likely. The algorithms used to calculate them, including existing multiple assessments in size. The most accurate in determining the duration of a project is the Monte Carlo method [2]. But one of practical and effective methods to circumvent the risk is, of course, the identification of possible risks and applying to each of them outrun events. For such an approach qualified designers are needed – an experts. But it is very important to have a clear, approbated technology design tasks.

The actual representatives of the organization created the design of the task. It is important to mention that these representatives were the employees who worked on Master student learning process development, learning technology and software availability that was used for database systems. Based on this the foreseen problems were decreased to minimum.

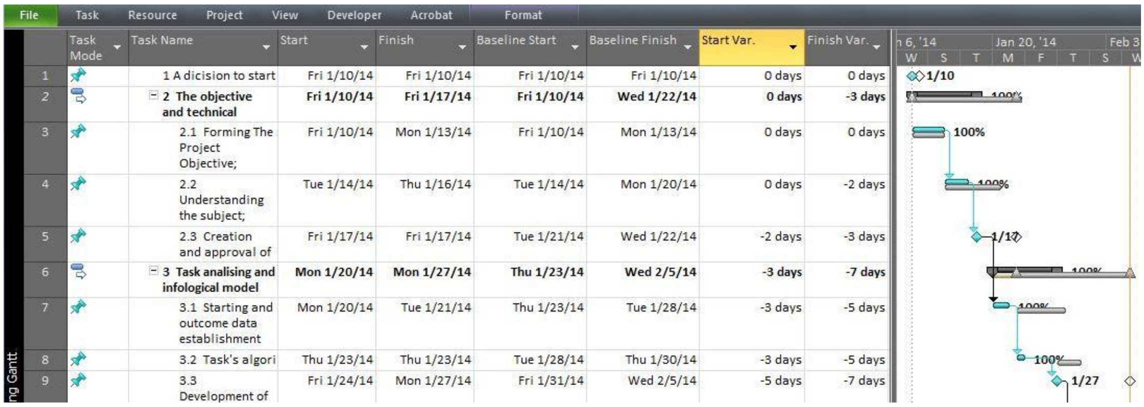
The only risks that occurred were connected to education process - political process – new way of teaching, grading principle of Master Program student, pay roll change for professors, etc.

The use of technology for databases ensures easy and quick exchange of the information in the framework of the assigned tasks. Easy way to update the existing data, adding new structural entities and based on the one database receiving different forms and reports (including non regulated), gave ability to easily foresee the risks, problems and be prepared for changes.

Readiness for the risks (problems) was expressed right from the beginning. It was correctly determined. The main goal was to determine scale of the work, quantity and qualification of the project designers. However, during the project development several base plans were designed. Below you can see the forms, which were created (received) while the project design and execution process.

Project process monitoring and analysis

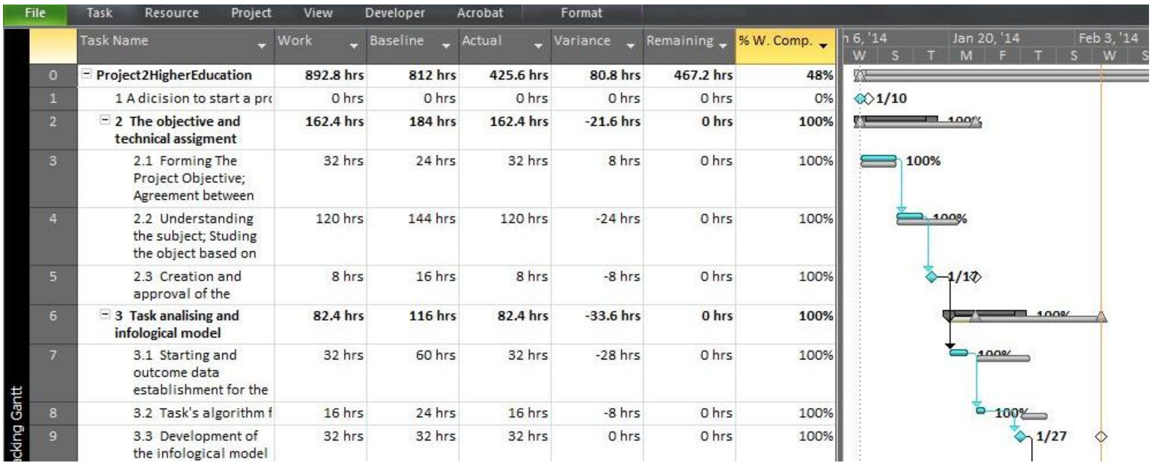
For analyzing the process performance the different tracking tools were used. Deviations were made from Based Plan to the plan, which was corrected after and into the plan with different indicators. For example from start to the end (variance), workloads, costs, costs of base plans (entry). Different tracking diagrams were made as charts, which indicated deviations. Below in Figure 9, 10, 11 examples are represented.



	Task Mode	Task Name	Start	Finish	Baseline Start	Baseline Finish	Start Var.	Finish Var.
1		1 A dicision to start	Fri 1/10/14	Fri 1/10/14	Fri 1/10/14	Fri 1/10/14	0 days	0 days
2		**2 The objective and technical**	**Fri 1/10/14**	**Fri 1/17/14**	**Fri 1/10/14**	**Wed 1/22/14**	**0 days**	**-3 days**
3		2.1 Forming The Project Objective;	Fri 1/10/14	Mon 1/13/14	Fri 1/10/14	Mon 1/13/14	0 days	0 days
4		2.2 Understanding the subject;	Tue 1/14/14	Thu 1/16/14	Tue 1/14/14	Mon 1/20/14	0 days	-2 days
5		2.3 Creation and approval of	Fri 1/17/14	Fri 1/17/14	Tue 1/21/14	Wed 1/22/14	-2 days	-3 days
6		**3 Task analising and infological model**	**Mon 1/20/14**	**Mon 1/27/14**	**Thu 1/23/14**	**Wed 2/5/14**	**-3 days**	**-7 days**
7		3.1 Starting and outcome data establishment	Mon 1/20/14	Tue 1/21/14	Thu 1/23/14	Tue 1/28/14	-3 days	-5 days
8		3.2 Task's algori	Thu 1/23/14	Thu 1/23/14	Tue 1/28/14	Thu 1/30/14	-3 days	-5 days
9		3.3 Development of	Fri 1/24/14	Mon 1/27/14	Fri 1/31/14	Wed 2/5/14	-5 days	-7 days

Fig. 9. **Track Gantt with variance by Start and Finish (fragment)**

This table shows Baseline with duration in 62 days. So when correcting the duration of the project to 32 days in the columns of variance appear the number with minus sign (Fig.9).



	Task Name	Work	Baseline	Actual	Variance	Remaining	% W. Comp.
0	**Project2HigherEducation**	**892.8 hrs**	**812 hrs**	**425.6 hrs**	**80.8 hrs**	**467.2 hrs**	**48%**
1	1 A dicision to start a prc	0 hrs	0 hrs	0 hrs	0 hrs	0 hrs	0%
2	**2 The objective and technical assigment**	**162.4 hrs**	**184 hrs**	**162.4 hrs**	**-21.6 hrs**	**0 hrs**	**100%**
3	2.1 Forming The Project Objective; Agreement between	32 hrs	24 hrs	32 hrs	8 hrs	0 hrs	100%
4	2.2 Understanding the subject; Studing the object based on	120 hrs	144 hrs	120 hrs	-24 hrs	0 hrs	100%
5	2.3 Creation and approval of the	8 hrs	16 hrs	8 hrs	-8 hrs	0 hrs	100%
6	**3 Task analising and infological model**	**82.4 hrs**	**116 hrs**	**82.4 hrs**	**-33.6 hrs**	**0 hrs**	**100%**
7	3.1 Starting and outcome data establishment for the	32 hrs	60 hrs	32 hrs	-28 hrs	0 hrs	100%
8	3.2 Task's algorithm f	16 hrs	24 hrs	16 hrs	-8 hrs	0 hrs	100%
9	3.3 Development of the infological model	32 hrs	32 hrs	32 hrs	0 hrs	0 hrs	100%

Fig. 10. **Track Gantt with variance by Work (fragment)**

Deviation in work expanses are calculated between planned and baseline values. Difference = Work-Baseline, the remaining work expanses Work: Remaining = Work-Actual. Shortages are shown in the work expanses, which were foreseen by plan. But overall difference of work expanses for the project is positive.

	Task Name	Total Cost	Baseline	Variance	Actual	Remaining
0	Project2HigherEducation	12,214.00 Lari	11,728.00 Lari	486.00 Lari	3,159.20 Lari	9,054.80 Lari
1	1 A dicision to start a project	0.00 Lari	0.00 Lari	0.00 Lari	0.00 Lari	0.00 Lari
2	2 The objective and technical assigment	5,228.00 Lari	5,264.00 Lari	(36.00 Lari)	1,228.00 Lari	4,000.00 Lari
3	2.1 Forming The Project Objective; Agreement between the client and the developer;	2,392.00 Lari	2,336.00 Lari	56.00 Lari	392.00 Lari	2,000.00 Lari
4	2.2 Understanding the subject; Studing the object based on task requirements;	2,744.00 Lari	2,816.00 Lari	(72.00 Lari)	744.00 Lari	2,000.00 Lari
5	2.3 Creation and approval of the technical assigment;	56.00 Lari	112.00 Lari	(56.00 Lari)	56.00 Lari	0.00 Lari
6	3 Task analising and infological model establishment;	580.00 Lari	708.00 Lari	(128.00 Lari)	580.00 Lari	0.00 Lari

Fig. 11. **Track Gantt with variance by Cost (fragment)**

The similar situation was observed with the costs. Here we can see the difference in both ways – positive and negative sides (negative numbers in parentheses).

To assess the project process the Earned value analysis method was used too. It is possible to change the calculation database assessment by used received values. File-Options-Advanced- Baseline for Earned Value calculation and choose base plan for calculating earned value. Having base plan and actual data, it is possible to assess the project state in a specific data.

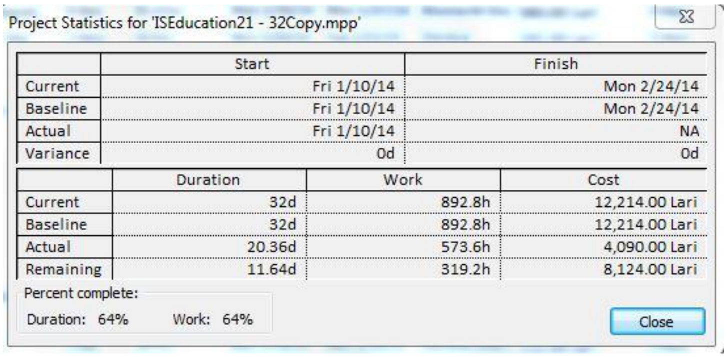
Also it is possible to use the same tables, as for the variance analysis, but from the Task Sheet or Resource Sheet. On the Figure 12 the fragment the Earned Value Analyses table of tasks is presented.

	Task Name	Planned Value - PV	Earned Value - EV	AC (ACWP)	SV	CV	EAC	BAC	VAC
0	Project2HigherEducation	3,792.00 Lari	6,878.00 Lari	2,646.00 Lari	3,086.00 Lari	4,232.00 Lari	4,511.82 Lari	11,728.00 Lari	7,216.18 L
1	1 A dicision to start a pr	0.00 Lari	0.00 Lari	0.00 Lari	0.00 Lari	0.00 Lari	0.00 Lari	0.00 Lari	0.00 L
2	2 The objective and technical assigment	3,264.00 Lari	3,264.00 Lari	1,228.00 Lari	0.00 Lari	2,036.00 Lari	1,980.45 Lari	5,264.00 Lari	3,283.55 L
3	2.1 Forming The Project Objective; Agreement between	336.00 Lari	336.00 Lari	392.00 Lari	0.00 Lari	(56.00 Lari)	2,725.33 Lari	2,336.00 Lari	(389.33 La
4	2.2 Understanding the subject; Studing the object based on	2,816.00 Lari	2,816.00 Lari	744.00 Lari	0.00 Lari	2,072.00 Lari	744.00 Lari	2,816.00 Lari	2,072.00 L
5	2.3 Creation and approval of the	112.00 Lari	112.00 Lari	56.00 Lari	0.00 Lari	56.00 Lari	56.00 Lari	112.00 Lari	56.00 L

Fig. 12. **Earned value analysis by tasks** (fragment)

Here are presented: the cost of tasks scheduled (BCWS), cost of work performed (BCWP), actual cost of work performed (ACWP), earned value schedule variance (SV = BCWP-BCWS), cost variance (CV = BCWP-ACWP), estimate at completion (EAC), the baseline cost for the task, which includes the cost of assigned resources and task fixed cost (BAC), the variance at completion (VAC = BAC-EAC). In the table, it is important to pay attention towards negative values. In our case these are CV and VAS task index 2.1. Both numbers are exceeding the estimated costs. Positive values of deviations of earned value fields (SV, CV, EAC) means that the project is ahead of the schedule.

Along with the analyzing tools ready made reports are widely used. Their spectrum is very wide. In addition, you can use the import data in Excel to get a informative charts and graphics. For the manager of the project it is also easy to use Statistics for tracking the project process (Fig. 13).



	Start	Finish
Current	Fri 1/10/14	Mon 2/24/14
Baseline	Fri 1/10/14	Mon 2/24/14
Actual	Fri 1/10/14	NA
Variance	0d	0d

	Duration	Work	Cost
Current	32d	892.8h	12,214.00 Lari
Baseline	32d	892.8h	12,214.00 Lari
Actual	20.36d	573.6h	4,090.00 Lari
Remaining	11.64d	319.2h	8,124.00 Lari

Fig. 13. **Statistics process performance of the project**

After analyzing the execution of the project, it is necessary to make changes in project taking into consideration the mistakes. It is also possible to create another data plan. The main manager decided that this is not necessary for the following reasons: first - the actual and plan performance were equal in summary tasks, the differences was shown in subtasks. Second – for the working resources the changes were made in unfinished project, but the changes were made without changing the content and following tasks; third – the project was ending but the differences indicated were minor in relation towards the common indicators of the project.

Completion of the project

Completion of the project or project phase – it is the ending process for every project managing process. When closing the project, the project manager considers all information to ensure that all work on the project have been completed and the project has achieved its goals. Since in this case the document has been Technical Assignment and it created a project management plan, project manager produced an analysis of this document to make sure that all project requirements are met and the project is finally completed.

Conclusions, proposals, recommendations

1. The main aim of the project was to develop information system that would guide, administer and assess the learning processes of Master's Degree students at Ivane Javaxishvili Tbilisi State University. The users of this can be university employees or students who are interested in the information available through the database. The final stage of creation of information system is the construction of an interphase. For database management we use MS Access and SQL Server software, for the system administration – MS Project.

2. Task subject areas were examined and structured hierarchical system of their relationship. This relationship is presented, as it should be as a result of the establishment of information system – by a hierarchical system of the switchboard.
3. One more requirement to perform was – division of the system in two parts: Server and Client. Back end database is placed on the server and on the user's computer is loaded design division. If desired, the customer can be divided into separate complexes of project tasks.
4. After determined the goals of what the project "Higher Education" is and the tasks that will have to decide, one should set the following indicators: date, when a new project should be developed, what is the budget, what kind of the technical resources available for the customer and the designers, what technology use for the development. Also it is important to determine who is responsible for the work as a whole and for individual stages. All these data were Technical Assignment, it was used as a functional document.
5. The results of the project planning were defined: a list of tasks, the durations and sequence of their execution; the links between them; resources for the tasks, calendar schedules. After which the critical path was determined.
6. During the process the project supervised by the tools of MS Project – daily statistics of work performed according to a schedule, actual the variance of the activities besides planned, earned value analysis of resources to tasks and the project as a whole.
7. Expert and preliminary planning methods were applied for adjusting the risks. Extra working resources were prepared (foreseen), which were used based on needs.
8. Baseline plan had to change twice: the first time because of the decision of the project manager to reduce the duration of the tasks, and the second time due to a lack of work resources to the task of database design and testing tasks.
9. Work expanses deviation was 48 hours; in comparison with the beginning base plan this deviation was equal to 129 hours; in The project was completed with some deviations in timeline and work expanses. Regarding last base plan for the comparison between the base plan and last base plan the difference in project duration added three more days; The cots of the resources increased by 336 GEL and became 12,550 GEL total.
10. The performers were appointed from the same educational institution for which the project was created. They devoted their time and experience to the project. They knew the tasks posed by the system, the software tools used to develop the project, and have had the experience of similar system development. All this is in many ways defined the success of the results. Prospect of project is using the project as part of a unified system of accounting and control of training not only at Ivane Javaxishvili Tbilisi State University, but also in such institutions of higher learning.
11. The perspective of the project is to use this project as a unified system for controlling quality and managing the education process not only in TSU, but in any similar educational institutions.
12. Based on the experience of this project can be said about sharing 3 software systems-MS Access, SQL Server and MS Project: the link is justified in practice, is useful in the design of such systems and should have prospects.

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REGIONAL PROJECT MANAGEMENT OF TOURISM DEVELOPMENT IN GEORGIA

Larisa Korganashvili, Ivane Javakhishvili Tbilisi State University, Georgia[1];

Natalia Kharadze, Ivane Javakhishvili Tbilisi State University, Georgia

Abstract

The structure of the economy has changed after restoration of the state independence of Georgia and after its socio-economic transformation. If in 1990 the share of Agriculture in Georgia's GDP was 32%, share of Industry – 33% and share of Services – 35%, while in 2012 these figures were 9%, 23% and 68% respectively. Among services tourism holds major place, which recently has rapidly grown. At present time practically there is no region of the country left, where tourism projects' implementations have not started. The groundwork for the development of tourist business has been established in Adjara, Kakheti, Svaneti and other regions. However, experience shows that the regional tourism development projects in Georgia have not been properly calculated. In this paper we identified the main problems that exist in the development of regional tourism projects in Georgia, and also showed that the solutions to these problems require a qualitatively different level of effective management of these projects.

Key words: *region, tourism, analysis, project management, development, Georgia*

JEL codes: O22, R11

Introduction

Georgia is the country with small economy, which in the post-soviet period endured deep political and economic crisis, and underwent through the serious social-economic transformation. If in 1990 in GDP of Georgia the share of the Agriculture was 32%, of the Industry – 33% and of the Services – 35%, in 2012 those indicators accordingly made 9%, 23% and 68%. Among the services the significant position is held by the tourism. At present there is no region in the country actually, in which the work has not commenced for development of this field. In Ajara, Kakheti, Svaneti and other regions of the country the foundation is arranged for the future successful development of the tourism business.

In recent years, tourism is seen as a priority sector, which should provide Georgia's economic growth, create new jobs, reduce poverty, develop small businesses, etc. The priority of tourism in Georgia is due to the rich tourist potential on the one hand and with on the other hand, its multiplier effect, whereby it can ensure the development of transport, agriculture, commerce and other sectors of the economy. Due to this, the topic of tourism development projects is becoming urgent. However, it should be noted that the effectiveness of project management as a model of governance in the country is not yet understood.

[1] Corresponding author – e-mail address: qorghanashvili@yahoo.com, telephone: +995 32 2303567

The purpose of this paper is to study the current state of development of tourism in Georgia and to show the value of development of effective projects of its development, taking into account the specifics of the tourism product.

The object of research is the regional tourism, as the specific open system in the contents of the tourism of the country, and the subject to research – is the complexity of theoretical and methodological problems of development of tourism on basis of the project management.

It is widely spread that the tourism keeps developing at the definite territory – in the touristic region. Under the tourism region usually the territory is meant, which has the sharply set borders, holds the touristic-recreational resources and offers the touristic services. Any region of Georgian corresponds to this concept, and for the purposes of our research the region of Georgia is identical for the concept of the touristic region. Each region of Georgia represents the multifunctional and the multi-aspect system and differs with the levels of the social-economic development, the branch structure and the spatial relations. At the same time the social-economic development of the region is considered in reciprocal relation with the other regions in the contents of one integral whole – the economy of the country.

The tourism is developed in the region with participation of three general groups: each of those groups having their own goals and interests, which often are controversial and require compliance and integration. In order to overcome the controversies, the significant role might plaid by the project management. Notwithstanding the fact that the project management is the effective managerial technology, tested on practice by many large world-wide companies, currently in Georgia there is almost no experience in its full application and that is the really serious problem.

Methodological basis for the research is elaborated by the Institute of Project Management methodology Project Management Body of Knowledge – PMBoK.

In 2012, PMI released for presale A Guide to the Project Management Body of Knowledge (PMBOK® Guide) – Fifth Edition. The latest edition adds a tenth Knowledge Area (Project Stakeholder Management), as well as four new planning processes (Plan Scope Management, Plan Schedule Management, Plan Cost Management and Plan Stakeholder Management). Also in 2012, PMI released The Standard for Program Management – Third Edition and The Standard for Portfolio Management – Third Edition for presale (PMI 2012).

The role of tourism in the economy of Georgia

Under the influence of globalization and as a result of recognition of tourism as a priority sector for the economic development of the country, increases its role in the socio-economic development of the country. In 2012 the direct contribution of Travel & Tourism to GDP was 4.5%, while the total contribution of Travel & Tourism to GDP was 15.9%, which is 1.6 and 6.6% higher than the corresponding world average (Table 1).

As can be seen from Table 2, all indicators of the economic contribution of Travel & Tourism in Georgia's GDP since 2010 has a positive growth trend (except Other indicators: Expenditure on outbound travel in 2012, where there is a decrease of 0.3%). The highest growth rate of visitor exports was observed in 2010 – 35%, domestic expenditure (includes government individual spending) in 2011 – 19%, direct contribution of Travel & Tourism to GDP and Total contribution of Travel & Tourism to employment in 2011 year was 22.8 and 18.5% respectively (Table 2).

Table 1

The contribution of tourism in socio-economic development of the world and Georgia

		World		Georgia	
		Bn USD	**%**	**Mil GEL**	**%**
1	The direct contribution of Travel & Tourism to GDP	2,056.6	2.9	1,157.5	4.5
2	The total contribution of Travel & Tourism to GDP	6,630.4	9.3	4,057.1	15.9
3	Employment: direct contribution	101,118,000 jobs	3.4% of total employment	68,000 jobs	4.0% of total employment
4	Employment: total contribution of Travel & Tourism to employment, including jobs indirectly	261,394,000 jobs	8.7% of total employment	243,000 jobs	14.2% of total employment
5	Visitor exports generated	1,243.0	5.4% of total exports	1,825.8	19.7% of total exports
6	Travel & Tourism investment	764.7	4.7% of total investment	149.5	3.4% of total investment

Source: WTTC Travel & Tourism Economic Impact 2013: Georgia. 5 p.

In 2012, the share of tourism in total output of Georgia amounted to 6.7% and remained at the level of the previous year. In total output of tourism sector about one-third (31.6%) are made up of services of restaurants, bars and cafeterias. Slightly less (28.3%) is contributed by other land transportation services; water transport services. The growth trend observed in Travel agency and tour operator services; tourist assistance services and etc., share of which has reached 20.9% (Table 3).

According to preliminary data, in 2013 in Georgia recorded 5,365,356 international tourist arrivals, which is 21% higher than in 2011 (4,428,221 people)[2]. In the structure of inbound tourism in Georgia, mainly can be traced flows from Europe – in 2012 they accounted for 63% of international arrivals. In the total number of international arrivals 88% of flows are from countries that have a common border with Georgia. In particular, the share of Turkey is 30% (it is on the first place), Armenia – 24% (second place), Azerbaijan – 20% (third place) and Russia – 14% (fourth place). Given this cross-border tourism is characterized by high amount of short-term tours and excursion (mostly overnight) tourism. Considering tourism as one of the priority sectors of the national economy, the government is undertaking a number of concrete measures aimed at its further development. For this purpose, in the frame of a technical assistance project of Trade and Development Agency U.S. (agreement on the implementation of this project was signed by representatives of the Agency and the Government of Georgia on 20th June 2007) “Strategy of tourism development and investment in Georgia” was developed. In 2011, the Government of Georgia has also developed “Strategic Development Plan of the country”, according to which tourism in the country should develop in two combined directions.

[2] http://gnta.ge/stats/portal/

The first direction is the "horizontal policy", which is designed to create favorable conditions for tourism in the country. The second direction is "vertical policy" which includes investments in tourism infrastructure, as well as improving the current balance.

Table 2

The economic contribution of Travel & Tourism to GDP of Georgia: Growth* (%)

	Georgia, Growth* (%)	2007	2008	2009	2010	2011	2012	2013**
1	Visitor exports	4.6	-6.3	21.9	35.0	24.1	3.9	5.1
2	Domestic expenditure (includes government individual spending)	-19.0	-9.5	1.5	-0.3	19.0	7.8	5.8
3	Internal tourism consumption (= 1 + 2)	9.6	7.9	0.8	7.4	1.9	5.5	5.4
4	Purchases by tourism providers, including imported goods (supply chain)	9.7	-7.7	10.0	17.9	21.5	5.4	5.4
5	Direct contribution of Travel & Tourism to GDP (= 3 + 4)	-10.0	-8.6	12.5	17.1	22.8	5.5	5.4
6	Other final impacts (indirect & induced) Domestic supply chain	-10.0	-8.6	12.5	17.1	22.8	5.5	5.4
7	Capital investment	7.0	-18.5	-30.0	22.3	11.9	6.8	7.0
8	Government collective spending	60.7	21.5	-8.8	-8.2	5.2	8.2	2.0
9	Imported goods from indirect spending	-5.1	-6.4	8.9	14.4	20.9	5.7	5.1
10	Induced	-7.3	-7.6	15.2	12.7	20.8	6.2	5.0
11	Total contribution of Travel & Tourism to GDP (= 5 + 6 + 7 + 8 + 9 + 10)	-6.7	-7.4	9.4	15.1	21.3	5.8	5.2
12	Employment impacts ('000) Direct contribution of Travel & Tourism to employment	-21.5	-16.0	20.7	8.6	19.9	0.8	1.5
13	Total contribution of Travel & Tourism to employment	-18.9	-14.9	17.7	6.6	18.5	1.0	1.3
14	Other indicators. Expenditure on outbound travel	-6.4	2.8	9.5	0.8	14.2	-0.3	7.0

* 2007-2012 real annual growth adjusted for inflation (%);
** preliminary data.

Source: WTTC Travel & Tourism Economic Impact 2013: Georgia. 12 p.

Despite the above-noted positive developments in tourism in Georgia, the country has not yet developed the concept of its development, there is no perfect legal framework, travel & tourism of Georgia is characterized by a lack of competitiveness (by The Travel & Tourism Competitiveness Index 2013 Georgia is on the 66th place[3]), the country's image has not yet formed as a tourist destination, there is a lack of qualified personnel, etc. To solve these problems, it is first necessary to ensure the effective management of tourism development and for this, project management is very important.

[3] http://www3.weforum.org/docs/TTCR/2013/TTCR_OverallRankings_2013.pdf

General provisions of the project management for development of tourism in the regions of Georgia

Notwithstanding the high priorities of the tourism, up to the date this field has been developing in Georgia in a rather chaotic way, without the scientifically founded concept and specific of the field, often on basis of the voluntary decisions by the managers of several ranges.

Table 3

Total Output of Production in Tourism related Services

Indicators	Mil. GEL				Share in Total Output of Production in Tourism related Services, %			
	2009	2010	2011	2012	2009	2010	2011	2012
Hotel services; camping sites and other short-stay accommodation	111.8	147.5	205.8	238.4	6.5	7.1	8.4	9.1
Restaurant services and other serving of food and bevarage	529.2	639.1	749.7	831.1	30.7	30.8	30.7	31.6
Railway transportation services	86.0	110.5	125.0	123.4	5.0	5.3	5.1	4.8
Other land transportation services; water transport services	526.0	624.4	720.3	742.0	30.5	30.1	29.5	28.3
Air transport services	199.5	205.6	172.4	139.0	11.6	9.9	7.1	5.3
Travel agency and tour operator services; tourist assistance services n.e.c.	271.5	348.0	467.4	549.8	15.7	16.8	19.2	20.9
Total Output of Production in Tourism related Services	1724.1	2075.1	2440.5	2623.7	100.0	100.0	100.0	100.0
Total output by Economy	26315.1	30467.3	36430.7	39292.9				
Share of total output in tourism related services in the output of total economy, %	6.6	6.8	6.7	6.7				

Source: http://www.geostat.ge/index.php?action=page&p_id=119&lang=eng

Tourism as the object for administration is characterized by specific peculiarities, among which the following shall be underlined:

- Difficult structure of the tourism industry, and also its reciprocal relation with the other field of economy, as the result of which it is difficult to define the goals and the tasks of its structural elements and the level of influence (multiplication effect) over the other fields;

- Scope of the touristic services: touristic services are applied for by the huge amount of the people inside the country as well as abroad. They create the global touristic flows, crossing in time and space:
- Complexity of defining of the contribution by the tourism into the social-economic development of different territorial units: cities and towns, villages and countryside, region, country, continent, etc. As the data of the tables 1 and 2 show, the tourism has the direct as well as implicit contribution;
- Specifics of the touristic services and the touristic product, as well as the specific of interaction of the tourist with the local population;
- Dependence on the variety of the objective and the subjective factors: natural and climate, demographic, economic, political, etc.;
- Totality of the private and the public sectors, implementation by the branch of the commercial as well as of the social functions.

These peculiarities evoke necessity of the complex approach towards the issue of the project management for development of the tourism at any territorial level, and all the more, this issue shall be reviewed as the integrity in the framework of the country, which might be presented as the huge corporation with its complicated structure, embracing all the regions of the country. Thus, the project management for development of the tourism in the particular regions shall be considered taking into account the following circumstances:

- Tourism in the region is the open complex social-economic system, containing the reciprocally related elements: touristic potential, tourists, local population, infrastructure of the tourism, administrative bodies, public/societal organizations and other structural formations and elements, activities of which is directed towards rendering services to the tourists in accordance with their needs and capabilities of the limited economic resources;
- Tourism in the region is the integral part of the tourism of the country, and at the same time the significance of the problem of the tourism development deals with the national as well as the international interests;
- Development of the tourism is the regime of functioning, oriented towards the positive dynamics of all its parameters and indicators, effective utilization of the touristic potential, providing of its sustainable development with the balanced mix of proportions of development together with the adjacent fields;
- Forming of the purposed programs and the projects for development of the tourism with the reasonable combination of principles of centralization and decentralization, initiated by the governing bodies of the country as well as the regional and the municipal administration.

At present the tourism of the particular regions develops for account of applying for the acting market mechanisms. Participation of the state in those processes is insignificant, though without the real support and the active coordinating participation of the government of country it is impossible to turn the country into attractive spot from the touristic point of view. Participation of the state might be reflected in development of long-termed, integral, multilevel system of the project management for development of tourism, in which the particular levels will be reciprocally preconditioned, dependent and at the same time divided into the great variety of the subprojects.

The project for development of the tourism of the country and its sub-projects (regional, municipal, etc.) shall be elaborated on taking into account the following five process groups (PMBoK, 2013): Initiating, Planning, Executing, Monitoring and Controlling, Closing. And also the following ten fields of knowledge shall not be forgotten:

- Project Integration Management, which means implementation of various integral actions with the purpose of successful management of expectations of the interested parties and implementation of the defined demands. As the result of such processes one might get the synergetic effect.
- Project Scope Management, which enables to implement sampling, filtration and grouping of the works, required for the successful completion of the project.
- Project Time Management, which secures the timely completion of the project.
- Project Cost Management considers planning and development of the budget, and also management of the expenses, which secure completion of the project in the framework of the approved budget.
- Project Quality Management, which shall comply with the needs, in sake of which those needs were initiated.
- Project Human Resource Management, which involve the processes of administration of the human resources and their effective application.
- Project Communications Management, which is carried out with the purpose to secure the timely forming, preparing, distribution, archiving, transferring, receiving, and utilization of the information regarding the project.
- Project Risk Management, which embraces the processes related to planning of the risks management, their identification and analysis, elaboration of the methods of response to the risks, etc.
- Project Procurement Management, which involves purchase of particular products, services, etc.
- Project Stakeholder Management means, on one hand, communication of the project team with the interested persons, and on the other hand, the works directed towards their needs and decision of the problems which might incur modifications of the project.

For elaboration and realization of the defined processes of the project it is required to apply for the various instruments and technics described in the methodology PMBoK, assisted by which the effectiveness of the project implementation might be raised, the risks might be foreseen, the optimal routes of implementation of the project might be set, and the opportunities and the situations of its implementation might be appraised, as well as the right decisions might be drawn, etc.

Elaboration and realization of the projects for development of the tourism in the country and its regions is related with the multiple problems. Among them especially shall be indicated absence of the qualified personnel for the project management, legislation basis, regulating the tourism activities, and also the partnership relations of the triad of the project participants (population, entrepreneurs and the administrative bodies). Without solving those problems it is impossible to secure efficiency of the project management for development of the tourism in the regions of Georgia and of the country as a whole.

Conclusions

Currently, the tourism in Georgia is the dynamically developing field, which plays significant role in the structural reformation of the economy of Georgia and is the significant factor of development of its regions. Considering the tourism as one of the most prioritized field of the national economy, the state undertakes the measures aimed for its development and particularly in the regions such as Ajara, Kakheti, Svaneti, etc. Though, the practice shows that the tourism in Georgia has being developed in chaotic way, without the scientifically based concepts and specifics of the field. Regarding that for the following development of the tourism it is necessary to apply for the opportunities of the project management, which enables to solve the problems accumulated in the field and will facilitate to establishment of the partnership relations of the triad: population, entrepreneurs and administrative bodies.

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"PROJECT EXPERT" AS A TOOL OF INVESTMENT PROJECT MANAGEMENT

Vjacheslav Andreevich Kozlov, Moscow State University of Economics, Statistics and Informatics (MESI), Russian Federation[1];

Larisa Aleksandrovna Danchenok, Moscow State University of Economics, Statistics and Informatics (MESI), Russian Federation

Abstract

The article discusses one of the most effective modern tools of investment project management – financial-analytical system *Project Expert*. In the article it is proved that use of information technology today is not only something innovative distinctive feature and competitive advantage for organizations, but it is a necessary condition for effective business. The article discusses the main functionality of financial-analytical system *Project Expert* as an effective tool of investment project management and instrument of business planning. The main advantages which organizations get from *Project Expert* program use are in detail considered. Thus in the article *Project Expert* is considered as the effective tool of investment project management which allows to receive a number of advantages and to carry out the qualitative analysis of projects.

Key words: *investment project management, investment analysis, business-planning*

JEL code: M13

Introduction

Now both to businessmen and investors it is necessary to carry out the comprehensive analysis of a set of investment projects to choose from them what meet their requirements on need of resources, the period of investments return, investment effect, etc. And it's realized in the conditions of resources limitation – first of all time resource, human, financial and other kinds or resources. In these conditions one of modern methods of investment project management is application of specialized computer programs in the process of investment projects analysis and planning. One of such software products is *Project Expert* which allows to calculate automatically necessary financial activities, to provide interpretation of their concrete values, to carry out the comprehensive analysis of investment projects from the point of view of their efficiency. It allows the user to make a right choice according to selection criteria of projects. In the article the main opportunities and distinctive advantages of financial and analytical *Project Expert* system as modern instrument of investment project management are considered.

1. The role of planning and analysis in investment project management

[1] Corresponding author – e-mail address: VKozlov@mesi.ru, telephone: 8-916-418-86-54

There is a set of approaches to concept definition «management of investment projects» today. One of them is the most complex approach which consists in the analysis of investment project management as set of processes of planning, organization, coordination, motivation and control throughout all life cycle of the project on the basis of using of system of modern methods and equipment of the management which main goal is ensuring effective realization of the project's results connected with structure and amount of works, the cost, quality and satisfaction of project participants. Certainly planning of investment projects is the most important part of investment project management process and it's the first stage of this process. All subsequent stages of investment project management throughout all stages of project's life cycle depend on correctness of the analysis of investment projects and rationality of a choice of the most optimum projects by certain criteria.

2. Features of *Project Expert* as the tool of investment project management

Basis of assessment of investment projects efficiency in *Project Expert* system is the full financial model of the organization. In this model all payments connected with implementation of the project, receipts from sales, accounting operations are imitated. The model of the company constructed in the program allows to analyze repeatedly various variants of implementation of the project, to estimate influence on the project of changes of various external factors (taxes, exchange rate, inflation, the changes in raw materials and materials price, etc.).

Having constructed by means of *Project Expert* financial model of the investment project users have an opportunity:

- to develop the detailed financial plan and to define need for money during future periods of time; *Project Expert* allows to analyze several variants of the business development goals and to choose the optimal one. While it is possible to estimate the margin of safety of business with regard to the risk of changes in the most important factors influencing project realization. The program also allows you to evaluate how the implementation of the business plan will affect the efficiency of the enterprise activity, to calculate the payback period of the project, predict the total showings of investment projects financed from the general budget. *Project Expert* allows you to create business-plan of the enterprise according to international standards (IFRS), to prepare proposals for regional investment program or a strategic investor, defining for each participants total economic effect from implementation of the investment project and the efficiency of investments.
- to define the financing scheme, to estimate opportunity and efficiency of money from various sources; to define the financing scheme, to assess the feasibility and effectiveness of raising funds from various sources; using *Project Expert* you can develop a scheme for financing the investment project with consideration of future cash requirements based on a forecast of cash flows for the entire planning period, to choose the sources and conditions of attracting funds for the implementation of the business plan, assess possible time constraints and build schedules of repayment. Also there is a possibility to design the capital structure of the company and to evaluate business value.

- to elaborate the plan of implementation of the investment project, to define the most effective marketing strategy and also the strategy of production which provides rational use of material, human and financial resources; *Project Expert* allows you to analyze the planned cost structure and the profitability of individual units and products, to determine the minimum volume of production and marginal costs, to choose the production program and equipment, procurement schemes and variants of sales in the market.
- to analyse various scenarios of development of the project, varying values of the factors which are capable to affect its financial results;
- to create standard financial documents, to calculate the most widespread financial activities of investment projects;
- to prepare the business plan of the investment project;
- to control the execution of the business plan; *Project Expert* will help you to control the execution of the business plan comparing in the process of its implementation the planned and actual indices.

3. The advantages of using *Project Expert* in the analysis of investment projects and business-planning

The organization which uses such tool of investment project management as *Project Expert* enjoys a number of competitive advantages which in the conditions of modern economic reality are very important factors of company's success in the market. In the article some advantages from *Project Expert* program use are described.

1. Economy of temporary time, human, financial and other resources. Firstly the most important advantage is the saving of resources (time, human, financial and other) from the use of this software product. Many operations that would be the developer of the business plan had to manually implement, *Project Expert* automates – for example, the construction of the main forms of financial statements or plans, analysis of various business development scenarios depending on the influence of many factors, etc.
   Currently the development of good business plan of the investment project involves the construction and analysis of alternative variants of business development and choose the most optimal, corresponding to certain criteria. Without the use of specialized software developer would have to manually count the many variants of business development, different scenarios depending on many factors – it leads to the increase of the cost of the business planning process.
   Using the method of imitation modeling in *Project Expert* (which is based on the scenario approach) allows to study various scenarios of development of the organization automatically, the state of the external economic environment, the planned investment projects. Simulation models enable testing different ideas, hypotheses and assumptions about the business development, to analyze the consequences of its implementation.
2. The second advantage and peculiarity of the *Project Expert* is an complex approach to the analysis of investment projects which allows to consider the totality of stimulating factors of external and internal environment.

Comprehensive complex approach to business planning in *Project Expert* is that business planning is carried out with the greatest possible consideration of the totality of affecting factors of the external and internal environment – the prices of the raw materials, the impact of various macroeconomic factors (inflation, exchange rate), etc. The program allows to define the organization's cash need, to find the optimal scheme of financing and credit conditions, to estimate the margin of safety of business, the efficiency of investments for all participants of the project, choose variants of production, purchasing and sales and to monitor of the implementation investment projects.

3. Possibility of use in the organizations of various scale of activity is the next advantage of the *Project Expert*. The system allows to simulate the activity of the organizations of various sizes – from small private institution to holding structures. Using the program you can create and analyze investment projects of any complexity – from calculating the value of new equipment to evaluating the effectiveness of business diversification.
4. The possibility of representation of results in *MS Excel* and *MS Word* can also be attributed to the peculiarities of the program which distinguishes it from the programs of this class and which is one of its competitive advantages. Due to the capabilities of dynamic data exchange with *MS Excel* transmission of reports in *MS Word* and save them in *HTML* format, *Project Expert* can be used as an independent analytical program and as an integral part of informational-analytical system of the organization.
5. And finally the most important feature and advantage from the point of view of practical implementation and use of *Project Expert* software in the organization's activity is the simplicity of its using which allows users without special knowledge in programming, mathematics or financial analysts to carry out comprehensive analysis of investment projects. In general one of the main problems impeding the implementation of the development achievements of technics and technology in business is that they are perceived by potential users as something complex, confusing, which is a psychological barrier that inhibits the practical use of them in activities of the organizations.

   Project Expert does not require deep knowledge of mathematics, no programming skills – y u need only know the described business. Easy to understand interface guides the user through the steps of creating a model of organization and development of the business plan. The program automatically supports basic rules of accounting and financial analysis and provides a profound analysis of correctness of entered data during calculation which allows to avoid many mistakes at the planning stage.

   Project Expert has an easy to understand interface that allows the user to pass through all the stages of creation of the model of organization and development of the business plan. It allows to accelerate the process of training of potential users of the program and to provide the most seamless its introduction in the business.

Conclusion

Thus *Project Expert* allows to solve the problem of design of business development, risk analysis and the efficiency of investment projects of enterprises of different profile, industry and scale of activity and this program bases on financial modeling enterprises functioning taking into account the variable factors of economic environment. Using the *Project Expert* software as one of those tools of investment project management enables to significantly improve efficiency of business by implementing reviewed in this article certain competitive advantages.

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INTEGRATION OF PROJECT ACCOUNTING AND FINANCE: PROBLEMS AND SOLUTIONS IN EU-FUNDED INVESTMENT PROJECTS

Margus Kõomägi, Pärnu College, University of Tartu, Estonia[1];

Varje Kodasma, Pärnu College, University of Tartu, Estonia

Abstract

Due to the membership of the European Union, entrepreneurs in the Baltic States can use external financing in terms of public support provided by the European Union institutions. This has increased project-based work, caused the change in the companies' capital structure and raised different problems concerning project accounting and finance.

Traditional capital budgeting techniques are intensively taught at business schools and widely used by industry practitioners (e.g. financial and project managers). Much attention is paid to different analytical methods but the linkages between budget of a project (accounting side) and analytical tools (financial side) have remained less examined. Typical corporate finance textbooks provide in-depth analytical tools for evaluating project success, but they do not analyze the feasibility of the project in a real sense of accounting. The result of a common discounted cash flow analysis of a project does not mean that the owner of the project will get the required rate of return due to different reinvestment scenarios. Distributions of cash flows can be very different at certain point of time (bond vs. annuity loan financing), which means that the investment in net operating working capital must be calculated on the basis of accounting approach. Project-based balance sheet can solve the problem. The situation is even more complicated in case EU funding (or government assistance/grants) is used. Assets received or acquired through these schemes can be recognized in the balance sheet in different ways (e.g. gross or net method). As a result, the performance of the project can be quite different.

The second circle of problems concerns the evaluation of project's cost of capital. How to evaluate the weighted average cost of capital (WACC) if project is partly funded by EU? How to find the owner's required rate of return if the project is funded only by EU funds and by bank loans without self-financing. Could a risk free rate be a solution to that problem because in most cases the owner does not take any risk? If a company gets EU funding, the debt ratio of a company may result in very high value, which is based on the traditional capital assets pricing model (CAPM) and according to that the owner's required rate of return will also be very high. In fact, common financial management textbooks illustrate how the discount rate of a project is related to different debt levels below 90%. The problem will arise if the debt ratio is above 90%. The debt ratio should be modified and the modified leveraged beta coefficient should be applied if the EU funding is used. These problems have arisen during the consultations with the project management practitioners in Estonia and were solved during the discussions.

Key words: *project finance, project accounting, investment projects; EU project-based funding*

JEL codes: G31, G32, M41

[1] Corresponding author – e-mail address: margus.koomagi@ut.ee

Introduction

The EU grant-based financing has been present in the Baltic States with increasing amount and popularity for nearly ten years. More and more entrepreneurs have received different types of EU grants for financing their firm. The regulations and restrictions have also changed during that time and some specific grants have allowed them to use exceptional financing structures which are not common in everyday company financing but in reality it lacks a theoretical basis in that field.

The idea to write the article is two-sided. One of the authors has taught project accounting and another project-based financing for several years but the cooperation between them has been rather limited. The same situation appears to be in the related literature – accounting scientists are eager to deal with their debits and credits and book value based financial statements and financial management scientists are keen on using analytical approach and their own methods which does not match with accounting (different cost categories, rather a cash flow approach, market value approach used etc.). The situation is even more complicated in somewhat new approach – how to deal with these differences in financing projects by the European Union Structural Funds.

Due to the increasing amount of the EU financing provided for different entrepreneurs, there are some specific but practical cases, which are incompatible in a traditional corporate finance framework. The authors have consulted different entrepreneurs who have received the EU financing in recent years. For example, how to estimate weighted average cost of capital when a project is financed only by a bank loan and the EU grants or how to use CAPM in a very high financial leverage situation (debt ratio is above 90%) or how to explain the differences between accounting based ratios and project-based key performance indicators. How to apply traditional corporate financial models in the EU project financing context?

The aim of the article is to show the linkages between project-based accounting and finance which can explain the differences in the estimations based on accounting and financial management data used in project management and provide solutions to some of the specific problems concerning project estimation in corporate finance.

The article consists of two chapters. The first chapter provides the theoretical background and some new ideas concerning financing by the EU grants and the second chapter presents a scenario analysis based on theoretical concepts. All the scenarios are actually based on real Estonian cases.

1. Theoretical analysis

1.1. Capital investment projects

A project has been defined quite differently in academic literature. It depends on the source. In project management literature, a project has specific terms (time, scale and cost). For example, in PRINCE2 (an acronym for Projects in Controlled Environments) a project is defined as follows (Managing … 2005):

1. “A management environment that is created for the purpose of delivering one or more business products according to a specified Business Case”.
2. “A temporary organization that is needed to produce a unique and pre-define outcome or result at a pre-specified time using pre-determined resources”.

A project as a temporary organization (Lundin and Söderholm 1995) differs from a company. Vouri et al (2012) analyzed the relationship between the investment project and its parent suggesting that an investment project and its strategy can be analyzed by regarding a project as a venture. This internal corporate venturing is described as "internally staffed new business development projects" (Keil et al., 2009). Organizations carry out capital investment projects as internal development projects to assemble the facilities that allow them to meet or even renew their strategic objectives (Bower 2005) and develop their products (Brigham and Daves 2004).

The relationship between a project and an investment has also been discussed by Gareis (2005). In financial literature, a project is almost the same as a business case, but in project management literature a project is the first phase of a business case.

Capital budgeting is a subtopic which deals with investment projects in corporate finance. Most of investment projects are capital investment projects. A capital investment project can be distinguished from recurrent expenditures by two features: they are significantly large and generally long-lived projects with their benefits or cash-flows spreading over many years (Dayananda et al 2002). Capital investment projects assume significant initial cash outflow in order to receive positive net cash flows in future. The question is how to finance and estimate the projects. An extensive analysis has been carried out in corporate financial literature in that matter, but the financing of capital investment projects by the European Union grants has been less examined.

1.2. Financing projects by government assistance

In recent years the amount of projects financed by the European Union has increased enormously. Some of these projects are solely financed by the European Union; some of them have partly local government co-funding. There is also domestic public funding for entrepreneurs provided by the government. In this subchapter the accounting issues of government grants are analyzed.

The definitions of grant related terms which are needed for accounting purposes can be found in IFRS (International Financial Reporting Standards) for SMEs. Government grants are "government assistance in the form of transfers of certain resources and which are received if an entity's business activities meet certain predetermined criteria. Government grants exclude government assistance whose value cannot be determined reliably (for example, state warranties and free consultations offered by government agencies) and economic transactions entered into with the public sector under normal conditions. (IFRS for SMEs 24.1, 24.2)" Capital investment projects are financed by grants related to assets. These can be defined as "government grants whose primary condition is that an entity qualifying for them should purchase, construct or otherwise acquire certain non-current assets. Grants related to assets may contain additional conditions, for example the schedule for acquiring non-current assets, type of non-current assets to be acquired, the location and the period during which they are held." (ASBG 2014)

For grants related to assets, an entity must choose one of the following accounting methods:

1. Assets acquired using grants shall be recognized at cost on the balance sheet and accounted for based on the guideline ASBG5; grants received for acquiring assets shall be recognized as other operating income periodically if criteria not specified.

2. Assets acquired using grants shall be recognized at cost on the balance sheet and accounted for based on the guideline ASBG5; grants received for acquiring assets shall be recognized as income after criteria specified (IFRS for SMEs 24.4):
   a. A grant becomes receivable; and
   b. Any conditions related to the grant have been fulfilled.
3. Assets acquired using grants shall be recognized at net cost on the balance sheet – i.e. at cost of assets less grants received to acquire the assets. The transaction does not directly influence the right side of balance sheet. Acquired assets shall subsequently be measured based on the guideline ASBG 5. The fixed assets may be depreciated only by the proportion of own financing.

A company can choose between a number of methods: variant 1 or 2 depending on criteria met or not and method 3. It means that the company has only two main choices (see Figure 1). The chosen method must be applied subsequently on every financing round by government grants.

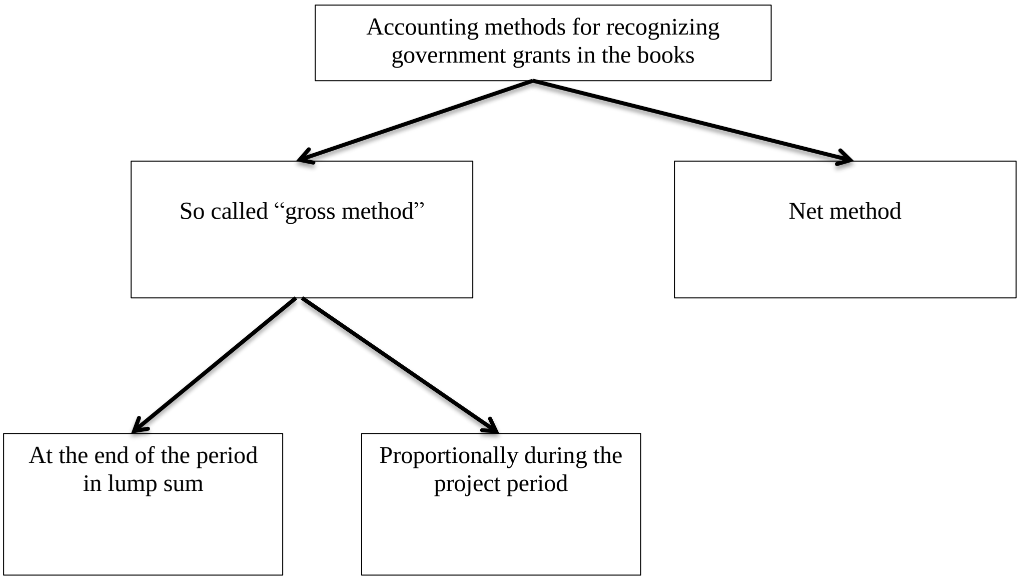

Fig. 1. **Accounting methods for grants in the books**

These methods have different impact on financial statements (here income statement and balance sheet) (see Figure 2). The first method influences directly liabilities and owners' equity in the balance sheet and also income statement, the second method excludes income statement and the third method influences mainly assets in the balance sheet.

It can be assumed that the most preferable is variant 3 in terms of financial accounting ratios. The second place belongs to variant 1 and the last one to variant 2. The reasons behind the preference lie on the fact that the sooner the company can record the profit from grant in the books, the better. If the company can use method 1, it is important to notice that the depreciable cost is at the same amount than income related to the grant. The financial accounting ratios are presented in the next subchapter and will be simulated in the empirical part of the article.

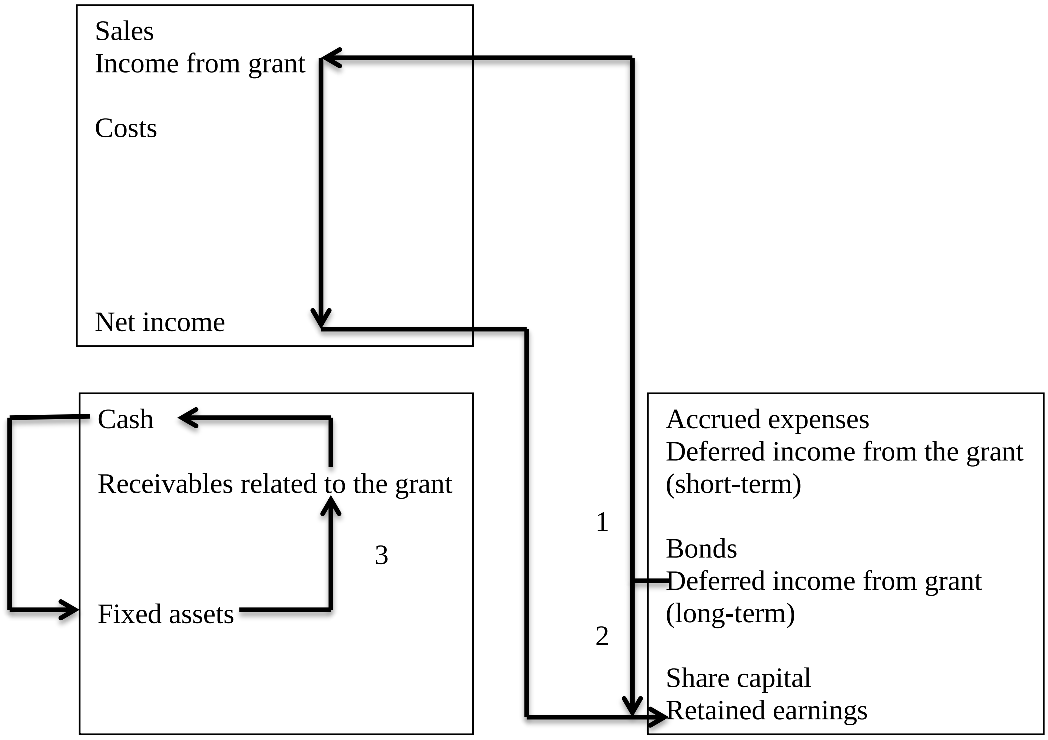

Fig. 2. **A grant funding recognition methods in the books**

Lastly, some important records are introduced how to recognize grants in the books. For example, an entity acquires a fixed asset to be used in production and 50% of its costs are compensated for by the European Union support funds. The condition of the grant is that the entity continues its production activities in the same field during the next 3 years (the length of the capital investment project). In the books, the grant is recognized as follows (mostly based on ASBG 2014):

1. Alternative A:
   Acquisition of fixed assets:
   D – Fixed assets
   C – Cash

   Upon the receipt of the grant:
   D – Cash
   C – Deferred income related to the grant

   Depreciation of fixed assets:
   D – Depreciation expense (the proportion of fixed assets financed by the grant)
   D – Depreciation expense (the proportion of fixed assets financed by own funds or loan)
   K – Accumulated depreciation (the proportion of fixed assets financed by the grant)
   K – Accumulated depreciation (the proportion of fixed assets financed by own funds or loan)

After conditions of the grant are met, i.e. after 3 years:
D – Deferred income related to the grant
C – Income related to grants

In order to avoid misinterpretation of last year's profit, the following record should be used:
D – Deferred income related to the grant
C – Last year income related to grants
C – Retained earnings (income related to grants in previous years)

If the conditions of the grant are not set, deferred income related to the grant should be carried proportionally into income related to grants every year:
D – Deferred income relate to the grant (the amount of one year)
K – Income related to grants (the amount of one year)

2. Alternative B (net method):
   Acquisition of fixed assets:
   D – Fixed assets
   C – Cash

   Upon the approval of the compensation application by the organization granting the aid:
   D – Receivables related to the grant
   C – Fixed assets

   Upon the receipt of the grant:
   D – Cash
   C – Receivables related to the grant

1.3. The financing structure of a project and accounting based profitability

Financing or capital structure can be measured by different financial ratios. The most common one is debt ratio (DR). Debt ratio can be used to estimate the proportion of assets (A) which is financed by debt (D). DR is calculated as follows:

$$DR = \frac{D}{A}. \tag{1}$$

Debt ratio should not be higher than 70% due to the risk of bankruptcy. The optimal level of debt ratio can be considered between 30-50% which enables the positive effect of financial leverage.

When government grants are used, the modifications of debt ratios can be developed. If the entity will comply with the conditions attaching to government grants, the debt financing can be considered at no cost. The debt entry "Deferred income related to the grant" is only temporary item and it will be transferred to equity directly or indirectly through income statement. Debt ratio without government grants can be calculated as follows (D* denotes the debt without deferred incomes from the grants):

$$DRG = \frac{D^*}{A}. \tag{2}$$

If a firm finances its projects by government grants the following inequality will apply:

$$DR > DRG. \tag{3}$$

It is important to notice that the deferred income related to the grant is a temporary debt partly recognized in long-term liabilities and partly in short-term liabilities. If net method is used instead of so-called gross method, grants are not recorded as debt in the balance sheet and the traditional debt ratio is smaller. Due to the accounting methods and manipulations, the performance of the company can be quite different, but the actual financial position based on cash flows is the same (see subchapter 1.5).

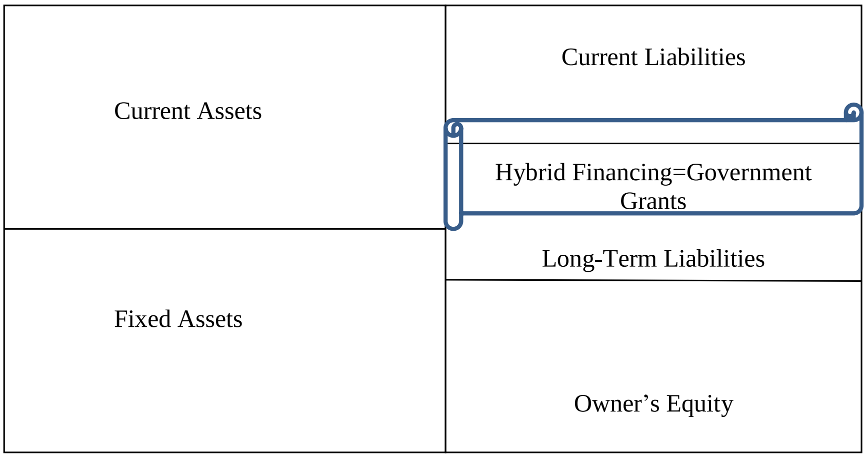

Fig. 3. **Government grants in company's balance sheet**

After estimating the financing structure of the company, the effects of financing structure should be explored on profitability ratios based on accounting data. There are three common profitability ratios: profit margin, return on assets and return on equity.

Profit margin (PM) measures the profitability of sales (S). It can be estimated based on earnings before interest and taxes (EBIT) or net profit (NI):

$$PM = \frac{NI}{S}. \tag{4}$$

Return on assets (ROA) measures the profitability of assets (A). It can be also estimated based on EBIT or NI:

$$ROA = \frac{NI}{A}. \tag{5}$$

Return on equity (ROE) measures the profitability of equity (E). It can be estimated based on NI:

$$ROE = \frac{NI}{E}, \tag{6}$$

Return on equity can be compared with owner's required rate of return (k_s). In order to create value to shareholders, the following condition must hold:

$$ROE > k_s. \tag{7}$$

This leads us to the cost of capital of the project.

1.4. The cost of capital

The most accepted and well know model to estimate the owner's required rate of return is capital assets pricing model (CAPM). CAPM enables to take into account the risk free rate of return (Rf), systematic risk of equity by beta coefficient (b), market risk premium (RP). The formula is as follows:

$$k_s = R_f + \beta_L \cdot RP\,. \tag{8}$$

If the company is not listed on the stock exchange, relative comparison method should be used. Unleveraged comparative beta coefficients (β_U) must be adjusted with financial leverage. The most common formula is as follows:

$$\beta_L = \beta_U \cdot \left[1 + (1-t) \cdot \frac{V_D}{V_E}\right], \tag{9}$$

The financial leverage factor is calculated by dividing market value of debt (Vd) by market value of equity (Ve) and this is adjusted by tax rate (t).

The formula for leveraged beta coefficient assumes that debt is risk free: $\beta_D = 0$ and therefore

$$\beta_A = \frac{V_E}{V_D + V_E} \cdot \beta_E \text{ and } \beta_E = \left(1 + \frac{V_D}{V_E}\right) \cdot \beta_A \tag{10}$$

Some companies have very high financial leverage (especially companies with government grants and/or subsidized loans provided by government agencies) and therefore the debt is not risk free anymore. Therefore the assumption provided in previous formula does not hold. Skardziukas (2010) suggests the following formula as a solution:

$$\beta_L = \beta_U + (\beta_U - \beta_D) \cdot \frac{V_D}{V_E}. \tag{11}$$

Debt beta is influenced by spread, market risk premium (MRP) and perceived market risk (PMR). Debt beta can be estimated as follows (Skardziukas 2010)

$$\beta_D = \frac{Spread}{MRP} \cdot PMR \tag{12}$$

The estimation of owners' required rate of return concerns at least two more problems. The financial leverage ratio should be based on market value of debt and equity. For simplicity, the book value of debt equals the market value of debt, but the market value of equity is usually higher. Sector price to book ratio (P/B) can be used to solve the problem. In order to obtain the market value of equity, the book value of equity of the company must be multiplied by P/B ratio.

Another problem concerns the situation common to hybrid financing (e.g. government grants). Some European Union funded projects do not require owner's financing (or any outside financing at all). For some projects, traditional debt financing can be a substitute to own financing. How to estimate the owner's required rate of return without own financing? One can suggest using risk-free rate of return:

$$k_s = R_f \tag{13}$$

This can be allied only if the need to refund the grant is close to zero or for example, a project is financed 50% by a bank debt and 50% by a nonrefundable government grant and if the project fails, the bank money can be refunded by the grant. This means that the liquidation value of the project is higher than the remaining amount of the bank loan:

$$PV_{project} > PV_{bankloan} \tag{14}$$

1.5. Evaluation of capital investment projects

The financial statement ratios are not common estimates for project success. The most common and accepted measure to evaluate the success of the project is net present value (NPV). It enables to measure the value of entire project not only the performance in specific years. NPV indicates the value added to owners. The project can be accepted if NPV>0. It can be calculated as follows:

$$NPV = \sum_{t=1}^{n} \frac{CF_t}{(1+WACC)^t} - IO. \tag{15}$$

It is important to notice that the success of the project should be estimated based on cash flows instead of net income. Cash flows from the project can be estimated using sales (S), variable costs (VC), fixed costs (FC), depreciation (DEP), other operating income (here income from grant) (OOI), taxes (T), capital expenditure (CapEx), the change in net operating working capital ($\Delta NOWC$). The indicator in brackets shows earnings before interest and taxes. In order to obtain operating cash flows OOI and DEP are the adjustment factors. These adjustments must be made because of non-monetary items.

$$CF_t = (S_t + OOI - VC_t - FC_t - DEP_t) - OOI_t + DEP_t - T_t - CapEx_t - \Delta NOWC. \tag{16}$$

It is important to notice that cash flows of a project are not influenced by grant funding from period t=1 till t=n. This means that the incoming cash flow from the grant is assumed to take place at t=0. Unlike cash flows, the operating profit is influenced on accounting methods of the grant and therefore the accounting ratios are different.

The weighted average cost of capital (WACC) is the second input of NPV formula. It takes into account the cost of debt (k_d) and the cost of equity (k_s) with their weights (w) in financing structure.

$$WACC = w_d \cdot k_d \cdot (1-t) + w_s \cdot k_s \tag{17}$$

The traditional problem using WACC formula is that the weights must be in market value (see the problem also in CAPM model presented previously).

The specific problem using WACC arises when government grants are used. How to estimate the required rate of return of government grants? The grant is received at the beginning of the project, initial outflow (IO) decreases the amount of the grant.

WACC method can be complicated if subsidized loans (provided by government agencies) or government grants are used for financing of the project. For example, if the capital investment project is financed only by bonds and government grants, the self-financing is 0 at first. The discount rate cannot be the cost of debt because of the risk factor. If net income is received in the first year, it must earn the required owner's rate of return and if it is not earned, the owner may need additional equity to survive.

FCFE (Free cash flows to firm) or adjusted present value (APV) methods should be used instead. Adjusted present value can be calculated as follows:

$$APV = NPV + NPVF\ . \tag{18}$$

NPVF (Net Present Value of Financing) could include positive side effects accompanied by government grants. APV analysis assumes two stages: first, estimate the NPV without grants and then a positive aspect accompanied by the grant. NPVF of the grant is the present value of the grant. The discount factor could be risk free rate of return if the chance to obtain it is close to 100%.

APV can indicate that the project may be not profitable as an investment but the project can be acceptable due to positive financing effects. This will be showed in the empirical part of the article.

NPV and APV measure the success of the project on an absolute value basis. In order to compare different projects, relative measure of return has to be found. Internal rate of return is the most well-known indicator of relative return and is calculated as follows:

$$IO = \sum_{t=1}^{n} \frac{CF_t}{(1+IRR)^t}. \tag{19}$$

IRR cannot be considered an accurate measure because of reinvestment problems in real world. Therefore the modified internal rate of return (MIRR) is developed:

$$MIRR = \sqrt[n]{\frac{\sum_{t=0}^{n} CF_t \cdot (1+k)^{n-t}}{\sum_{t=0}^{n} \frac{CFI_t}{(1+WACC)^t}}} - 1. \tag{20}$$

MIRR enables to use alternative reinvestment rate (k) instead of itself. It also differentiates investment cash flows (CFI) and cash flows from the project.

These project-based financial indicators are not influenced by different accounting methods used to recognize grants in the books.

2. Empirical scenarios and estimation

Scenario analysis is used in order to show the differences between various financing schemes of the project. Let assume that the value of fixed assets is 60 thousand euros. There can be 7 financing schemes:

1. 100% self-financing.
2. 50% bonds and 50% self-financing.
3. 95% bonds and 5% self-financing.
4. 50% bonds and 50% the EU grant financing (proportional method).
5. 50% bonds and 50% the EU grant financing (lump sum method).
6. 50% bonds and 50% the EU grant financing (net method).
7. 50% self-financing and 50% the EU grant financing (net method).

In order to compare these 7 cases, all except financing structures of the project is the same (sales, cost without depreciation, fixed assets) (see Tables 1-6). This means that the investment side of the project is identical, but the financing scheme is different. The aim of the various scenarios is to show the differences in income statement, balance sheet, accounting-based ratios and project-based financial indicators.

Starting from the first case, net income from the project is 0 throughout three years. This means that the project is not profitable on investment side. The project can be accepted only due to the more preferable financing scheme. The second and the third cases include bonds as a financing instrument. Due to the current interests, the net income is slightly negative compared to case one. The third case is quite special because of the very high financial leverage. This can happen if a firm receives a loan guarantee by national support structure (institution). In the theoretical part, this situation was analyzed in terms of cost of capital. The traditional CAPM cannot be used for estimating the owner's required rate of return. Applying formula 11, the size of the return will result in more logical result (see Table 5).

The remaining 4 cases (4-7) include the EU grant financing in the financing structure of the project. Income related to the grant is only recognized in case 4 because of proportional gross method. It could be assumed that the net income results in higher value, but actually it is not the right assumption. Due to the smaller depreciation expense related to net method, the difference in net income is actually zero. As a result, net income is quite different resulting from -1.5 to 10 thousand euros (the seventh case is not directly comparable to others because self-financing is used instead of bonds). It is due to different accounting methods for grants discussed in the theoretical part of the article.

Cases 4-6 are special due to the missing self-financing. Some EU grants enable to finance projects solely by outside financing. It leads us to very specific problem – how to evaluate the owner's required rate of return and weighted average cost of capital? As discussed in the theoretical part of the article, it depends on some circumstances. Here, it is assumed that the owner of the project will not have to repay some of the bonds by own capital. This is a risk free project for the owner and therefore a risk free rate of return can be used instead. The risk free rate should be used to discount free cash flows to equity not free cash flows to project. The traditional FCFE approach for NPV assumes initial cash outflow from owners but if it is 0, the internal rate of return cannot be calculated. One solution can be considered transaction costs as initial outflow if it is not a sunk cost.

Table 1

Project-based income statement (Year 1) (in thousands €)

Cases	I	II	III	IV	V	VI	VII
Sales	80	80	80	80	80	80	80
Income related to the grant	0	0	0	10	0	0	0
Costs (except depreciation)	60	60	60	60	60	60	60
Depreciation (not grant)	20	20	20	10	10	10	10
Depreciation (grant)	0	0	0	10	10	0	0
Operating profit	0	0	0	10	0	10	10
Interests	0	1.5	2.85	1.5	1.5	1.5	0
Net income	**0**	**-1.5**	**-2.85**	**8.5**	**-1.5**	**8.5**	**10**

Source: author's calculations

Various financing schemes and accounting methods also result in differences in the balance sheet (see Table 2). The size of the balance sheet mostly depends on method how fixed assets are recognized in the books. Net method assumes that the value of fixed assets is decreased by the amount of grant financing (already at year 1). Deferred income related to the grant is recognized in cases 4 and 5. This temporary income will be transferred to equity directly or indirectly during the life of the project (see Figure 1 in the theoretical part). In case 5, the owner's equity has a negative value.

Table 2

Project-based balance sheet (Year 1) (in thousands €)

Cases	I	II	III	IV	V	VI	VII
Cash	20	18.5	17.15	18.5	18.5	18.5	20
Fixed assets	40	40	40	40	40	20	20
Total assets	**60**	**58.5**	**57.15**	**58.5**	**58.5**	**38.5**	**40**
Deferred income related to the grant (short term)	0	0	0	10	0	0	0
Deferred income related to the grant (long term)	0	0	0	10	30	0	0
Bonds	0	30	57	30	30	30	0
Share capital	60	30	3	0	0	0	30
Retained earnings	0	0	0	0	0	0	0
Net income	0	-1.5	-2.85	8.5	-1.5	8.5	10
Total liabilities	**60**	**58.5**	**57.15**	**58.5**	**58.5**	**38.5**	**40**

Source: author's calculations

In year 2, the structure and values in income statement are the same (see Table 3). It is assumed that operating performance will remain the same during the life of the project for simplicity.

Table 3

Project-based income statement (Year 2) (in thousands €)

Cases	I	II	III	IV	V	VI	VII
Sales	80	80	80	80	80	80	80
Income related to the grant	0	0	0	10	0	0	0
Costs (except depreciation)	60	60	60	60	60	60	60
Depreciation (not grant)	20	20	20	10	10	10	10
Depreciation (grant)	0	0	0	10	10	0	0
Operating profit	0	0	0	10	0	10	10
Interests	0	1.5	2.85	1.5	1.5	1.5	0
Net income	**0**	**-1.5**	**-2.85**	**8.5**	**-1.5**	**8.5**	**10**

Source: author's calculations

The size of balance sheet is slightly different in year 2 compared to year 1. Fixed assets have been depreciated and the amount of cash has increased. The positive increase has been more than net income because the depreciation is a non-monetary cost. Deferred income related to the grant (long term) has disappeared because it will be transferred to equity in lump sum in year 3. Retained earnings consist of net income earned in year 1, because no dividends are assumed. As a result, owner's equity has a negative value in cases 3 and 5. The most interesting result concerns the value of owner's equity in case 6. Due to the accounting method, the deferred income related to the grant is not allowed to transfer to equity before any conditions related to the grant have been fulfilled (IFRS for SMEs 24.4). Such liability must be recognized on the balance sheet as current or non-current depending on when conditions attached to the grant are met. The condition of the grant can be that the entity continues its production activities in the same field and location during the next 3 years.

Table 4

Project-based balance sheet (Year 2) (in thousands €)

Cases	I	II	III	IV	V	VI	VII
Cash	40	37	34.3	37	37	37	40
Fixed assets	20	20	20	20	20	10	10
Total assets	**60**	**57**	**54.3**	**57**	**57**	**47**	**50**
Deferred income related to the grant (short term)	0	0	0	10	30	0	0
Deferred income related to the grant (long term)	0	0	0	0	0	0	0
Bonds	0	30	57	30	30	30	0
Share capital	60	30	3	0	0	0	30
Retained earnings	0	-1.5	-2.85	8.5	-1.5	8.5	10
Net income	0	-1.5	-2.85	8.5	-1.5	8.5	10
Total liabilities	**60**	**57**	**54.3**	**57**	**57**	**47**	**50**

Source: author's calculations

In year 3, 6 cases out of 7 have the same value of net income as in year 1 and 2. After the conditions met, the deferred income related to the grant is recognized as income. In order to avoid misinterpretations, only the right proportion of the income is recognized in the income statement. Other part of deferred income related to the grant is transferred directly to equity (record "retained earnings").

Table 5

Project-based income statement (Year 3) (in thousands €)

Cases	**I**	**II**	**III**	**IV**	**V**	**VI**	**VII**
Sales	80	80	80	80	80	80	80
Income related to the grant	0	0	0	10	10	0	0
Costs (except depreciation)	60	60	60	60	60	60	60
Depreciation (not grant)	20	20	20	10	10	10	10
Depreciation (grant)	0	0	0	10	10	0	0
Operating profit	0	0	0	10	10	10	10
Interests	0	1.5	2.85	1.5	1.5	1.5	0
Net income	**0**	**-1.5**	**-2.85**	**8.5**	**8.5**	**8.5**	**10**

Source: author's calculations

The length of the project is 3 years. The balance sheet at the end of year 3 shows the financial position of the project in accounting sense. All fixed assets are depreciated. The amount of cash is the same in cases 1 and 7 but the performance of these cases is absolutely different. Case 7 has much better result because the same amount of money has received only by half of the investment made in case 1. In the first case, the owner has received the same amount money as the initial investment. It means that the project is in accounting break-even point (no profit, no loss). Due to the time value of money, the performance is actually negative and not acceptable. Cases 2, 4-6 have also the identical cash account although the financing structure of the latter cases is different and therefore not directly comparable. As analyzed in the theoretical part, the different accounting methods for grants do not have an effect on cash (cases 4-6). Case 3 presents the unfeasible situation due to the negative cash account. The accumulated interests are bigger than the initial amount of investment by the owner's.

All debt items (deferred income related to the grants and bonds) have disappeared from the balance sheet at the end of project (year 3). It is important to notice that quite a lot of new equity (25.5 thousand euros) has been earned without any self-financing (see cases 4-6). This means that these are the most profitable cases. In order to estimate the profitability in relative sense, different accounting ratios will be calculated and interpreted.

Different accounting based financial ratios are presented in Table 7. The value of all financial ratios is zero in case 1, because of break-even point and self-financing. For comparison, it is a good starting point for further analysis.

Table 6

Project-based balance sheet (Year 3) (in thousands €)

Cases	I	II	III	IV	V	VI	VII
Cash	60	25.5	-5.55	25.5	25.5	25.5	60
Fixed assets	0	0	0	0	0	0	0
Total assets	**60**	**25.5**	**-5.55**	**25.5**	**25.5**	**25.5**	**60**
Deferred income related to the grant (short term)	0	0	0	0	0	0	0
Deferred income related to the grant (long term)	0	0	0	0	0	0	0
Bonds	0	0	0	0	0	0	0
Share capital	60	30	3	0	0	0	30
Retained earnings	0	-3	-5.7	17	17	17	20
Net income	0	-1.5	-2.85	8.5	8.5	8.5	10
Total liabilities	**60**	**25.5**	**-5.55**	**25.5**	**25.5**	**25.5**	**60**

Source: author's calculations

Table 7

Project-based accounting ratios

Year 1	**I**	**II**	**III**	**IV**	**V**	**VI**	**VII**
PM	0.00%	-1.88%	-3.56%	10.63%	-1.88%	10.63%	12.50%
ROA	0.00%	-2.56%	-4.99%	14.53%	-2.56%	22.08%	25.00%
ROE	0.00%	-5.26%	-1900.00%	100.00%	-	100.00%	25.00%
DR	0.00%	51.28%	99.74%	85.47%	102.56%	77.92%	0.00%
DRG	0.00%	51.28%	99.74%	51.28%	51.28%	77.92%	0.00%
Year 2	**I**	**II**	**III**	**IV**	**V**	**VI**	**VII**
PM	0.00%	-1.88%	-3.56%	10.63%	-1.88%	10.63%	12.50%
ROA	0.00%	-2.63%	-5.25%	14.91%	-2.63%	18.09%	20.00%
ROE	0.00%	-5.56%	-	50.00%	-	50.00%	20.00%
DR	0.00%	52.63%	104.97%	70.18%	105.26%	63.83%	0.00%
DRG	0.00%	52.63%	104.97%	52.63%	52.63%	63.83%	0.00%
Year 3	**I**	**II**	**III**	**IV**	**V**	**VI**	**VII**
PM	0.00%	-1.88%	-3.56%	10.63%	10.63%	10.63%	12.50%
ROA	0.00%	-5.88%	51.35%	33.33%	33.33%	33.33%	16.67%
ROE	0.00%	-5.88%	-	33.33%	33.33%	33.33%	16.67%
DR	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
DRG	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%

Source: author's calculations

Returns on sales, assets and equity are negative in cases 2 and 3 due to the debt financing which result in negative net income. The high variance of the ratios is caused by big financial leverage in case 3. Debt ratio measured by accounting weights of debt and equity is close to

100%. Return on equity cannot be calculated if the owner's capital is negative (cases 3 and 5 in different years). There are two types of debt ratio presented in the article in order to gauge the effect of grant funding (a temporary debt item). When comparing the debt ratios in cases 4-5, it can be seen that the difference is quite important. DRG should be used when making financial decisions and evaluating the capital structure in essence.

ROE is the most important financial accounting ratio and therefore a basis for choosing the best financing structure. As a result, it has a highest value in cases 4 and 6. Basically, it is only the best in accounting sense somewhat misleading. In order to find the truth, different project-based financial indicators should be measured and interpreted.

As analyzed in the theoretical part, the cash flows of the project (CF1…CF3) are not influenced by different financing schemes or accounting methods (see Table 8). This is totally different results compared to the previous analysis and shows the discrepancies between project-based accounting and finance.

Table 8

The cash flows and the project based financial indicators (in thousands €)

	I	II	III	IV	V	VI	VII
IO	-60	-60	-60	-30	-30	-30	-30
CF1	20	20	20	20	20	20	20
CF2	20	20	20	20	20	20	20
CF3	20	20	20	20	20	20	20
k_d	0%	5%	5%	5%	5%	5%	0%
beta	1	2.5	571.0	2.5	2.5	2.5	1
beta modified	1	1.9	343.0	1.9	1.9	1.9	1
k_s	6.35%	15.20%	3454.85%	15.20%	15.20%	15.20%	6.35%
k_s modified			2075.45%				
V_d	0	30	57	30	30	30	0
V_e	53	20.50	0.1	20.50	20.50	20.50	53.12
WACC	6.35%	9.14%		9.14%	9.14%	9.14%	6.35%
NPV	**-6.88**	**-9.50**		**20.50**	**20.50**	**20.50**	**23.12**
IRR	**0%**	**0%**	**0%**	**45%**	**45%**	**45%**	**45%**
MIRR	**0%**	**0%**	**0%**	**26%**	**26%**	**26%**	**26%**
	I	**II**	**III**	**IV**	**V**	**VI**	**VII**
IO (owner)	-60	-30	-3	0	0	0	-30
FCFE1	20	18.5	17.15	18.5	18.5	18.5	20
FCFE2	20	18.5	17.15	18.5	18.5	18.5	20
FCFE3	20	-11.5	-12.85	-11.5	-11.5	-11.5	20
APV				**55.44**	**55.44**	**55.44**	**59.64**
IRR	**0%**	**-23%**	**550%**				**45%**

Source: author's calculations

The calculations are based on the following assumptions. The cost of debt is 5%. The risk free rate of return is 0.3%, unleveraged beta 1, market risk premium 6.05%. Modified leveraged beta is only used for high leverage case (III). The market value of equity is found by the following system of equations:

$$\begin{cases} V_E = E + \sum_{t=1}^{n} \frac{CF_t}{(1+WACC)^t} - IO \\ WACC = \frac{V_D}{V_D + V_E} k_d + \frac{V_E}{V_D + V_E} k_s \end{cases} \tag{21}$$

This simultaneous system of equations can be solved using Solver in Microsoft Excel:

1. Set objective: $V_{E\,(\text{by formula})} - V_{E\,(\text{self-chosen})}$.
2. To: value of 0.
3. By changing variable cells: self-chosen V_E .

Although there are no differences in incoming cash flows, initial outflows vary from cases to case and different financing schemes result in different required rate of return. As a result, NPVs and IRRs are dissimilar. Projects financed by EU grants have the highest NPV and IRR. The best result can be achieved by EU financing combined by self-financing (due to the risk factor). The result is somewhat intriguing because the evaluation is based on estimations (forecasted data). If the success of the project is not as good as predicted, cases 4-6 will result in better position for the owner of the project (no self-financing included).

A project success measured in relative terms (IRR and MIRR) indicates that the project can be successful only due to the positive effects from financing. APV also asserts that. It is also important to notice that IRR overestimates the rate of return if cash flows are not reinvested at the same rate. Therefore MIRR is the best estimator for such circumstances.

In conclusion, the final decision whether to accept the project or not must be based on project based financial indicator, but it is also important to understand the project based accounting and the linkages between them.

Conclusions

The linkages between project-based accounting and finance was analysed in the article. Typically, project accountants are not aware of project-based finance and vice-versa. Even the scientific articles do not provide the connecting links between these topics (disciplines). Due to the increasing amounts of EU funding for entrepreneurs in the Baltic States, it is very actual to analyse the funding recognition in the books. The can be used various methods which result in different performance indicators. Scenario analysis was used in the article to show the differences in performance indicators due to various accounting methods and financing schemes of a project. Although the accounting financial ratios were quite different, the net cash flows of a project were the same and the project-based financial indicators varied also quite a lot. The decisions must not be based on project-based accounting estimates because of bias due to accrual accounting.

The second aim of the article was to show and solve some specific problems which arise then accounting based information is used in financial management context (book value vs market value, leveraged beta with very high leverage due to public support schemes, absence of self-financing, financing side-effects). These problems were integrated to financial management context and given various solutions.

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PROJECT MANAGERS COMPETENCE IN LATVIA

Inna Neimane, University of Latvia, Latvia[1];

Žaneta Ilmete, University of Latvia, Latvia

Abstract

Competence is the most often quoted notion in business literature. It is derived from the Latin word 'competentia'. The translation is approximately 'being capable of reasoning' or 'authorized to speak', and it relates to the competence of an individual in a particular field. The purpose of this article is to study the concept of project management competence and requirements for project managers in Latvia.

Keywords: *Project Management, Project manager*

JEL code: O22

Introduction

The global need for skilled project management is raised by such organizations as the International Monetary Fund, the World Bank, and the European Parliament. The maximum total figure for expenditure for European Union (EU) for the period 2007-2013 is 862,363 million Euros. To be able to absorb the financing that is becoming available through the EU accession framework programs and ensure the funds are spent effectively and the projects accomplished successfully, the economies of the EU countries will need increasing numbers of qualified and certified PMs, familiar with the globally accepted methodologies and skills and competence in managing projects, stakeholder expectations, resources, and risks (Pulmanis et al., 2012).

Skills, knowledge and experience, as well as service quality, reliability and a more flexible approach are the key factors needed to efficiently compete on the European and world markets and to attract foreign investment. In addition to technical know-how, employees have knowledge in such areas as project management, change management and risk analysis etc.

The purpose of the article is to analyse the employment market and requirements for project managers in Latvia, on the basis of a job advertisement analysis.

The methodological basis for the article is made up of the works of foreign authors, and research carried out by the authors.

The listing of literature provides references to works of foreign authors, standards and sources of publicly available information.

Competence in project management

There are several definitions of project management competence of a person, individual, in literature.

[1] Corresponding author – e-mail address: inna.neimane@gmail.com

The International Project Management Association (IPMA) explains an individual's competence in its competence guidelines (IPMA Competence Baseline-ICB), version 3, as "a body of knowledge, personal properties, skills, and experience necessary to perform certain kind of functions successfully".

The Project Management Institute (PMI) in their project manager competence development framework document explain competence in project management as "the ability to demonstrate readiness to perform activities within the limits of project environment that lead to expect outcomes based on defined and accepted standards".

The German Project Management Association (Deutche Gesllschaft fur Projektmanagement – GPM) in its work considers competence in project management from two perspectives – "on the one hand, as a person's formal competence and rights within a certain organization, and on the other hand as a person's ability (knowledge, practice, experience) and position".

In summary of the above, we can conclude that the individual competence in project management combines a person's readiness for a certain activity on a project and his/her ability to deal with the project task within the given time and costs.

Rapid increase in the project managers' individual competence level in project management could be observed around the world over the last few years. This is witnessed by both fast growth of the numbers of professionals organizations in many countries of the world, and inclusion of the professional higher education programmes for project managers in the university curricula.

Project management study courses were included in most university master study programmes as early as at the beginning of the 90s. Those were relatively small courses, where students were introduced to the basics of project management. Professional master study programmes for project management appeared in later years, when sufficient experience and knowledge in the project management areas had been accumulated and qualified professors had been prepared. However, the work in this area was still not all that smooth. This can be seen in the results of research carried out under the supervision of professor R.Gareis (Ilmete et al., 2012).

Authors' research on project managers' requirements in Latvia

The authors analysed 80 project manager job analysis from the State Employment Agency database and the project managers vacancies located in internet databases.

Overall assessment of the action spectrum which may be taken and imposed by the potential supervisor candidates with all the requirements groups it into four areas of responsibility. They are:

- professional competence,
- methodological competence,
- social competence,
- personal competence.

Professional competence includes the demand for higher education, specific technical knowledge in the area of operation. Figure 1 shows requirements of project managers education in project management field.

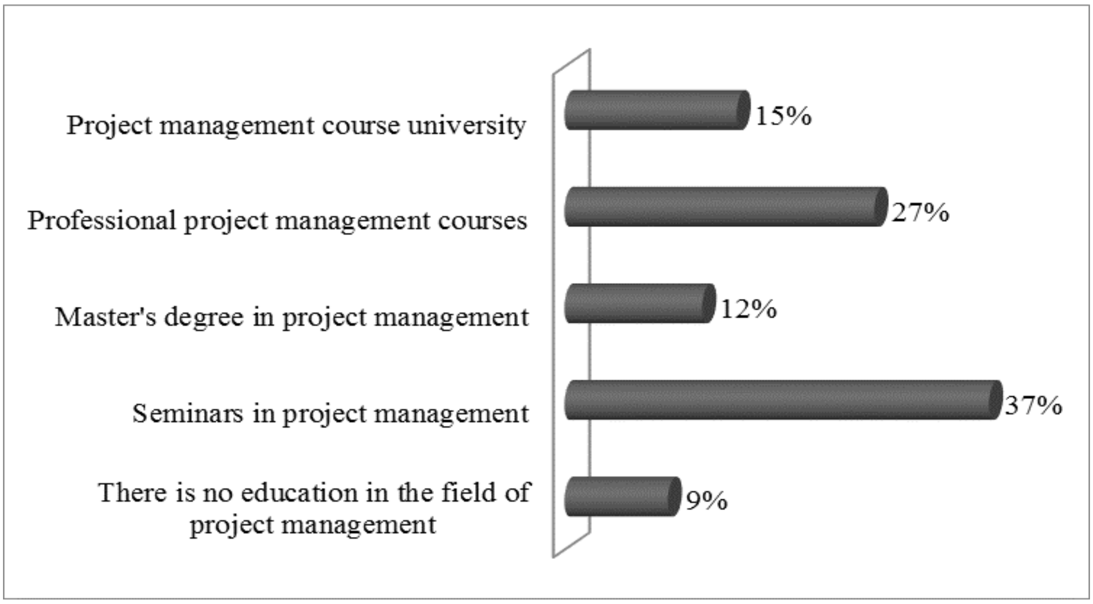

Fig. 1. **Project managers education in project management field (n=80)**

Also were required practical work experience in project management or similar area without the constraints in any field. Figure 2 shows project managers required experience.

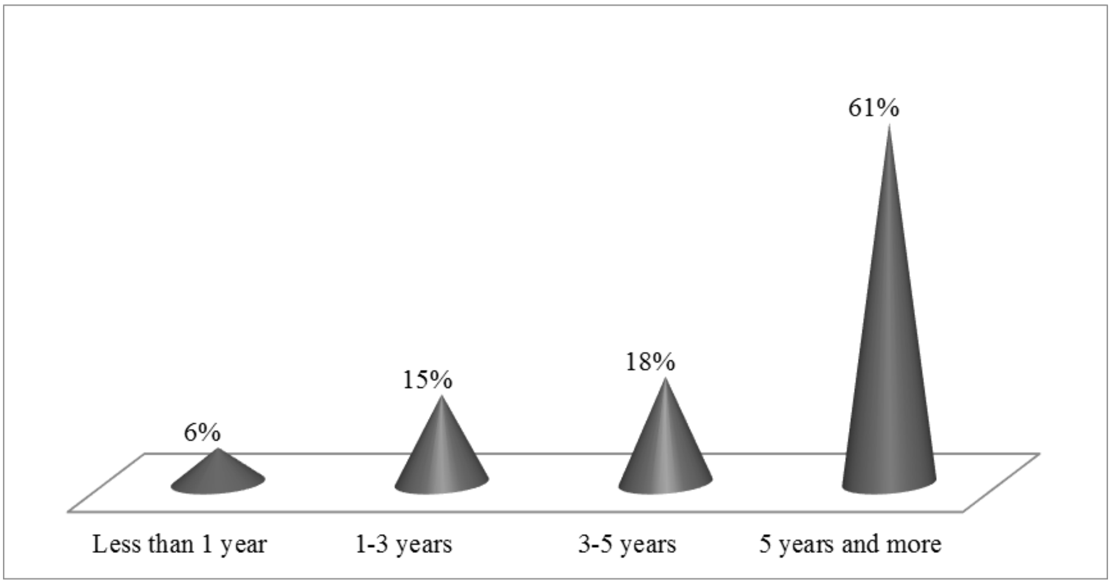

Fig. 2. **Project managers required experience (n=80)**

Methodological competence requires that the supervisor must have theoretical knowledge of project management planning, monitoring and targeting methods, techniques and tools, as well as the ability to apply them in practice. Social competence means good communication skills, ability to delegate tasks and skilled management of staff. In the present circumstances, no one can do without stress and conflict. They must be able to skilfully avoid these, as well as to motivate project staff to achieve common goals and ensure good coordination. Personality competence includes the project manager's personal qualities and ability to make decisions and develop initiative, positive attitude towards teamwork. In the analysis of project managers vacancies, the authors have summarized the demand for project managers by market sectors. See Figure 3.

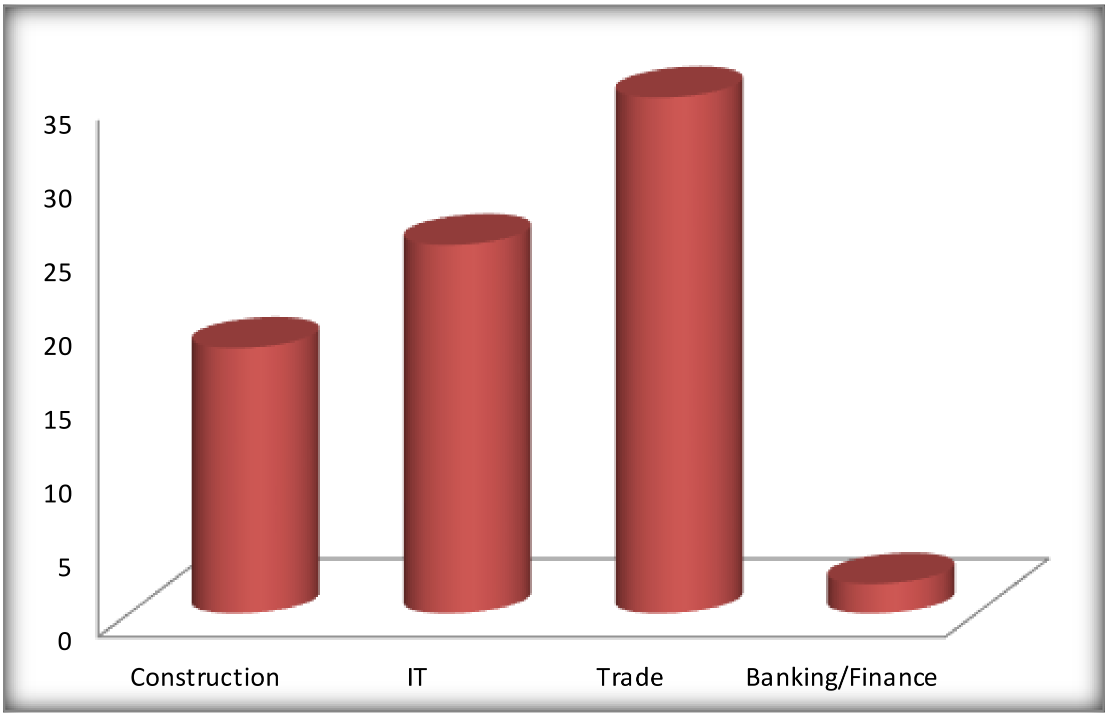

Fig. 3. **Management fields of requested PMs (n=80)**

The authors' research shows that 28% of all requested project managers are in the trade field, 23% of PMs are requested in the IT field 20% and 14.4% in the construction field. Research shows that project managers are requested also in banking field (1.6%).

Analysis of the requirements for project managers dramatically shows the situation in the project manager selection process. Most of the requirements (included in the job advertisement) are not adequate for the project manager profession and professional requirements stated in the Latvian project manager standard. Only 15% of PM job vacancies include the adequate project managers requirements(Figure 4). According to the project manager vacancy advertisements and requirement for project managers analysis, organisations are mainly looking for product and service vendors and client managers.

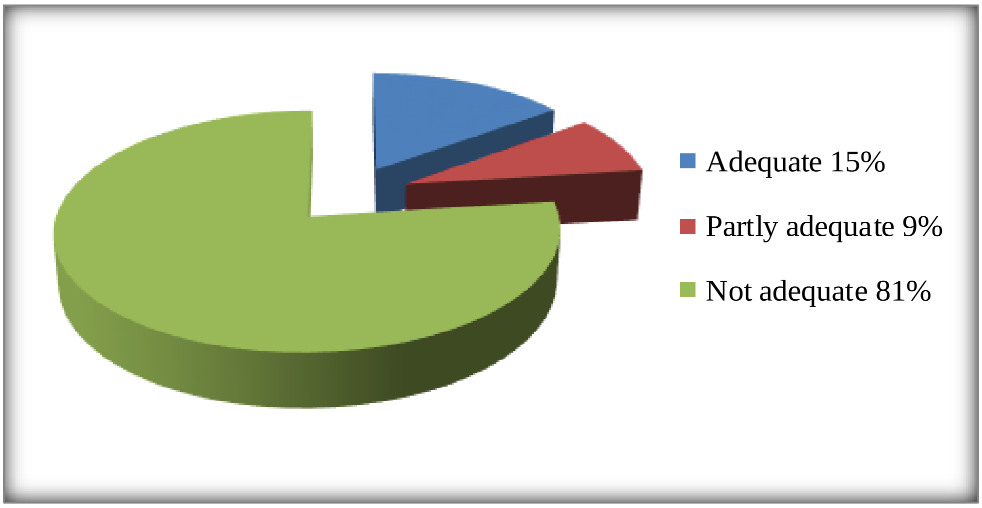

Fig. 4. **Project manager requirement analysis (n=80)**

Conclusion

Job advertisements are the main source of information for personnel search and selection for both the employer and employee. In order to avoid disputes between employers and workers, it should be considered what position requirements to include in a job advertisement. Unfortunately only some of project managers job advertisements include the adequate project managers requirements.

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DIGITAL BUSINESS ECOSYSTEM DEVELOPMENT FOR M2M PROJECTS

Ala Nuseibah, University of Applied Sciences and Arts, Palestine;

Carsten Wolff, University of Applied Sciences and Arts, Germany[1]

Abstract

Digital Business Ecosystems (DBE) are a holistic approach for the design of IT-based business models (Nashira, Nicolai, Dini, Lauam, & Leon, 2010). The idea is to provide not only a technical solution for a certain application but a comprehensive business model for all involved players and a change concept for the socio-economic environment. The IT view on such a DBE can be described as an information supply chain (Sun & Yen, 2005). Accordingly, the business view is based on the respective value chain. For Machine-2-Machine (M2M) scenarios, this approach is used to manage the joint development and operation of a specific industrial solution with various partners. Both the development and the operation of a DBE for a M2M solution are executed within an IT project and have to be managed accordingly. This paper derives requirements and concepts for a structured DBE development approach for the M2M domain.

Key words: *Digital Business Ecosystem (DBE), Machine-2-Machine Communication, Information Supply Chain, IT Projects*

JEL code: M150

1. Digital Business Ecosystems

The understanding and modeling of complex IT based solutions as a digital business ecosystem (DBE) became popular (and obvious) when Apple managed to create such ecosystems for their products. It became clear that it isn't sufficient to provide a certain IT product to create a commercial success (Basole & Karla, 2011). Smartphones have been developed long before Apple's iPhone. Nevertheless, they were not successful in the market. Apple's approach with a well-balanced offer including the smartphone but also tariff models, App-Store, iTunes etc., convinced customers to buy the products and to subscribe to the Apple ecosystem. The holistic approach combining the technical solutions with sound business models and a change strategy for the customer behavior was one key to this success. Today, various players in the IT arena try to repeat this market success by creating digital business ecosystems for their particular domain.

The approach looks promising for the Internet of Things (IoT), too (CERP-IoT, 2010) (CERP-IoT, 2011) (Kortuem & Kawsar, 2010) (Finnish Strategic Centre for Science, Technology and Innovation, 2011). Especially for the industrial part of the IoT applications a framework for the holistic IT solution development is crucial. This arena is currently driven by the Machine-2-Machine communication approach (Harbor Research, 2010). Meaning, it is not

[1] Corresponding author – e-mail address: carsten.wolff@fh-dortmund.de

targeting consumers but industrial or commercial customers. In many cases, the business ecosystems in this domain consist of various players (e.g. SMEs, machinery providers, service companies) forming a value chain. Furthermore, IT may not be the main focus of these players. To form an information supply chain for their respective information production and demand and to combine this with a value chain containing a valid business model for each of them is a major challenge for project management (Internet of Things Architecture (IoT-A), 2010-2013) (Sun & Yen, 2005).

2. Synchronize Technical Development, Business Development and Change

Digital Business Ecosystems (DBE) are a valid and holistic approach to organize, facilitate and orchestrate the Internet of Things solutions in the industrial M2M domain. Therefore, it is necessary to analyze the socio-economic environment around such DBE development projects. The analysis should cover questions about the players in the environment, their role, contribution and maturity level, the relationship between them, and the consequent flow of information.

2.1. Business Models

For this purpose, in this section, we present the Organizational Development Canvas (ODC) and an analysis of the M2M value chain and environment.

The Organizational Development Canvas is adapted from The Business Model Canvas and licensed under the Creative Commons Attribution to include environment analysis. (King, 2013) (Osterwalder, 2004)

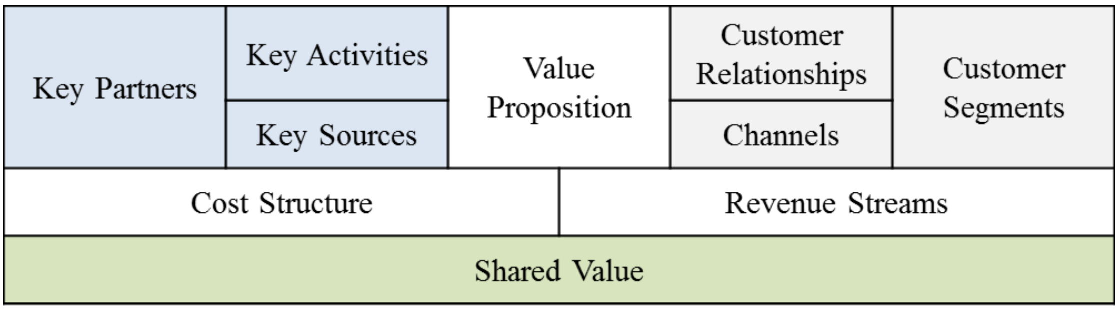

Fig. 1. **Organizational Development Canvas** (modified) (adapted from The Business Model Canvas and licensed under the Creative Commons Attribution) (King, 2013) (Osterwalder, 2004)

The building blocks of the Organizational Development Canvas (also, building blocks of the Business Model Canvas, in additional to the block "Shared Value") are:

1. Key Partners are the strategic and cooperative partnerships formed to increase the scalability and efficiency of the business, which in the case of a DBE include value chain members such as software and hardware providers, connectivity service providers, etc.

2. Key Activities are the core activities in which a company engages to establish a presence in the market, which differs depending on the type of company and its core business.
3. Key Resources are the assets and knowledge possessed by a company that allow it to deliver its value to customers in ways that other companies can't. Such differentiation might stem from strategic partnerships among DBE players, or exclusive licencing rights, etc.
4. Value Proposition is the unique value that a company's product or service creates for customers. A DBE offers much value to its customers (as well as its players) summarised in the ability to provide low-cost software development, resulting in a more inclusive and efficient market competition and a wider variety of quality products and services.
5. Customer Relationships: how a company plans to build relationships with the customers it is serving. The strategies relevant in this case are those related to B2B customer relationship management. Apart from that, traditional marketing strategies, such as advertising or user experience will not serve the needed purpose, since the "users" of M2M solutions are partly machines.
6. Customer Channels: channels used by DBEs, M2M value chain members or M2M E2E solutions to acquire, retain and continuously develop its customers.
7. Customer Segments: group(s) of customers that DBEs and M2M value chain members target with products, services or even complete M2M solution.
8. Cost Structure: the costs associated with each of the above elements and which components can be leveraged to reduce costs.
9. Revenue Streams: How DBEs or M2M value chain members pull all of the above elements together to create multiple revenue streams and generate continuous cash-flow. (Lumos Business Solutions Inc., 2013)
10. Shared Value is what promotes this canvas from a simple business model to a business ecosystem analysis tool. Given that a business ecosystem presents elements and their interconnections, it can be view as a cause-and-effect model, making it necessary to include the goals or impacts of a business ecosystem on its surroundings. The elements of Shared Value are the costs and revenues (previously presented). Ideally, the goal of any ecosystem is to minimize costs, maximize revenues and optimize value. (King, 2013)

Additionally, an appropriate business model specific for the management of Digital Business Ecosystems should ideally include a neutral intermediary in the value chain, offer flexible products and service that cover different types of customers and customer needs, support decentralized management and organization and user-driven process and content. (Hoyer & Stanoveska-Slabeva, 2009)

2.2. M2M Value Chain and Environment Analysis

In order to find the appropriate business model for managing M2M-technology based projects, it is essential to understand and analyse the M2M value chain, the environment and stakeholders revolving around this value chain and the role of each player involved.

Through the analysis of several value chain examples from leading companies in M2M solutions, such as Vodafone (Vodafone, 2013), Deutsche Telekom (Deutsche Telekom, 2013), Telit (Telit Wireless Solutions, 2013), Wyless (Wyless, 2013), etc., the most important components of an M2M value chain become obvious. Although the different value chains differ in size, labels, needs and core businesses, their integration provides the components:

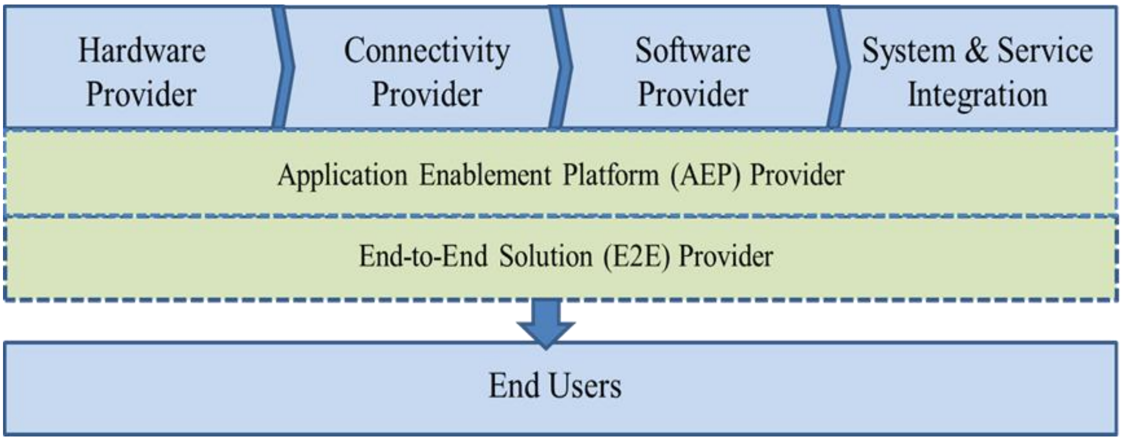

Fig. 2. **M2M Comprehensive Value Chain**

a. Hardware Providers: Device and module manufacturers produce and sell M2M devices, with built-in modules that enable connectivity, allowing machines, equipment, vehicles and devices to communicate over a network. The challenge is to provide devices that incorporate and cover the wide range of needs for M2M communication such as physical robustness, communication and network security and wired or wireless services. Hardware providers' role extends to include providing Machine Identification Modules (resembling a SIM card, MIMs identify machines, equipment and devices in the Internet of Things), module management services and sometimes subscription management services. They also work to customize hardware to the needs of the customer application. (Telit, m2mAir, 2013) (Telecompaper, 2008) (ITR Manager, 2008)

b. Connectivity Service Providers (CSPs): Mobile Network Operators (MNOs) and Mobile Virtual Network Operators (MVNOs) have taken the lead in trying to organize and rationalize the value chain to facilitate and simplify overall M2M development/deployment. Due to this, M2M connectivity providers' role has been extended much further than mere connectivity. MNOs and MVNOs benefit significantly from the fact that they already own the existing technology needed for providing M2M services.
CSPs offer SIM cards, M2M rates and billing services, quality, testing and IT security and finally, service level agreements (SLAs). They may contribute in, have partnership with or completely take over the role of the Application Enablement Platform (AEP) provider. (Viswanathan, 2012) (ABI Research, 2012) (Telco 2.0. Research, 2011) (Deutsche Telekom, 2013) (Vadafone, 2013)

c. Software Providers: There are currently two main methods in the M2M market for software development:

   1. An Application Service Provider (ASP) designing M2M applications and customizing them for customers. It also offers a complete M2M platform and deals with different customers to enable M2M functionality as they require.
   2. Due to the fact that the technical details and network infrastructure deployed by CSPs directly impacts the capabilities of an ASP in such areas as rapid service creation, ensuring Quality of Service, and enabling granular management and diagnostic tools, a tight collaboration between CSPs and ASPs is needed. It might either be done through a partnership or CSPs incorporating software development in their business units. (ABI Research, 2010)
      Regardless of the method used, the trend by both software providers and connectivity providers is to offer Software Development Kits (SDKs) and Development Platforms to everyone who wants to take a look or try to develop M2M applications and participate in the community. These kits include SIM card(s) with test duration, specific volume allowance, defined storage and defined network coverage, also possibly a module. (Developer Garden, 2013)

d. System & Service Integration: System integrators and providers of additional integrated services for M2M solutions are also important members of the M2M value chain, even if their roles overlap with some of the members already discussed.
   System Integrators and external service providers deliver value to companies by enhancing business processes and integrating machine data into the enterprise. This is important because M2M projects are very large and complex in scope. Additionally, professional consulting and integration services, Big Data & Analytics tools and billing and payment services would be needed to complete an M2M solution. (Zujewski, 2013) (Yaacobi, 2013) (Vadofone, 2013) (Deutsche Telekom, 2013)

e. End Users: End users of M2M solutions can be businesses or individuals, taking different business models of B2B, B2B2C and B2C and ranging between the different M2M service sectors. M2M implementation should ultimately provide end users with differentiation for their products or services. It should not only help them reduce costs, but give them the ability to transform their business and reinvent the user experience of their own customers. (Zujewski, 2013)

<u>Value Chain Members originating from New M2M-specific Business Models</u>

f. M2M Application Enablement Platform (AEP) Providers

M2M Enablement Platforms are “software systems designed to streamline M2M applications development across multiple verticals” (Dawson, 2012). A unified and holistic M2M Enablement Platform can help companies better monetize M2M through:

1. Transforming them into a one-stop shop for their M2M partners, with the flexibility to provide each partner with exactly what they need, from simple IP connectivity to more complex partner and device management.
2. Creating a richer network of ecosystem partners and delivering a superior experience to the end customer.

3. Accelerating time to market and M2M development with pre-integrated hardware, embedded application frameworks, network operators, and cloud applications and without any on-premise IT infrastructure. (Yaacobi, 2013)
   M2M Enablement Platform enables users to set the management rules for their M2M platform, allows for terminal management, remote automation, notification and user-defined fault handling strategy, includes tools for users' subscription management and administrational operational management and finally uses data captured from devices to perform real-time analysis, generating reports and providing insights that can help optimise business management to eliminate extraneous costs and increase revenue. (SingTel Corporation, 2013) (Datang Coproration, 2013)

g. End-to-End Solutions

   M2M solutions require consideration of the entire process chain, from the connection of devices to the integration into the IT infrastructure. For this purpose, it is necessary to understand the business processes, to take into account all the requirements and to choose the right components requiring the participation of several companies for a complete end-to-end solution. A single company usually offers services around its core business, and then works with partners for an integrated result. (SyroCon Consulting, 2013)
   A complete end-to-end M2M solution includes offering M2M modules with device management software, M2M connectivity, M2M data analysis and management, M2M applications, M2M integration framework and added services such as subscription and billing management. (Axeda Corporation, 2013)

2.3. M2M Ecosystem Environment

In addition to the elements of the M2M value chain, there are a few other players in the ecosystem who do not have a direct input in the creation of value from M2M solutions, but do aid in the success of the entire ecosystem:

1. Government and Regulatory Bodies: Local government and political unions can have an immense impact on the development and adoption of M2M Solutions. There are already a number of governments and regulatory bodies around the world which are enacting regulations mandating functionalities enabled by M2M, telematics and telemetry. Although these mandates do not require a specific technology to be used, M2M is often seen as a viable way of enabling the functionalities mandated (ABI Research, 2010). The role of such regulatory bodies is essential in solving issues such as numbering, identification codes, roaming rules, open source application development, etc. (Robinson, 2013) (European Commission, 2013)
2. Universities and Innovation and Research Centres: M2M projects can be found in a vast number of fields: architecture, construction, engineering, communications, cellular, medical and environmental (European Commission, 2013). Many efforts have been put to involve universities, professors and students and benefit from their young minds and innovative ideas. Many universities have put an effort into creating

in-house research labs specifically for M2M. Research centres and organisations, with the constant reports and forecasts; have helped understand the M2M technology, its feasibility and future outlook by offering advisory and custom reports, with forecasts of the M2M market opportunities and the qualitative issues shaping the market. (Machina Research, 2013) (Beecham Research, 2013)

3. Companies whose core business falls within M2M service sectors: M2M applications extend among a wide range of service sectors, from retails to energy to healthcare, etc. In order to create successful M2M solutions that precisely fulfil customer requirements, it is crucial to involve companies from all these sectors when developing solutions.
4. Manufactures of Machinery and Appliances: Manufactures of factory machinery, cars, and home appliances, for example, should have an understanding of the potential of M2M Solutions and already embed the needed features in their products. On the other hand, if M2M Solution Providers do not communicate with these manufactures, they would not be able to fulfil need requirements for connectivity and module management.

3. Requirements for the development of Digital Business Ecosystems for M2M

A proper project management approach has to run the technical engineering, the business development and the change of the socio-economic environment in parallel. It has to synchronize these three streams of project management to contribute to a holistic solution. IT project management provides tools and methods for all three project facets. Nevertheless, the cross domain character of such DBE development projects requires an integrated approach. This would be the basis for a requirements analysis and will help to outline a project management process and a development process for DBEs in the M2M arena.

The implementation of an M2M solution can be regarded as an IT Project, which entails change along organizational tools, methods and business processes. In order for this change to be successful, it is important to consider the effect on people, including both organisational staff and customers.

Therefore, it makes sense to derive the particular M2M project management process through analyzing and aligning processes such as IT Project Management (according to PMBOK) (Project Management Institute (PMI), 2009), Business Process Re-engineering (approach is based on the analysis of the BPR approaches of Underdown and Timothy) (Underdown, 1999) (Timothy, 1993) and Change Management (approach is based on the analysis of PMBOK, Mintzberg, Kotter) (Project Management Institute (PMI), 2009) (Mintzberg, 1998) (Kotter, 1995).

Table 1

Alignment of IT Project Management, Business Process Re-engineering and Change Management Processes

	Initiation	**Planning**	**Execution & Go-Live**	**Project Closure & Operations**
IT PM	• Project Preparation • Project Charter • Business Case	• Project Design • Business Requirement Specification • Service Level Specification • Project Plan (including budget & schedule)	• Project Implementation • Pilot Testing • System integration • Launch & Go-Live	• Documentation • Lessons learnt • Project product in use • SLA in operation
BPR	• Strategic purpose • BPR justification	• Map & analyze As-Is and To-Be processes	• To-Be process execution • Pilot Testing • Validation • Launch	• Feedback • Continuous Improvement
CM	• Need • Concept • Analysis	• Change Preparation & planning • Communicating change	• Execution • Team & End-user Training • Change Stabilization	• Lessons learnt • Continuous improvement

The synthesis of the above table and the M2M value chain (presented in Section 2) allows for further development of M2M-specific project management approach. By aligning, integrating and selecting the appropriate process steps from the above table that are relevant for M2M project management, a four-step approach can be derived, composed of Project Initiation, Project Planning, M2M Solution Execution and Go-Live and finally Project Closure and M2M Solution Operation. However, due to its particular nature, some M2M-specific process steps should be included or emphasized, such as the creation and operation of Service Level Agreements (SLAs), M2M Partner Contracts and Partner Management, M2M Platform creation and management, etc. The result is a process map specific for M2M Project Management:

1. Project Initiation	2. Project Planning	3. M2M Solution Execution & Go-Live	4. Project Closure & M2M Solution Operation
• Business need • M2M concept • Change concept	• Analysis of As-Is Process • Map To-Be Business Process after M2M Solution • Communicating Change • Partner selection for M2M Solution	• Platform & Coding realization • Integration Testing • Platform & Partner Compatibility Testing • Pilot Implementation & Testing • User Acceptance Testing • Launch M2M Solution • Team & End-User Training	• Document project & results • Continuous Improvement • M2M Solution in use
❑ M2M Project Charter ❑ Business Case	❑ M2M Solution Process Map ❑ Project Plan ❑ Outsourcing/ Partner Contracts	❑ Testing Results ❑ Change requests ❑ Training Manual ❑ Execution Report	❑ Project Documentation ❑ Lessons Learnt ❑ SLA ❑ M2M Solution Documentation

• Action/Process step ❑ Document

Fig. 3. **M2M Project Management Process Map**

The process map provided is simple and can provide orientation for the understanding of M2M requirements and for the deployment of any M2M solution, in general. However, many complications and challenges arise during the actual deployment of M2M Solutions. These challenges are discussed in the next section.

4. Results and Conclusion

In the previous sections, the concept of Digital Business Ecosystems and Machine-to-Machine Technology were presented along with an analysis method for the relevant business model and business environment. An understanding of the M2M value chain and extended environment, along with an analysis of relevant concepts such as IT project management, business process re-engineering and change management all lead to a better grasp on the process of M2M project management.

However, the methodology, implementation and results of any M2M project differ depending on many considerations, such as type of project, the sector in which it is implemented, the major players in the project and the different aspects of the project players.

Moreover, M2M project management still presents a lot of challenges and open questions to DBEs. In the following list, some of these challenges and considerations are presented.

Table 2

Further challenges and considerations in the M2M arena

Phase	Challenge / Consideration
M2M Project Initiation	1. *What kind of project is needed? How to integrate project management and business process reengineering?* 2. *Who are the project initiators and the major players?* 3. *How much customization does the suggested project need, from the M2M project management process map?* 4. *What is the most appropriate business model for the particular project?* 5. *What is the scope of the project? Consequently, how much change will be implemented? What is the size of this change (company-wide, city-wide, country-wide)?* 6. *Are there any other parties involved that may aid in M2M project management (governmental bodies, research centers, etc.)? What is their role?*
M2M Project Planning	Depending on the business model used to deploy the M2M Solution: 1. *Who are the business partners?* 2. *What type of contractual commitment binds them together?* 3. *How much of the M2M solution will be built-in and how much would be outsourced?* 4. *Do the partners form a complete M2M End-to-End Solution together to offer to customers?* 5. *What is the extent of the SLA capabilities and commitments?* 6. *How to choose the appropriate M2M Platform that fits the needed services and is compatible with the connectivity service provider's systems?*
M2M Solution Execution & Go-Live	1. *How to get the M2M solution up & running?* 2. *What project execution model (e.g. Agile, e.g. V-Model) will be used? What is best for the project?* 3. *How to integrate the M2M platform, with the selected hardware, software and connectivity?* 4. *What type of additional services are needed (for testing, integration, etc.)? Can they be performed by the business partners or do they need to be outsourced?* 5. *What type of training is the most appropriate for staff members and for end-users?*
Project Closure & M2M Solution Operation	1. *How to use the project experience to further implement M2M solutions?* 2. *How to hand over the resulting solution to IT maintenance and operations?* 3. *What kind of improvements are needed?* 4. *How to implement continuous improvement in the M2M arena?* 5. *Are the SLAs fulfilling the need?*

The challenges connected to M2M project management are an interesting starting point for further research in the field. As long as these questions are open, M2M solutions will remain a challenge to most companies. Therefore, there is a need for further research and case studies to use as a point of comparison, in order to lay-out the path towards successful M2M project implementation and a more sophisticated approach towards Digital Business Ecosystems.

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DO CLIENTS REALLY KNOW WHAT THEY WANT ABOUT BIM? CLARIFYING BIM SPECIFICATIONS IN TENDERING

Yi Peng, The University of Hong Kong, Hong Kong[1];

Weisheng Lu, The University of Hong Kong, Hong Kong

Abstract

Building information modeling (BIM) is believed to provide a good communication platform for early involvement of various stakeholders. Therefore, it is widely advocated in both academic and industry. Gradually, BIM has been required by the client in the tendering. However the BIM would be useless and costly if the client could not clearly specify the requirements in the tendering document. Herein, it is quite important to investigate whether BIM specifications in the tendering document are clear and concrete. However, it was quite difficult to get such contracts through public and free means. Yet, it was found that some standards or guidelines issued by relevant institutions are mentioned in tendering. Therefore, this study converts the comparison of tendering documents of BIM into comparison of relevant BIM standards and guidelines. Common items as well as the differences of the BIM standards/guidelines in five countries/areas were investigated. Based on the results, this study further provides a list of BIM specifications used by the keen clients for tendering.

Key words: *Building information modeling (BIM), specification, content analysis, project management*

JEL code: Z00

Introduction

Recent years have seen burgeoning research agenda on building information modeling (BIM) in the architecture, engineering, and construction (AEC) industry. Despite a wide range of BIM definitions, certain consensus is reached that BIM is not a simple three-dimensional (3D) model, but a process to improve the performance through the whole life cycle of buildings. Based on these understandings, BIM can be used for a wide range of purposes, e.g., design and construction integration, project management, and facilities management (Azhar et al. 2008; Bazjanac 2008; Schlueter and Thesseling 2009). Building information modeling is argued to be a useful tool for reducing the construction industry's fragmentation, improving its efficiency/effectiveness, and lowering the high costs of inadequate interoperability (Succar 2009). Building information modeling is also recognized as a virtual design and construction (VDC) environment, a vehicle facilitating communications amongst stakeholders, an information model that can be used throughout the project life cycle, a learning tool for the stakeholders to improve productivity, or an education platform that can be used in universities or colleges (Lu and Li 2011; Lu et al., 2013). It is changing the traditional AEC practices in a broad sense in terms of people, processes, working culture, communication, and business models. Some even advocate that

[1] Corresponding author – e-mail address: pengyihz@gmail.com, telephone: +852 2219 4379

the traditional AEC practices are facing a paradigm shift with the application of BIM (Lu and Li 2011).

BIM is promoted in the construction worldwide due to its inherent merits. A number of studies have been conducted to demonstrate the benefits of BIM brought to organizational project management in the construction industry. Kaner et al. (2008) revealed clear improvement in engineering design quality, in terms of error-free drawings, and a steadily increasing improvement in labor productivity by applying BIM to four detailed case studies. Sacks et al. (2005) found that the potential benefit of adopting BIM is estimated to be in the range of 2.3-4.2% of total project cost for precast concrete companies. Sacks and Barak (2008) reported that BIM helps gain an increase of productivity ranging from 15-41% for cast-in-place reinforced-concrete structures in the drawing phase. Patrick and Raja (2007) conducted a questionnaire survey and found that quality, on-time completion, and units per staff-hour were ranked as the highest benefits from BIM. Comparing it with traditional methods, Azhar et al. (2008) stated that a case project with BIM in place has helped save an estimated $600,000 in extras and avoid months of potential delays. On the basis of 32 major projects using BIM, Stanford University Center for Integrated Facilities Engineering (CIFE) (CIFE 2007) logged several benefits contributed by BIM, such as up to 40% elimination of unbudgeted change, cost-estimation accuracy within 3%, up to 80% reduction in time taken to generate a cost estimate, savings of up to 10% of the contract value, and up to 7% reduction in project time.

The wide application of BIM in the construction industry also encounters some barriers from the traditional project-based organizations (PBO) structures, although BIM is widely promoted. The implementation of BIM in PBOs can be seen as a spectrum, on the one end of which is null BIM adoption (Mode 0), while on the other end is a seamless integration between BIM and integrated project delivery (IPD) (Mode N). Falling within the spectrum are various BIM implementation modes. To take Hong Kong as an example, one-off private clients mainly rely on BIM consultancy. Long-standing private clients such as real estate developers in Hong Kong normally set up in-house BIM centers and require major parties in the PBOs to stay and co-produce the BIM model (Mode 1). Government clients such as the HKHA and the Mass Transit Railway Corporation (MTRC) in Hong Kong have also set up in-house BIM centers. The HKHA tenders out BIM development, while the in-house team supervises the development (Mode 2). MTRC develops BIM in-house (Mode 3). From the supply side, the ideal way to realize the benefits of BIM is for architects and engineers to incorporate BIM directly in their design, and then for this BIM model to be used and enhanced throughout the project's lifecycle; this is called holistic BIM (Mode 4). However, in reality, only a few designers and contractors have the capability to adopt BIM directly, and the majority tend to buy in BIM consultancy. At times designers may hire a consultant to develop a BIM model based on their drawings (Mode 5), while the BIM model may or may not be inherited and re-interpreted by the contractors, who in turn will hire their own BIM consultants to create BIM models for construction use (Mode 6). These two modes obviously undermine BIM's capacity to reduce fragmentation and discontinuity. There are rumors from the industry that project teams may just hire a BIM technician to draw a BIM model to satisfy the government's BIM mandatory requirement without really using the model to exploit its benefits (Mode 7). Government clients often see IPD as a "utopia"; for fairness and transparency, they have to tender out their works and so DBB seems unavoidable. The HKHA thus suggests a “thinner” version of IPD, whereby an extra unit is set up in the PBO to supplement all the required knowledge for BIM, construction, and facilitates management (Mode 8). These modes are by no means exhaustive.

Tendering of BIM is therefore unavoidable where and when IPD is not realized such as in Hong Kong right now. This means the clients should clearly specify the requirements of BIM in the tendering documents, otherwise the developed BIM cannot be appropriately used in organizational project management at the stage of construction and facilities management. However, few studies have been conducted to investigate whether the clients know what they want about BIM. In order to fill this research gap, this study aims to find whether the clients know what they want about BIM through investigating the tendering documents about BIM in in various areas such as Hong Kong, Singapore, USA and Europe. A list of BIM specifications would be developed based on the results. The following sections would introduce the involved research methods, further present the findings and finally concludes this study with practical suggestions on the relevant research.

Research Methods

In order to find the real concerns about BIM, the contracts with BIM should be investigated. Efforts have been spent to collect the contracts specifying the requirements on BIM in various areas such as Hong Kong, Singapore and Europe. However, it was quite difficult to get such contracts through public and free means. Yet, it was found that some standards or guidelines issued by relevant institutions are mentioned in tendering. Therefore, this study converts the comparison of tendering documents of BIM into comparison of relevant BIM standards and guidelines.

The specific research process was illustrated in Figure 1. There are mainly five steps in this research. First, a comparison framework should be developed based on the logical analysis of existing research. This is also a trial process and more comparison themes can be included during conducting content analysis of the collected standards and guidelines.

Second, web search would be conducted to find the publicly issued BIM standards/guidelines through the key words “BIM and standard” and “BIM guideline”. Those standards/guidelines without free access would be abandoned although their link can be found online. Third, content analysis would be adopted to investigate the important items under the five themes. Other important themes would be put forward through examining the table of contents of relevant documents if necessary. After that, comparison would be used to first check whether the publicly issued BIM standards/guidelines involve the five themes and further find the differences. Figures or tables would be used to present the comparison results. Finally, a list of BIM specifications would be developed based on the comparison results. The following section would present the findings by following the research process.

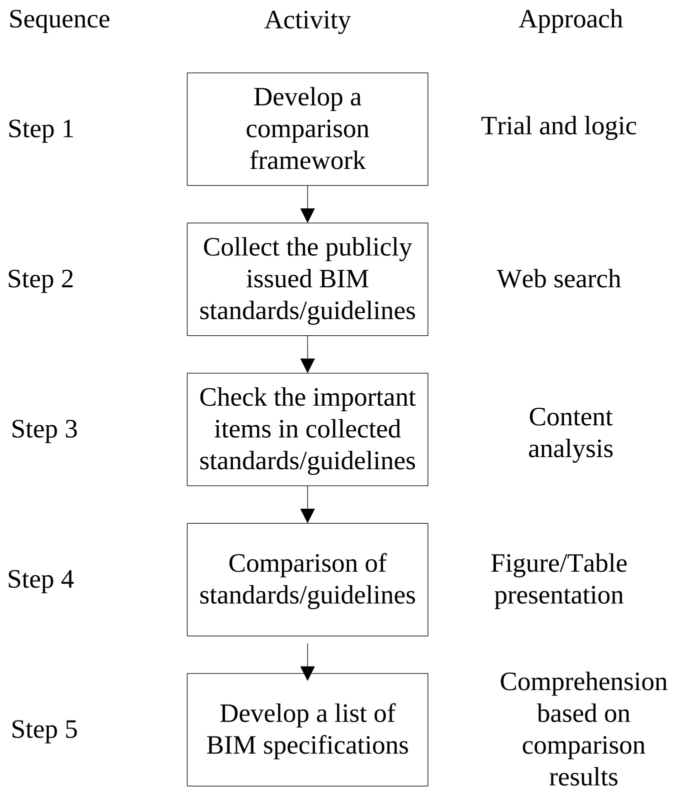

Fig. 1. **Research process of this study**

Findings

Through web search, the publicly issued BIM standards/guidelines can be found as shown in Table 1. According to the survey of BIM standards and guidelines conducted by the American Institute of Architects (AIA), there are about seventy types of relevant BIM standards or guidelines worldwide. However, the authors can only successfully access these standards/guidelines as shown in Table 1. These guidelines in the five countries/areas still have some representative implications in geography, although not all standards/guidelines are included. The following section would further compare these standards/guidelines and present the common issues and differences.

Content analysis was conducted to find the important items in the standards/guidelines. To simplify the procedures of content analysis, the title of respective chapters was checked to find the important items in the standards/guidelines. These items are also the developed comparison framework. The relevant subheadings in respective chapters were collected to deepen the understanding of the identified items. Information under the subheading can also be checked for detailed comparison. However, limited by the time, the comparison in this study mainly focused on the important items in the standards/guidelines rather than the detailed requirements.

Table 1

A non-exhaustive list of publicly available BIM standards/guidelines

Country/area	Organization	Title	Version&Date	Reference/Link
Hong Kong	Hong Kong Institute of Building Information Modeling (HKIBIM)	BIM Project Specification	V 3, 2011	HKIBIM, 2011
Singapore	Building and Construction Authority (BCA)	Singapore BIM Guide	V 2, 2013	BCA, 2013
UK	AEC (UK) Initiative (AECUKI)	AEC (UK) BIM Protocol	V 2, 2012	AECUKI, 2012
Norway	Statsbygg	Statsbygg Building Information Modelling Manual	V 1.2, 2011	Statsbygg,2011
Canada	AEC (CAN) Committee (AECCANC)	AEC (CAN) BIM Protocol	V 1, 2012	AECCANC,2012

Common issues can be found that all standards/guidelines have an introduction part, which defines BIM and specify the objective and main contents of the documents. BIM execution plan is an important part before starting the BIM project, which documents the agreed BIM deliverables and processes for the project. However, the guidelines of Hong Kong and Norway do not involve this important item. Through examining the BIM execution plans in Singapore, UK and Canada, it can be found that this part should clearly define the following issues: project information; BIM goal & uses; each project member's roles, staffing and competency; BIM process and strategy; BIM exchange protocol and submittal format; BIM data requirement; collaboration procedures and method to handle shared Models; quality control; and technology infrastructure & software for this project. For the roles involved in the BIM project, the objectives & responsibility matrix mentioned in HKIBIM (2011) and BCA (2013) is a useful tool for the BIM project manager to conduct work.

In addition, all standards/guidelines specify the BIM deliverables and relevant requirements, although different contents are involved in the documents. However, by combing these issues, a comprehensive list of BIM model specifications can be obtained as follows:

- Model data & level of detail;
- BIM model basics;
- Presentation styles;
- Naming system;
- BIM methodologies & processes;
- BIM deliverables;
- Hardware specifications;
- Software specifications.

Check list is useful for the client to systematically and clearly present what they want in the contract or tendering document. However, only the BIM guidelines in Norway (Statsbygg, 2011) provides such a template in the appendix. Efforts can be spent to develop such a template for promoting the application of the relevant guidelines. The results of the comparison can be further illustrated in Table 2.

Table 2

Comparison of involved BIM standards/guidelines

Item	Hong Kong	Singapore	UK	Norway	Canada
Introduction	Included	Included	Included	Included	Included
BIM execution plan	Not included	Included	Included	Not included	Included
BIM Model specifications	Included	Included	Included	Included	Included
Check list	Not included	Not included	Not included	Included	Not included

Note: "included" implies that the standards/guidelines have such item while "not included" do not have

Based on the identified common issues and differences in the five BIM standards/guidelines, a check list of the important items to specify the concern of the client can be delivered as shown in Table 3.

Table 3

A check list of important requirements in tendering BIM project

BIM requirements	Item	Sub-item
Requirements	Model data & level of detail	Data in the form of information and/or properties about the building components and objects such as construction materials, concrete and steel grade, precast or in-situ, functional; be modelled precisely according to their quantity, size, shape, location and orientation; according to the requirements at different stages.
	BIM model basics	Architecture modeling; landscape architecture modeling; interior design modeling; geotechnical engineering modeling; structural engineering modeling; mechanical engineering modeling; electrical and communications engineering modeling; acoustical engineering modeling; fire safety engineering modeling; BIM construction and As built requirements; BIM for facility management and operations; BIM for decommissioning and disposal.
	Presentation styles	Annotation; text assignment; line weights; line patterns; line styles; hatching and filled regions; view templates; dimensioning; drawing borders and title blocks; symbols; copyright.
	Naming system	General naming conventions; model file naming; division naming; library object naming; object property naming; view naming; view list scheduling; data organization; sheet naming.
	BIM methodologies & processes	Graded component creation; drawing compilation; spatial location & co-ordination; units and measurement.
	BIM deliverables	Native BIM models; BIM review models; Plans, sections, elevations, details and RFI's; clash analysis reports; visualizations; equipment supplier specific models; and reports specifying drawing in general, export of other model formats, "Zero-D" (0D) data, open "Issue" format BCF
	Software specification	IFC compliant

Conclusions

Since IPD has not been fully adopted to facilitate implementing BIM, tendering of BIM is unavoidable in many areas such as Hong Kong. Therefore, the clients should clearly specify the BIM requirements in the tendering documents in order to get a satisfied BIM for better management in construction and facilities management. However, few studies have investigated this issue and therefore few reference can be provided for industry practice. This research therefore examined the publicly issued BIM standards/guidelines to find the common items as well as the differences, as these standards/guidelines are used for reference when tendering while it is difficult to get the real tendering documents for investigation. It was found that these standards/guidelines have common issues and some different specifications although under similar categories.

A list of BIM specifications was put forward based on the identified common issues and differences. The most important items include model data & level of detail, BIM model basics, presentation styles, naming system, BIM methodologies & processes, BIM deliverables and software specification. The subcategory of these important items were also put forward through combing the relevant specifications in the five standards/guidelines. This check list is useful for the client to make tendering documents or making the BIM execution plan before starting the project. Moreover, it also lends a tool for relevant organizations to update the standards/guidelines. However, it should be noticed that this research did not answer the question whether the client know what they want of BIM in tendering documents as it is difficult to get such documents. Future research would collect such real-life documents, find the real answer for this question and put forward suggestions accordingly.

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PROJECT STAKEHOLDERS' SUPPOSITION ABOUT PROJECT SUCCESS FACTORS (A COMMUNICATION PERSPECTIVE)

Shaheen Pouya, University of Vaasa, Finland[1];

Marja Naaranoja, University of Vaasa, Finland;

Jussi Kantola, University of Vaasa, Finland

Abstract

The purpose of this study is to compare the most important factors for project success based on ideas and conceptions of engineers and managers working on projects. This research is based on an online survey from individuals working on construction and EPC projects in Finland. The results indicate that planning and communication are the major project success factors while budgeting appears to gain the lowest attention among all. Also it seems, there are some differences of ideas based on participants' working sector and job experience. This research helps project organizations to distinguish leading factors for project success and consider their importance to take relevant actions. Accordingly it helps individuals to gain a better understanding on other stakeholders' ideas about important factors in projects.

Key words: *Project Management, success factors, Project Planning, Communication, EPC Projects*

JEL code: M16

Introduction

Stakeholder management is essential in any project (Kangas, 2011; Cleland, 1986; Miller & Olleros, 2001; Olander & Landin, 2005). Stakeholders are influential players on implementation and sustainability of the project. Ignoring stakeholders and not enough attentions being paid on stakeholder management has the potential of becoming main causes of the project failure (Kangas 2011). From 1984, when Freeman started the inception of stakeholder approach in project management, stakeholder management gradually becomes a relatively popular topic during the past decades; practice of stakeholder management becomes a key challenge in project management (Littau et al. 2010). Nowadays the stakeholders concept tend to be more complicated and comprehensive, researchers approach stakeholder management from different perspectives and they all highlight the importance of stakeholders in project management(Littau et al., 2010).

Besides the role of stakeholder satisfaction towards projects success, there is lots of evidence showing that neglecting stakeholders or their power can easily have negative influence on golden triangle (Kolk 2006, Bryde 2005, Aaltonen 2005). For instance in Netherlands which is well-known for its stakeholder-oriented 'polar model' (Kolk 2006), a big bridge construction

[1] Corresponding author – e-mail address: shaheen.pouya@student.uva.fi

project dealt with an unexpectedly delay by protest action, some boats owners claiming that they were not informed about this project and its effects. Researching about the roots of this problem revealed that the project management team did not consider these people as stakeholders and did not communicate with them and explain the positive aspects of this project in their life because they misjudged about their roles and thought they do not have the power to influence on such a huge project (Achterkam 2008).

Definition, Identification, classifying of Stakeholders

Freeman (1984) has defined project stakeholders as any group or individual that have the possibility to effect or be affected by project. Recently Schwalbe (2010) defined them as involved individuals or groups in projects and categorized stakeholders into external and internal groups. PMBOK presents a comprehensive definition as follows: "…..project stakeholder are person or organization such as customers, sponsors, the performing organization and the public that are actively involved in the project or those whose interest maybe positively or negatively affected by the execution or completion of the project".

Considering the example above, the importance of identifying stakeholders in planning phase of project is emphasized, although there are lots of different definitions towards stakeholder notion. Stakeholder definitions provide a static point of view to identifying and classifying different stakeholders but do not mention the dynamic aspects of attention to stakeholder needs during the time (Aaltonen 2008). In project management literature, it is widely accepted that most of projects have lots of stakeholders (Wang 2006) and project managers have limited time on communication (PMBOK). Utilizing stakeholder categorization models can help project managers organize the communication with different stakeholders within limited time, prevent conflicts among different stakeholder, prioritize stakeholders and maximize positive influences and mitigate negative effects (PMBOK).

On the other hand, Winch (2001) makes consideration on the dynamism of the power and interest of stakeholders; they have developed the Power/Interest matrix to classify stakeholders. In their model, grading the stakeholders is based on their level of authority ("power") and their level of concern ("interest"). Grouping stakeholders in power/interest matrix provides manager a better understanding on the effects of communication with the stakeholders and the implementation of the projects. Olander (2005) states that once the classification of stakeholders is done, the next stage is to identify the stakeholders in projects. However, the identification of stakeholders is more difficult than it seems, even if one uses stakeholder classification models. The classification model defines four specific roles of stakeholders: client, decision maker, designer as who are actively involved and the stakeholders who are passively involved (Achterkam, 2008). PMBOK standards consider the active stakeholders as key stakeholders and it adds in order to identify, project organization chart, project plan, project procurements and enterprise environmental factor are usually used. It mentions that identifying passive stakeholder is more difficult and could be done through interviewing the identified stakeholders.

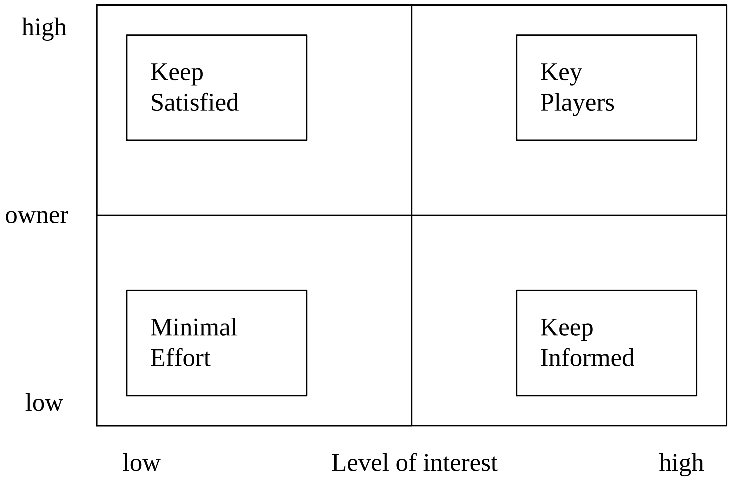

Fig. 1. **Stakeholder mapping, the power/interest matrix**

Artto et al. (2008) defined project strategy as "a direction in a project that contributes to success of the project in its environment". As stakeholders' satisfaction is a key factor to project success then identifying stakeholder helps to define project strategy. In fact the numbers of stronger project stakeholders with project independence notion are used to define four types of strategies as follow: obedient servant, independent innovator, flexible mediator and strong leader. Figure 2 shows four obvious project strategies depending on these two factors.

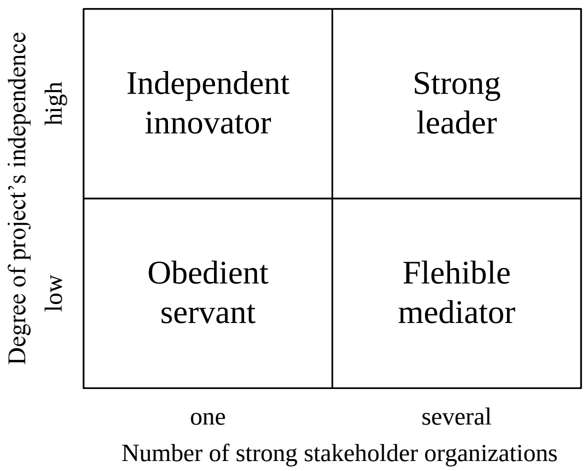

Fig. 2. **Project strategies for managing stakeholders**

Communication for stakeholder management in projects

"Good communication is key to successful project management" (Michalski 2000). According to PMBOK (2008) it is not possible to separate project's communication and stakeholder management as it is a link between different stakeholders and connects the organization and individual cultures. Communication process is the major factor to manage stakeholders' expectations and accordingly the stakeholder management tools and techniques are places in the communication part of PMBOK. Based on a research of Henderson et al. (2008) there is a significant and direct relationship between the project manager's ability in communication and project's team members satisfaction and productivity. It is the project manager in the key position to make and keep the communication links with both internal and external stakeholders. It is estimated that 90% of the project managers working time is taken in some type of communication; it is a tool for manager to build interpersonal relationships, inspire team members, handle conflicts and negotiate with stakeholders (Burke 2003).

Projects success factors

Project success is the highest priority for project managers and project stakeholders (Muller and Jugdev, 2012). The likelihood and possibility of project success has permanent and strong relation with project success factors; otherwise, if these factors are not taken enough care, it could lead to the project failure. Success is defined as achieving the objectives of project as well as working as scheduled and managing the costs as planned, it all could be happened with maximized and sufficient performance (Pinto and Prescott, 1988). Basically, numerous empirical researches have been including a variety of success factors for projects, the factor that are majorly referenced and repeated in existing literature, are listed in alphabetical order below; clearly some of these factors might interfere and point on the same issue:

availability of the required technology and expertise, detailed project planning and control, clear objective, client acceptance, client consultation, communication, Coordination, effective and committed leadership, management of human resources, management support, monitoring and feedback, organization structure and control, personnel (recruitment, knowledge and experience), predetermination and planning, problem solving, project schedule/plans, relationship, technical tasks, the concept and feasibility of an event, the handling of relationships and good communication with stakeholders' project mission, top management support, and troubleshooting.

The above factors have been studied in different occasions, and for different types of projects (Rofner, 2009; Waeffler and Pfister, 2008; Pinto and Slevin, 1987; Slevin and Pinto, 1986; Belassi and Tukel, 1996; Westerveld, 2002; Muller and Jugdev, 2012; Panda and Sahu, 2013). It is clear that this diversity is based on different opinions and perspectives from different projects (Andersen et al., 2006). On the other hand the variety of these factors together with different perspectives from many authors and scholars, has leaded the related studies to categorize and classify the success factors. However, there is not any global categorization for them and likewise the factors many groups could be found in literature. Belassi and Tukel (1996) clustered the success factors into four groups: factors that are related to

- Project;
- Project manager and team;
- An organization and
- External environment.

Gemünden and Lechler (1997) categorized the factors in other groups including context, participants and functions, while they also identified qualities of the management and project team as well as communication to have significant impact on project success. Andersen and Jessen (2000) made a framework to summarize the critical success factors into major groups to include all aspects of project work: scope, planning, organization, execution and control. Their categorization has considered every other approach prior that research.

On the other hand PMBOK (2008) has referred project success as meeting stakeholders' needs and expectations. In the first version of PMBOK (1996), it is addressed the project success to Pinto and Slevin's (1988) success factors (Scope, time, costs, quality) and states that balancing those factors will lead to succeed in project (Muller and Jugdev, 2012).

Methodology

The objective of this study is to determine the importance of communication for individuals who are active in projects, for this purpose in the beginning a group of success factors were picked, the chosen factors majorly could represent the diversity of perspectives and ideas about project success. First, based on the existing categories stated above, four choices were created to be asked in the survey: Communication, Project work / execution, Project planning and personnel's knowledge and experience. Another factor was added to these four after qualitative interviews with project experts and academic professor as a representative of financial and controlling factors: Project budgeting / control.

These five factors have been sent out through an online survey among three companies working on Engineering, Procurement and Construction (EPC) projects in Finland. The survey was held among approximately 300 individuals and 40 acceptable replies were received. Later, inferential statistics (T student test and ANOVA) were implemented using SPSS software to avoid errors and uncertainties caused by low response rate.

Results

Participants have been asked to rate the selected success factors as their importance and effectiveness on project success. Each factor could obtain a rating between 1 and 5; also it was not possible for two factors to gain the same rating. Figure 3 shows the results in a cumulative graph. As it could be seen, generally good planning gained the highest rate with a significant difference from second factor. Communication gained the second place while personnel's knowledge and experience, project work and execution and finally project budgeting and control were rated respectively. Using ANOVA analysis, it is assured that with 95% confidence, there is a significant difference between means of the stated factors as it is stated in Table 1.

Table 1

ANOVA analysis for general results, F is higher than F critical

Source of Variation	F	P-value	F critical
	9.447568	7E-07	2.428164

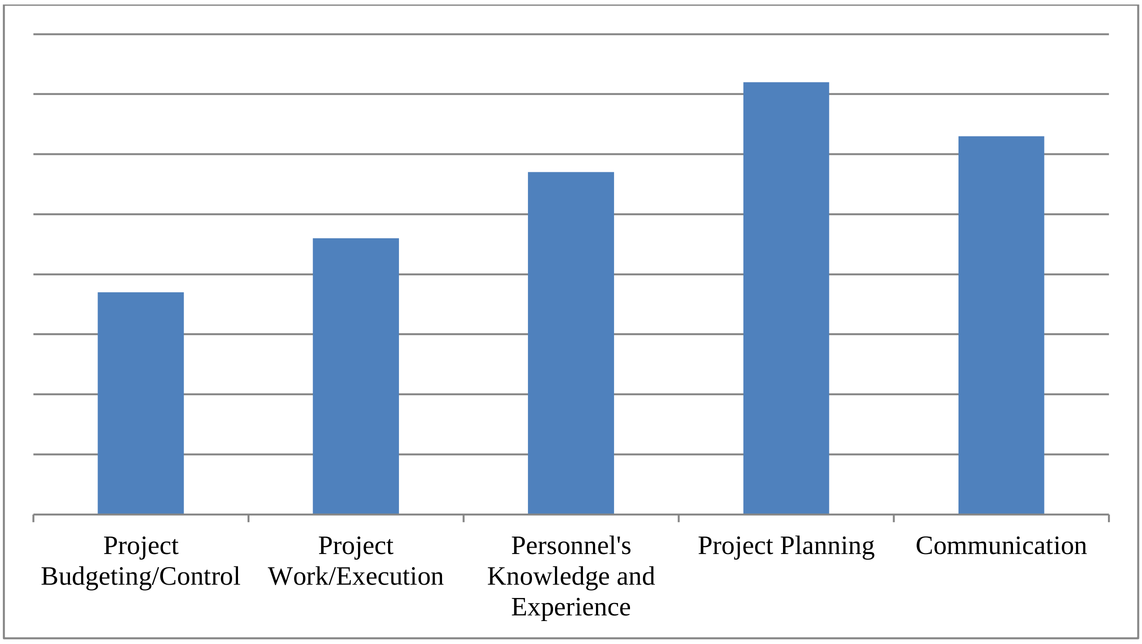

Fig. 3. **Project Success Factors, overall view**

According to Figure 3, project planning has the highest rate and communication is second; although, after implementing a t student statistical test, the significance of the differences between every pair of above factors has been checked. As summarized on Table 2, there is a significant difference between project planning and communication while no significant difference between communication and personnel's knowledge and experience could be found. Subsequently, there is a difference between ratings of personnel's knowledge and experience and project execution nonetheless on the other hand project work and execution does not indicate a difference in its score with project budgeting and control. Accordingly it seems that there are three levels for the success factors, level 1 which is project planning, communication and personnel's knowledge and experience create level 2 and finally project work and execution gains the lowest rating as well as project budgeting and controlling.

Table 2

The t test characteristics on success factors' differences

First factor	Second factor	t Statistical	t Critical	Difference
Project Planning	Communication	1.44	1.29	Significant difference
Communication	Personnel's Knowledge and Experience	0.93	1.67	No significant difference
Personnel's Knowledge and Experience	Project Work / Execution	1.86	1.66	Significant difference
Project Work/ Execution	Project Budgeting / Control	1.29	1.71	No significant difference

There are many factors affecting on project success and as reviewed communication plays an essential role for reach this goal. Participants' answers indicate that they assume good communication as one of the most important tools for projects success after project planning. This simply shows the consideration of importance of communication between organization employees and acknowledgement of this fact. Probably communication as a humanistic factor would have gained more attention if there was not any other similar factor in the survey (knowledge and experience). On the other hand controlling and financial issues surprisingly obtained least attention from project stakeholders.

Figure 4 indicates the results based on participants' companies. It is essential to mention that company 2 is mostly active as client in projects and company 1 as well as company 3 is working as designer and contractor. The highest interest for company 2 goes to personnel's experience and knowledge and communication stands in third place after project planning. This graph clearly illustrates the variety of perspectives between different parties in a project. However, communication as an important factor for project success is well considered even by the second company as it stands higher that budgeting and execution. There might be a relation between these differences of ideas and the conflicts related to the priorities in projects.

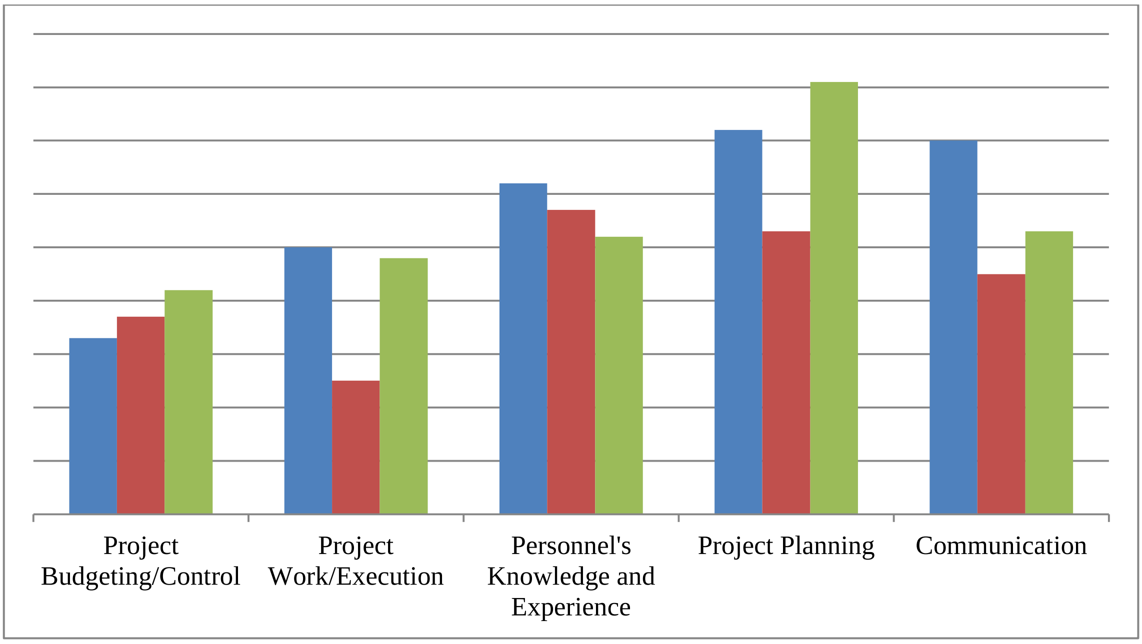

Fig. 4. **Project Success Factors, Company overview**

Finally, Figure 5 illustrates the rating of project success factors based on working experience. As it could be seen in the graph, the stakeholders with highest rate of working experience have chosen communication as the most important project success factor. Individuals with less experience have rated communication in the second place after planning. Although there is not a significant correlation between experience and communication's cumulative score, this graph indicates the importance of communication as an essential success factor in projects that experienced stakeholders assume it as the first factor.

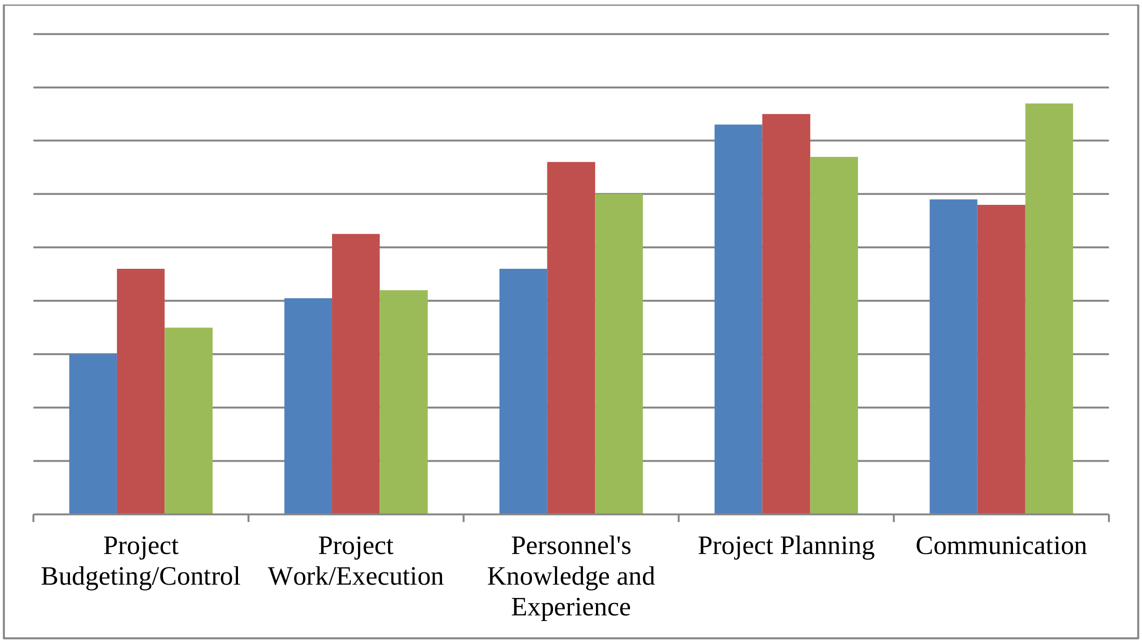

Fig. 5. **Project Success Factors, working experience overview**

Conclusion

Communication as an essential factor for success has always been mentioned in literature, moreover the importance of this process is well considered in project management and organizational management culture. However, a global theory or tool to manage communication is hardly recognizable, neither in academic society nor practical or industrial procedures. This study helps these groups to understand stakeholders' suppositions about communication among other project success factors and improves the knowledge about different stakeholders' opinions. This knowledge might help organizations and managers to a superior understanding about stakeholders' needs and accordingly more efficient management.

The majority of stakeholders tend to consider project planning as the first success factor in projects, communication stands in the second place while some groups take communication as their highest priority. There are already sufficient tools and techniques to maximize quality and efficiency of planning, including the new types of project planning that includes construction materials and every process in the project such as BIM. These tools and techniques also apply to the other defined success factors except for communication. Hence stakeholders seem to need extra effort on communication to fulfill this demand; probably this is the reason that stakeholders with higher experience have chosen communication as the first factor.

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PROJECTIFICATION OF SPORT MANAGEMENT

Liina Puusepp, Pärnu College, University of Tartu, Estonia[1];

Arvi Kuura, Pärnu College, University of Tartu, Estonia

Abstract

Sport management and project management are both inter- or multi-disciplinary fields. Thus, one can assume to find substantial linkages between those two disciplines. According to academic literature both areas have developed quite separately and linkages are almost missing. For instance, a recent bibliometric study (Shilbury, 2011) states that theme 'project management' appeared only once in 25 sport-related management manuscripts published in generic journals. The only occurrence is quite typical – related to 'major' (or 'mega') projects like the Olympic Games (Pitsis *et al.*, 2003). We aim to bring out possible linkages between those two disciplines.

As legitimation is a critical issue for young and immature academic disciplines, we show the relations between legitimations of sport and their counterparts in project management. There are five generally recognised sport legitimations (Chalip, 2006); we found three nearly matching and two indirect counterparts.

We also carry out a small pilot study examining volleyball on macro level (i.e. the national federation and its relations to the National Olympic Committee) and one volleyball club in Estonia. Using document analysis and semi-structured interview we show the extent of projects in sports.

We can conclude that the level of projectisation is relatively small, both on the level of National Volleyball Federation and sports clubs. Volleyball club (examined in our case study) depends mainly on subsidies, which are not regular. The club depends on its main sponsor to a great extent, and this should be seen as a risk. Currently the club has some small and short-term projects but having larger and long-term projects (or programmes) could ensure sustainability of the club.

Key words: *sports management; projectisation, projectification, volleyball*

JEL code: L83

Introduction

Sport management is considered to be relatively young (Chalip, 2006), being introduced in the 1940s (Slack, 1998). Sport management, as its name refers, is an inter-disciplinary field, encompassing both sport and management. The term "management" is used in the generic sense, referring to all aspects of business studies, including management, marketing, and finance (Chalip, 2006). Sport management is "*grounded in both business and leisure, which in turn are derivatives of sociology, psychology/social psychology, economics and law*" (Shilbury & Rentschler, 2007, p. 32). Sport management encompasses strategies evident in the majority of modern business, government, and non-profit organisations (Hoye *et al.*, 2009). Sport managers engage in strategic planning, manage large numbers of human resources, deal with broadcasting

[1] Corresponding author – e-mail address: liina.puusepp@ut.ee, telephone: +372 507 4586

contracts and work with global networks of international sports federations, national sport organisations, and government agencies (ibid).

According to mainstream views, project management as an academic discipline is also young but developing. Modern project management has its roots in the late 1940s and it started as an off-shoot of optimization theory. (Turner et al., 2010) Project management has developed more quickly, compared to sport management, which has had developing difficulties (Slack, 1998). Yet, project management is a discipline that often gets overlooked when moving strategy outside the boardroom (Longman & Mullins, 2004). Can this be a reason for lack of connection between project management and sport management?

Sport management and project management

Every new discipline has to legitimise its existence as a separate field. According to Chalip (2006) sport management must prove that is can provide us with theory that is grounded in sport and not just management (marketing and finance included). Thus, Chalip (2006) brings out two complementary models of sport management research: derivative model (based on mainstream management) and sport-focused model (grounded in sport phenomena). Chalip (ibid) reveals the necessity to find out distinctive elements of sport management, if they exist at all, but does not provide any of them. It is reasonable to assume that to certain extent, an inter-disciplinary field can yield theory based on different grounds. Gomez et al. (2010) present a sport business model, which consists of three dimensions, and in addition to usual management issues (financial performance and performance for stakeholders) describes sport performance. Thus, sport does have unique features that other industries do not have. Based on that, we can conclude that sport-focused model, producing theories grounded in sport, is going to be more and more important in the future. One has to bear in mind that some aspects (e.g. value creation) have a slightly different meaning than in mainstream management.

Eve (2007) claims that world´s best companies are adopting project management as a “way of working" rather than a methodology or tool set. Among others, such companies as Boeing, Hewlett Packard, and IBM, have reported average profits increase by 6 per cent and the return on investments even by 20 per cent, when adopting project management as a way of working (ibid). Thus, it would be only reasonable to use it more often in sport management as well. Academic literature concentrates only on sports mega projects, like the Olympic Games (Pitsis *et al.*, 2003). Today, 205 National Olympic Committees are recognised by the International Olympic Committee, and their teams have the right to participate in summer and winter Games (Robinson & Minikin, 2012). National Olympic Committees have an important role within their nation´s sport system. Success at Olympic Games requires a system that produces elite athletes. In most countries, this system is primarily the responsibility of National Federations (e.g. Estonian Volleyball Federation). National Federations have talent identification programmes, athlete and coaching development programmes; they provide the athletes, technical staff, and officials who contribute to the human resources of the National Olympic Committee. (ibid)

Shilbury (2011) brings out the connection between sport management and related areas. Among 25 sport-related management manuscripts the most dominant theme was human resource management (8 manuscripts) followed by strategy (7), organisational change (6), organisational theory (2), project management (1), and organisational behaviour (1). To a great extent, sport depends on sponsors. It may vary across nations, events (e.g. volleyball, basketball), and levels (e.g. elite athletes), but especially young athletes and sports clubs of national leagues need extra money. It could be gained by implementing successful projects and programmes.

Several authors (e.g. Chalip, 2006) claim that there are linkages between sport management and project management. Yet, they do not bring them out. One of our aims is to clarify the topic and try to find out which similarities are there between those two fields, and what could be the principle differences.

One must not forget the socio-historical differences of sport contexts across countries but despite those differences there are five legitimations for sport that are espoused internationally: health, socialisation, economic development, community development, and national identity (Chalip, Johnson, and Stachura, 1996; see also Chalip 2006). Relations between sport legitimations and project management are presented in Table 1.

Table 1

Sport legitimations and connection to project management

Sport legitimation	Activities	Comparison to PM
Health	Public health campaigns Physical recreation Physical activity promotion	No direct counterpart but health and other (promotion) campaigns are project-based activities and treated in PM literature
Socialisation	Socialisation programmes targeted at children and adolescents (e.g. to prevent antisocial behaviour, dropping out of school)	Projects (as temporary organisations and/or activities) often bring together people who work in separate organisations or subunits, thus promote socialisation and cooperation
Economic development	Projects and programmes to finance professional sport teams and their facilities, special sport events, recreational sport facilities	ca 1/3 of the world's economy* (and 1/2 of Estonian economy**) is done via projects; projects and programmes are used for similar purposes much wider, not just in sport
Community development	Investments to marketing sport programmes and events are turned into social and psychological benefits	Social and community, environ-mental, etc. projects are proliferating and constitute an emerging topic in PM research / literature
National identity	Its utility depends on how sport is linked to other initiatives	No direct counterpart but societies become more and more projectified

Source: authors´ construction based on Chalip (2006), Turner et al (2009), and Kuura (2011)***

As it is shown in Table 1, we have brought out the relations between sport legitimations and project management. In case of four out of five internationally recognised sport legitimations have similar counterparts in project management. Economic development and health are sport legitimations having the strongest relations to project management and community development is becoming more and more important in project management as well. Only national identity does not have a direct counterpart in project management.

Projectification and projectisation

Projectification as a phenomenon has been explored in the context of large businesses (Midler, 1995) and it is still researched mostly on organisational level, primarily in businesses but nowadays, also in non-profit and public (or semi-public) organisations. Projectification is nowadays explicable as a development process in which organisations focus their operations on projects and project management, accompanied by application of pertinent structures (Bredin 2006). This notion is already nearly 20 year old, being introduced by C. Midler (1995) in his seminal article, examining Renault's way towards project orientation. The underlying concept of project orientation, introduced by R. Gareis (1989), is already 25 years old. This concept considers that simultaneous performing of a set of projects creates demand for a new management approach called 'Management by Projects'. This approach considers (in addition to the management of single projects) also the relationships between the projects and the permanent organisation. (ibid) Yet, the phenomenon is considered to be much older: according to Packendorff (2002), it has often been claimed that the societies are becoming increasingly projecticised – i.e. organised in terms of time-limited sequences of (inter)action since the mid-1960s. This development was caused by increased use of the project work form. Relying on this observation, Packendorff (ibid) claimed that projectisation has also affected peoples´ personal lives.

As seen in this brief overview, different terms and notions – project orientation, projectification and projectisation – appear. They all are related and have similar but not the same meanings. Especially projectisation and projectification have somewhat different significations. According to Müller (2009) the (level of) projectisation indicates the extent to which an organisation is based on projects and the degree of proliferation of project work. Maylor et al (2006) have made a significant contribution to understanding this paradigm. First of all, they adjusted the understanding of projectification, eliciting that the most important thing is not the trend of organising work through projects, but concurred organisational changes. Thus, projectisation is a precondition to projectification; the last has much wider meaning, comprising also projectisation. The most important contribution of Maylor et al (ibid) was introducing of programmification, standing for implementation of programs and portfolios of programs as management mechanisms in organisations. In addition, they distinguished the main levels of projectification (and programmification) – societal, organisational, and personal. The central is obviously organisational but its essence – changes in organisational and governance structures (to increase the primacy of the processes of projects) are not limited to the central (focal) organisation but comprise also its supply networks. Thus, there is a link to the next level – societal projectification. Hereby it is worth to mention that Gareis (2002) has expanded his concept of project orientation also to societies, using a construct of 'project-oriented society'. Besides, he claimed that more and more projects are performed in voluntary associations and even in families and in private lives of people. In this context voluntary (or non-profit) organisations have specific importance because their relations with individuals are different – work relations (contracts) are used much less and are mainly replaced by voluntary participation. Therefore, there is a loop to the individual level of projectification but more proper handling of all levels and their interconnections do not fit into the scope of this article.

An interesting question is the extent of projectification (and projectisation) in current societies and organisations but unfortunately, this question has not yet got a good answer. These phenomena are not reflected in statistics, nor have been studied much; the existing research is almost entirely focused on particular firms. As the most important matter in projectification is organisational changes, there is a clear need for mostly qualitative approach. For generalisation, there is a need for a number of comparable case studies. But yet, an obvious precondition for projectification is the certain extent of organising work through projects – projectisation. This is a more quantitative phenomenon and thus allowing comparative analyses across organisations, regions, etc., and to express trends over time.

Ekstedt et al (2005) stated that projectisation is a typical trend for contemporary organisations and in modern society it has a visible role in many significant developments, including the labour market. Ekstedt (2009) also claimed that projectification is related to several developments in economy and society, where the most important is phenomenon called 'servicefication'. Increase in service activities leads to the usage of more temporary solutions (i.e. projects) in organisations. An attempt to estimate the total share of project activities in world economy has been made by Turner et al (2009). Considering the share of new capital formation (mainly infrastructure projects) and the share of projects in the SME sector, they claimed that at least one third of the world´s economy is done via projects. They (ibid) also concluded that the overall level on projectification is probably higher in fast developing economies. This claim was supported by findings of Kuura (2011). Following the approach used by Turner et al., he estimated that in Estonia the overall level of projectification is 52% – that is, more than a half of economic activities are (or should be) carried out by projects.

Projects in sport organisations

In this part of the paper we examine the share of funds gained from projects of Estonian Volleyball Federation (hereinafter EVF) and one volleyball club. Document analysis and semi-structured interview were the methods used. The relation between the Estonian National Olympic Committee (hereinafter NOC) and EVF, as well as the relation between EVF and volleyball club are being examined.

The NOC is funding EVF on several occasions, the most important are: a) annual funding for Olympic preparations*, b) annual funding for coaching training**. EVF is being financed also from governmental public sector finances (e.g. Ministry of Cultural Affairs). The annual sum from the NOC depends on achievements on international competitions, the level of activity of the national federation, and the number of athletes participating in this particular field of sports.

Document analysis was conducted based on the annual report (2012) of EVF (as the annual report of 2013 is due in June 2014). According to the annual report, EVF organises two major tournaments: Estonian Volleyball Championships for Men, Estonian Volleyball Championships for Women. It is also concerned with young athletes, providing them with tournaments in five different age groups.

Table 2

Estonian Volleyball Federation´s subsidies from different sectors

Sector	2011	2012	Change 2011-12	Average 2011-12
Governmental	48.9%	58.5%	9.6%	53.7%
Private	23.5%	8.9%	-14.6%	16.2%
Other	27.6%	32.6%	5.0%	30.1%

Source: authors´ construction based on annual report of 2012 of Estonian Volleyball Federation.

* Olympic preparations may sound senseless because up to now Estonian national volleyball team has not participated in the Olympic Games but hopefully one day it will.
** Since 2011 those trainings have been financed by Innove – Estonian association of life-long learning.

As the Table 2 shows, the private sector is the least reliable. Subsidies from the governmental sector account in average for half of the funds EVF gets annually. Among those subsidies are short-term projects. Are these enough to fulfil the obligations of the Federation? We try to find an answer to this question by interviewing the representative of one of the volleyball teams.

A semi-structured interview with the representative of one of the Estonian volleyball teams was conducted on February 10, 2014. Based on the information gained with this interview, the club is supported financially by the local government, EVF, government, and sponsors (the proportions are presented in Table 3).

Table 3

Volleyball club´s subsidies from different sources

Source	Percentage
Local government	40.8
Main sponsor	40.8
Estonian Volleyball Federation	13.1
Projects	5.2

Source: authors´ construction based on the interview.

It is quite obvious that the club functions thanks to the local government, which has annually been supporting it. Sponsors change over the years and sometimes there are no major sponsors. The support from the EVF is regular, but proportionally small. The number of projects is usually four and the amount of money not sufficient.

Conclusions

1. The level of projectisation in sports (based on the case of volleyball in Estonia) is relatively low – the number of projects is quite small, the projects are small in terms of funds (budgets) and durations

2. Both National Federation and sports clubs mainly rely on one sector/source which should be seen as a risk.
3. The amount of money provided as subsidies is not enough to assure club´s sustainability.

Proposals

1. Both clubs and the federation should apply more for long-term projects (duration more than one year) or programmes.
2. Both clubs and the federation should find new ways to attract customers and fans.

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PUBLIC SECTOR PROJECT MANAGEMENT PLANNING AND EFFICIENCY PROBLEMS

Emīls Pūlmanis, State Regional Development Agency, Latvia[1]

Abstract

The application of Project Management (PM) tools and techniques in public sector is gradually becoming an important issue in developing economies, especially in a new development country like Latvia where projects of different size and structures are undertaken. The paper examined the application of the project management practice in public sector in Latvia. Public sector project management in Latvia become popular in recent years as there is different type of public funding sources available. The paper describes the public sector project management practice in Latvia. Study shows the evaluation of impact factors in public sector projects efficiency and sustainability. Research period covers the time period from January 2013 – November 2013.

Key words: *project management, project planning and initialization, efficiency*

JEL codes: O220, H430, H540

Introduction

Government and organizations usually embark on different projects with the aim of creating new service or improving the functional efficiency of the existing ones. All these projects require appropriate skills and techniques that go beyond technical expertise only, but encompass good and sound skills to manage limited budgets, and monitor shrinking schedules and unpredicted outcomes, while at the same time dealing with people and organizational issues (Abbasi and Al-Mharmah, 2000). The application of project management practice in public sector has been identified as an efficient approach which would help in upgrading management capabilities and enable public sector to efficiently complete projects and attain developmental objectives (Arnaboldi, Azzone and Savoldelli, 2004).

Recipients of funding – both public authorities, public institutions and businesses, is a major challenge for financial gain and to promote public welfare. However, the benefits bring with them the responsibility for waste and financial records and reports on practical goals. Funding Administration requires thorough knowledge and understanding of the law. A growing number of mass media and the administration of financial instruments institutional statements we hear that a large number of project applications, which is a low quality place. Now that the errors and weaknesses in project development and administration are unacceptable, more and more to think of an effective system that would be according to the conventional project management theory. Such a system would be built at local level, ensuring appropriate project specialist, but the program level, i.e. need to improve the administration of financial instruments including methodical and regulatory documents update and synchronize project management theory to improve the project initiation process and ensure the quality of project applications

[1] Corresponding author – e-mail address: Emils.Pulmanis@gmail.com, telephone: +371 26896748

development, thus resulting in an effective and rational use of taxpayers' money (Pulmanis, 2012).

Viewed in a broader sense, it can be concluded that the planning process phenomenon consists of three connected plans: the strategic plan, functional plans and project plans. Project plans are a reflection of the strategic plan, while functional plans represent a detailed guide to using resources to achieve a set purpose. Project realization planning represents a rational determination of how to initiate, sustain and complete a project (Cleland 1999).

The **object** of the research is public sector project management.

The **aim** of the article is to evaluate project planning and initialization practice in public sector in Latvia.

The **objectives** of the article are as follows:

- assess the public sector project initialization practice and identify the problem areas of public sector project management in Latvia,
- analyse theoretical background of project management concepts as well as project initialization and planning process in public administration,
- provide proposals for public sector project management process improvement.

The research **methods** used in the article include the project and program empirical data analysis and literature review as well as survey based on questionnaire.

1. Project management context and literature review

The term project is described in different ways in the research literature. This is illustrated below:

- Project is defined as a temporary endeavour undertaken to create a unique product or service, Temporary means that the project has a definite ending point, and unique means that the product or service differs in some distinguishing way from all similar products or services (PMI, 2013, p. 4)
- Project has been termed as a human endeavour and may legitimately be regarded by its stakeholders as a project when it encompasses a unique scope of work that is constrained by cost and time, the purpose of which is to create or modify a product or service so as to achieve beneficial change defined by quantitative and qualitative objectives (Cooke-Davies, 2001, p. 20).
- Project is described as a "value creation undertaking based on specifics, which is completed in a given or agreed timeframe and under constraints, including resources and external circumstances" (Ohara, 2005, p. 15)
- A project is a regarded as a business case that indicates the benefits and risks of the venture, demonstrating a unique set of deliverables, with a finite life-span, by using identified resources with identified responsibilities (Bradley, 2002). The common themes in these definitions is that projects are unique in their output, having a definite starting and ending point, are temporary in nature and are carried out to manifest the organisation's strategic objectives. These temporary structures are playing a vital role in today's modern organisations and a growing interest is recorded in the significance of these temporary structures in organisations.

Project management is defined in different ways in the research literature. Some of these definitions are as follows:

- Project Management is describe as a collection of tools and techniques to direct the use of diverse resource toward the accomplishment of a unique, complex, one time task within time, cost and quality constraint. Each task requires a particular mix of these tools and techniques structured to fit the task environment and life cycle (from conception to completion) of the task (Oisen, 1971: Cited in Atkinson, 1999).
- Project Management is express as planning, organising, monitoring and controlling of all the aspects of a project and the motivation of all the involved stakeholders to achieve the project objectives safely and within agreed time, cost and performance criteria. (APM, 1995).
- Project management is term as an application of knowledge, skills, tools and techniques to project activities to meet project requirements. Project Management is accomplished through the application and integration of the project management processes of initiation, planning, executing, monitoring and controlling and closing. (PMI, 2013).
- Project management is also articulated as a professional's capability to deliver, with due diligence, a project product that fulfils a given mission, by organising a dedicated project team, effectively combining the most appropriate technical and managerial methods and techniques and devising the most efficient and effective breakdown and implementation routes (Ohara, 2005).

Turner (1996) suggested that project management could be described as the art and science of converting vision into reality whereas Atkinson (1999) argues that perhaps project management is simply an evolving phenomenon, which will remain vague enough to be non-definable. This flexibility can be regarded as its strength. In its early days the project management was solely concerned with the implementation of single project in that era (Kartam et al. 2000). But, today many organizations have embraced the concept of project management. This is mainly because of its systematic approach of managing the projects (Morgan, 1987). It's a way to generate consistent results when undertaking new initiatives and a powerful business tool that can transform an organization's ability to perform well (Artto et. al, 2008).

Conceptualization according to Pinto (2007) refers to the development of the initial goal and technical specification for a project. The scope of work is determined, necessary resources (people, money, material & machine) identified, and important organizational contributions or stakeholders signed on. Also, feasibility study is conducted at this stage to investigate whether the project can be continued or not. Planning is the stage in which detailed specifications, schematic, schedules and other plans are developed. It is also a stage where the project solution is further developed in as much detail as possible and steps necessary to meet the project's objectives are put in place. At this stage the individual pieces of the project called work packages are broken down, individual assignments made, and the process for completion clearly delineated. Project schedule, the actual work and the estimated cost of completion are also identified. Anything that might pose a threat to the successful completion of the project is also identified at this stage. Finally all the project stakeholders must be identified at this stage of the project so as to establish a communication plan that describes information needed and the delivery method to be used to keep stakeholders informed (Patel, 2008).

Project management is defined as an application of knowledge, skills, tools and techniques to project activities to meet project requirements. This is accomplished through the application and integration of the project management processes of initiation, planning, executing, monitoring and controlling and closing (PMI, 2013). Mintzberg (1983) cited in Soderlund (2004b) states that most of the emergent industries since world-war II are project intensive. This widespread use of projects in organisations demanded an approach that can efficiently manage these temporary endeavours which are critical to the organisations strategic objectives. This led the researchers and professionals of the field to devise an approach that can efficiently manage the projects. Initially the focus of research on projects was exclusively on the implementation of a single project (Crawford et al, 2006). Project research in general now spans a variety of level of analysis. Concept such as the management of projects and the management by projects clearly point to the current devotion of project research (Soderlund, 2004a &b). An important factor here is that the researchers suggest management of projects to be at the core of understanding the modern firm (ibid). Public sector organisations are differentiated in comparison with their commercial counterparts in the private sector. There is no profit maximising focus, little potential for income generation and, generally speaking, no bottom line against which performance can be measured (Boland and Fowler, 2000). The vast majority of public sector organisations still generate most of their income from the State (ibid). However, the capability of the public sector is pivotal to the growth of the economy (Rwelamila, 2007). Furthermore, the need for project management expertise in public sector organisations has become fundamental in order to deal with the enormous responsibility of managing a number of projects (ibid).

In less developed countries the implementation of project management tools and techniques is still in its early phases of development. It is a relatively modern practice that attempts to achieve planned objectives within specific time and cost limits, through optimum use of resources and using an integrated planning and control system (Abbasi and Al-Mharmah, 2000). According to Schlichter (1999) project management has led a number of organisations to be more effective and efficient in delivery of their products and services, to have more accurate budgeting and scheduling and improved productivity. The growth and acceptance of project management is continuing to increase as resources become scarce in less developed countries.

2. Theoretical aspects of project initialization and planning

Effective and accurate planning is required at the start of the project for the project to be successful. In public sector projects the planning and decision making inevitably become political activities (Dennis, 2000). Planning becomes a process not only of analysing problems, goals and alternative course of action, but also of advocating position, influencing behaviour and intervening in the policy making process to affect the outcome of decisions (Rondinelli, 1976). Planning consists of a set of procedures whereby decision makers attempt to:

- Identify and define major problems and goals,
- Analyse relevant environment and strategic conditions,
- Project trends, needs, opportunities and constraints,
- Transform goals into operational targets,
- Identify alternatives course of action for achieving goals and targets,
- Calculate cost and benefit of each alternative,

- Estimate the probabilities of future events,
- Projected trends occurring,
- Determine the potential non-economic gains,
- Losses and consequences of each alternative,
- Choose the optimal alternatives or set of actions,
- Integrate the chosen course of action into a comprehensive plan.

In addition to understand the above characteristics of planning in a public project there are number of processes that need to be followed to plan project effectively. These are:

- Defining the deliverables,
- Defining the work packages,
- Estimating the work,
- Scheduling the work packages,
- Managing resource availability,
- Creating the budget,
- Integrating schedule and budget,
- Identifying key performance Indicators,
- Identifying critical success factors. (Harpum, 2004)

Procurement / Contracting Strategy in Public Sector Projects Spittler and McCracken (1996) states that by choosing a properly matched contracting strategy the chances of projects success can increase.

Author analysis of the scientific literature in the field of project management found that very little role has paid to project initiation and the problem definition importance in the frame of project management. Study shows very broadly analyse and present methods and tools for project planning and problem solutions. British PRINCE2 project management standard requires that in some situations, a feasibility study might be required to investigate the situation and determine options for the way ahead. Using PRINCE2, the optimum approach would be to handle the study as a separate and distinct project and then operate a second project to implement the results of the study.

The America's national project management standard PMBOK defines project scope planning as "the process of developing a written scope statement as the basis for future project decisions including, in particular, the criteria used to determine if the project or phase has been completed successfully" (PMBOK, 2008).

Problem analysis identifies the existing situation and establishes the *'cause and effect' relationships* between the problems that exist. It involves three steps:

1. Precise definition of the framework and subject of analysis.
2. Identification of the major problems and dangers faced by target groups.
3. Visualisation of the situation.

The recurring costs of investment projects on completion will have to be clearly understood and estimated by Public Bodies before embarking on the decision to go ahead with the projects. Investment projects may be funded from Government-owned resources, grants or loans from foreign institutions and/or by the private sector.

According to A.Walton project planning may be considered a form of information development and communications. As the project team develops the project plan, the project team should learn more about the project goals, strategies, and team member roles. The project objectives then can be decided in terms of cost, schedule, and technical performance. Satisfaction of project goals is accomplished through the completion of the project work packages. The project strategy is a plan of action with accompanying policies, procedures, and resource allocation schemes, providing general direction of how the organizational effort will be used to accomplish project goals and project objectives. Simultaneous project planning is the process of having the project team considers all aspects, issues, and resources required for the project plan on a concurrent basis. Concurrent planning means that everything that can or might impact the project is reviewed during the planning phase to ensure that an explicit decision is made concerning the role that all resources, however modest, might have on the project (Walton A., 1996).

The Project should be defined in the initialization phase, and the definition should show that the project will be conducted in a logical and proper manner (Charvat J., 2002).

Project problems are ordinarily complex, consisting of many aspects that require analysis and insight (Heerkens R., 2007). We need to invest an appropriate amount of time to fully understand all aspects of the problem. Very often, what appears to be the problem is actually masking a bigger, more fundamental problem. Uncovering that fundamental problem is referred to as *identifying the true need*.

Governments in some jurisdictions provide guidance on how to appraise proposals, using cost-benefit analysis, before committing significant funds. For example, the governments of Australia, New Zealand, the United Kingdom, and the United States provide guidance on the issues and techniques that should be considered when assessing new regulatory, revenue or capital policies, programs, and projects. Such guidance advises public sector departments and authorities on how to undertake conventional analysis however; such guidance can offer advice on a broader economic cost-benefit analysis that can be more valuable to the public interest.

Definitely the most important thing in the project development process is the topicality of the problem and its accurate definition. The project goal is determined when performing the justified problem analysis. Next, the definition of project problems, target groups, and goals is analysed in the project submissions of particular municipalities.

Analysis of the initiation documentation of the selected projects reveals the main mistakes in the problem situation description:

1. Project topicality is not described – no justification of the significance, importance of the problem for the specific city, in the particular period of time.
2. Some fragments mention the region or state in general, others the municipality.
3. Terms are not understood.
4. Generally known statements are used, not sustained by facts.\
5. Part of that problem has been the lack of a structured approach for decision-making, project approval, and project execution.

All this can be satisfied with a sound project management methodology (Pūlmanis, 2013).

Problem solving models attempt to capture important aspects of the problem solving process. As decision-making and problem solving are intimately related, it is not surprising then that the Simon model of the decision-making process is the foundation for a number of problem solving models (Brightman 1978, Van Gundy 1988, and Sprague 1982).

The analysis of efficiency and effectiveness is about the relationships between inputs, outputs and outcomes. In 1957, Farrell already investigated the question how to measure efficiency and highlighted its relevance for economic policy makers. "It is important to know how far a given industry can be expected to increase its output by simply increasing its efficiency, without absorbing further resources" (Farrell 1957). Since that time techniques to measure efficiency have improved and investigations of efficiency have become more frequent, particularly in industry. Nevertheless, the measurement of efficiency and effectiveness of public spending remains a conceptual challenge. Problems arise because public spending has multiple objectives and because public sector outputs are often not sold on the market which implies that price data is not available and that the output cannot be quantified.

Assessing the efficiency and effectiveness of public spending requires the measurement of the inputs entering into the production of public sector activities. This can be done in monetary and non-monetary (physical) terms. Compared to the private sector, the estimation of the actual costs of public sector activities is relatively complicated. While in the private sector, data are available at a very detailed level of activity, public sector accounts are typically designed differently, making it difficult to obtain information on all input costs, in particular at a disaggregated level. Estache et al. (2007) stress that public budgets are not really designed to track down specific sectorial expenditures.

Recent literature (Afonso et al. 2006) highlights especially the indirect costs, such as opportunity costs of using government-owned assets, like school buildings and hospitals, and the allocation of government fixed costs. The higher tax burdens associated with an increase in public expenditures cannot be neglected either. This, however, would lead to an even broader approach to evaluating the impact of public policies. This paper chooses a more narrow approach and considers the public spending allocated to the production of a given public service, like public spending on health, education or infrastructure as a measure of input. It also takes into account the complementarities of public and private spending. An alternative approach to defining appropriate input indicators is to use non-monetary factors, like the number of civil servants deployed for a public activity or working hours spent on this activity. For instance, in the area of education the teachers/students ratio, class size and instruction time are quite common measures of inputs.

3. Research

Authors has elaborated survey questionnaire for local municipality project management specialists.

Questionnaire has been sent to all Latvian municipalities (in total 119), in the frame of study 97 responses has been collected (research sample is 97 out of 119, n = 97). Research period is January 2013 – March 2013.

In order to obtain a mathematically reasonable view of the project planning capacity in the public sector – quantitative analysis of the survey data obtained through analysis of education, training and practical work experience aspect of the relationship with the real action methods. Quantitative analysis carried out in two steps: describing the central tendency and variation of parameters and in accordance with the empirical distribution with the normal distribution choice of parametric or non-parametric method for Inferential Statistics.

The author evaluated the public sector practice in project development and initialization processes in Latvia. In the frame of research evaluation of project problem and goal definition has been done.

Study shows that in public sector project management there is lack of deep problem and situation analysis. 45.78% of respondents elaborated project proposals based on local municipal development programs and policy planning documents and don't provide deep analysis of problems. 26.05% of respondents accepted that they don't use situation analysis methods but project proposals are elaborated based on desired situation. Still 28.17% of respondents showed that they used project management methods such as current situation analysis and research, case study methods by clarifying the factual situation and the desired situation.

To be mathematically justified fair view of the project planning capacity in the public sector – was made in the survey data obtained in quantitative analysis, analysis of prior training, continuing education and practical work experience aspect of the relationship with the real operation of the methods used. The quantitative analysis carried out in two steps: describing the central tendency and variation in performance and in accordance with the empirical distribution with the normal distribution of parametric or non-parametric choosing the method of conclusive statistics. If the calculation of descriptive statistics showed observational results with the normal distribution, the correlation coefficient was used (Pearson r), but if you failed to prove the empirical normal distribution – Spearman's rank correlation coefficient . Spearman's rank correlation coefficient, as well as Pearson correlation coefficient, the relationship is characterized by the direction and closeness. Relevance is statistically significant when the calculated correlation coefficient or modulus $|r|$ is greater than the critical value. The data used for quantitative analysis of IBM SPSS. 20 (Statistical Package for the Social Science) statistical package.

From the empirical study, the results derived statistical conclusions:

- There is no statistically significant relationship between the local project management specialists formal education and project management methods used – range in rs_{apr} .079 < RKR .196 ($\alpha = 0.05$).
- There is no statistically significant relationship between the local project management professionals in obtained continuing education obtained or the number of certificates in project management and project management methods used – range in rs_{apr} - .036 < RKR .196 ($\alpha = 0.05$).
- There is no statistically significant relationship between the local project management experience as a professionals and project management methods used – range in rs_{apr} - .184 < RKR .196 ($\alpha = 0.05$).
- There is no statistically significant relationship between the experience of local project management professionals and the content – completely or partially developed projects and advisory activities and/or project management methods used – range in rs_{apr} .173 < RKR .196 ($\alpha = 0.05$).
- There is a statistically significant weak positive correlation between the length and content of experience in project management, as rs_{apr} .201 < RKR .196 ($\alpha = 0.05$).

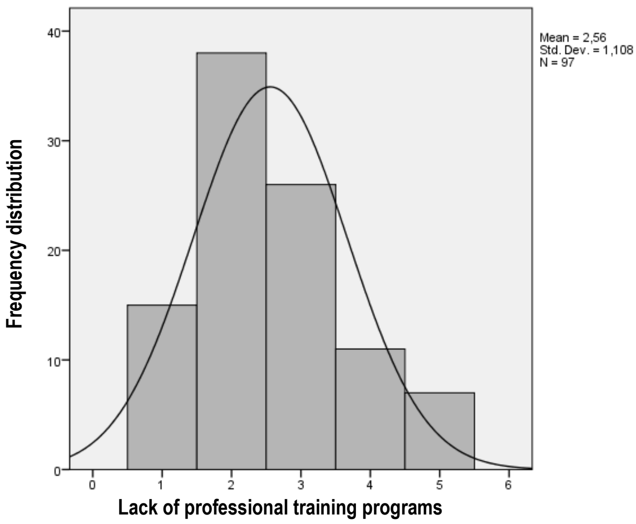
Quantitative analysis of the most important obstacles, why not apply the appropriate municipal planning project management methods and tools. Analogous to studying the local staff training, experience and professional development characteristics of the practical application of learned techniques of project initialization, planning and management processes, the study of the most significant obstacles were first implemented in the descriptive statistics.

First, the t-test one sample (t-test for one sample) was used, do local government employees by the responses have a statistically significant difference from neutral obstacle evaluation – or one of the obstacles is considered important, why not apply the appropriate municipal project management planning techniques and tools. Overall, an analysis of the assessment of the obstacles as "lack of professional training programs", "shortages of project management competencies and skills", "lack of human resources to ensure the project planning and implementation", "lack of adequate textbooks in Latvian", "lack of project staff initiative at the planning and implementation phase", "responsibility of officials and political leaders understanding of project planning importance and role" and "inappropriate and poor quality methodological documentation and guidelines".

Second, to show complex analysis of existing barriers to cross-structure were used factorial analysis. Factor analysis allows you to not only find the factors in several variables based on commitment, but also makes it possible to evaluate the association between factors and observed signs and answers the question, how big of a factor within each characteristic (Teibe, Beris, 2001). The descriptive statistical methods specific questionnaire looked at a sample of central tendency scores – the mean, the median, and the modules – drawing conclusions about the empirical distribution with the normal. Also identified were the asymmetry and kurtosis the fourth round of the moment.

Descriptive statistics for the lack of professional training programs in project management

Descriptive data show a bimodal distribution as the arithmetic mean of 2.56, correspond to any real-world amount. Therefore, the arithmetic mean is not a good enough indicator of central tendency. The median or arranged in rows in the middle of a variation of an existing value is 2, the most frequently occurring value distribution mode – and 2 but the standard 1.108. Overall, the figures illustrate the central tendency of a higher frequency response in a relatively cautious in its evaluation of professional training and programs such as the lack of which is a rare, almost no or only individual project planning and implementation processes.



Source: author empirical research

Fig. 1. **The value of the frequency distribution of the view of professional training programs in Project management**

Variations of parameters were determined asymmetry coefficient, which shows the frequency distribution of the degree of asymmetry, offset from the zero point, that is, the .580. Compared with the critical value of 100 respondents in the group at the confidence level of 0.05 A_{apr} .580 > A_{crit} 0.477, which shows the empirical distribution with the normal. In turn, kurtosis is - .231. Kurtosis shows how the frequencies are grouped on the x-axis, or they are more centered on the mean, or more dispersed over the whole measurement range of the scale. The greater the variation, the greater the excess, and it is negative. In principle, the local assessing participants' perceptions of professional training programs and the lack of visible diversity of views across the rating scale range. This means that there is no consensus on the issue of training and programs and why appropriate project planning methods and tools not applied. Kurtosis is – .231. It is obtained by adding the fourth consecutive 3 pointer or K4 moment. For group of 100 respondents K_{apr} 2.77 > K_{lb-kr} 2.35 or 2.77 K_{apr} > K_{ub-kr}. 3.77. The empirical distribution corresponds to the normal and is in accordance with the fourth round of the moment.

Descriptive statistics for the lack of experience and professional skills in project management

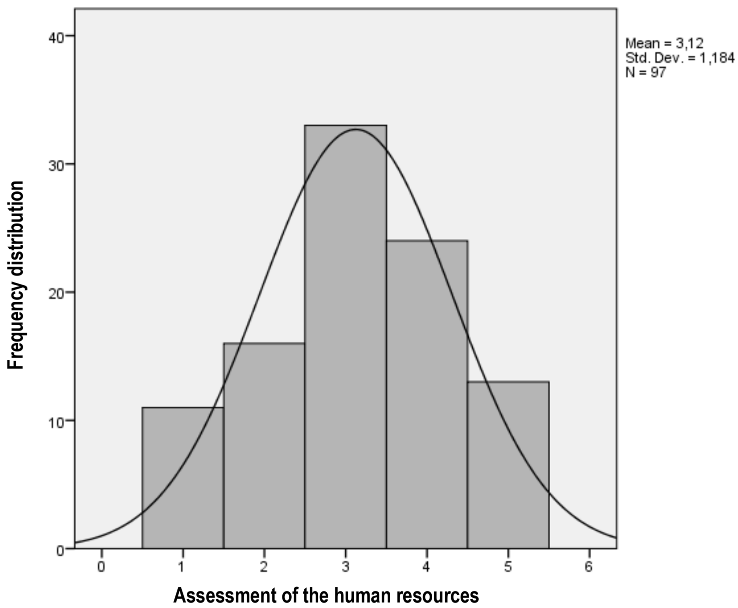
By the analogy, tests for descriptive statistics on the issue of competence and professional skills of the lack of importance of proper project management planning methods and tools were concluded. Were identified indicators of central tendency (arithmetic mean, or χ = 2.55, median 2 and mode 2), asymmetry and kurtosis compared with the critical limits. As A_{apr} 278 > A_{crit} 0.477 ($p < 0.05$), but kurtosis - .684, from which finished fourth row index K_{apr}. 2.32 < K_{lb-kr} 2.35 or 2.32 K_{apr} > K_{ub-kr} 3.77. ($P<0.05$), it could be concluded that the empirical distribution by contrast with the normal asymmetry factor, but after the fourth round of the moment in a modest deviation. Figure 2 shows that the competence and professional skills of assessment methods in the context for lack of professional training programs in the project management is similar but not identical.

Source: author empirical research

Fig. 2. **The frequency distribution of the competence and professional skills importance**

Descriptive statistics – assessment of the human resources

Also set of statistical indicators for the next questionnaire. The issue of human resource role of the arithmetic mean is 3.12. The median is 3, the mode is the third the standard deviation of human evaluation data is 1.184. Skewness coefficient is - .167, it means that a group of 100 people A_{apr} | - .167 | < .477 A_{crit}, which shows the empirical distribution with the normal. Kurtosis is - .698. K_{apr} 2.30 < $K_{lb\,-\,kr}$ 2.35 or 2.30 K_{apr} > $K_{ub\,-\,kr}$. 3.77. According to this indicator data empirical distribution does not meet the normal, which is illustrated in Figure 3. The value of the frequency distribution shown in the histogram. Unlike previous issues of human resources respondents evaluated as important, considering that this is a problem not only affects certain aspects of the use of the project management methods, but it's essential and very important problem, which affects the ability and capacity of local governments in project design and implementation.



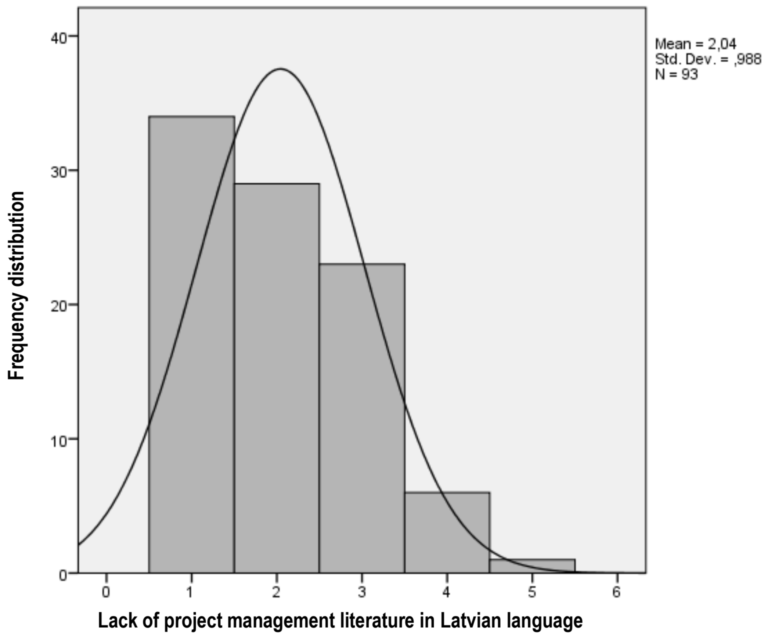
Source: author empirical research

Fig. 3. **The frequency distribution of the view of the importance of human resources**

Descriptive statistics for the lack of textbooks in Latvian language

Statistical analysis of the respondents' assessment of the lack of literature in Latvian language shows that arithmetic mean is 2.04. This means that statistically the average municipal employee considers the lack of project management literature rather than an insignificant problem and only isolated cases occurring in professionals practice. The median is 3, but the mode 1, which indicate that also the most common answers focused directly around the lower values contained in the response "we are faced with such problems", it is obvious that the histogram (sk.3.43. figure). The standard for project management textbooks evaluation is .988.

Skewness coefficient is .603, it means that A_{apr}, 603> A_{crit} 0,477, so the empirical distribution of the contrast with the normal. Kurtosis is - .374 K_{apr} 2.63> $K_{lb\ -\ kr}$ 2.35 or 2.63 K_{apr} <$K_{ub\ -\ kr}$. 3.77, Which also indicate the normal distribution.



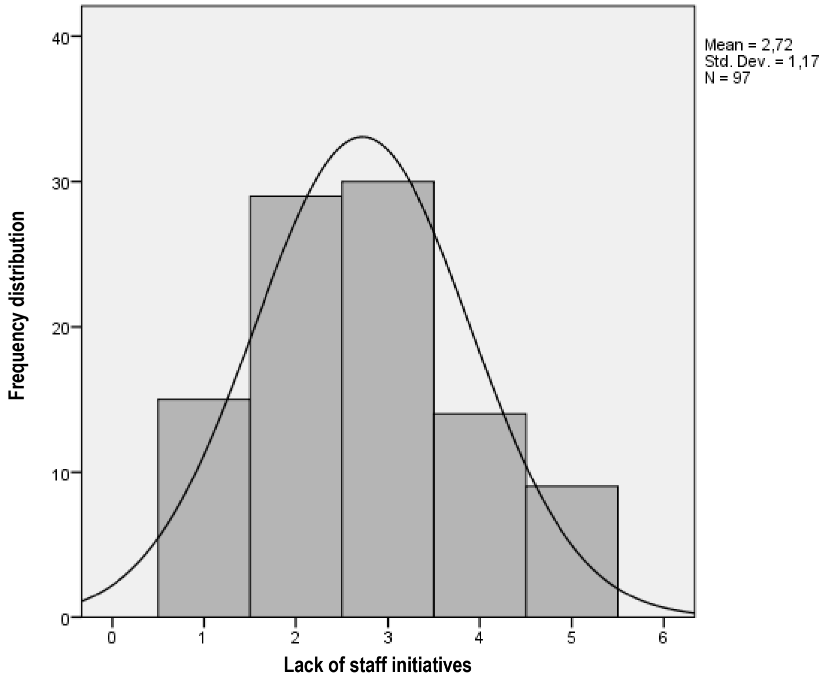
Source: author empirical research

Fig. 4. **The frequency distribution of the view of the lack of project management literature in Latvian language**

Descriptive statistics on employee initiative, lack of assessment

The following parameters were considered in the statistical analysis – lack of initiative of municipality staff in project planning and implementation processes. The results show evidence that local government officials conditionally critical concerns for employees' responsibilities – in both the median and the mode is 3, but the arithmetic average is close to 3 (2.72). This means that most of professional's has lack of initiative and it's a factor that affects the specific project planning and implementation processes, however, refrain assess the lack of initiative as a very significant problem. A_{apr} 2.72 > 0.477 A_{crit}, which shows the empirical distribution of non-compliance with the normal. Kurtosis is - .615. K_{apr} 2.39 > $K_{lb\ -\ kr}$ 2.35 or 2.39 K_{apr} < $K_{ub\ -\ crit}$. 3.77. Although the fourth consecutive fall in the critical moment of the theoretical value within the overall results indicate non-compliance with the normal data distribution.

The histogram in Figure 5 shows that opinions about the lack of importance of employee initiatives grouped around the average values of the relative trend in the swing of the lower ratings that lack of initiative is not considered a major problem in project planning and implementation context.



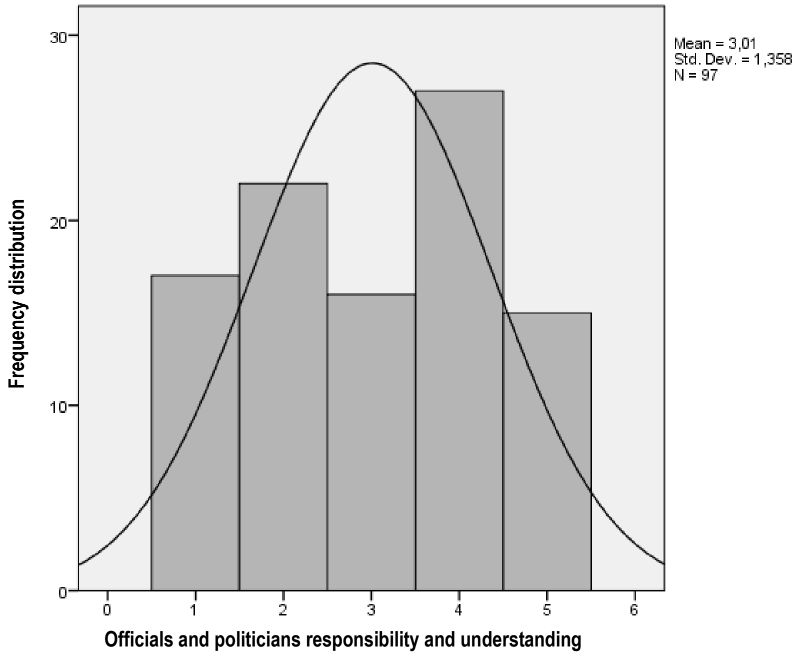
Source: author empirical research

Fig. 5. **The frequency distribution for the lack of staff initiatives**

Descriptive statistics for the officials and politicians responsibility and understanding of project management methods

Statistically, describing the poll question on the officials and local politician's responsibility and understanding of project planning and implementation methods and their role, it was found that the arithmetic mean is 3.01. Median 3, and mode 4, a standard deviation is 1.36. Since the mode is 4, which means that most local government officials who were interviewed chose the answer – "A major issue that has affected the ability and capacity of local governments in project design and implementation". Asymmetry parameter is - .070 as A_{apr}. $|- .070| < A_{crit}$ .664 ($p < 0.05$), it can be concluded that the empirical distribution corresponds to the normal distribution. Excess ratio is -1.264. So the fourth round figure obtained by adding 3 is 1.74. K_{apr} 1.74 < $K_{lb\ -\ kr}$ 2.35 or 1.74 $K_{apr} < K_{ub\ -\ crit}$. 3.77 ($p < 0.05$), therefore it does not meet the normal empirical distribution.

Figure 6 graphically displayed on the respondents' views of officials and politicians responsibility and understanding of project planning processes in local municipalities. The barriers to local project management specialists evaluated as the different views – ranging from the lack of contact with a similar problem – to the assessment that it's essential or very important problem. Moreover, this is a barrier that is considered to be very significant in relation to the research problem.



Source: author empirical research

Fig. 6. **The frequency distribution for the incomprehension of officials and politicians**

Conclusion

Public sector project realization planning represents a project management phase that encompasses goal definition and the determination of ways and measures for achieving the set goals, i.e., that the project is realized in the planned time, at the planned cost.

Study shows that self-assessment of public sector organizations in Latvia is quite high. Project management specialists define them self as very experienced in Project management, but meanwhile the self-assessment of organization project maturity (efficiency) levels shows that organizations is only at the beginning of setting up the appropriate Project management system. The public sectors project management usually is described as different kind of foreign financial instrument and program implementation.

To improve project management practice and efficiency in public sector in Latvia, author can recommend:

- To increase the capacity and professional skills level for local municipal project management staff (training programs, supervisions etc.);
- Define the appropriate organizational structure for project elaboration and implementation (matrix or pure project organization structures);
- Project management tools and techniques should be applied gradually (should be as an obligatory requirement in big scale public sector projects).

In addition for adequate analysis and for ensuring adequate flow of information of public investment evaluation, project managers play a vital role in:

- identifying potential investment sources, assess the strategic impact and socio-economic grounds, the potential benefits;
- identifying alternative solutions;
- ensuring that information is used in a manner that permits acceptance of suitable alternatives;
- coordinate the decision-making process with the organization's management tools;
- carry out an ex-post evaluation.

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THE CONTROLLING SYSTEM IN MANAGEMENT OF SMEs ENTERPRISES PROJECTS IN LATVIA: ISSUES OF FORMATION

Inese Ratanova, Baltic International Academy, Latvia[1];

Eduards Gross, University of Latvia, Latvia

Abstract

For the survival and development of the enterprises, especially small and medium-sized, they must adapt not only to rapidly changing environmental conditions, but also to the speed of changes. The tasks that solve the enterprises related to strategic changes and renewal of production, finding of new markets and good sales channels, cost management and cost reduction, alternative strategies development and competitiveness. Solving these problems requires from the manager of the enterprise the strategic competence and awareness of the need for change. Therefore, the management of the companies is in need in relevant mechanisms of information and analytical support of the necessary system information to manage the business almost online mode. Therefore, the management of enterprises must pay attention to the latest concepts of business management where the controlling plays a key role. The authors of the article substantiate the necessity of using approaches based by controlling concept in management of small and medium-sized enterprises in the modern economy conditions in Latvia.

Key words: *controlling, small and medium-sized enterprises, project management*

JEL code: M10

Introduction

Under the objective conditions, markets are becoming more global with new competitors, product life cycles are shortening, customers are more demanding and the complexity of technology is increasing. In the knowledge-driven economy, innovation has become central to achievement in the business world. With this growth in importance, small organizations have begun to re-evaluate their products, their services, even their management culture in the attempt to maintain their competitiveness in the global markets of today. While new business models represent new opportunities, small and medium enterprises have recognized the advantage of these developments, which can help them to survive in the face of increasing competition. Controlling tools with their typical interaction of planning, information gathering and control in the controlling cycle are highly important for future success. The **problem** of the management the small and medium enterprises is that the small and medium enterprises are limited in the implementation of system of controlling because of insufficient resources, knowledge. However, any enterprise wants to improve its strategies and take the advantage of the modern management tools independently of company size.

The **purpose** of this paper is to study the issues of application of the system of controlling in projects management of the enterprises SME category. The **object** of the study refers to small

[1] Corresponding author – e-mail address: inese.ratanova@bsa.edu.lv

and medium-sized enterprises in Latvia. The **subject** of the research is the using of controlling tools in management of SME in Latvia. The **methodological basis** for the article is made up of data analysis, statistical data analysis, and regulations, and guidelines of the Republic of Latvia as well as works of foreign authors, and research carried out by the authors. The listing of literature provides references to works of Latvian and international authors, and sources of publicly available information.

The theoretical aspects of the controlling concept

The system of controlling supplies information and provides instruments with which this information can be processed and evaluated. Due to the extensive and complex nature of the information itself, such steps are only possible with the help of electronic data processing systems. Thus, system of controlling is computer-aided and based on efficient software.

In each company, there are four hierarchical levels of management: material, operative, strategic and intellectual. These levels of management are responsible tasks connected with running the enterprise. The first two levels (material and operative) are concerned with operative controlling and the last two levels (strategic and intellectual) are concerned with strategic controlling. In German academics' understanding controlling is:

- a form of corporate management which is holistic, target-oriented, future-based and problem-solving in nature
- a system involving objectives and planning, organisation and implementation, supervision, steering and directing
- a method of corporate management which is contemporary, success-oriented and well-versed with targets and figures.

The transformation of controlling into a form of management had led to the development of a system of controlling which represents the core of far-reaching corporate governance. Müller and Horvath see Controlling as synonym to coordination. (Horvath, P., 1996) They take the Controlling as all the functions exercised by management in coordinating planning and control with the supply of information in order to achieve the firm's objectives, Controlling enables management to adapt the firm to changes in the environment by the process of planning and to carry out any coordination functions which may be necessary. (Horvath P., 1978) Albrecht Becker defines "Controlling" as a German word. "It is only partly identical with the present participle form of the verb „to control". In Business Administration in German speaking countries (which I will refer to as „Betriebswirtschaftslehre") it denotes a rather heterogeneous field covering what Bruggemeier calls „coordination of management by management information" ("Fuerungskoordination durch Fuehrungsinformation"). "Controlling" is understood as a device for, or even philosophy of, coordinating and controlling management, which in some way is related to the fields of management accounting and control systems and controllership. „We can define the controllership as the coordination function in a business, working in a detached an unbiased way, and charged with the responsibility of playing for profits and providing suitable profit control machinery. It is the investigative, analytical, suggestive and advisory function, studying the business all the time, and formulating what the proposed practice should be with reference to sales and production control, which, when excepted or modified by the executive management, becomes the approved practice for use by performance or 'line' function." Knoeppel. (Knoeppel C., 1987)

In nature of controlling are two different concepts – a German and an American. German concept is based on the internal aspect, American concept – including the external accounting systems, such as financial accounting. German-speaking countries controlling function is seen as a service function – support of managers in the strategic and operational management processes. In U.S.A, the record is limited to operational information to the management of the company through the accounting system.

American model of controlling focused on external users, so based on the audit and the audit approach. German controlling in the first place is a set of tasks related to the planning, the integrated information management system for tracking data. Controlling is the whole process of defining objectives, of planning and controlling (in the sense of steering and regulating) and includes all relevant financial and commercial aspects by the words of Peter Horvath. The German definition is close to Anthony's concept of management control. Throughout the 20th century, American and German academics were engaged in deep and thoughtful debate of "Controlling" definition and finally have made the conclusion, that German term "Controlling" corresponds to American term "Management Accounting". (Sharman P., 2004) Controlling involves monitoring, evaluating departmental, and staff activities on an ongoing basis, and taking appropriate corrective action when necessary. It is impossible to control departmental and staff activities without having a set of plans, standards and guidelines against which to compare actual performance. Senior management's monitoring activities are designed to monitor adherence to information systems policies, standards and procedures. Most current definitions of control refer to the strategy process in the same way. Roberty Anthony, for example, defines management control as "the process by which managers assure that resources are obtained and used effectively and efficiently in the accomplishment of the organization's objectives" and later as "the process by which managers influence other members of the organization to implement the organization's strategies". (Anthony, R. 1964)

Robert Anthony in 1964 suggested the classification for the various components of planning and control systems. (Anthony, R. 1964) According to Anthony these components or topics include the following criteria, described in table 1.1:

Table 1

Planning and Control Systems

Subsystem	**Definition**
Management Control	The process of assuring that resources are obtained and used effectively and efficiently in the accomplishment of the organization's objectives.
Strategic Planning	The process of deciding on changes in the objectives of the organization, in the resources that are to be used in attaining these objectives, and in the policies that are to govern the acquisition and use of these resources.
Technical Control	The process of assuring the efficient acquisition and use of resources, with respect to activities for which the optimum relationship between outputs and resources can be approximately determined.

Source: prepared by authors based on the classification by Robert Anthony

Anthony defines "managed costs" in making a distinction between management control and technical control. Management control involves the whole organization and includes those parts of the organization where managed costs are significant (Anthony, R. 1964). Technical control involves only activities where there are no significant managed costs. Management control covers the whole organization, where technical control relates to subunits, or activities of subunits.

The focus of management control has changed over the years. Historically, the focus of management control was the accounting, base on financial information. Factory accounting, budgeting and cost accounting were the main activities performed. Management accountants provided support in areas of planning and control using financial data. Non-financial data was used only in providing financial advice.

The term "control" is used in a wide variety of situations to describe many different phenomena. Consequently, different disciplines use the term differently. A useful way to describe what is meant by management control in the context of financial management is: Management control systems consist of all organization structures, processes and subsystems designed to elicit behaviour that achieves the strategic objectives of an organization at the highest level of performance with the least amount of unintended consequences and risk to the organization. Controlling involves the action designed to ensure that an entity is successful in achieving its objectives. In an organization, this usually involves managing people in such a way as to elicit their best efforts on behalf of the organization. The controlling process consists of:

1. Goal-setting, governed by the overall objectives of the organization, its owners, members or managers; goals could be specified in terms of the expected behaviour of individuals or in terms of the expected outcome.
2. Performance monitoring and measurement, based on observation of behaviours and/or outcomes.
3. Comparison of goals and achievements and identification of variations between them, particularly significant under-achievements.
4. Seeking explanations for variations between goals and achievements, especially under-achievements.
5. Rewarding success and taking steps to reduce or eliminate causes of failures to achieve goals.
6. Following-up to ensure that actions taken in connection with problems are adequate.

Controlling hierarchical perspective:

- Strategic planning, carried out at the top levels of the organization, is a process of deciding on goals and selecting strategies for attaining those goals.
- Managerial control, carried out at the middle management levels of the organization, is a process of ensuring that departmental plans and programs designed to fulfil the strategic plans of the organization are carried out.
- Operational control, carried out at the operating levels of the organization, is a process of ensuring that specific tasks are carried out properly and efficiently.

In their monograph entitled Criteria for Management Control Systems, Robert Mautz and James Winjum describe various concepts of control from a historical perspective and distinguish between accountants' views about control and management's views. (Mautz R.,

1981) They point out that management's concept of control is much broader than that traditionally espoused by accountants.

Controlling is also viewed as an integral part of managerial responsibilities and activities. Thus, controlling is not something performed after the fact, but a continuous function performed along with other functions (planning, organizing and directing) necessary to the success of the organization.

It is widely recognized that management's functions include planning, organizing, staffing, directing and leading, controlling, and coordinating. It is management's responsibility to put enterprise resources to use, sometimes taking risks, to achieve the goals of the organization, whether it be to earn a profit (in the private sector) or provide a social service (in the public sector). Management sets goals and formulating policies, developed plans to achieve goals within the framework of the entity's policy guidelines, implements programs of action designed in accordance with the plans, maintains information systems to report progress towards achieving the specified targets, and reviews the results of all of these activities, identifying needed changes to goals, policies and plans. (Garrison, R., 2003)

2. The role of controlling: practical aspects

The economic communications globalization, information technologies development, technological progress, competition and market requirements it processes, which characterize the present stage of the world economy development. The modern enterprise is a complex system that has developed on the basis of scientific and technical progress, the rapid changes in the external environment and highly competitive environment. In these conditions the achievement their strategic targets is not a simple task. For the operative decision-making, every manager need timely and relevant information about the changes occurring both in external and internal enterprise environment, therefore enterprise management system must be constantly improved. For the survival and development of the enterprises, especially small, they must adapt not only to rapidly changing environmental conditions, but also to the speed of changes. Tasks that solve enterprise are associated with strategic changes and renewal of production, finding new markets and good sales channels, cost management and cost reduction, the development of alternative strategies and increase of competitiveness. Solving these problems requires the manager of the business strategic vision and competences. Therefore, the management of enterprises must pay attention to the modern concepts and approaches of business management where the controlling plays a key role.

Controlling services of foreign companies provide systematic data collection, processing and analysis of information across all the departments of the company, determines its compliance with the adopted strategy of development, prepares constructive proposals for governance and management for effective problems solving in a timely manner. Duration of successful functioning of any organization always depends on efficiency of decisions accepted by their management. This major purpose puts organizational structure in position of a controllable process. For this reason, controlling combines all the functions, exercised by management in coordinating planning and control with the supply of information in order to achieve the enterprise objectives. Controlling enables management to adapt the enterprise to changes in the environment by the process of the planning and to carry out any coordination functions that may be necessary. Being on crossing of the accounting, a supply with information, the control and planning, controlling takes a special place in operation of business: it connects together all functions of the enterprise, integrates and coordinates them, and does not just substitutes for operation of business, but also gives it a qualitatively new level. The increasingly competitive economy, the large amount of new laws and regulations has put significant pressure on managers' abilities to make informed business decisions to maximize their companies' performance. As a response to these needs, a range of management techniques, such as system of controlling has been created and adopted by corporations. However, the systems of controlling, created for the large corporations, are too expensive and complicated for the small and medium enterprises. Small and medium enterprises are the fastest-growing sectors of the economy and they are constantly dealing with change. Small and medium enterprises are volatile, often experiencing growth and decline rates with high degrees of non-linearity. Especially small and medium enterprises must be capable of adapting because they are often growing at a relatively rapid rate and can be drastically affected by small changes in society. Small and medium enterprises usually operate under the complicated circumstances of aggressive surroundings: such as uncertain increasingly complex and dynamic business environment; complexity of the management processes; small budget and limited resources. Under the objective conditions, markets are becoming more global with new competitors, life cycles of product is shorter, customers are more demanding and the complexity of technologies is increasing.

In the knowledge-driven economy, innovation has become central to achievement in the business world. Controlling tools with their typical interaction of planning, information gathering and control in the controlling cycle are highly important for future success. It should be noted that initially only large enterprises began to apply the system of controlling, but today possible to say that this concept longer is not the prerogative of big business. Certainly, this concept application by small enterprises requires appropriate methods, regulatory procedures, development taking into account the size, and complexity of enterprise business processes.

Obviously, that small business needs in the application of innovative management techniques to create the management system in small enterprises, which would be take into account the specific needs of small businesses in Latvia. At present, controlling models are rarely applied in practice in Latvian business. Being a small business enterprise, it means standing alone, coping with high level of autonomy.

3. Entrepreneurship aspects and statistical data of SMEs in Latvia

3.1. Entrepreneurship aspects

Entrepreneurship makes economies more competitive and innovative and is crucial in achieving the objectives of several European sectorial policies. Commercializing new ideas improves productivity and creates wealth. Without the jobs from new firms, average net employment growth would be negative. New companies, especially SMEs, represent the most important source of new employment: they create more than 4 million new jobs every year in Europe. Yet the engine for this recovery has been stuttering: since 2004, the share of people preferring self-employment to being an employee has dropped in 23 out of the 27 EU Member States. While three years ago for 45% of Europeans self-employment was their first choice, now this percentage is down to 37%. By contrast in the USA and China this proportion is much higher: 51% and 56% respectively. Moreover, when new enterprises are founded, they grow more slowly in the EU than in the USA or emerging countries, and fewer of them join the ranks of the world's largest firms. The level of entrepreneurship and its nature vary widely between Member States, and there as ones for low enthusiasm for an entrepreneurial career are therefore diverse. Some Member States with higher levels of entrepreneurship are less successful than others at helping new and small enterprises to grow. Generally would-be entrepreneurs in Europe find themselves in a tough environment: education does not offer the right foundation for an entrepreneurial career, difficult access to credits and markets, difficulty in transferring businesses, the fear of punitive sanctions in case of failure, and burdensome administrative procedures. (Entrepreneurship 2020 Action Plan, 2013)

Robert Hisrich gives, in our opinion, one of the most concise definitions of the essence of entrepreneurship: the process of creating something new, something that has value, and entrepreneur - a person who spends all this necessary time and effort, assumes all financial, psychological and social risk, receiving in reward the money and satisfaction from achievements. (Robert Hisrich)

Entrepreneurs are individuals who recognize opportunities where others see chaos, contradiction, and confusion. They are aggressive catalysts for change within the marketplace. The global economy has been revitalized because of their efforts and the world now embraces free enterprise as the most significant force for economic development. The passion and drive of entrepreneurs move the world of business forward. They challenge the unknown and continuously create breakthroughs for the future.

The terms entrepreneurs and small-business owner sometimes are used interchangeably. Although some situations encompass both terms, it is important to note the differences in the titles. Small businesses are independently owned and operated, are not dominant in their fields, and usually do not engage in many new or innovative practices. They many never grow large and the owners may prefer a more stable and less aggressive approach to running these businesses; in other words, they manage their businesses by expecting stable sales, profit and growth. On the other hand, entrepreneurial ventures are those for which entrepreneur’s principal objectives are innovation, profitability, and growth. Thus, the business is characterized by innovative strategic practices and sustainable growth. Entrepreneurs and their financial backers are usually seeking rapid growth and immediate profits. They even seek the sale of their businesses if there is potential for large capital gains. Thus, entrepreneurs may be viewed as having a different perspective from small-business owners on the development of their firm. (Kuratko D., 2008)

The personal backgrounds of the individuals who undertake industrial activity are strongly influenced by several internal and external factors including the world situation, political trends, etc. Thus, a multitude of factors affect people’s entrepreneurial spirit and they, in turn, cast their influence on their environment (Pande J.2009).

The definition of the term as provided by the Small Business Act of 1953 in the United States. According to this act, a small business is one that is independently owned and operated and not dominant in its field of operation. The act also autorized the Small Business Administration (SBA) to develop a more detailed definition that takes criteria as sales volume and the number of employees in the firm. It is also important to acknowledge the qualitative factors that distinguish a small business from a large firm. The Committee of

Economic Development has outlined four characteristics that describe the domain of small business:

1. Management is independent, since the manager usually owns the firm.
2. Capital is supplied and one individual or a few individuals hold ownership.
3. The area of operations is primarily local, although the market isn't necessarily local.
4. The firm is small in comparison with the largest competitors in its own industry.

Taken together, these characteristics provide a qualitative description of small business. However, it is important to consider both the quantitative definitions and the qualitative factors when trying to define small business.

The basis of national competitiveness is the existence of competitive businesses, whose success depends on the factors of entrepreneurship environment. For successful economic transition to a new stage of development, it is necessary to solve a series of questions, and first we need entrepreneurs who are ready to start their own business and to set up new companies. (Hodgetts R., Kuratko D., 2002)

Enterprises are relatively stable organizations and institutions of the economy - the host in different countries and periods of history, various legal forms, especially ownership - which, thanks to its many outdoor and potentially autonomous abilities (goals) provide households with higher long-term utility owned by them capital (human, tangible, monetary, intellectual, social) than they themselves could achieve by their own management in a market economy, the state, or any thereof mix. More than 99% of businesses in Europe are SME that employ more than a half of the employed. (Noga A., 2009)

The Entrepreneurship Action Plan is a blueprint for decisive action to unleash Europe's entrepreneurial potential, to remove existing obstacles and to revolutionize the culture of entrepreneurship in Europe. Investments in changing the public perception of entrepreneurs, in entrepreneurship education and to support groups that are underrepresented among entrepreneurs are indispensable if we want to create enduring change.

Only if a large number of Europeans recognize an entrepreneurial career as a rewarding and attractive option will entrepreneurial activity in Europe thrive in the long term.

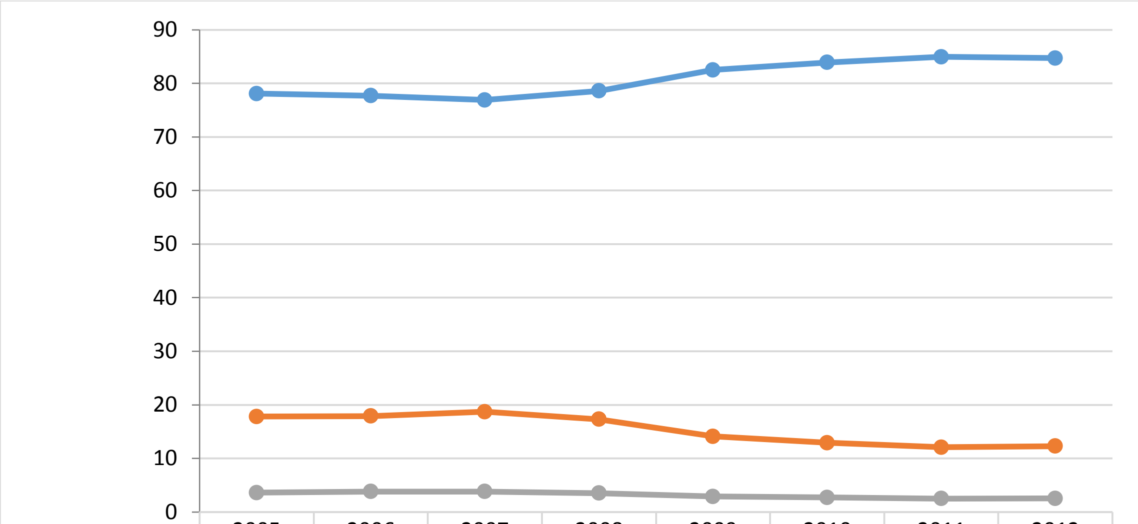
The Entrepreneurship 2020 Action Plan is built on three main pillars:

1. Entrepreneurial education and training.
2. Creation of an environment where entrepreneurs can flourish and grow, and
3. Developing role models and reaching out to specific groups whose entrepreneurial potential is not being tapped to its fullest extent or who are not reached by traditional outreach for business support. (Entrepreneurship 2020 Action Plan, 2013)

3.2. Statistical data of SMEs in Latvia

Small business in the economies of many countries occupies a decisive role, number of small and medium-sized enterprises in France is about 2 million ,in Germany – 2.3 million , in the UK – 3 million, in Italy – 5 million , in Japan about 5.7 million, representing 99% of the total number of enterprises . United States of America shows 20 million small businesses, which provide jobs for more than half of the active population of the country, but it should be noted that in other countries the number of small business are lower than in the U.S.A. China has 3 million small businesses and more than 30 million individual businesses, which account for only 55 % of the total number of enterprises. In Singapore are 140 thousand small enterprises it is 90 % the market sectors, in Russia - 1.6 million enterprises, of which 1.3 million are micro enterprises. Small business employs most of the population – 60% in the U.S., Germany, France, Italy – 65-80%, 80-88% in Japan.

In Latvia, just as elsewhere in Europe, SME form a major part of the national economy and play a significant role in building the GDP and in employment. According to the CSB preliminary data, there were 89 106 economically active individual merchants and commercial companies in Latvia in 2012 (excluding farms, and fish farms and self-employed persons, who perform economic activity), 99.53% of which belonged to the category of SMEs. The breakdown of economically active SMEs in Latvia is the following: micro-enterprises – 84.72%, small enterprises – 12.29%, medium-sized enterprises – 2.52%, large enterprises – 0.47%. The data in the Figure 1 demonstrates that the percentage of micro enterprises is increasing. However, at the same time, it means that an enterprises size reduction is taking place; we see that the percentage of the small and medium enterprises is substantially falling.

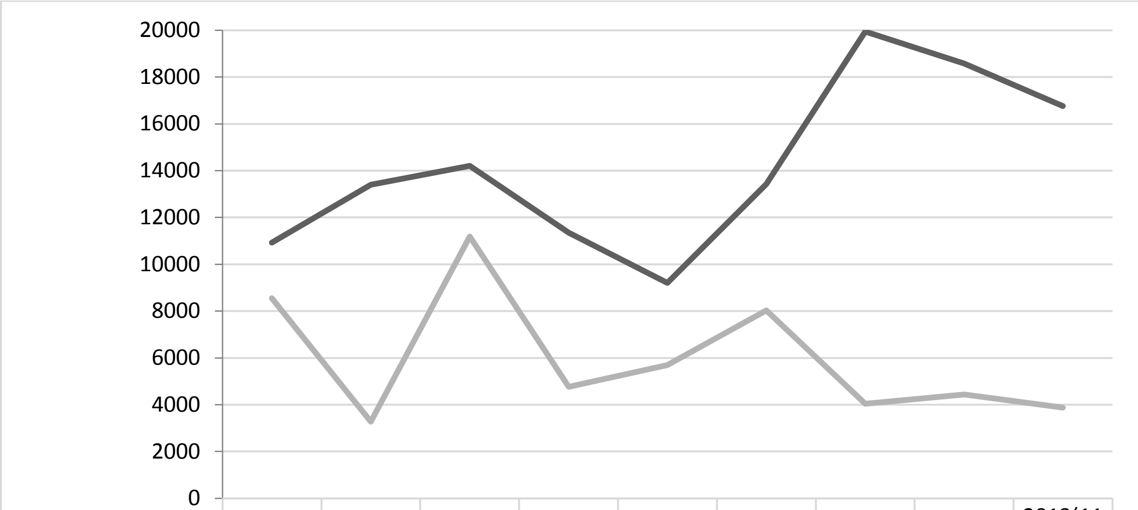


	2005	2006	2007	2008	2009	2010	2011	2012
Micro	78,1	77,7	76,9	78,6	82,5	83,9	84,94	84,72
Small	17,8	17,9	18,7	17,3	14,1	12,9	12,08	12,29
Medium	3,6	3,8	3,8	3,5	2,9	2,7	2,51	2,52

Source: prepared by the authors based on the data of the CSB

Fig. 1. **Dynamics of active merchants and commercial companies in relation to the total number of registered subjects in Latvia (2005-2012), (%)**

According to the statistics of the Register of Enterprises, 18 574 subjects were registered and 4443 subjects were liquidated in the year 2012. Whereas, in the eleven months of 2013, 16 758 subjects were registered and 3871 subjects were excluded from the registers of the Register of Enterprises.



	2005	2006	2007	2008	2009	2010	2011	2012	2013(11 months)
Registered	10927	13404	14208	11347	9207	13421	19942	18574	16758
Liquidated	8555	3274	11186	4764	5698	8035	4041	4443	3871

Source: prepared by authors on the base of data's of the Central Statistical Bureau Register of Enterprises and Commercial Register

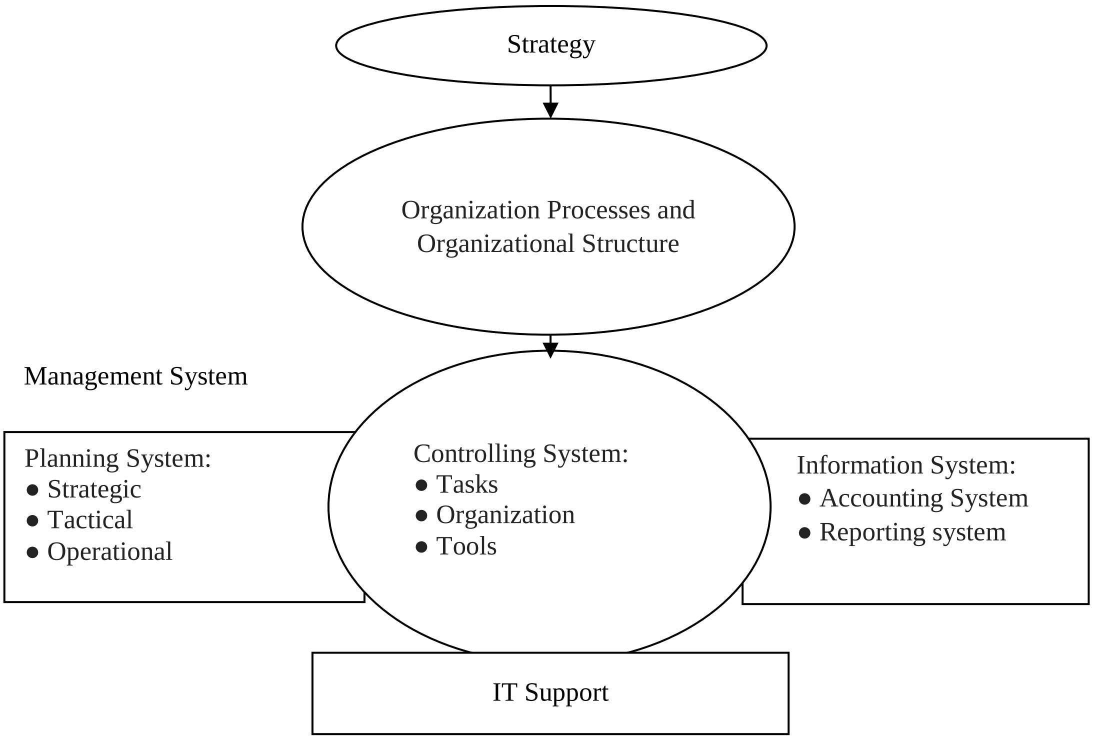
Fig. 2. **Dynamics of registered and liquidated subjects (2005-2013), units**

Figure 2 shows that the peak in the number of registered and closed enterprises are closest in 2007. That year 14208 subjects were registered and 11186 enterprises closed. In 2008 and 2009, there was a steady trend of reduction in the number of registration of new enterprises and the increase in the number of those closing. In 2010, the registration of new enterprises increased, but so did the number of closed enterprises. This trend correlates with the growth in the number of micro-enterprises and also with the reducing numbers of the small and medium-sized companies. 2012 and 2013(11 months) shows a negative trend of the number of registered subjects in comparison with 2011.

An important indicator characterizing economic activity is the number of economically active merchants and commercial companies per 1000 inhabitants. This indicator in Latvia has grown constantly over the last 10 years from 17 in 2001 to 38 in 2012. However, it is equally important to emphasize the number of performers of individual work (self-employed persons) in 2012 – 47 878 (23 per 1000 inhabitants), as well as the number of farms and fish farms in 2012 – 13 192 thousand (6 per 1000 inhabitants). Taking into account the fact that there is no single methodological practice among the EU Member States for calculating such an indicator characterizing the economic activity as the number of enterprises per 1000 inhabitants, it is difficult to perform an objective comparative analysis of this parameter. The current practice of the responsible EU institutions shows that calculation of the number of enterprises per 1000 inhabitants includes not only individual merchants and commercial companies, but also performers of individual work, farms, and fish farms, etc. Therefore, by applying an analogous practice, in 2011 in Latvia there were 69 performers of economic activity per 1000 inhabitants. Nevertheless, after a severe contraction in 2008-09, with significant support from EU funds, the Latvian economy started to grow again towards the end of 2010. The economy expanded by 5.5% in 2011, driven mainly by exports and investments. Latvian GDP per capita is nevertheless one of the lowest in the EU (58% of the EU-27 average in 2011). Without any competition, Riga is by far the centre for enterprise formation and entrepreneurial activities in Latvia. The Riga region has the number of economically active commercial entities is twice as high as in all other planning regions together and produces two times more GDP.

4. Formation of controlling system: general approach

Implementation of the system controlling the organization involves the creation of effective organizational structures that are better adapted to function in a changing economy. Layered vertical controlling system provides enterprise management system (group of companies), flexibility and value to changes in conditions of the external and internal environment, while maintaining the overall strategic direction of development units (individual companies). Controlling system is shown in Figure 3.



Source: author's construction based on Horváth & Partners

Fig. 3. **Scheme of the controlling concept**

First, in the forming of the controlling system should be interested owners of capital, as the efficiency of its use will determine the level of costs of alternative investments. The main objectives of the formation of controlling system in company will be:

- Optimization of the organizational structure of the company.
- Organization of an effective system of accounting operations and results.
- Implementation of planning, monitoring and analysis activities.
- The ensuring of staff motivation in improving the performance of the company.
- Automation of accounting and management of company.

Table 2

Formation and implementation of controlling at small and medium sized enterprises (sequence of stages)

Stage	Designation	Tasks
Stage 1	Planning activities	• Elaboration system of planning • Revenue planning • Cost planning • Planning financial results
Stage 2	Management accounting	• Bringing the entity's accounting policies in conformity with the requirements of management accounting • Development and implementation of management accounting by products, by business units, by activities
Stage 3	Organization of work units	• Bringing organizational structure in compliance with the goals, objectives and functions of the enterprise • Development a system of performance indicators for company / units / employee. • System implementation of control and motivation • Development of system of the internal documentation and reporting
Stage 4	Development a system of analysis of performance indicators	• Financial (economic efficiency, financial stability, solvency, breakeven, etc.) • Customer (product quality and customer satisfaction, market share, sales volumes dynamics, prices, turnover and customer base, etc.) • The level of technology and staff quality • Deviations from targets and analysis of the causes of deviations
Stage 5	The financial and economic control	• Creating a control unit, providing the solving analytical issues, monitoring and providing the managers of company most objective information
Stage 6	Automation of manage-ment pro-cesses	• Planning for income and expenses, cash flow, the upcoming tax payments • Operational reports on the formation of the current state of performance of the company; plan / fact, analysis of deviations • Internal workflow and reporting • Integrated and modular automated enterprise management system

Source: prepared by author's

Table 3

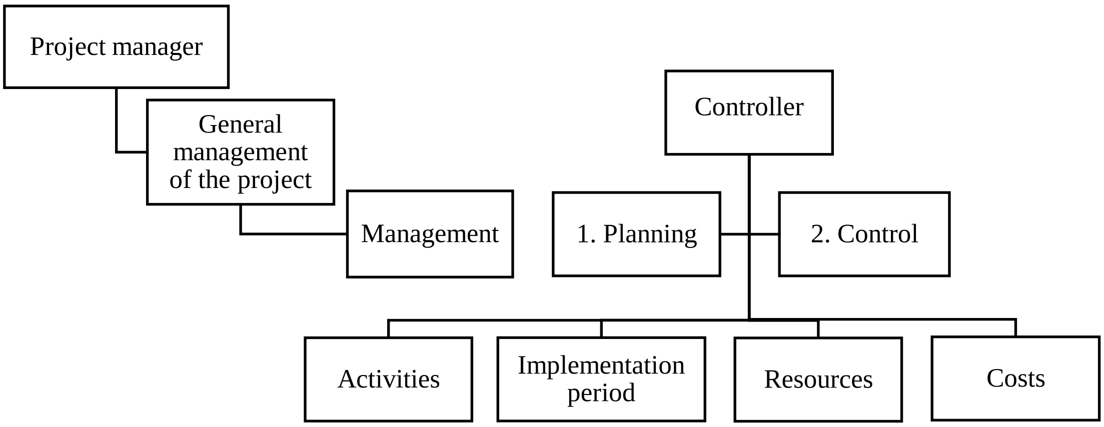
The criteria of the implementation of system of controlling

Criteria	Designation
Appropriateness	• appropriateness of solution compared to the enterprise's needs • objectives compared with available resources • comparison of need now with original need
Effectiveness	• original objectives compared with outcomes (what was desired and what was achieved) • outcomes compared with needs • outcomes compared with standards • present outcomes compared with past outcomes • comparison between target groups within the enterprise
Efficiency	• current costs compared with past costs (people, processes, technology and tools) • costs compared with similar systems • extent of implementation compared with targets
Financial indicators	• current working capital compared with past working capital • current liquidity ratios compared with past liquidity ratios • current profitability indices compared with past indices

Source: prepared by author's

4.2. Project controlling: Controller functions in the SMEs projects

Currently, innovation is no longer the prerogative of large businesses. More and more companies category of small and medium sized businesses use innovation to grow your business. The lack of effective management of innovation processes is one of the main reasons for the failure of commercial innovations. Of special importance is the process of managing innovation in an increasingly dynamic market. Moreover, innovations in technology and product features heavily than other types of activities, involve risks (technical, time, economic) and investments. Innovation in the enterprise can be regarded as separate projects, because they has all the features of the project: novelty, no regularity, complexity, poor structuring; risks and limited budget, implementation period, phases with intermediate goals and objectives. Thus, if the innovation can be regarded as individual projects, for their control can be used the Project management methodology. For project management in the enterprise can be used different organizational forms. The most widely spread the Institute of project managers. There are different forms to incorporate project teams in organizational structures of management. At the project management are created one or more groups in which concentrate the material, human and financial resources. Project Manager determines the content and timing of the project, coordinates technical and financial aspects of the project. In a rigid system of project management fits concept project-controlling. The main objective of the project-controlling is to oversee the progress of the project, in the control and information support effective management of the project. Before you monitor and to control, it is necessary to make project implementation plan. The task of planning the project involves formulation and establishment of project parameters: activities (jobs), timing, human and material resources, and costs. (Figure 4)



Source: author's construction

Fig. 4. **The functions of controller in project controlling: distribution of functions planning and control**

The Controller itself does not develop a plan innovative project; this function is assigned to project manager. However, techniques and planning tools should be developed and presented to the project team by controllers. Development of forms for the planning and supervision (control) project relates to the functions of the controller. The functions of the controllers working in the project group, includes accounting tasks , the fixation of the planned and actual deadlines and facilities used , as well as an intermediate calculations. Controller reflects the identified deviations of actual values from the plan in the reports, as well as the reasons for deviations and possible measures to address them. Depending on factors such as the cost of the project, the level of risk, competition and other factors depends the frequency of control with which oversees the implementation of the project and providing of reports. According the data of accounting conducted on the basis of their calculations, the controller provides an analytical report to the project manager.

Conclusions

In order to increase the effectiveness of the enterprise's activity in the present economic conditions are necessary new methods of supervision corresponding to the complexity of external and internal environment of the enterprises. The dynamism of the modern market economy determines the need for using concepts of controlling in the practice of Latvian SME enterprises. According to the authors, objective reasons reflecting the needs in controlling application by Latvian enterprises include the following:

1. In the highly dynamic market environment of today, unique competitive positions in the market can be achieved small business enterprises if they are always one step ahead in the external development, and has already adapted its management strategy before a changes occurs.
2. The increasing of information flows at the enterprise while reducing the relevant information requires the elaboration of the special system of management information and decision support. The complication of the enterprise management system requires the coordination mechanism within the system.
3. The controlling system as part of the company's development in the small enterprises is as project that include strategic and tactical objectives of system operating conditions. It is important choosing the appropriate tools as well as the employees ability to collect, process and analyze the data.
4. The design of system of controlling is a potentially never-ending process, aimed on support of competitiveness. The research demonstrated that the existing classic systems of the controlling are complicated for the small companies.
5. The formation of the system of controlling for the small and medium-sized enterprises should be based on already existing operational tools and their adapting to the specific demands of enterprise.
6. Entrepreneurship makes economies more competitive and innovative and is crucial in achieving the objectives of several European sectoral policies. Commercializing new ideas improves productivity and creates wealth. It points at that, the small companies and managers of these companies needs to improve enterprise management system, implement management technologies that meet the business needs of today's time.
7. In the forming of the controlling system should be interested owners of capital, as the efficiency of its use will determine the level of costs of alternative investments.
8. The controlling concept requires appropriate methods, for application by small enterprises, such as regulatory of procedures, development taking into account the size, and complexity of enterprise business processes. Obviously, that small business needs in the application of innovative management techniques to create the management system in small enterprises, which would be take into account the specific needs of small businesses in Latvia. At present, controlling models are rarely applied in practice in Latvian business. Being a small business enterprise, it means standing alone, coping with high level of autonomy.
9. More and more companies category of small and medium sized use the innovation to grow their business. The lack of effective management of innovation processes is one of the main reasons for the failure of commercialization of innovations. Innovation in the enterprise can be regarded as separate projects, Innovation in the enterprise can be regarded as separate projects where in a rigid system of project management fits concept project-controlling.
10. The project-controlling concept can be successfully applied in a rigid system of project management, where the project controlling is playing the main role, providing a high level the oversee the progress of the project, and the control and information support effective management of the project.

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DEFINING THE VALUE OF SUSTAINABILITY IN PROJECTS

Pascal Reusch, The European University of Applied Sciences, Germany[1]

Abstract

The project manager is in a unique position. Due to the fact that he is leading a project he is leading substantial change in the organization. Especially in large projects he therefore influences long-term structures of the company, e.g. production facilities, supply networks.

Besides his imminent project scope he therefore has to take into account the long-term effects of the project as well as the risks that might hit the company in the further future – and needs to take action to deliver sustainable project results. However sustainability is a complex issue covering social, environmental and economic topics. A necessary first step is to define which special aspects of sustainability create a VALUE for the company and especially for the customer.

We apply the tool of Value Analysis to the context of sustainability. Value Analysis is a standardized tool defined in several European Norms. The standard describes a systematic method to identify the "value" of products and services. Value, as defined, is the ratio of function to cost. Value can therefore be increased by either improving the function or reducing the cost. In this article we focus on the interpretation of sustainability as a function – especially a function to deliver value to the customer.

Key words: *sustainability, value, value analysis*

JEL codes: L210, Q510

Introduction

Why is sustainability important to create value?

"A project is a temporary endeavour undertaken to create a unique product, service or result" (PMI, 2013, p. 1). In a business environment this is typically done to achieve a competitive advantage. "Competitive advantage grows fundamentally out of value a firm is able to create for its buyers that exceeds the firm's cost of creating it. Value is what buyers are willing to pay, and superior value stems from offering lower prices than competitors for equivalent benefits or providing unique benefits that more than offset a higher price." (Porter, 2004, p. 3) If for example a new product is designed as a project result, project success will be defined by the acceptance of this product in the market.

The project work is thereby part of the firms "collection of activities that are performed to design, produce, market, deliver, and support its products. All these activities can be represented using a value chain." (Porter 2004, p. 36)

This value chain has to take into account all different kinds of aspects that generate value for the customer. The "shadow side of industry has been overlooked in the value chain concept, which gauges how each step in a product's life, from extracting materials and manufacture through distribution, adds to its worth. But the notion of the value chain misses a crucial part of the equation: while it tracks the value added at each step of the way, it ignores the value subtracted by negative impacts." (Goleman, 2009, p. 27)

[1] Corresponding author – e-mail address: reuschp@gmail.com, telephone: +492232/5673-620

In recent years the effects of the negligence of these negative effects of global business have become more and more transparent due to public discussion about Global Warming, resource depletion etc. (Berns, et al., 2009, p. 20) This publicity showed consumers the effect of the consumption besides the imminent exchange of a good for money. Consumers start to ask questions about the “origins of the raw materials, specifics of the production methods, geographical shipments, environmental or social labels and the company’s human rights policies.” (Das Gupta-Mannak, 2011, p. 125) This change in customer values needs to be integrated into project work in order to generate project results that truly deliver stakeholder value.

Research results and discussion

How to come from values to project deliverables.

The structured approach to derive what part of a product or service is of value for a customer – called Value Analysis – dates back to 1947 and was proposed by Lawrence D. Miles.

Miles was working for General Electric Co. and was confronted with shortages of skilled labour, raw materials, and component parts due to the WWII. He looked for acceptable substitutes and noticed that these substitutions often reduced costs, improved the product, or both. He therefore defined a systematic process to rethink how products can be built. (Miles, 1969, p.69)

The main idea of the concept is the functional analysis. Underlying is the believe that the customer does not have an interest in buying a specific object but only in the functions – or the impact – that the object delivers. (VDI, 2011, p. 5) Anyone who bought for example a cordless electric screwdriver in a hardware store can experience this thinking when reflecting the purchase. No one gets value out of the fact that he owns a screwdriver – it sitting on the shelf in the workshop getting dusty and taking up space. The value is delivered by the possibility to hang up pictures or repair furniture whenever necessary.

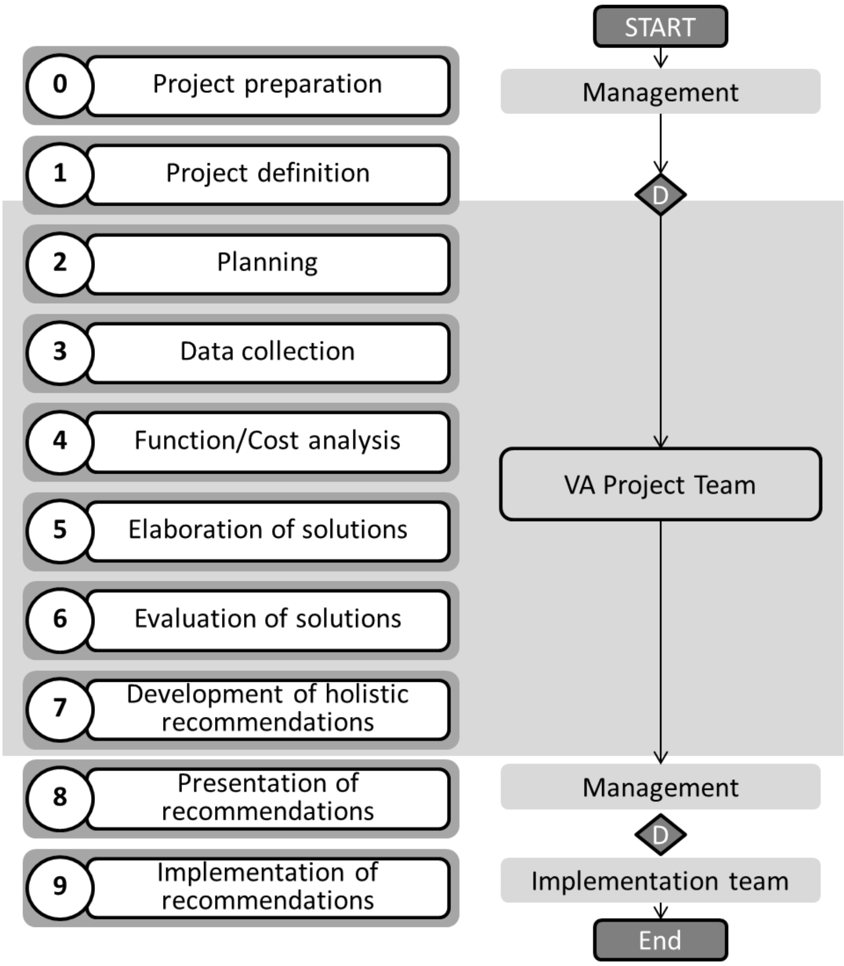
The European Norm on Value Analysis DIN EN 1325-1 defines a “need” as something that is necessary for a user or is requested by him. This need can be explicit or implicit as well as a current or a potential need. (VDI, 2011, p. 14)

Since value can only be grasped when exchanging goods or services, quantification of value can be achieved by comparing the level of fulfilment of needs to the resources that have to be given in exchange. The European Norm on Value Management (DIN EN 12973 2000) puts this in the following relation. The symbol α in the relation below shows that this is not a mathematical equation but rather a flexible ratio where all components need to be weight against one another.

$$Value \propto \frac{Fulfillment\ of\ a\ need}{Use\ of\ resources} \tag{1}$$

Value Analysis defines a structured process shown in Fig. 1 to identify these values. This process in itself is set up like a project. It starts with the project preparation where the Project Manager and the Project Scope are defined. In the following project definition the Target Key Performance Indicators need to be defined, Target Values need to be set and the boundaries of the project need to be specified. Result is a detailed requirements specification. The planning phase includes teambuilding activities and typical Project Planning tasks like scheduling.

With phase number three the actual project work begins and all the necessary data is collected and analyzed. During the Function/Cost analysis this data is used to structure the needs of potential users and to define the costs that are related to each of the function relevant for the user (for example defined as the production cost to build this function into a future product). This Function/Cost analysis is typically focused on a current product. In the next phase several creativity techniques are used to identify or develop new solutions for delivering the function. These alternatives are then evaluated with regard to the predefined Target Key Performance Indicators. Since these alternatives are still on a functional level, these solutions for value generating functions need to be combined to deliver a product or service that can be sold.



Source: author's construction based on (VDI, 2011, p. 40)

Fig. 1. **The Value Analysis Work Schedule**

How to integrate sustainability into the value concept.

If sustainability has value and value can be described as the relation between the fulfilment of a need and the use of resources to fulfil the need there are two possibilities to integrate sustainability.

Sustainability as resource usage: The discussion about sustainability tells us a lot about the fact that we need more resources than we have available. For example the ecological footprint paradigm tells us that in order to supply the resources for humanity living a western lifestyle would require about 2.5 worlds. (Global Footprint Network, 2007, p. 2) So a purchase e.g. of an industrially produced good would have "costs" for the consumer besides the purchasing price because buying a product produced unsustainably uses up the planets resources everyone needs to survive in the long run. However, this resource usage is not directly related to the purchase. They are generated anywhere on the world and might have originated a long time ago (reflect how long it might take tin from a tin mine in Indonesia until it is built into a smartphone and the smartphone is then sold to a consumer). It is therefore very hard to interpret this resource usage in terms of a price to pay for a good.

Sustainability as a fulfilment of a need: The fulfilment of a need stands in direct connection to a business transaction. (When buying item x, my needs 1, 2 and 3 are satisfied.) As described earlier, consumers are getting more and more concerned about sustainability factors of their purchases – the own impact on the world. They therefore feel a need to act responsibly and project this need on their purchases. Due to this projection, a product or service will not only have to measure up to expectations regarding basic functionality (power of a screw driver, nutrition facts of cereal etc.) but also fulfil the need towards the sustainability values of the customer (was child labour involved, were rivers polluted or high amounts of CO_2 emitted into the atmosphere during the lifecycle of the product).

Even the 1987 Report of the World Commission on Environment and Development "Our Common Future" defined sustainable development based on needs. It is defined as ensuring "that it meets the needs of the present without compromising the ability of future generations to meet their own needs".

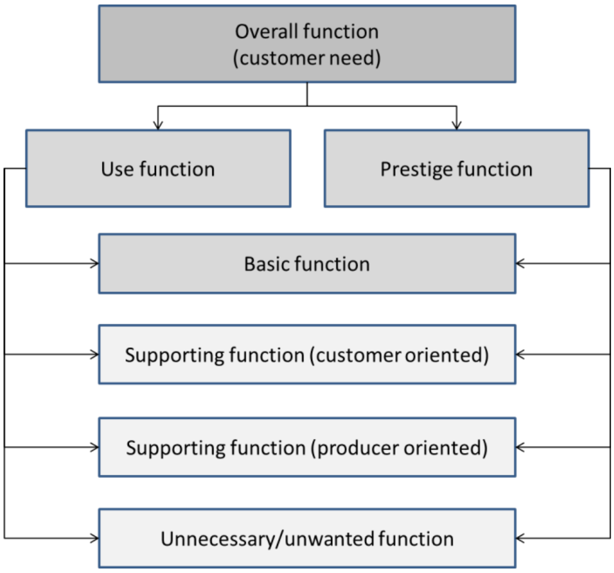
In terms of Value Management it therefore makes sense to integrate sustainability as a functional aspect of products or services to fulfil this need.

How to use Value Analysis to derive the value of sustainability

Function Analysis is a key technique of Value Analysis.

As shown in Fig. 2, functions can belong to different kinds of categories. A "use function" is necessary for the technical and economical use of the object (like a screw driver will need to be able to tighten screws). A "prestige function" on the other hand does not directly influence the usability of an object and is usually only subjectively quantifiable (like a luxury car functioning as a status symbol). These two functional categories can than again be subdivided into basic, support, and unnecessary functions.

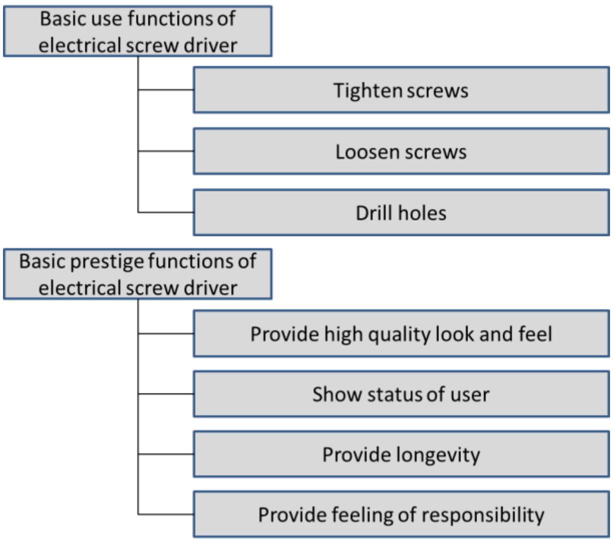
Basic functions are essential to the existence of a product. Support functions are those that differentiate one product from a similar one. OGC (2010, p. 46) categorizes supporting functions under five headings: assure dependability, assure convenience, enhance product, please senses, satisfy customer.



Source: author's construction based on (VDI, 2011, p. 62)

Fig. 2. **Functional classes**

When formulating a function the usual convention is to use an active verb and a measurable noun. If it adds clarity also a qualifying adjective or phrase, including a performance metric, might be used in the verbalization of the function. Examples for this phrasing can be seen in Fig. 3.

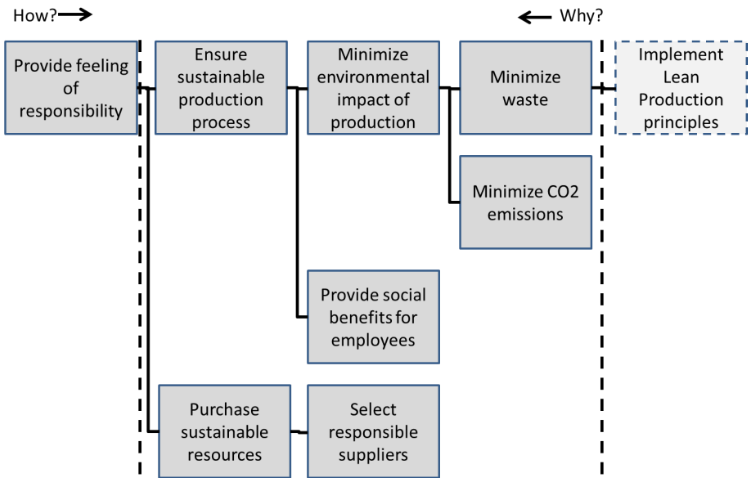


Source: author's construction

Fig. 3. **Example for basic functions of an electrical screw driver**

When defining these top-level functions of the object it is important, that sustainability aspects are integrated. Usually these are not part of the use functions even for very "green" products and services. For example the use function of a solar panel is to provide electricity and the use function of an LED light is to illuminate its surroundings. However, prestige functions can represent sustainability aspects in several different ways. The above mentioned solar panel has for example the prestige function to "reduce CO2 footprint" and the LED light to "save electricity". The LED light however has also further prestige functions regarding sustainability – for example the life expectancy measured in usage hours is more than ten times as long as for halogen lights. How exactly these sustainability functions can be integrated into the Value Analysis depends on the specifics of the product or service at hand. A "powerful set of tools for quantifying, evaluating, comparing, and improving goods and services in terms of their potential environmental impacts" is Life Cycle Assessment (LCA). (Rebitzer et al., 2004, p. 717) "LCA supports the identification of opportunities for pollution prevention and for reducing resource consumption through systematic analyses, thus avoiding dogmatic objectives which can be, while intuitive, incorrect even in their general tangent." (Rebitzer et al., 2004, p. 717f).

When Top-Level functions are defined it is necessary to gain clarity about the details of these functions as well as to stimulate creativity in the search for different ways to perform the functions. This can be done with the Function Analysis Systems Technique (FAST). This is a graphical representation of functions and their hierarchy. On the left hand side of a FAST diagram the high-level or primary functions are displayed. For each of these the question is asked how the function can be delivered. While doing this, the "how" is also tried to be described as a function. The technique stops asking the "how" question on the right hand side of the diagram when it cannot be described as a function anymore but only as a technical solution or product. When reading the diagram in the other direction – from right to left – it tells you why the proposed lower level function is needed by pointing to the corresponding higher level function. Fig. 4 gives a compact example of this approach applied on a sustainability function.



Source: author's construction

Fig. 4. **FAST diagram for sustainability functions**

The next challenge is to derive the significance of the derived functions. The importance of a function needs to be derived from the individual preferences from the stakeholders regarding the needs underlying the function. Since individuals have problems to assess these preferences directly (how important is limiting your impact on climate change for you), methods need to be applied to support this assessment. An easy to use method is the "Paired Comparison" where stakeholders need to evaluate only two aspects against each other (which aspect is more important to you: A or B or are they equally important).

	A	B	C	D	E	F	Criterion	Score	%
A	**1**	3	3	3	3	3	Provide high quality haptics	16,0	27%
B	0,3	**1**	1	5	5	3	Show status of user	15,3	26%
C	0,3	1	**1**	5	5	3	Provide longevity	15,3	26%
D	0,3	0,2	0,2	**1**	1	3	Minimize hazardous materials	5,7	10%
E	0,3	0,2	0,2	1	**1**	2	Provide enery efficency	4,7	8%
F	0,3	0,3	0,3	0,3	0,5	**1**	Provide feeling of responsibility	2,8	5%
							∑	60,0	

Source: author's construction based on (VDI, 2011, p. 69)

Fig. 5. **Paired Comparison Matrix**

When possible options for a new product or service are defined they need to be evaluated with respect to the defined criteria. The criterion weight can be taken from the Paired Comparison Matrix. Since the fulfilment of a need is associated with certain costs the "value for money" helps to assess the economic impact.

Option	Costs for option	Criterion weight	Criterion 1 27%	Criterion 2 26%	Criterion 3 26%	Criterion 4 10%	Criterion 5 8%	Criterion 6 5%	Total	**Value for money**
Option A	10	Benefit ranking	8	6	7	2	2	2		
		Benefit x weight	2,16	1,56	1,82	0,2	0,16	0,1	6,00	**0,60**
Option B	100	Benefit ranking	2	3	4	3	4	5		
		Benefit x weight	0,54	0,78	1,04	0,3	0,32	0,25	3,23	**0,03**
Option C	1000	Benefit ranking	2	3	4	3	4	5		
		Benefit x weight	0,54	0,78	1,04	0,3	0,32	0,25	3,23	**0,00**

Source: author's construction based on (OGC, 2010, p. 59)

Fig. 6. **Option Evaluation Matrix**

Conclusions, proposals, recommendations

How to integrate value analysis into Project Management Standards

The function analysis as key component of value analysis is currently not part of Project Management Standards like the PMBOK. However it was shown, that the focus on function away from certain objects opens up the opportunity to integrate sustainability thinking into the process – because completely new solution ideas become possible.

Besides that, the Value Analysis Workplan defines a standard process that lacks many important project management activities. It therefore makes sense to include the positive aspects of Value Analysis into modern Project Management Standards to benefit from the best of both worlds. Fig. 7 shows which Value Analysis step needs to be integrated into which PMBOK process.

Following the PMBOK approach to Project Management, the initial part of Value Analysis needs to be done as part of the Initiating Process Group in Project Integration Management. Here the project charter is defined which formally authorizes a project and documents the initial requirements that satisfy the stakeholder's needs and expectations. (PMI, 2013, p. 71) These needs and expectations need to be documented in a functional way for further detailing in following steps. This is especially important when innovative ideas are needed to implement sustainable solutions. Berry (2011, p. 70) gives examples for purchasing projects that made significant contributions on the sustainability of the participating organizations. She defines a procurement cycle with the initial step of "identifying business need" and states, that in order "to maximize opportunities for sustainability, it should be considered at the very outset of the procurement process". This is the point where creativity regarding the function requested by the customer and the way to deliver that function can have the most significant effect.

The other important knowledge area of the PMBOK that needs to take into account the Value Analysis approach is Project Scope Management. As part of Project Scope Management, values become important when collecting requirements. "Collect Requirements is the process of defining and documenting stakeholders' needs to meet the project objective." (PMI, 2013, p. 110) At the end of this process the functions need to be clear in every detail. Therefore the Value Analysis steps 2, 3 and 4 need to completed and for example a holistic FAST diagram is available to show all functional requirements.

To point Project Managers more actively towards using Value Analysis is also should be integrated into the Tools & Techniques section of the Collect Requirements PMBOK Project Management Process. In addition to that it is important that the results of the Value Analysis are being integrated into the Requirements Traceability Matrix which "links requirements to their origin and traces them throughout the project life cycle" (PMI, 2013, p. 118).

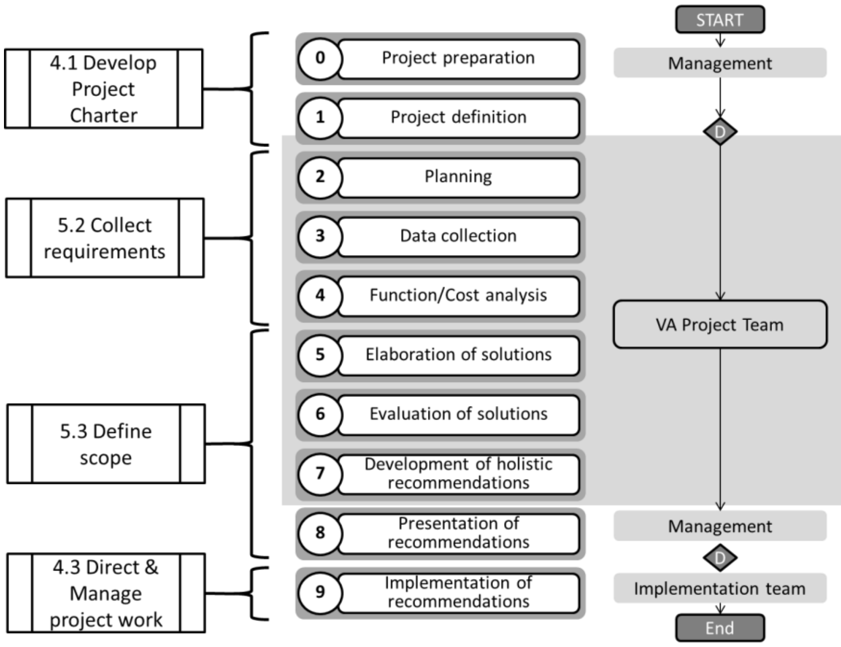
When the value contributing functions have been integrated into the project scope, all following project management activities take them into account without any adjustments to the known processes. For example "Monitor & Control Project Work" uses the Project Management Plan as an input which itself is based on the Project Charter.

The following Value Analysis steps 5, 6 and 7 should be integrated into the Define Scope process. Based on the information gathered in the Collect Requirements process the Define Scope process "develops a detailed description of the project and product, service or result". (PMI, 2013, p.121) From a Value Analysis point of view this is achieved with the holistic recommendation that efficiently fulfils the customer needs based on the elaborated solutions for each function which is signed of by management for implementation.

The PMI also sees Value Analysis as part of the Define Scope process since they mention it as a possibility for Product Analysis in the Tools & Techniques Section of the process.

However they give no recommendation how these to approaches should be aligned. (PMI, 2013, p. 122)

The final step of Value Analysis –the implementation – corresponds to the PMBOK process Direct and Manage Project Work, which is "the process of leading and performing the work defined in the project management plan" (PMI, 2013, p. 79).



Source: author's construction

Fig. 7. **Matching PMBOK processes with Value Analysis steps**

How to support your organization to work with sustainability values in projects

George Stigler, a Nobel Prize winner in economics, points out that "information has its price: the 'cost' of searching for it, whether reckoned in time, effort, or cognitive demands". (Goleman, 2009, p. 77) Therefore companies that are truly interested in making a difference in sustainability need to invest into information sources for the employees involved in the Value Analysis project. This can be achieved with access to industry databases as well as a tutoring program teaching the employees how to efficiently use the information in these databases.

The information base collected for the Value Analysis can after the successful project be used for marketing purposes of the new product or service. As long as a company can be sure that customer values were the basis for the development of the product or service, the publication of the results will always be beneficial. Transparency allows shoppers to vote with their dollars for more ecological intelligent technologies, ingredients, and design – and so shift market share. Since the initial investment in e.g. sustainable value analysis can be substantial these customer requirements towards transparency will give those competitive advantage that prepare themselves today, start developing sustainable products and services – and making the value added transparent on the market.

Who would buy a product full with toxic chemicals, assembled by enslaved children, polluting the local rivers in the production process – if these informations are transparent and a more sustainable product is identifiable on the shelf next to it.

Especially when working in complex supply chains it can become tricky to get all the information on the sustainability factors of the components that are purchased. A major problem that needs to be addressed in future research is that especially those suppliers that use unsustainable production processes have the highest interest in hiding this information because when keeping information secret or hidden makes a producer more money, there is little if any incentive to divulge it" (Goleman, 2009, p. 72) The main problem is, that in this situation the free market cannot function because of the information asymmetry. In order to provide a sustainable product a manufacturer therefore needs to find ways to deal with these hidden characteristics.

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DEPENDENCY MANAGEMENT IN PROJECTS

Peter J. A. Reusch, University of Applied Sciences and Arts, Germany[1]

Abstract

In projects we often have a wide variety of dependencies. Here we classify dependencies and describe the scope of dependency management. Four approaches for dependency management are compared. Besides classical approaches based on mathematical models and simulation, new approaches that help us to uncover dependencies become more and more important. Visualization can support dependency analysis and dependency management with a strong focus on communication and creativity. New software systems based on graph databases open a door and give us new options and a lot of flexibility for dependency analysis and dependency management.

Key words: *project management, dependency analysis, dependency management, design structure matrix, graph databases, object role model*

JEL codes: C63, D70

1. Introduction

1.1. On dependencies

Not only projects but the human life and the whole universe are full of dependencies. A classification of dependency types we meet in projects can help to understand the scope of dependencies and detect the keys for dependency management.

We meet dependencies in complex projects where many details are often unknown and a clear description of the impacts is impossible. We meet dependencies with a strong impact on a project, and others that are weak and often ignored. We meet dependencies that become visible only after a long time. Long term improvement of the image of a company or a brand can stimulate customer requests and innovations.

The following tables collect some kinds of dependencies regarding following aspects:

- Fixed external dependencies;
- Fixed internal dependencies;
- Changing external dependencies;
- Changing internal dependencies.

Fixed dependencies here are such dependencies that are at least fixed for a while.

[1] Corresponding author – e-mail address: Peter.Reusch@fh-dortmund.de

Table 1

Selected types of fixed dependencies

Fixed (for a while) external dependencies	
Dependencies based upon physical, technological, or other limits	If we want to organize an event indoors in a town the largest hall available will give the limits we have to recognize. If we want to move from one place to another there are technological limits regarding speed, load, tec.
Dependencies based upon technological conditions and processes	The tasks to build a house must be organized in a special sequence starting with the ground work and ending with the roof.
Dependencies based upon natural environmental conditions	Climate and seasons for example have an impact on projects.
Dependencies based upon economical conditions	GDP level and economic power of a country or area
Dependencies upon given rules and regulations	Labor law (working hours, …), security, tax,
Dependencies in the given culture	Values, habbits, seasons (Easter, Ramadan, …)
Fixed internal dependencies	
Dependencies based on the roots of an organization	Public, private, embedded in a company group, embedded in a consortium
Dependencies based upon given strategies and missions	Sustainability, safety, etc.
Dependencies upon given rules and regulations	Supplier selection, safety regulations, etc.
Dependencies based upon the power of an organization	Options for bank credits
Dependencies based upon the resources of an organization	Quality, quantity, availability, … of resources
Dependencies based upon given restrictions for a project	Time, budget, etc.
Dependencies based upon scheduling in a project	Predecessor–successor relations, results of tasks needed for other tasks

Fixed dependencies can often be managed by classical approaches – structural analysis is dominating here.

Changing dependencies extend some of the dependency types above. Additional types are shaped by the change itself.

Table 2

Selected types of changing dependencies

Changing external dependencies	
Dependencies based upon new economical and political conditions	Economy, financial crisis, energy demand, policy regarding renewables
Changing rules and regulations: New requirements regarding environment protection, etc.	Extended noise protection at the new airport Berlin-Brandenburg for example causes delays
Changes in markets and customer expectations	Competitors come with strong innovations
New technology	New technology is available and reshapes a project
Population, migrations, open labor markets	New specialists are available for prosperous countries
Changing roles and responsibilities of external stakeholders	Stakeholders have new functions
Loosing acceptance	Delays, less results than expected
Dependencies regarding scheduling and resources	Delays and changes in priorities
Changing internal dependencies	
Changing roles and responsibilities of internal stakeholders	Changes from project to line functions or back,
Changing interest of stakeholders	When main results for a stakeholder are already given
Loosing acceptance	Delays, less results than expected
Dependencies regarding scheduling and resources	Delays and changes in priorities

Changing dependencies need other approaches than fixed dependencies – simulation is useful in many cases. But for simulation we need well developed models. When we start, we need concepts and tools helping us to uncover dependencies – as mentioned below.

1.2. On dependency management

The broad scope of dependencies needs different approaches to analyse and manage dependencies. There are 4 main types of dependency management we will discuss here:

1. Dependency management based upon a clear understanding of dependencies and strong methods and tools that can be applied – mainly mathematical approaches.

2. Dependency management used to uncover and communicate dependencies.
3. Dependency management based on ontologies and object role models
4. Dependency management focused on changes and simulation.

1.2.1. Management of dependencies based on mathematical approaches

In the first group we have dependencies that can be described in a network or a matrix for example. In the figure below there is a matrix representing 7 resources. The matrices describe dependencies among resources. Resource 6 for example depends on resource 1 – or, resource 1 gives an input for resource 6. In the basic matrix on the left the resources are not ordered and clustered. In the matrix to the right columns and rows of the matrix are reordered so that resources are clustered with the main groups 1-6-5, and 4-2-3-7. If we arrange the resource according to these clusters, we will have less problems in communication and control.

This approach is based upon the design structure matrix that was introduced by Don Steward in 1981 and goes back to concepts developed in the 60th – www.dsmweb.org. It is a mathematical approach supported by many tools.

↗	1	2	3	4	5	6	7
1						X	
2	X		X	X			X
3				X			X
4					X		X
5	X			X			
6	X				X		
7		X	X	X			

↗	1	6	5	4	2	3	7
1		X					
6	X		X				
5	X	X		X			
4			X		X	X	X
2	X			X		X	X
3				X			X
7				X	X	X	

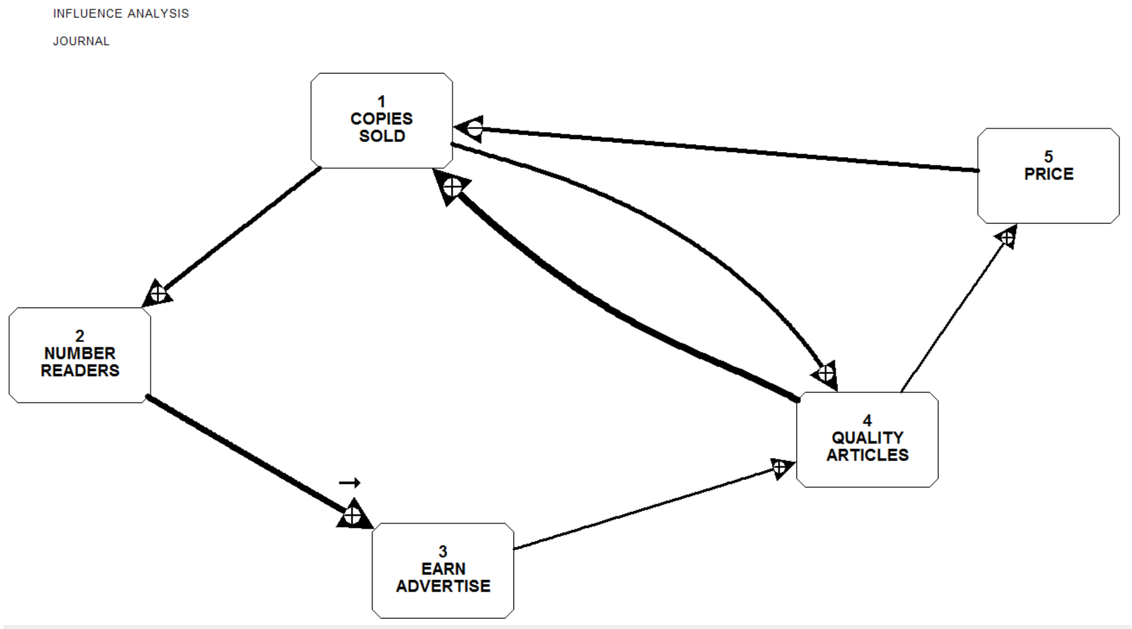
Fig. 1. **DSM – derived from http://dsmweb.org/**

1.2.2. Management of dependencies based on uncovering dependencies

In the second group we have dependencies we cannot fix in a basic mathematical models – first we must uncover the dependencies. The following figure shows a dependency graph for the introduction of a new journal. Five factors are represented:

1. Copies sold.
2. Number of readers.
3. Earning from advertising.
4. Quality of article.
5. Price of the journal.

The number of copies sold is the core factor for the success of a new journal. The price of the journal and the quality of the articles are important influencing factors. People buy journals, they and additional people read these journals. The number of readers is a core parameter for the money one can make with advertisement.



Source: Reusch, Lecture notes

Fig. 2. **Dependency graph for the introduction of new journal based on GAMMA**

The dependency graph has arrows for the representation of dependencies, and these arrows have 3 core parameters:

1. The kind of influence.
2. The strength of influence.
3. The delay of influences.

The arrows with a + show impacts of simultaneous increase and decrease. When the number of copies sold increases, the number of readers will increase. When the number of copies sold decreases, the number of readers will decrease.

The arrows with a – show reverse impacts. If the price of the journal will increase, the number of sold copies will decrease. If the price of the journal will decrease, number of copies sold will increase. These influences are not alone. Customers will pay higher prices, if the quality of the articles will be improved.

The strength of influence is described by the width of the arrow. Earned money from advertising can help to improve the quality of articles, but the corresponding impact from the number of sold copies is stronger.

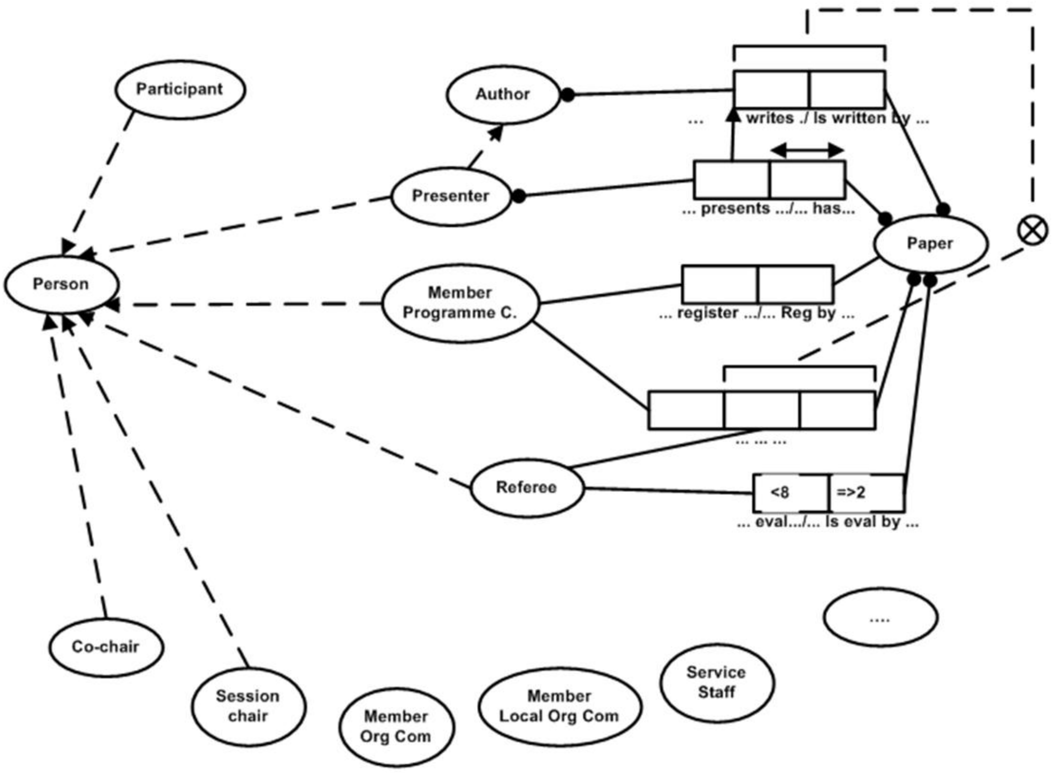
The impact of changes in the number of sold copies on the number of readers acts immediately. An increase in the quality of a single article will not stimulate more customers to buy the journal. But an enduring increase in the quailty of articles will have an impact on the number of copies sold.

The figure above was made with GAMMA, a tool that was used many years to support systems thinking and to prepare business games for example – Senge: The fifth discipline, http://www.thinking.net/Systems_Thinking/systems_thinking.html. At the university of the author, it was used over many years to prepare TOPSIM business games – http://www.topsim.com/de/startseite.html. GAMMA was also used for dependency analysis in a broader area – Hub: Ganzheitliches Denken im Management.

1.2.3. Management of dependencies based on ontologies and object role models

The following figure shows an object role model for conference management. Object types are represented in ellipses, roles in labelled rectangles connected with object types. There are a couple of constraints represented in this model. Only authors are allowed to present a paper – presenters are a subset of authors in the model. Each paper must be evaluated at least by 2 referees. The number of papers for a referee is limited by 8. Referees are not allowed to evaluate their own papers, etc.

Dependencies are defined in the object role model, and a database that meets these constraints can be derived from this model. That makes dependency management very strong – but of course there is not so much support to detect and uncover dependencies and to communicate and shape dependencies. Object role modelling and ontologies have a place in dependency management – now and in the future.



Source: Reusch, Project Management Supported by Object Role Modeling

Fig. 3. **Part of an object role model for conference management**

1.2.4. Management of dependencies based on simulation

In the 4th group of approaches for dependency management we have mainly approaches based on simulation and tools like SIMUL8 – http://www.simul8.com/ – or Simulink – http://www.mathworks.co.uk/products/simulink. That will not be discussed here.

2. New Concepts for Dependency Management

Regarding mathematical approaches and simulation models for dependency analysis and dependency management there is a well established area. Regarding uncovering we need new approaches for dependency analysis and dependency management. The most important point for such approaches are concepts and tools that make dependencies visible and improve communication, creativity, and problem solving.

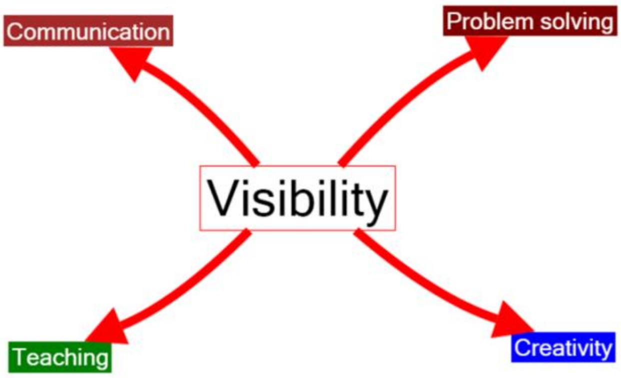


Fig. 4. **Visibility**

After many trials of concepts and tools – including different kinds of graph databases and ontologies – the author today enjoys an approach based upon NodeXL – http://nodexl.codeplex.com/. The figure above is made by NodeXL and the figure below, that describes factors influencing a new conference. There are critical factors for a conference like other conferences running in parallel. There are stimulating factors like good prior conferences or well known and motivating chairs. The width of arrows indicate the strength of impact. Further parameters are also available.

NodeXL is based upon Excel, vertices and edges of graphs are defined in Excel tables. An Excel tool can draw the graph. External data can simply be copied into a NodeXL application. That is already well described in Hansen, Shneiderman, Smith: Analysing Social Media Networks with NodeXL. The graphical representation can also help to uncover and discuss dependencies.

But there are many more opportunities when we use such tools. We can combine the graphical representation and calculations.

The figure below shows an impact analysis of the dependency graph created with NodeXL – similar to the graph in figure 2. Additional features of NodeXL are used, like labelling of edges – here indicating the reverse impact of the price – when the price increases, the number of copies sold will decrease – and the other way round. In the right part of the figure below is an overall impact analysis of the graph on the left side. All outgoing arrows with the weights of the impact are added for each node – giving the overall impact of this node on all others. All incoming arrows with the weights of the impact are added for each node – giving the overall influence from all other nodes. In the table of the figure below rows and columns show the impact of the nodes in the graph. The maximum of all added weights of the impact arrows at the nodes is 7. Node 1 in the table has an impact on others with weight 7 in total, and an impact from others with weight of 6. Nodes in an upper and right position in the table are regarded as critical nodes. Dependency management has to take care of such factors. Nodes in a lower or left position are regarded as less critical.

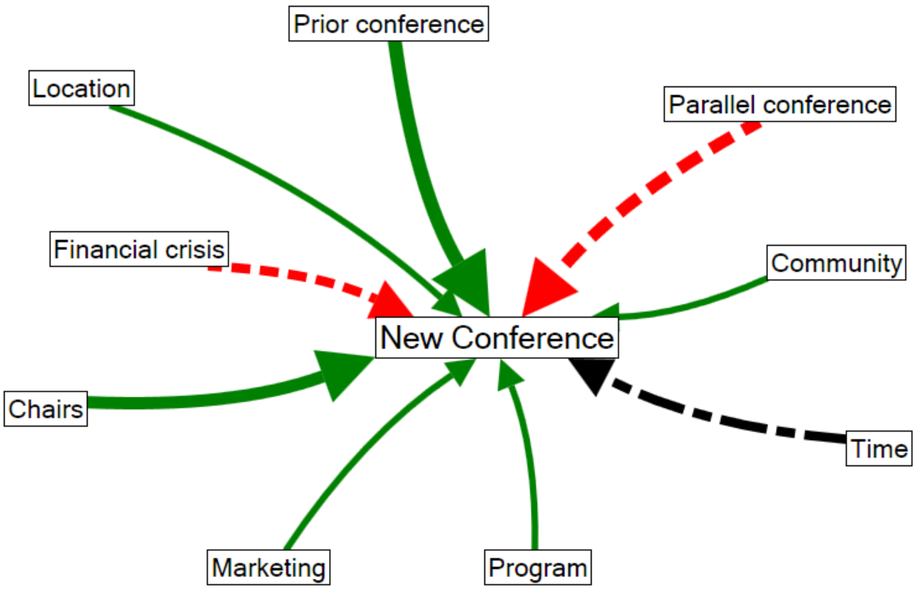


Fig. 5. **Factors influencing a new conference**

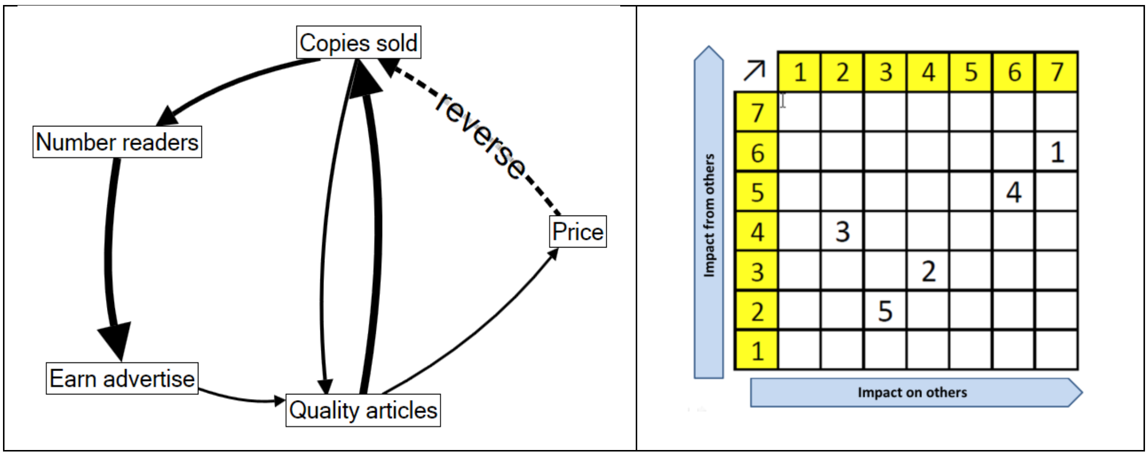


Fig. 6. **Impact analysis – NoteXL model**

Tools like GAMMA or NodeXL can help us for example to:

- develop a dependency graph, discuss it with others, and create solutions;
- calculate critical factors and show these factors in tables like the table above;
- detect cycles in graphs – cycles are critical because cycles are often hard to control;
- show the propagation of impacts over the time.

In NodeXL we can represent the graph and we can calculate an impact analysis ourselves. We can do it in the same way as GAMMA – or in a more advanced way with trends that change impacts. In GAMMA that is not possible. And if we would organize that in tools focused on simulation, we would loose part of the basis impact analysis. GAMMA is a tool used for more than 20 years in many cases of dependency analysis by the author. GAMMA has not been improved over all these years – and is simply outdated today. Heraklit – http://www.vernetzt-denken.de/heraklit-software/index.htm – can be regarded as successor of GAMMA – with new functions, functions for example that can be used to change impact weights over the time. That brings Heraklit close to simulation – but Heraklit by the marketing strategies of the owners is not appropriate for a broad scientific community – a community that does not like dongles.

3. Conclusions

Dependency analysis and dependency management have a very broad scope – many concepts and tools can be used in projects successfully – now and in the future. Concepts and tools to uncover and communicate dependencies based upon graph databases can improve dependency analysis and dependency management in the future significantly.

NodeXL is a system based on Excel and is very flexible. There are other graph database systems like Gephi – https://gephi.org/ – or Neo4J – http://www.neo4j.org/ – with other possibilities especially for larger data sets – see also Robinson, Webber: Graph databases. The results we got with NodeXL will help us to test such products in dependency analysis.

For very special kinds of dependency management there are other approaches like Maven – http://maven.apache.org/guides/introduction/introduction-to-dependency-mechanism.html – that goes down to the components of software systems and supports software updates for example.

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DEMINING PROJECT MANAGEMENT IN AFGHANISTAN

Maria Sadat, Swiss UMEF University of Afghanistan, Afghanistan[1];

Edgar Bellow, NEOMA Business School – Reims Campus, France

Abstract

In 2002, the government of Afghanistan ceded control of the demining operation to the United Nations. By 2008 the country was able to begin taking limited responsibility within its borders, under the auspices of the Afghan National Disaster Management Authority (ANDMA). This paper addresses a management plan for a demining project in Afghanistan. It determines the impact that demining could have on the local and national economy as well as the social impact of the demining action.

Key words: *Afghanistan, IEDs, mines, demining, project management*

JEL codes: O11, L32

1.1. Introduction

This project develops a management plan for a demining project in Afghanistan. It determines the impact that demining could have on the local and national economy as well as determining the social impact of the proposed action. Previous research (GICHD, 2004) has shown that there is a connection between demining activities, and improving a country's economy. Demining activities impact all areas of a country's economy, from decreasing medical costs to improving food security by making the supply chain more secure, as well as making it safer for rural populations to grow their own food.

The research determines the benefit demining can have on the population from a social viewpoint, determines the economic impact of demining, and utilizes a project management approach in developing the demining action in Afghanistan. The project considers the impact of public-private partnerships on the demining process. The International Road Transport Union activities are considered as a case study relating to public-private initiatives (IRU, 2013).

1.2. Background

In 2002, the government of Afghanistan ceded control of the demining operation to the United Nations. By 2008 the country was able to begin taking limited responsibility within its borders, under the auspices of the Afghan National Disaster Management Authority (ANDMA) (UNMAS, 2013). As of 2013, 53 different groups employing over 12,000 people in 19 provinces have been involved in demining Afghanistan. 662,732 anti-personnel mines (AP) have been destroyed; 27,597 anti-tank mines (AT) have been destroyed; 707 abandoned IEDs were destroyed, and over 16,145,516 unexploded ordinances have been destroyed (UNMAS,

[1] Corresponding author – e-mail address: maria.sadat43@yahoo.com

2013). Today, Afghanistan has a 40% reduction rate in victims relative to the figures in 2006, and hospitals, power line projects and even a copper mine have begun operation in furtherance of the economy. However, the process is slow, and some regions of Afghanistan remain in jeopardy from unexploded mines.

1.3. Problem

Demining must be accomplished if Afghanistan is to provide a safe working environment and develop its economy through increased industry and technology. The cost of training and monitoring is staggering. The problem is to clear the mines for a reasonable cost investment, while showing a positive impact on the populace and the economy without endangering demining personnel and consultants.

1.4. Purpose

The purpose of the project is to develop a plan for demining in Afghanistan using a project management model to minimize risk and minimize cost and collateral damage.

1.5. Research questions

The following questions guide the research:

1. What is the impact that demining could have on the economy of Afghanistan and how can positive impact be maximized?
2. What is the social impact of an effective demining action?
3. What is the impact of public-private partnerships on the demining process in Afghanistan?
4. What project management approach will best suit the demining project?

The second, third, and fourth questions flow naturally from the first question. While the first question is the overreaching theme of the investigation, the other questions serve to guide and inform the project.

1.6. Definition of terms

IED. Improvised explosive device or do-it-yourself bomb common in many war zones.
Mines. Buried explosive devices, generally mass produced.
MDD. Mine detecting dogs.
MDR. Mine detecting rats.

1.7. Framework

The project is approached from the cost benefits analysis framework with emphasis on public private partnerships.

1.8. Summary

This chapter has established the background for the study as well as the purpose, the problems, and the questions that will guide the research. The terms were defined. In the next section, a literature review is conducted.

2. Literature review

2.1. Introduction

Any time that a military or support action is considered, a cost benefits analysis should be conducted. Byrd and Gildestad (2001) conducted an investigation into the socio-economic impact of mine action in Afghanistan. This cost benefits analysis, in 2001 dollars, clearly shows that there is a tremendous cost benefit to clearing mines from Afghanistan. The Byrd and Gildestad (2001) study considered a number of options and concluded that there were particular actions that could be taken that would minimize output for maximum benefits. Benson (2012) pointed out that despite millions of dollars invested in high technology solutions, lower tech solutions still work best for mine detections, particularly improved explosive devices (IEDs). Today, IEDs are one of the major threats to public safety in many areas of the world, particularly areas that have recently seen combat, whether by military, insurgency, or terrorists. The primary difference between IEDs and mines is that mines are generally mass produced and buried; IEDs are individualized destructive units and can be buried, or disguised on the side of the road. Either type of device is fatal. For the purposes of this investigation, both IEDs and mines will be considered in the general area of research relating to mines.

2.2. Background

Demining began in Afghanistan in 1989. Since that point over 16 million explosive devices have been destroyed. Nearly 2400 communities have been restored and 20 million Afghanis have received mine avoidance education. Jones (2011) highlights the issues related to demining and IED detection when he points out that the process is "painstakingly slow and extremely expensive" (p. 56). Left undetected, mines and IEDs will eventually maim or kill hundreds of thousands of people. The presence of unexploded devices is a major health concern in approximately 70 countries. The devices maim and kill, but they also take millions of acres of land out of production or from usage for recreation or expansion purposes (Jones, 2011).

Jones describes the method for discovering mines. The first step is to identify areas that are suspected of harboring hazards, designated suspect hazardous areas, or SHAs. This is done by the reviewing any records of where IEDs and mines have been found or unexploded device accidents have taken place (Jones, 2011, p. 56). Operators are deployed to the field, or hired from other organizations and deployed to the field. The operators conduct surveys in the designated hazard areas. Interviews with local inhabitants take place so that the investigators can try to narrow the area that may be harboring unexploded devices. This step is dependent upon residents agreeing to speak with the investigators. In some areas, residents may decline from fear.

Once smaller areas have been defined the operators can chose to bring in mechanical detection devices or detection animals. Detection devices can include "an array of metal detectors and ground-penetrating radars carried by armored vehicles, MDDs, and mine-detection rats (Jones, 2011, p. 57). Jones reports, however, that the most common method of mine detection still involves not only the use of people, but of relatively untrained people. Investigators typically recruit local residents, provide them with personal protective equipment (PPE) and train them in mine detection.

When humans are utilized, the process is daunting. The human puts on the PPE, is given a metal detector and a prodder, and a selection of digging tools. The persona uses the metal detector; when it alarms they step backwards, kneel, and begin to dig. Because the rate of false positives is very high when using metal detectors, and because the area that must be excavated upon each alarm is fairly big, it can be very time consuming to clear an area. It is also very dangerous for the human mine detector. Once the area has been cleared, a secondary method of mine detection is brought in and the area is re-checked to ensure that the clearance was successful (Jones, 2011).

2.3. IEDs and roadside bombs

IEDs are one of the most commonly used tools to inflict damage in war zones. There are a number of strategic, tactical, and operational reasons that IEDs are a weapon of choice. These devices are easy to place and inexpensive to make, and inflict devastating damage. According to the Joint Chiefs of Staff (2012) the effect of the IED is far more effectively strategically and operationally than tactically. Because of their unobtrusive profiles and high impact results, these devices have the capacity to leave a population in fear. The results of exploded IEDs are quite demoralizing, particularly when combined with media impact of reports of horrific injuries.

From a tactical point, IEDs inflict casualties but also insulate a population from their desired exposure to friendly forces. Freedom of movement is disrupted, and friendly forces may avoid the area rather than put themselves at risk. From an operational view, IEDs can be used to isolate the people from the control of their host nation, and to slow down the government or friendly force movements. Importantly, they can be used to create insecurity among the populations in the designated area. From the strategic point the use of IEDs in an area can help convince not only the population but the military in the area that the goals are a lost cause. Achieving this is a strategic victory because it can cause division in multinational groups, discourage host nations, and influence the national will (Joint Chiefs of Staff, 2012, p. 1-4).

Smith (2008) makes the point that when IEDs are in use, the battlefield becomes less clearly defined; there are no front lines, and everyone everywhere is at risk. Smith’s words, describing the battle in Afghanistan, are chilling, but they express the problem succinctly:

> ...all the people, anywhere, are the battlefield. Military engagements can take place anywhere – in the presence of civilians, against civilians, or in defense of civilians. Civilians are the targets; they are objectives to be won, as much as an opposing force. (p. 6).

The very nature of the IED highlights the strategic and operational advantage it provides. As Benson (2012) points out, IEDs are made of unconventional materials and utilized in an unconventional manner. They can include chemicals, pyrotechnics, incendiary chemicals, noxious gasses, and bits and pieces of shrapnel. In the past, they were referred to as booby traps or jerry-rigged bombs (Benson, 2012). Many of the items called booby traps in the Vietnam War would now be called IEDs. They are essentially the do-it-yourself version of bombs.

IEDs are comprised of a charge, which can range from C$ or TNT to fertilizer; a power source, which can range from batteries to a switch; an initiator; and a container. The container contributes to the disguise; it can be anything from a vehicle to a dead animal and literally anything in between (Benson, 2012). They do not have to be assembled in advance because they are easily concocted at the site, and the components are easily disguised. This combination of factors makes it easy to transport them and emphasizes the portable and ubiquitous nature of the threat (Benson, 2012). Further, when the enemy's favorite method of IED production is discovered, they can simply change methods within hours. To place this in a business context, the IED is the epitome of the lean and agile production system.

2.4. Mechanical demining

In general, demining occurs for two reasons: military, and humanitarian. Humanitarian demining is conducted to protect the population that remains in a war area. Military mine clearance, on the other hand, is conducted to ensure the military has a safe zone of operation. Military mining operations are conducted to give military personnel safe passage; they are conducted rapidly and result in more injury than humanitarian procedures. In humanitarian demining, the reclamation is conducted so that the previously mined areas can be returned to civilian use. The procedures can take longer and can be conducted more thoroughly. Metal detectors can be used for these operations, but they have a very high rate of false positives. Mahoney (2012) suggested that the rate of false positives may be as high as 1000 false hits for every real mine. With a rate of inaccuracy this high, deminers seek to supplement mine-detection techniques. Habib (2012) revealed that the likelihood of a false alarm increases in proportion to the time and cost of the demining process.

Mechanical demining has had little success in Afghanistan; it is expensive and results in negative cost-benefit ratios. Byrd and Gildestad (2001) recommended that mechanical demining be considered only in situations where it would be feasible and there would be little alternative. Given that each case would have to be considered individually, this suggests that even the planning costs would be high. Another possibility exists, however, and it comes in two cost effective options. Both dogs and rats can be used to assist in mine detection, and both are highly trainable and very accurate.

2.5. Demining dogs

A better alternative in most cases would be the use of mine-detection dog (MDD) teams. In 2001 this was the method that provided the highest ratio of benefits to cost. Sargisson, McLean, Brown, and Bach (2012) reported that there are both advantage and disadvantages to using dog-led mine detection teams. One of the primary disadvantages is that the dog teams have more difficulty during particular times of the year. Detection rates were highest in October, which tended to be dry; detection rates suffered in the humid and wet seasons (Sargisson et al., 2012).Sargisson et al. (2012) suggested that either dogs be held down when humidity was high, or high humidity days be reserved for working with maintenance training during those periods.'

2.6. Demining rats

Poling et al., (2011) suggests that the utilization of rats is a coup of sorts; rats are merely responding to operant conditioning. The International Mine Action Standards establish a threshold for providing accreditation to mine-detection animals. With a .33 false alarm forever 100m^2, mine detection rats (MDR) are well within the guidelines for accreditation. Cricetomys breed, or African pouched rats, have an excellent sense of smell. They are resistant to local parasites and native diseases. They are also too small to trip the mines by accident (Poling et al., 2011).

Guelle, Smith, Lewis, and Bloodworth (2003) pointed out that one of the issues in mine detection is that a number of mines are generally missed when doing sweeps. These false negatives can negatively impact anyone who comes into the area. Victims of mines generally end up handicapped but unable to afford rehabilitation, adding to the human and fiscal cost in war regions. The goal, then, is to have a zero rate of false negatives, although as Guelle et al. (2003) pointed out, this is not always possible to attain.

Training of Cricetomys can take place over a 185 day period. From the time they are four weeks old, rat pups are socialized to humans, handled extensively, and exposed to various environmental and social stimuli. Clickers are used to signal that food will be forthcoming. Rats are taught initially to respond to the click. Rat pups must listen for the click and stick their nose in a hole in order to get chow. Once the pup is able to accomplish this feat, the ante is upped. Gradually the rat pups are exposed to the smell of TNT and rewarded when they detect it in the training venue. Once the rat is able to detect TNT in buried metal eggs for every test over a two day period, the ante is again upped. They are taken to a simulated landmine field for field training. The rats are taught to walk with a harness. Rats were rewarded with food treats for an accurate positive hit (Guelle et al., 2003). Once rats have reached a certain level, they are final field tested and then given an accreditation test. If they pass, and 95% of them do, they are licensed as mine detection animals.

There is, however, one issue with the rats. Since the human handlers do not know where the mines are laid out in actual fieldwork, they cannot reward the animal immediately for detecting the mine nor can they immediately determine if the rat has missed some mines or responded with a false positive. According to Mahoney (2012) the handlers can compensate for this by continuing training exercises when the rats are return home. When the handlers know where the mines are and can reward the rat, the reinforcement helps the rat remain motivated.

According to McLaughlin (2010), it costs approximately 6600 euros ($7,700 USD) to train a rat, while it costs approximately $23,000 to train a dog. Rats are easier to move around than dogs; they are easier to reproduce than dogs. Providing living situations for the rats is also far cheaper than providing living zones for dogs. Three hundred rats can be seen by only one veterinarian, allowing an entire platoon of rats to be seen by the vet on a weekly basis. One further advantage is that rats do not bond with a single human handler like a dog does. They will work for any handler. Handlers can train rats in a shorter period of time than dogs, and the handlers themselves do not have to be highly trained. However, rats cannot work in high grass or heavy brush, while dogs can. In general, McLaughlin (2010) reports, rats are a complement to dogs but will not replace them.

2.7. Clearance costs

The cost of min clearing is generally shared by governmental agencies and donors. Some donors will provide funds directly to non-governmental agencies with mine clearing operations but the majority will contribute to trusts set up for that purpose. Trusts generally charge a handling fee, while NGOs endeavor to have their contributions go directly to the removal action. Because donations made to NGOs do not have to be reported to the government, it is difficult to tell exactly how much money goes directly into the NGOs for this purpose.

One recent example of a successful clearance resulted in 4,000 new homes being built in Afghanistan after the United Arab Emirates contributed $25 million USD for the Emirates Mine Clearance Project Afghanistan (National Staff, 2014). The UAE contracted with an American company that worked to clear 38 million square meters in Kandahar. According to the National, over 1,600 Afghans worked to clear the land, which benefitted 100 communities. $23 million of the donation wen directly into mine-clearing and $2 million was paid into the N trust. According to the National, 26,000 people in Afghanistan live within 500 meters of a minefield. The UN disagrees, however, asserting that nearly one million Afghanis live within 500 meters of contaminated areas (Hartley, 2014). This difference in account highlights one of the major problems in mine removal in Afghanistan, that of transparency and accountability. The National purports to quote the UN, but the difference between 26,000 and 1 million endangered residents is stunning.

The UN reports that from early 2011 on, mine accidents have caused injury or death to an average of 32 civilians a month (Hartley, 2014). The majority of these incidents have occurred in either the north or south areas of Afghanistan. The remaining minefields are largely in agricultural areas (80%) meaning that desperately needed agriculture cannot resume until a number of vineyards, rangeland, cropland, cultivated land, orchards, and forests are cleared (Hartley, 2014). As Hartley (2014) points out, with 70% of the employment in Afghanistan related to agriculture, having these areas still filled with mines is significantly depressing the national economy.

Afghanistan has established a Mine Action Program (MAPA), which is comprised of nearly 50 public or private partnerships involved in the mine clearing process. It is almost exclusively funded by foreign organizations although the Government of the Islamic Republic of Afghanistan (GIRoA) contributes a small donation (Hartley, 2014). The original goal was to have Afghanistan mine free by this point, but an extension has been submitted for another ten years. The nation hopes to be mine free by 2023 but the practical reality is that unexploded ordinance or IEDs may be located for many years to come.

The impact that demining could have on the economy of Afghanistan is nearly uncountable. In 2001, Byrd and Gildestad (2001) determined that if only one person a year died from mines, the loss would be $69,000 USD (in 2001 dollars).The cost of clearing was only $35,000 per km^2, netting a considerable cost savings. In 2001, Byrd and Gildestad also estimated that every km^2 of agricultural land cleared would result in $36,000 UD (in 2001 dollars).

2.8. Summary

In this chapter, the literature relating to demining was reviewed. The relative efficacy of different demining actions was considered, in the context of mechanical, human, dog, and rat detection. A brief discussion of some of the current funding issues and initiative was presented. A discussion of the mine free goals contributed the chapter. Chapter three reviews the methodology of the study.

3. Methodology

3.1. Introduction

The research aims to determine the social and financial cost of demining in Afghanistan, to develop a cost benefits analysis and to develop a plan to use project management techniques to establish a demining program utilizing private and public partnerships.

3.2 Research method

The method utilized in this study utilizes secondary and tertiary information. No primary research was conducted. The general method of research is qualitative in nature, as the goal is to determine how a cost effective project can be developed and management utilizing project management techniques. By utilizing information that has been collected by other researchers, the cost of the research is kept at a minimum and the benefits are maximized. Utilizing exiting research also minimized the possibility of conflicts of interest or invasion of privacy.

Secondary and tertiary data was collected for this study. It was collected through a review of published materials, including seminar papers, governmental policy papers, proceedings from conferences, journals, dissertations, textbooks, newspapers, periodicals, and government reports. In some cases the secondary research materials provided resources that otherwise the researcher might not have discovered (Creswell, 2014).

Yin (2005) asserted that there are two main approaches to research in the field of business and social sciences. The first form, qualitative research, focuses on gathering information that will aid in understanding of a problem. Solving the problem occurs by collecting and analyzing the data, particularly relating to ideas, and applying the results to the problem at hand (Saunders et al., 2009). Quantitative research, however, concentrates on gathering fiscal or numeric data from large sample in an effort to relate variables (Saunders et al., 2009).

Qualitative research methods were utilized for this project because the goals were to develop an understanding of how a particular technique (project management) could solve a problem in Afghanistan (effective removal of mines and improvised explosive devices, or IEDs). And, while a cost benefits analysis is conducted as part of the project, that analysis is both fiscal and humanitarian in nature. Since the overall goal of the research is to develop a process, rather than to explore the project from a quantitative perspective, the qualitative research method was deemed to be most suitable to the project.

Sarantakos (2010) suggested that one of the primary goals of qualitative research should be the purpose of attaining data to understand a situation from the perspective of the individuals who are involved in it.

3.3. Data collection and analysis

Creswell (2014) suggested a simple method of data analysis when utilizing archival research. He recommended the following steps in the analysis process:

1. Select appropriate materials from databases and libraries.
2. Note and summarize the literature.
3. Organize the materials into general threads of information, based on the research questions that were established to guide the research.
4. Summarize the source information, and extract and analyze the pertinent data.
5. Prepare the literature review and discussion (Creswell, 2014).

These steps were followed throughout the research.

3.4. Summary

This chapter described the method by which data was gathered and analysed. The qualitative project utilizes qualitative secondary and tertiary materials. In the next chapter, the discussion of the research is provided.

4. Discussion

4.1. Introduction

This chapter discusses the implications of the literature and provides suggestions for application to project management.

4.2. Discussion

The research showed that there is a significant connection between demining activities and an improvement of the nation's economy. With somewhere between 26,000 and one million Afghanis living near a mine zone, and many of the remaining mine zones located in agricultural areas, the country is essentially remaining hostage to unexploded bombs. Agricultural production (representing 70% of the nation's employment) cannot resume until more fields are cleared of mines. Transportation venues are also limited with many roads remaining areas of danger. Further, the nation had expected to be largely cleared of mines but the slow pace of manual mine removal has resulted in a ten year delay in goal achievement. Even when the country is largely cleared of mines, there will still be unexploded ordinance located over the next generation.

Medical costs impact the people of Afghanistan greatly. Individuals injured by bombs are nearly always killed (thus depriving their families of their livelihoods) or disabled (increasing medical costs while depriving families of livelihoods). The social cost is equally high, with normal childhood and adult developmental activities postponed for safety reasons.

The majority of the demining is Afghanistan is overseen by a UN partnership of 60 to 70 private and public partnerships. Most of the donations that come in for funding are filtered through MASA, the demining administrative unit. While no one disagrees that demining must occur, the cost is staggering both in human terms and in fiscal terms. The problem is to clear the mines for a reasonable cost investment, while showing a positive impact on the populace and the economy without endangering demining personnel and consultants. The use of MDD and MDR seem to offer the best alternative to more traditional and mechanical means of mine detection.

The research established that there is a difference between mines (which are mass produced and generally buried) and improvised explosive devices, a do-it-yourself version of the mine that can be camouflaged as every-day items and detonated either locally or remotely. For the purposes of this paper, both types of devices were considered, simply because they represent the same danger. Both types of devices must be detected and once detected, disarmed.

There is a tremendous cost benefit to clearing the mines from Afghanistan. The combination of medical and social financial benefit is staggering. Combined with the benefits of returning agricultural land back to agricultural use, the improvement in the Afghan economy is clear. Further, the cost to other nations (who contribute to cleanup) and to private philanthropic organizations (which provide donations) is rarely considered in a cost benefits analysis. To fail to do so is a grave error; as the research determined, the UAE alone contributed over $25 million to the mine eradicated effort, surely money that the UAE could have used for its own people and program. The total cost of demining in 2013 alone was *$99 million* (Hartley, 2014), and the process has been ongoing since 1989.

Lower tech solutions appear to be the most cost effective for mine and IED detection. The use of MDD and MDR offer significant advantages over mechanical detection or detection by people with metal detectors. There is less human life, the animals are faster and more effective, their 'salaries' are cheaper, and they can be housed in little space. Although dogs offer a significant savings over the use of humans, rats offer and even greater savings because they are smaller, more portable, eat less, and can be housed in a rat dormitory in essentially one room of space. The nose and detection capabilities of rats and dogs are remarkably similar. Rats are small enough that they do not trip the bombs, and dogs sometimes lose track of the scents when humidity is high. It is harder to keep rats motivated, but in the final analysis, it costs only one third to train a rat compared to a dog. Failure to use rats in detection is related to human squeamishness rather than practicality.

Still, once the bombs are detected, they must be de-armed; in the case of mines, they must be removed from the ground and de-armed. The majority of the cost saving comes from not having to use humans to detect the bombs in the first phase of the investigation and not needing to house as many technicians in the process of detection and removal. A number of mines are generally missed when doing sweeps, negatively impacting the local populace and endangering them if it occurs too often. In order to combat this problem, animals are being given certifications showing their ability to detect with very few or no false positives and negatives.
Although a great deal of Afghanistan has been cleared, there are still an average of 32 civilian deaths a month from exploding mines and IEDs. Employment remains depressed and risk remains high.

4.3. Project management

A project management approach to demining should be adopted in order to decrease costs and improve efficiency. While the initial goals are to reduce risk, a continuing operation must be to develop and adopt program objectives and develop a plan to achieve these objectives.

Needs Assessment. The first step should be to conduct a needs assessment. While the assessment should be conducted at the beginning of the project, it should be repeated annually because needs will change as the demining progresses. The geographic information must be considered, including locations of potential minefields or likely IED concentrations. Locations of buildings must be considered as well as paths and human inputs. Every needs assessment should also consider location of hospitals and medical facilities.

Legal Considerations. Any legislated conditions must be investigated and observed. In Afghanistan, the government has ceded control to a UN agency. Organizations working with demining must be aware of who is in charge and what regulations apply. In addition, any international conventions that apply must be considered. Private land ownerships must be observed, and the legal status of any NGOs that will assist must be known.

Institutions. Desired capacity-building outcomes must be defined. The institutions that may need to be involved in the demining process should be notified.

Community Health. Public health organizations should be consulted for the latest local statistics from mine or IED incidents. Any input that the public health organizations can provide should be solicited. The hospitals may be aware of conditions which cause residents to take risks, for example. They may also have access to emergency planning that would be of help.

Geo-spatial Considerations. Determine where people live, where they work, and how the population is distributed as well as the location of minefields, bridges, utilities, and infrastructure.

4.3.1. ***Develop a Framework***. Organizations should understand the political and social context of the proposed actions. Hazards must be considered and the needs assessment defined above completed. A history of any mine removal actions should be developed, as well as the current status of existing programs. Problems that have been reported with other agencies or organizations should be included as well as the likelihood of developing partnerships. The vision, goals, and objectives for the mine removal initiative should be developed. This should include specific goals, with specific target dates for achieving those goals. Every goal should have appropriate objectives. Tasks to accomplish those objectives should be developed and tied into the project management chart.

An accounting of available resources should be completed and any assumptions or dates associated with those resources should be included on the chart. Finally, a risk management plan should be developed. All of these items should be entered on the project management guide. Achieving strategic goals should be tied into compensation plans.

4.2.1. ***Schedule dates for Evaluation***. Although the plan that is developed will have built in milestones, there should also be specific review dates programed in. Finally, for multi-year projects, an annual review date should be established for all departments.

4.4. Summary

This chapter has discussed the information revealed in the literature and proposed a plan for project management. In the final chapter, conclusions and recommendations are provided.

5. Conclusions and recommendations

5.1. Conclusions

5.1.1. Conclusions of the research questions

Question 1 and 2. The socio-economic impact that demining could have on the economy of Afghanistan is astounding. In 2001 dollars USD, the loss from one person per year would be $69,000 spread over 15 years. With 32 civilians a month being killed (384 a year), the cost over 15 years would be $26,496,000 for each year of loss (USD in 2001 dollars). When this is compared to a $35,000 cost per km^2, for cleared land, there should be no debate whatsoever which is more cost effective.

Question 3. Public private partnerships are largely responsible for the demining process in Afghanistan since the government of Afghanistan is unable to fund the initiative.

Question 4. The project management approach described in chapter 4 should be adopted for future demining projects.

5.1.2. Conclusions for project management

By conducting a thorough investigation of the local circumstances and developing a risk assessment analysis, the organization should be able to implement the general project management plan proposed in chapter 4. Implementing the plan provides a set of strategic goals, helps with scheduling of milestones, and ensures that no major activities are overlooked. With a good project management plan, the organization should be able to avoid the time overruns that have been so glaring in working with demining in Afghanistan to date.

5.2. Recommendations

A project management solution for supervision of demining initiatives should be adopted; the approach defined in chapter 4 is recommended. However, each of the demining initiatives should consider the use of MDD and MDR not only as an effective cost cutting measure but also as a measure of effectiveness and safety.

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PROJECT COMPLEXITIES IN CREATING PRODUCTS AND DELIVERING SERVICES: DEFINING SUCCESS FROM THE PRACTITIONER PERSPECTIVE

Marie Sams, Coventry University, United Kingdom[1]

Abstract

The aim of this paper is based on investigating the similarities and differences in project management when defining project success across two different organisations based in the product and services sector in the United Kingdom (UK).

In exploring the perceptions of the role of project management from a services and product based approach, two large (+250 employees), project mature organisations in the United Kingdom participated in this study where full ethical approval was granted from the host institution. The first organisation is concerned with service delivery projects for the benefit of the public taxpayer, and the second an engineering product based supplier.

This paper presents the findings of 10 in-depth interviews with experienced project managers, with a particular emphasis on how projects were classed as successful, assessing the contributing factors for this. The study revealed some differences in what each organisation placed importance on when defining success.

This paper contributes to the ongoing debate on how project success is defined, and will be beneficial to project managers, researchers and educators with an interest in the differences in project management success factors when delivering services or products.

Key words: *project management, success, public, private, services*

JEL code: M10

Introduction

The research and practice of project management has evolved over recent years, and has significantly contributed to organisations achieving strategic goals and gaining competitive advantage (Frame D., 1995). First used in Engineering and IT, it is not surprising that many large, private sector organisations are now deemed as ‘project mature’. Additionally, the UK public sector has increasingly been utilising project management methods to deliver organisational efficiencies and in promoting change to services (Crawford L et al., 2003). The challenges of delivering such projects are apparent in the context of defining success, as the value and benefits on public change projects is not often evidenced until some time after project completion. Furthermore, some projects designed to improve services or benefit the public taxpayer attract negative publicity due to it’s perceived failures in meeting success criteria. Examples of this include the National Health Service IT project (Guardian 2013), and the construction of the Millennium Dome (NAO 2000).

[1] Corresponding author – e-mail address: edu083@coventry.ac.uk, telephone: +44 247765 7055

There is a great deal of literature on defining project success (Munns A, Bjeirmi B., 1996, Fortune J, White, D 2004), and the research is further evolving in recognising that there may not be one standard model to account for the growing complexities and different types of projects (Westerveld E., 2003, Muller R & Turner R, 2007).

This paper aims to explore the similarities and differences in defining what 'success' means to the product (private) and services (public) sector in the United Kingdom. A preliminary research study draws on findings from ten in-depth interviews with experienced project managers in both sectors, and discusses findings related to individual, project and organisational success factors.

The methodology adopted for this study was interpretive in nature as it was not seeking to test any hypothesis, and rather explores the complex perceptions of the role of project management from a services and product based approach. An opportunist case study method (Otley, D and Berry, A 1994) was selected based on two large (+250 employees), project mature organisations in the United Kingdom who were willing to participate in the research study. Whilst the limitations of the opportunist method suggests that the data can be 'restricted to a few aspects of organisational life' (Collis, J & Hussey, R 2009), it is recognised that the data collected and analysed can generate interesting and worthy conclusions which can shape the basis for larger scale research studies.

The two case studies are 1) a UK based company in the engineering sector concerned with current and new product development for multiple, global manufacturing based clients, and 2) a UK based government funded organisation concerned with service delivery projects which generate some value to the public taxpayer. Both organisations are classed as being project management mature, with key expertise responsible for the running and delivery of a portfolio of projects.

The in-depth interviews were semi structured to allow an overarching focus on the topic area, however allowed the questions to develop throughout the interview based upon the project manager's thoughts and responses on particular matters related to their own experiences of project management (Easterby-Smith, M. et al 1991).

Research results and discussion

This section of the paper considers the findings analysed from the interviews, and considers the most significant response areas related to defining success. This included project success factors at individual and project level, with consideration on how this contributes to organisational strategy. Respondents are labelled as [*SS*] service based sector, and [*PS*] product based sector, to allow a distinction when discussing the main differences in setting and measuring success factors.

Additionally, each area draws on literature from the field to engage in the current debate on project success, leading to some conclusions and thoughts for further research.

1. Project constraints: Cost, Time, Quality

The interview participants were asked to talk about how their organisations classed a project as being 'successful'. There were some distinct differences in how each organisation, and in some cases individuals measured success. Aspects of the well-known project management iron triangle, or triple constraint model (cost, time and quality) was referred to by 7 participants, and more so in the product based sector (all 5 participants):

"*I guess we are judged on two things, I think the ability to deliver the job on time, and on budget*." PS1

"*Bringing in projects to budget, and within time scale are the most important aspects*." PS3

"*I never compromise on cost*." PS2

"*The main factors are about bringing the project in on time, and without too many cost overruns*." SS2

Interestingly, the difference on perception of cost as a success factor demonstrated that in the product based organisation this was often the one thing that was always met. 4 respondents [PS] discussed the project constraints as often being pre-set by sales departments and business development managers, who would then hand over the project once costs and timescales had been agreed:

"*Sales set the job up, by the time it reaches us we already have the budget and time frame we have to work with*." PS1

"*Unfortunately, even with the best will in the world you are judged on a budget where things may have been missed at costing stage but we have to deliver*." PS4

In this case, it is suggested that in creating products for clients, the project manager may not have full involvement at the outset. This could be common practice as the business development function has responsibility for bringing in new contracts which are often fixed price, however as Wateridge J.H (1995) suggests, in order for a project to be managed most effectively the project manager should work with the client during initiation phase to understand and set requirements, and decide on the most appropriate techniques to manage the project.

On the other hand, respondents from the SS organisation referred to several cases where costs had overrun on some publicly funded projects for a number of reasons, yet this was not deemed as the project being 'unsuccessful', but necessary in meeting a number of goals where scope had changed at various points during the project:

"*The client, for the right reasons may change things throughout the projects which affects your outcomes and budget*." SS2

"*Aspects of the project have changed, and that has meant a requirement to change budgets. Happens sometimes*." SS3

Interestingly, quality as the third major project constraint was not a factor that was brought up as a predominant success criteria in the interviews (only 2 PS respondents mentioned this by name overall). However 9 respondents did highlight the importance of involving and meeting client expectations as part of defining project scope and this in itself suggests some discussion on levels of quality. Atkinson, R (1999) describes the project success factor of quality a 'phenomenon', and suggests that project quality can emerge depending on the beliefs of key stakeholders involved in the project. Additionally, the perceived value of projects often do not come to fruition until after the project has been completed (Papke-Sheilds. K.E. et al, 2010). This could suggest why the focus from the project managers perspective is still on time and cost more predominantly than other success factors, as it is more explicit to measure, even if at times more challenging to control.

2. Client and stakeholder expectations

In the product based organisation, respondents indicated that client requirements in relation to setting scope and defining product expectations appeared to be tightly focussed at the initiation of the project. This may be attributed to the business development managers/sales who advise the client on specifications, detailed cost breakdowns and time scales for production (albeit identifying some challenges with this approach have already been identified).

"*We create the product, the client needs it for a specific time and there is absolutely no leeway on that.*" PS3

Conversely, the service based sector participants discussed client expectations as more of an evolving process, similarly along with other project constraints. There was some indication that although remits on what needed to be achieved existed at the start of projects, that this often developed throughout project execution and there were more likely to be change requests.

"*The client doesn't really know what it is that they want, so we have to set the success criteria, but this can often change throughout the project.*" SS5

3 respondents from the service based organisation felt that although involving the client was important in defining success, it could at times be challenging:

"*Measuring spend and time scales is straight forward, the customer satisfaction is the part I struggle with." SS3*
"*Everything is about the client. We involve them at every stage and it takes a significant amount of time*." SS1

In addition, SS discussed the complexities associated with working with clients, as the majority of the time, the client was not the end user. In this case the end user had to form part of the project team:

"*It depends on the project. We definitely have to involve service users as well*." SS1
"*We recruit people from the community to feed into project development*." SS2
"*If they don't like something, we have to consider changing the plan*." SS4

This suggests that the main criteria for success on the service projects were more complex to define. In projects where the public are the beneficiaries of project outcomes (such as building new schools, parks etc), the number of stakeholders involved in the project seemed to increase. This could be the reason why there were more likely to be change requests on the project, and quality criteria evolved rather than remaining static throughout the lifecycle. The more stakeholders involved in public change projects, whilst absolutely essential in meeting the business case, the more complex the project success criteria can be to manage as expectations will change over time (Turner R. Zolin R., 2012).

Whilst it is recognised that defining success criteria for projects can be dependent upon the size, type and level of complexity of the project, there are some key differences in the way the public and private projects were perceived in relation to success. In the PS organisation, the success factors were still heavily focussed on time, money and client satisfaction. This concurs with Muller R & Turner R (2007) who suggest that the private sector are more concerned with meeting client expectations, and bringing in projects on time and within budget which will lead to recurring business opportunities. This of course will depend on the level of complexity of the product being created, and whether any experience lies in delivering similar projects beforehand. SS organisation projects appeared more complex to define, considering the amount of input from different stakeholder groups and end user involvement.

There is lots of debate in relation to why project success has not dramatically increased considering the evolution of project management methodologies, creation of project management offices and the development of project management maturity in many organisations (Mir F. & Pinnington, A., 2014). Many projects may deliver on time, but go over budget, vice versa, or some other aspect of the project may be compromised. Throughout the interviews, 8 respondents discussed having to adapt project constraints at some point to ensure the project met the priority criteria.

"*We make the projects fit to budget.*" PS3

"*It's an aggressive industry, you have to deliver or lose the client, and sometimes we have to carry the extra cost. Simple as*." PS1

"*It's a public event therefore we couldn't compromise on time. More money was made available.*" SS4

Recent studies have all pointed to numerous success factors that are considered important when defining project scope including people, risk, resources and stakeholders. Excellent project managers are still sometimes referred to as those bringing in projects on time and budget (Gardiner P, 2005), however it has recently been recognised that this no longer reflects the complexities and requirements of different types of projects. It has already been identified that in the PS organisation, time and money are the prominent factor when defining project success (in creating products), however in the SS organisation, this was indeed more complex to define, with various different factors contributing to how project success is measured, depending on who the service or change was directed at.

3. Learning Lessons and Project Management Offices (PMO's)

In addition to respondents discussing project constraints and client expectations as significant areas of consideration for achieving project success, the methods adopted throughout the organisation for how projects are managed and delivered also emerged as a significant theme.

The PS organisation had a PMO, whilst the SS organisation did not (although there was a central database of project management documents and procedures that could be used when planning and managing projects). Research suggests that PMOs positively impact on the success of projects (Unger B. et al., 2012), and this was also found when interviewing respondents:

"*As a team we all know the standard way of doing things*." PS3

"*There are particular documents, meetings and ways in which we do things round here to increase our chances of meeting client goals*." PS5

"*We have documents we can draw on, but we are not all in the same area so it can be difficult, some people will do their own thing*" SS2

"*I follow Prince2, though I know others who don't*." SS1

Even though not formalised, the SS organisation had the option of using standardised project management techniques, however these were utilised to differing degrees, and project teams were all geographically dispersed. Additionally, learning lessons formally, which is one of the many functions of the PMO, were overwhelmingly discussed by all 10 respondents in how undertaking this exercise impacted on the way in which future projects were planned. In both organisations this happened on different levels of formality.

"*We have wash-up meetings with the client to see what we could have done better and what went well*." PS3

"*We don't do it formally, but sharing office space you tend to discuss what went wrong and what went well anyway*." SS1

"*We capture lessons learned in a formal way where we can, however we sometimes don't always have the time*." SS3

The benefits of capturing lessons was clear, however when teams in some instances are not situated in the same area, it is easier for things to get lost in translation, and formal learning for success can be compromised.

4. Skills for success

Finally, throughout the discussions on how the project managers involved in this study perceived project success, the issue of expertise and skills was raised several times in the context of what was important to own as a project manager and how this linked to the way they viewed themselves as being successful or otherwise. The skills required to deliver a successful project was greatly emphasised in the majority of the interviews [8] and referred to at a minimal level in [2], such as:

"*People skills are fundamental, you have to be able to negotiate and get things done!*" SS3

"*Being an organiser leads to a successful project, but that is a big skill with lots of things going on around it.*" PS2

Most of the characteristics for being a successful project manager brought no new knowledge to that of existing studies which suggest that the ability to be able to work with people, organisational skills among many others are imperative to delivering successful projects (Cooke-Davies T., 2002). However, there is also the acknowledgement that personal objectives can affect the way that project managers perceive the way they have managed a project successfully or otherwise (Dvir D. et al., 2006, Muller R. & Turner R., 2007).

This proposition reflects the responses given by the interviewee's, as some raised the point that they became project managers in the areas that they used to work on the actual execution of projects. 4 respondents felt that these project management skills were non transferable, and that they were effective in their jobs because they knew the business environment well.

The skills necessary for undertaking a successful project are fundamental, however there were no patterns in relation to the different skills required between each organisation/sector.

Conclusions, proposals, recommendations

This preliminary investigation into project managers perceptions on success has surfaced some interesting concepts. There are a great deal of similarities in both sectors in relation to how project managers define success from both an individual and project perspective.

Not surprisingly, the literature has recognised that success is very often dependent on the type of project, type of organisation, and the methodologies and approaches used. Whilst the data collected from this study concurs in the majority with this position from an individual project managers viewpoint, there were some differences in relation to how project success was perceived from an organisational perspective.

In the product based organisation [PS], the criteria for delivering successful projects appeared to be clearer and more tangible to measure than those projects attempting to achieve a longer term change, where often the value of project activity may not surface until long after the project has been completed. The product based sector clearly focused on client requirements, and when the client/customer is typically the same, it is no surprise that the success criteria can be more distinctly defined. Additionally, all project activity in this case study was managed from a central location (PMO), where research has clearly evidenced the benefits to this approach.

In the service based organisation [SS], the main issue for government funded initiatives are in deciding which projects are worthy of initiation. It was clear that the focus on achieving success in these types of projects included working closely with the clients to set success criteria, however this could often change once additional stakeholders (especially the public) are identified and involved in the project. It was clear that project managers working in this organisation identified with the need to be flexible to meet customer expectations, and as the project evolves. In some cases project constraints needed to be flexed as a result of differing stakeholder opinions. Could this be the reason why some government funded projects often go over schedule and budget?

Additionally, whilst in the service based organisation [SS] there was evidence of excellent project management, the different project management teams were in the main geographically dispersed. Whilst there was an available methodology to use, and each project had different methods of capturing lessons, it could be suggested that further centralising this into a formal project management office would carry some benefits in co-ordinating approaches to the management of projects and in setting initial success criteria.

Project management skills exist in both sectors, to varying degrees and it is recognised that the use of PMOs are invaluable in developing project management knowledge and majority in both sectors. Capturing lessons in a more formal manner needs to be built upon in some project situations.

The benefits of project management in both sectors are fundamentally clear. However, closer consideration needs to be given on how project success is defined. The old concept of ‘excellent’ project managers being those that bring in projects on time and to budget is now perhaps too dated, and organisations need to be able to adapt existing models to suit their organisational, project and indeed individual project manager needs, without compromising alignment to strategic aims and objectives. Clearly, time and money are tangible factors that are more easily controlled than aspects of quality, stakeholder engagement and risk.

Limitations and thoughts for further research

The limitations associated with this study are that the sample size chosen may not be too limited to generalise across the entire sectors in the UK. Although responses provided thought practical and theoretical implications on defining project success in two different sectors, this study would benefit from extension into other companies, including service based organisations that operate in the private sector. Additionally it would be interesting to see how results fare further than the United Kingdom.

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SELECTION OF THE START-UP STAGE INVESTMENT PROJECT

Shota Shaburishvili, Ivane Javakhoshvili Tbilisi State University, Georgia[1];

David Sikhrulidze, Ivane Javakhoshvili Tbilisi State University, Georgia

Abstract

One of the most important factors of success is in the field of venture capital to select right investment project. Investors consider this process more precisely, because it is uncertain what project will have more chance to become a high-class innovative enterprise and emerge as a leader. According to the assessment of the American investment consulting company, "Baganov International Group" out of the ten business proposals only one project gets funding. Thus, evaluation of a project at the start-up stage is rather difficult and often a long process.

Project analysing and selection procedure may vary in terms of investors' goals and approach. It is sometimes a simple interview but mostly it's time-consuming and formalised process of project selection. In some cases applicants are required to write up a project including financial statements. The investor sometimes participates in the formation of project that helps the beginner entrepreneur. Although there are many approaches, this article will focus on the standard scheme of early stage of investment project selection.

1. Deal flow – first stage of nascent stage of investment project selection is to search competitive idea. The key source of information is the description of the project that investor get familiar with. Decision making of investor is based on the intuition, which is derived from the first opinion. Generally, at this stage most of the considered projects are rejected.
2. First meeting – both parties get familiar with, supervise each other, and try to feel "the chemistry" of further relationship.
3. Due diligence – the process of complex monitoring of project. This stage may last several months and finish by the final decision about investment. This stage usually discusses the issues of business concepts including a) product, market, prospects, and team; b) issues of intellectual assets; c) production process; d) investment terms and financial indices.
4. Final meeting – in case of positive decision working on implementation of the business plan begins.

Based on the analysis of separate stages of this scheme specific recommendations are stressed in the article which simplify nascent entrepreneur to interact.

Key words: *start-up, deal flow, due diligence*

JEL code: M1

Introduction

Developing "the Business based on the contemporary idea" has become basic natural law of growth demand on the start-up investment from the entrepreneurs and supply of small but

[1] Corresponding author – e-mail address: shota.shaburishvili@tsu.ge, telephone: +995 99259435

long-term and venturesome capital. In the early stage of business development, entrepreneurs mostly do not have the sufficient experience of the business relationship. They do not have business model, main team structure, and target market and business strategy to adopt it. Financial performance of such kind of enterprises is rather optimistic guess than the forecast based on the calculation. Due to the lack of actual data about the project development, investors apply the simple models for project valuation, which increasingly depends on the intuition and expectation of valuator. Evaluating project, the lack of the impartial criteria and unskilled entrepreneur complicate the simple formula "business based on the idea". If you have a attractive and commercially viable idea, it is necessary to find investor. It is the fact, that the most potential transaction between investor and entrepreneur will have been revealed after first meeting. The reason is that parties cannot achieve consensus. Sometimes they speak in different language and do not have desire to understand each other.

Project selection is an important stage for investors in the process of evaluating of those enterprises in which capital investment is intended. The efficiency of this process directly determines the quality of transaction flow, minimization of the risk and high rate of return on invested capital. In the process of project selection investors can resort to assistance of third party or implement this difficult procedure independently. Project analysing and selection procedure may vary in terms of investors' goals and approach. It is sometimes a simple interview but mostly it's time-consuming and formalised process of project selection. In some cases applicants are required to write up a project including financial statements. The investor sometimes participates in the formation of project that helps the beginner entrepreneur. Although there are many approaches, we will focus on the standard scheme of early stage of investment project selection. Early stage of investment project selection consists of two sequential stages: deal flow and due diligence.

Deal Flow

Deal flow – First stage of early stage of investment project selection, when competitive idea is being searched (Kashirev A., 2008). At this time the main source of information is the description of project that investor become familiar with. In turn investor is searching for the perspective entrepreneurial ideas through advertising aids, the printed media, and venture fair, data bases of business-angels and association of venture investment, R&D and analysing of personal contacts. Regardless of the personal effort of investors in making decision the most important is to solve the following issues:

1. The degree to which the project is suitable investors efforts?

Investors are interested in the project with high growth potential in those fields they know well and have some working experience. Investors often set the priorities using the gradual elimination and they first eliminate: franchising, retail stores, publishing house, real estate, entertainment business (cinema, TV, restaurant, theatre performance, sport, gambling etc.) and natural resources.

Early stage firms is most interesting, which have intellectual property, thereby it is important to focus on the date of product development. If the product development needs long term for example 7 years, it means that enterprise does not know how to manufacture the new product and the prospect of expected return on project is uncertain (Mazerlis U.D., 2009).

Investors basically work in the enterprises at a 3-4 hours distance from house. It is necessary to keep contact with firm. In selection of early stage project investors pay attention the recommendation of partner or existing investors.

2. Which Enterprise has ability to operate effectively?

It's natural that the result of capital investment is the production of marketable product. But in the process of project selection main job of the managers is to process the documents. Therefore a lot of things is depends on the professional and personal features of management of enterprise. In order to gain investors' confidence they have to get practical experience about specific industry and have business knowledge.

There are two type of enterprises, in which business angels and their networks are not interested:

- "One man show" – enterprises where everything is adapted for only one person and if one of the owner retires, dies, or is declared legally incompetent, the enterprise essentially ceases to exist. It is natural, in this case, the risk factor is high.
- Family business: the practice of investors activities revealed that it is not worth having relations with them.

3. The degree to which enterprise has the ability to market the high Quality product?

It is important for any enterprises not only to realize that they have competitors but also how can be distinguished in some way from its competitors. Investor needs core competences (intangible assets, tacit knowledge). Core competence is represented by the strategic resource (asset) that competitors cannot easily imitate and which has the potential to earn long-term profit.

4. The degree to which product or service is suitable for market Requirement?

The likely advantages of Product have to be distinguished. It is needed to notice the characteristic of the product. Whether it is "pain-allaying" or vitamin. It is also important to know the future market potential.

Investors considering early stage project they usually do not require one billion dollars of market size. They often consider those enterprises that will not probably receive venture finance but have the ability to have stable position in the market. Investors are also interested whether entrepreneur in which he or she can compete successfully and how it is easy to adopt this market segment with minimal marketing costs.

5. Are the required funds enough to achieve goal?

The Required finance has to be sufficient that enterprise could achieve break-even point and new stage of development where it will be possible to use other sources of finance. Otherwise, the project will cause the incredulity of investor.

6. To what extent can the enterprise justify the attractiveness of the project?

In order to convince investor, it is necessary for manager of enterprise to realise all expected strengths, weaknesses, opportunities, and threats. To what extent the finance, personnel and material resources of enterprises is consistent with the goals.

7. To what extent the given project is attractive in terms of finance?

Special attention is focusing on the determination of the future value of the company. In many industries, company that has not profits will not be able to justify, that its future value will exceed 3 million dollars. There are, however, exceptions – if the intellectual property is well protected. It is also important to have profitable strategy of exit i.e. when deciding to leave the project, investor have to be able to get the several time more income than implementing investment.

In the process of deal flow, the procedure of the project analysis needs a few times. When making decision, investors mostly rely on the intuition, which is based on their first impression and their personal experience. In this stage, as rule, most considering project is rejected. Investment seeker has to remember this and try to create the positive impression in the beginning. At this time entrepreneur have to be perfectly frank and show up the real, firmly reasoned advantages. Any attempt to create the exaggerated expectation to investors may be the basis of the rejection of the project afterwards, since the experienced investor, as a rule can realise this quickly. If the fact is revealed after investing then the result between entrepreneur and investor will be time-consuming part of conflict situation.

Due Diligence

Due diligence – Due diligence is a process of thorough examination (Hill B., 2008). This stage may last several months and finish with final decision about investing. In this case, all aspect of market condition is being analysed and those opportunities that comes from the project realisation.

In the process of due diligence main objectives are the following:

- Identification the growth prospect of business and enterprise value;
- Examining management's capabilities of company;
- risk assessment;
- analysing project financial prospects;
- examining market and competition environment;
- Understanding the technological and competitive advantage of project;
- Understanding the mechanism of profit generation and market risks in the business-model;
- Examining the condition of intellectual property and existing assets;

Inasmuch as investors mainly deal with the enterprises i.e. with idea, research and projects being in the early stage, the realization of which is just beginning, the performance of financial operation has not existed yet and the forecast is characterized with low accuracy. In many cases business plan does not exist too. Consequently due diligence, first of all is the study of prospects of business and market and also prerequisite and ground of project implementation and the analysis of each activities of whole value chain of production and selling. Basic attention is focusing on the main idea formulated by the entrepreneur and on the general vision of perspectives. In the process of due diligence, in-depth analysis of project's technological aspect is conducted. Due to this reason appropriate field experts may be invited. Although, it is also important financial aspect of the project: investor will necessarily want to look at the initial financial forecast.

In the process of due diligence, essential issue is the determination of the project's value. In the process of project's assessment, both parties are enabled to look the future business impartially and in a new way, specify the uncertain details of business-model, analyse the basic sources of income and costs, correct the forecasted operation indices. Consequently, in spite of the results, the value of assessment procedure is high for both investors and entrepreneur.

In the early stage of project's assessment process the qualitative method considerably depends on the expectation of values. It is not surprise, because in the early stage of business, enterprise does not have yet the market share and economic efficiency indices, while precise forecast is almost impossible. Due to the lack of actual data about project development, when estimating the project, the simple method is being applied.

Therefore, the answer on this question – what is the early stage project worth – is not so simple.

All methods of early stage project's assessment to some extent depends on the forecast of subsequent development. Even though if estimation is being made on the base of value of current assets. The valuation of this assets (especially in tangible assets) is based on the income forecasts as well. Enterprise often borrow money from the bank or issues bonds, equity. Therefore in practice of corporate finance there is differences between enterprise value (EV), equity value (market capitalization) and value of long-term loan – D. If Cash is cash flow of enterprise, then the formula is the following:

$$EV = MC + D - Cash \tag{1}$$

Inasmuch central point is the early stage enterprises that have not issued equity, bonds and use the credit rarely, in the subsequent discussion we will consider that EV = Equity Value.

Table 1

Some methods of seed stage project value assessment

Methods	Description
Agreements	The value of enterprise is determined with the agreement between parties. Value is formed with the cost of creation of enterprises or with the current value of its assets (building, intangible assets, furniture). Some expert methods of market indices are applied in relation to the qualitative indices.
Comparable estimates	The value of venture is being calculated by coefficients, which is derived from the indices of similar venture operating in the market, about which actual data is already known.
Discounted Cash Flow (DCF)	Forecasted index (5-10 years) of future net cash flow is Discounted by using compound interest.

Using any approach of valuing is needed to distinguish the following indices.

$\text{Value}_{\text{pre-money}}$ – pre-money value, project value before getting investment.

$\text{Value}_{\text{post-money}}$ – post-money value. Project value getting with the considering investment.

Discussion these indices means, that venture is already founded. $\text{Value}_{\text{pre-money}}$ – substantially is the capital of the founder. If $\text{Value}_{\text{investment}}$ – is the value of capital investment, while the share of the investor ($\text{Share}_{\text{investor}}$) is determined by the following formula:

$$Share_{investor} = \frac{Value_{investor}}{Value_{investor} + Value_{pre-money}} = \frac{Value_{investor}}{Value_{post-money}} \tag{2}$$

In the process of due diligence investors examine venture's top managers capabilities with special attention. Investment decision is being determined with the strength of management team. Experienced managers know well, that strong managers team can become market leader by low technology or vice versa. High technology – does not matter what is its market potential that is used by unexperienced management team will die with long and expensive death (Shaburishvili, 2009).

Consideration, that good management team is the key factor of success it is acknowledged among the investors circle. Manager's team has to be characterized with the competences in the following fields:

- Field knowledge – top managers have to know their business field: know key players and their competitive position in the market, industry in which there are potential consumers, current wants and needs, product life cycle.
- Positive experience of business – there have to be one person yet in the management team who has managed or created successful company before. Top managers have to know early stage of business operation characteristics and have experience to solve those difficult issues that enterprise faces in the early stage of development. One of important factor is to determine the experience and achievement of management team. Past experience determine the future potentials of enterprise. If manager worked in top company, he or she does not probably hold sufficient experience to run early stage project. although it happen rarely. Many entrepreneur fails in, when they find that they have to be secretary, office-cleaner, interpreter, accountant in the most difficult first months of enterprise function. The lack of the assistance, long and hard work schedule and the necessity of own saving cause the disappointment of the early stage of project managers' expectation.
- Ethic and honesty – is important factor. In many cases, entrepreneurs are the swindler. Therefore, recommendation is crucial for the identification of person's reputation. The world is small.
- Enthusiasm – whether the enthusiasm of management team quite enough or not to do everything for the ensuring of the profitability of enterprise. Every stage of business development is characterised by the contradictions, this especially refer to the early stage of development, therefore managers team have to work for 24 hours a day to do impossible. Unique idea is the one side, but transforming into profitable enterprise is second side. It is necessary to have the strong will, capability to overcome obstacles and competence to create "working" idea.

Due to strict control from the public funds, the procedure of due diligence is complex and long-term. It is characterised by the high level of formalization and necessity of filling of various forms. In the stage of due diligence, investors can provide great assistance in the process of transformation of perspective idea into business project, therefore initial business proposal may be changed. Many issues, that the venture funds and other formal investors expect that the entrepreneur have to solve, the investor decides with entrepreneur.

In the process of due diligence, when transaction is not yet conducted entrepreneur have to examine potential investor – biography, the origin of property, working style and history of previous business angel's projects. This work have to be implemented skilfully and in the secret situation for which the question can be asked so that will not scare him/her and damage the subsequent relationship, but at the moment of the dealing, entrepreneur has to understand who will be his/her partner in the business.

The term of due diligence is also widely applied in the sector of FDI, mergers and acquisition. But in this case firms have history and successful business process. Therefore due diligence is based on financial and managerial statement, juridical document, managerial decision analysis. This process is being implemented by the assistance of specialized law, audit consulting company. The cost of their consultation is about 50 000 – 70 000 dollars and the length of this process may exceed 6 months. In the sector of venture investment, the procedure of due diligence is less formalized and is passing rapidly.

Negotiation process with investor

Transition from deal flow into due diligence is the meeting between entrepreneur and investor, when both parties become familiar and observe with each other. It is important to highlight the personal side of a business relationship. This includes the discussion of personal and social interests to see if there is a good “chemistry” between the prospective partners. After first meeting, the meeting is taking place in the office, laboratory or in the building of future factory, where investor inspects the production facilities and the products prototype.

Negotiation between entrepreneur and investor is so similar to marriage contract process. You want to remain long-term relationship and at the same time, you would like to know about all detail of living together. If some party starts the negotiation with dishonest intention and makes nonretail terms, family will not be formed or will be broken after agreement. In order to keep relationship between parties in the process of negotiation, it is necessary to be honest and transparent (Traisi, 2008).

Investors are skilled and intelligent people and if they cannot get the comprehensive answers, entrepreneur must not attempt to avoid with various ways. It is better to avow the truth and explain that he/she is not yet interested in the given issue. Investors pay attention not on the design of the business proposal but on the degree to which author has the ability to turn this planned project into practice. Therefor the pretender of the funds has to show that he/she is not only generator of innovation but also he/she is the capable and energetic person.

Investors are not interested in those projects, where initiator has not desire to take a risk of property. During the negotiation, entrepreneur has to represent, that his/her own financial ability has been exhausted and so as to finish the business it is needed to resort to help. Thereby, entrepreneur’s effort to reinvest whole profits received from the business is perceived by investors as the sacrifice of past for the future goals. Investors do not like, when managers have the high salary before the project will become profitable.

Traditionally, during negotiation each party tries to protect their position and repeal the opinions of the second party. Negotiation with the preliminary position fixed by parties is mostly time-consuming and damage the relationship and cause the negative results. People, who carry negotiations in this way they find them self in uncertain situation.

Negotiation is not competition with each other in obstinacy, there are a lot of ways to make a mutual profitable trade-off. Thereby, Negotiation had better mean to reveal the opinion and interest of second party. If entrepreneur asks the reason and listen the corresponding answer he/she can conduct not only acceptable transactions but also understand well the capabilities and efforts of investor. Understanding and right vision of partners is the main clue for the successful finishing of negotiation process. When one partner achieves the desired result, it means that he/she make compromise in the important issues.

Time of meeting, cheating and uncertainty complicate the relationships and rarely lead to the success. Thus, negotiation has to take place in the environment of honest and mutual respect taking into account the principles of partners. In the final meeting, in the case of positive decision, Contract writing and detailed planning process is starting. At this time, it is reasonable to hold a celebration and improve relationship in informal environment.

Even in the case of refusal, final meeting with investor is useful, as during the negotiation investor can receive a many valuable advices. In many cases, first unsuccessful due diligence used to become the reason of project detailed revision and fund raising in the future.

Conclusion

Thus start-up project analysis and selection procedure may vary in terms of specific investor's effort and features. Thereby in the early stage of project development, unskilled investment seeker, lack of actual data and the impartial criteria greatly complicate this process. Although, for analysing and identifying main characteristics of early stage project selection process has been singled out the key stages: deal flow, due diligence and final meeting.

At the first stage of early stage of project selection is discussed the project's goals suitability to the business interests of investors, capability of project's implementation in terms of enterprise's resources, enterprise's ability to market the high quality product, product's suitability to the market, required fund's suitability to the project's goal. Meanwhile, the main source of information is the description of the project. At this stage, as rule, many projects are being rejected. Investment seeker has to remember this and try to create the positive impression in the beginning. Thereby, any attempt to create the exaggerated expectation to investors may be the basis of the rejection of the project afterwards, since the experienced investor, as a rule can realise this quickly. If the fact is revealed after investing then the result between entrepreneur and investor will be time-consuming part of conflict situation. In the process of due diligence, prospects of business and market potential and also prerequisite and ground of project implementation and each activities of whole value chain of production and selling are analysed. Basic attention is focusing on the main idea formulated by the entrepreneur and on the general vision of perspectives. In the process of due diligence, in-depth analysis of project's technological aspect is conducted. Due to this reason appropriate field experts may be invited. Although, it is also important financial aspect of the project: investor will necessarily want to look at the initial financial forecast.

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A PRACTICAL INSIGHT ABOUT USE OF AGILE METHODOLOGY ACCORDING TO TYPE OF PROJECT

Lubna Siddique, University of Oslo, Norway[1];

Bassam A. Hussein, Norwegian University of Science and Technology Trondheim, Norway

Abstract

This paper gives practical insight about use of agile methodologies in different types of projects. The aim of this paper is to provide practical insight into use of agile in different types of projects. More and more Software companies have started using agile methodologies, irrespective of the matter that whether agile is suitable for the given project or not. However, before adopting agile methodologies, it should be kept in mind that agile might not suitable for all types of projects. This paper therefore targets to answer this question that "which type of project should use agile". To find answer of this question, we conducted qualitative study i.e. interviews in software companies using agile methods in Norway. We conducted fourteen agile professional's interviews from fourteen different software development organizations in Norway. These organizations businesses vary from consulting organizations to in-house development organizations.

Our interview findings suggested that both (supplier and customer) consent is necessary although supplier tends to propose agile approach but it is finalized through mutual dialogue. However they suggest that agile is inevitable for project with high degree of unpredictability in terms of the specific final scope or simply as a way to boost productivity and if requirements are not well understood or they are highly changeable during the project. Also for projects with broader scope professionals avoid waterfall and try to use agile because of its flexibility. All of the participants agreed that agile should be used in all types of projects, whether it is a small project with low risk and innovation level or large complex software or safety critical software they want to use agile by any means.

However, agile professionals recommended for not using agile for security and real time systems and for system critical software middleware.

Key words: *Agile methodologies, Waterfall, Complex software, Grounded Theory, Security and real time systems*

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Introduction

Agile projects have attributes that makes them fit well with large and complex projects. The reason for this is that such projects have more changing requirements along with meeting the deadline pressure. One of the agile methods XP was used in such kind of projects to get desired result and to get the project delivered in less time (Cao, Mohan et al., 2004) (Elssamadisy 2001; Reifer, 2003).

From one of the industrial case study, Peterson and Wohlin found that there are multiple advantages of implementing agile and incremental practices in large-scale software

[1] Corresponding author – e-mail address: lubnas@student.matnat.uio.no, telephone: +474 6270731

development .He found that when scope is reduced in small incremental releases then it becomes much easier to do correct estimation and more chances of getting accurate requirements. Agile methodology put emphasis on co-located teams so, when teams interact directly then there is less need for any kind of documentation. With agile methods, product is released in an increments and it make easier for early detection of all kind of bugs and mismatched requirements. Since agile methods keep requirements flexible during the course of the project therefore it is much easier to change them in agile projects than in waterfall projects (Petersen and Wohlin 2009).

Agile methods give emphasis on customer collaboration over contract negotiation therefore when stakeholder assure their involvement during the project it was proven to be a successful way of working in large scale of projects (Sidky and Arthur 2007; Soundararajan and Arthur, 2009). Along with benefits with agile methods, there come also many challenges. Although using small and coherent teams was helpful for increasing productivity of the project and keeping everything in control but coordination problems may arise at management level.

Peterson and Wohlin (Petersen and Wohlin, 2009) found that implementing agile and incremental practices in large-scale software development leads to benefits in one part of the process, while raising issues in another part of the process. For example, using small and coherent teams increases control over the project, but leads to new issues at the management level where coordination of the projects has to take place (Petersen and Wohlin, 2009). They pointed out number of challenges that can arise when agile and incremental practices in large-scale software development can be many including

The purpose of this paper was to gain practical insight into use of agile methods according to type of the project. The research method used in this paper is grounded theory. In section 2, we have presented methodology. In section 3 interview findings are presented. Section 4 contains discussion and analysis. In last section based on interview findings some recommendations are presented.

1. Methodology

We conducted fourteen agile professional's interviews from twelve different software development organizations in Norway. These organizations business vary from consulting organizations to in-house development organizations. Three of the participants were from consulting companies who are using subcontracting regularly as part of their businesses. Almost all of the participants were using combinations of Scrum, XP, Lean and Kanban. The participants had many years of experience with IT ranging from 3 to 40 years. Most of the participants were using agile since its inception or even they started working with the methodology before it got name Agile (Table 1).

The products and services offered by the participants' organizations include web-based applications, front and back-office applications, and software development services. The interviewed participants were, Scrum Masters/Project Managers and developers. This enabled us to view problems form multiple perspectives.

We conducted semi-structured Interviews. These were conducted through various mediums. It includes face to face, via email and via Skype meetings. To take multiple issues into consideration interview questionnaire was designed to incorporate different issues related to the research question.

Table 1

Participants Profile

Name	Company Name	Designation	Agile Methods worked with	No. Of years of experience IT	Years of Experience with Agile
AP1	C1	Owner/Developer	Lean, XP, Scrum	15	10
AP2	C2	Project Manager	Scrum, KANBAN	3	3
AP3	C3	Project Manager	Scrum	40	6
AP4	C4	Manager	Lean, XP, Scrum	20	12
AP5	C5	Leading advisor	Scrum	25	5
AP6	C6	System Developer	Scrum	6	6
AP7	C7	Project Manager	RUP, tailor	15	15
AP8	C8	Project Manager/ Technical Leader	Scrum, KANBAN	15	5
AP9	C9	Project Architect/ Chief Scientist	XP, Scrum	12	12
AP10	C10	Management Consultant	Scrum	20+	4
AP11	C11	Principal Consultant	Scrum/IAD/XP	17	5
AP12	C12	Partner	Scrum, KANBAN	20	10
AP13	C13	Senior consultant-System developer	Scrum, KANBAN	6	5
AP14	C14	Senior Consultant	Scrum, KANBAN	6	5

1.1. Procedure adopted for interview analysis

We used grounded theory for our data analysis. The very first step is collection of data. After collection of data, incidents are coded into categories. The theoretical properties of the categories are developed, by comparing incidents in newly collected data, with previous incident in the same category. This helps to develop the properties and dimensions of those categories (Adolph, Hall et al, 2008).

Grounded theory uses constant comparison method for data analysis where the analyst starts by coding the data for incidents to explain what is happening in the data. This leads to development of codes. As codes are developed they are compared with previous codes from within the same interview and from other interviews. Codes are then clustered into related categories. As coding progress, code comparison changes into comparing properties of the categories (Glaser, 1965) [Pp. 440].

1.2. Validity and Reliability Issues

Validity measures how accurate are research findings (J. Creswell, 2008). To determine the accuracy of research findings researcher have to measure. This research was conducted in 12 different organizations and participants were chosen from the perspective according to their suitability of the study. We also make sure that participants have enough experience and knowledge of the subject under study. This was insured by asked them multiple questions. Reliability measures how consistent research is. We ensured this by cross checking results of different participants and we found it reliable. After transcribing interviews, it was sent to the concerned informant so that he can check for any omissions.

2. Interview Data

From interview data we found following categories i.e. Methodology Selection, which projects should use agile, whether agile methods will be used or waterfall for given project? Also we have discussed in which types of projects will benefit from agile most?

2.1. Methodology Selection

According to AP2, AP3, AP7, AP8 and AP14 it is supplier who decides whether or not to use agile. AP8 told us that 90-95% customers don't know what they want. "These are us who decides to use agile".

AP3 told us that "Usually we do [decision of using agile], but sometimes the customer requires agile project. That is becoming more and more normal".

AP4 adopt the following strategy while making decision for using agile: "We tend to propose, but whether or not the proposal is well met depends entirely by the maturity level of the customer, and whether or not they have accepted the concept of agility (which to some degree most customer say they do) and understood the consequences (which lot of them don't). So ultimately it is the customer".

AP5 was from a public company so he told us that "Process owner is responsible for using best practices. The best practice is agile. If he don't want to use agile he need to request for deviation by defining reasons that why he don't want to use agile".

According to AP6: "The development team. We're struggling to "sell" the idea of agile software development to the business side of our company – they feel much more comfortable with waterfall based development".

AP1, AP9, AP10, AP11, AP12 and AP13 told us that both (supplier and customer) consent is necessary although supplier tends to propose agile approach but it is finalized through mutual dialogue.

2.2. Which project should use agile

AP1, AP3, AP8 and AP14 want to use agile in all types of projects.

AP2 told us that "We use it for all our development (Scrum for larger projects where we have a dedicated team; KANBAN for line oriented work on multiple projects in one team)".

AP4 suggest to use agile with "Project with high degree of unpredictability in terms of the specific final scope or simply as a way to boost productivity and time to market".

In same way AP12 want to use agile "If requirements are not well understood or they are highly changeable during the project".

While AP5 told us that he use agile "For projects with broader scope we avoid waterfall and try to use agile because of its flexibility".

According to AP6: "We wish to use agile whenever we can and do so for all projects managed by ourselves. It gets more complicated when the business side insist on using their own project managers".

AP7 point of view is that "If there are non-functional requirements you cant use agile. Like for security and real time issues you can't use agile. Likewise for system critical software middleware (limited functionality but lot of technicality) I prefer not to use agile".

AP9 thinks about agile as follows "As "agile" is loosely defined, it's hard to say. In general: I always want a project that allows for learning as we go along. I always want a project that focuses on incremental fulfilment of scope. Any project with those qualities would qualify as agile, as far as I can say".

AP11 recommends using agile software development in following situations.

Agility can be used in almost every project setting, but one need to take an active position regarding the level of agility the project situation can handle.

A good "agile situation" can be:

a. High level of Agile Maturity at customer site.
b. Appropriate contact situation.
c. High level of trust and collaborative setting.
d. High level of requirement uncertainty. Needs iterations.
e. Time-to-market is critical.
f. Co-location Customer/Supplier.

2.3. Use of agile in different types of Projects

According to AP1, AP2, AP3, AP5 AP6, AP8, AP9, AP10, AP11, AP12, AP13and AP14 agile should be used in all types of projects, whether it is a small project with low risk and innovation level or large complex software or safety critical software they want to use agile by any means.

While AP4 thinks that for small project, low risk, low innovation level agile should only be used "If there is an available team that is well trained in agile methods (say, SCRUM) then it may be worth using that approach. Otherwise for small project the learning overhead is too large".

About use of agile for large complex software, he thinks that "It depends on the situation. Besides the very small project, it is not a matter of complexity or size but the external environment, which influences the project and its result. The more that environment is dynamic, the more agile methods are appropriate".

Similarly about a question for use of agile in Safety critical software, he told us that "Safety critical projects need other devices, independent from the management style, to attain the level of quality which is warranted. Some practices often associated with agility (like pair programming and continuous integration and testing) may be helpful, but they still won't be enough – direct code inspection, cleanroom techniques, beta testing, field testing, and other post-production devices will be necessary".

According to AP7 “If there are non-functional requirements you can’t use agile. Like for security and real time issues you can’t use agile. Likewise for system critical software middleware (limited functionality but lot of technicality) I prefer not to use agile”.

Sim1ilarly for Safety critical software she replied that

We will use more waterfall for technical, integration requirements. For functional requirements we can use agile.

However AP7 wants to use agile for smaller projects.

Discussion and Analysis

All of the participants agreed that agile should be used in all types of projects, whether it is a small project with low risk and innovation level or large complex software or safety critical software they want to use agile by any means. Agile professional recommend that if there are non-functional requirements don’t use agile. Like for security and real time issues and for system critical software middleware (limited functionality but lot of technicality) prefer not to use agile. They recommend using waterfall for technical, integration requirements. Respondent’s opinion about using mix of agile and traditional approach is according to Soundararajan and Arthur (2009), who suggested to use combine features both from waterfall and agile. He suggested using the soft-structured framework (hybrid approach) for a larger scale system development projects. He thinks that agile methods are highly suitable for changing requirements so; this feature must be combined with waterfall approaches. According to him combining in this way can help to boost productivity of large-scale project. (Soundararajan and Arthur, 2009) Some other studies (Reifer, Maurer et al., 2003; Lindvall, Muthig et al., 2004; Ambler 2006) focus on scaling of agile methods to large-scale complex projects.

Although participants are eager to use agile approach in every type of project but Cockburn (2002) recommends using serial development for cost-sensitive projects. He recommends using concurrent development for projects with shifting requirements (Cockburn, 2002).

Participants believe that agile approach must be used for projects with high degree of unpredictability in terms of the specific final scope or simply as a way to boost productivity and if requirements are not well understood or they are highly changeable during the project. This is in accordance with Erdogmus who demonstrates that agile methods are most appropriate for high uncertainty projects (Erdogmus, 2005).

Recommendations

When agile methods were introduced there comes different opinions from experts. Some were of the opinion that agile methods are only suitable for smaller projects and large complex projects should always used waterfall approaches. (Boehm and Turner, 2003). It is also being said that agile can only be used with small collocated teams. Agile methods were also regarded unstructured and undisciplined so, they were regarded highly unsuitable for large complex projects. Later there came different studies to show that agile is proven equally good for small or large projects. Most of the participants irrespective to size of the project, want to use agile in all types of project. This is in accordance with Boehm who thinks that as agile are equally good for any kind of project. Since they are not designed for some targeted projects. So, all kinds of projects should get benefit from them (Boehm, 2002). Literature also shows applicability and scalability of agile methodologies to large-scale projects but it can require some additional overhead, which make it hard to manage. Leffingwell, 2007). Agile methods are designed for uncertain and instable large projects. This was made in an attempt to reduce failure rate for such kind of project (Rico, 2010). So, based on our interview findings we recommend to use agile for large projects.

Whether agile or waterfall development approach will be used for a project all participants agreed that both (supplier and customer) consent is necessary although supplier tends to propose agile approach but it is finalized through mutual dialogue. However they suggest that agile is inevitable for project with high degree of unpredictability in terms of the specific final scope or simply as a way to boost productivity and if requirements are not well understood or they are highly changeable during the project. Also for projects with broader scope professionals avoid waterfall and try to use agile because of its flexibility. All of the participants agreed that agile should be used in all types of projects, whether it is a small project with low risk and innovation level or large complex software or safety critical software they want to use agile by any means.

Agile professional recommend that if there are non-functional requirements don't use agile. Like for security and real time issues and for system critical software middleware (limited functionality but lot of technicality) prefer not to use agile. They recommend using waterfall for technical, integration requirements.

Conclusion

From interview findings it was found out that choice of using agile or not is made with mutual consent of customer and supplier. Mutual dialogue is necessary to come to conclusion. Participants thinks that agile is inevitable for project with high degree of unpredictability in terms of the specific final scope or simply as a way to boost productivity and if requirements are not well understood or they are highly changeable during the project. They recommend to use agile for projects with broader scope professionals avoid waterfall and try to use agile because of its flexibility. All participant agreed that agile should be used in all types of projects, whether it is a small project with low risk and innovation level or large complex software or safety critical software they want to use agile by any means.

Agile professional thinks that if there are non-functional requirements don't use agile. Like for security and real time issues and for system critical software middleware (limited functionality but lot of technicality) prefer not to use agile. They recommend using waterfall for technical, integration requirements.

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PRACTICAL INSIGHT INTO ESTIMATION PROCESS IN SOFTWARE PROJECTS USING AGILE METHODS

Lubna Siddique, University of Oslo, Norway[1];

Bassam A. Hussein, Norwegian University of Science and Technology Trondheim, Norway

Abstract

This paper aims at exploring practical insight into estimation process of agile projects in software companies Norway. Qualitative research i.e. Interviews were done to explore different issues related to estimation process in software companies using agile methodology. We conducted fourteen agile professional's interviews from twelve different software development organizations in Norway. These organizations businesses vary from consulting organizations to in-house development organizations. Our research on estimation was mainly focused on following subtopics i.e. the most widely used estimation technique, who does the estimation, product owner involvement in estimation process, frequency of revisions of estimates, reasons of revision of estimates and reasons for inaccurate estimates. Grounded Theory was used to assign codes to data. From interview findings, it was found out that planning poker was most widely used estimation technique and its users seems find it very interesting and helpful. Some companies were using User stories/Points mainly along with planning poker and wide band Delphi. Other estimation techniques that are used commonly includes parametric estimate, expert judgment (Delphi), analogy / comparison estimating, three point estimation, work breakdown structure +weighted effort estimation in hours. Everyone in team (management, testers, developers, designers etc.) is involved in estimation. Customers were not involved in estimation process in most of the companies. Reasons of inaccurate estimates were said to be many but too much optimistic behaviour is most common among all reasons in most practitioner's view. Based on interview findings, some recommendations are made including iteration-based estimation along with developer's involvement in estimation. The goal of this paper is to identify estimation issues in projects using agile methodologies and suggesting some guidelines to make estimation process more efficient.

Key words: *Agile methodologies, Planning Poker, Delphi, User Stories/Points, Wide band Delphi, Grounded Theory*

JEL codes: O22, L86

Introduction

Software development process starts with effective planning. Planning involves planning and allocation of resources, estimation etc. Doing correct estimations is a difficult task; therefore estimation is sometimes regarded as an art (Keaveney and Conboy 2006). Estimation is a very tactical process. Traditional projects have more tendencies of having wrong estimates. So for these kinds of projects it is quite common to have different estimation figures at end of the project than what was measured at start. Agile methodologies stand on the philosophy is delivering best value to customer therefore agile projects have different project management

[1] Corresponding author – e-mail address: lubnas@student.matnat.uio.no, telephone: +474 6270731

techniques especially when it comes to estimation approach. The focus of this paper is to give practical insight into estimation process of agile projects (Tamrakar 2010).

In this paper, we have presented qualitative study findings of research conducted in Norway software industry. The purpose of this paper was to gain practical insight into estimation process in agile projects. We asked informants different questions related to estimation. The most widely used estimation technique, who does the estimation, product owner involvement in estimation process, frequency of revisions of estimates, reasons of revision of estimates and reasons for inaccurate estimates are the issues discussed in more detail. The research method used in this paper is grounded theory. In section 2, we have presented methodology. In section 3 interview findings are presented. Section 4 contains discussion and analysis. In last section based on interview findings some recommendations are presented.

1. Methodology

We conducted fourteen agile professional's interviews from twelve different software development organizations in Norway. These organizations business vary from consulting organizations to in-house development organizations. Three of the participants were from consulting companies who are using subcontracting regularly as part of their businesses. Almost all of the participants were using combinations of Scrum, XP, Lean and Kanban. The participants had many years of experience with IT ranging from 3 to 40 years. Most of the participants were using agile since its inception or even they started working with the methodology before it got name agile (Table 1).

The products and services offered by the participants' organizations include web-based applications, front and back-office applications, and software development services. The interviewed participants were CEOs, Scrum Masters/Project Managers. This enabled us to view problems form multiple perspectives.

We conducted semi-structured Interviews. These were conducted through various mediums. It includes face to face, via email and via Skype meetings. To take multiple issues into consideration interview questionnaire was designed to incorporate different issues related to estimation.

1.1. Procedure adopted for interview analysis

The very first step is collection of data. After collection of data, incidents are coded into categories. The theoretical properties of the categories are developed, by comparing incidents in newly collected data, with previous incident in the same category. This helps to develop the properties and dimensions of those categories (Adolph, Hall et al. 2008).

Grounded theory uses constant comparison method for data analysis where the analyst starts by coding the data for incidents to explain what is happening in the data. This leads to development of codes. As codes are developed they are compared with previous codes from within the same interview and from other interviews. Codes are then clustered into related categories. As coding progress, code comparison changes into comparing properties of the categories (Glaser 1965) [Pp. 440].

Table 1

Participants Profile

Name	Company Name	Designation	Agile Methods worked with	No. of years of experience IT	Years of Experience with Agile
AP1	C1	Owner/Developer	Lean, XP, Scrum	15	10
AP2	C2	Project Manager	Scrum, KANBAN	3	3
AP3	C3	Project Manager	Scrum	40	6
AP4	C4	Manager	Lean, XP, Scrum	20	12
AP5	C5	Leading advisor	Scrum	25	5
AP6	C6	System Developer	Scrum	6	6
AP7	C7	Partner/CEO	RUP, tailor	15	15
AP8	C8	CIO/Technical Leader	Scrum, KANBAN	15	5
AP9	C9	Project Architect/ Chief Scientist	XP, Scrum	12	12
AP10	C10	Management Consultant	Scrum	20+	4
AP11	C11	Principal Consultant	Scrum/IAD/XP	17	5
AP12	C12	Partner	Scrum, KANBAN	20	10
AP13	C13	Senior consultant – System developer	Scrum, KANBAN	6	5
AP14	C14	Senior Consultant	Scrum, KANBAN	6	5

2. Interview Data

From interview data, we have developed following categories i.e. most used estimation technique, drawbacks of different estimation techniques, team involvement in estimation, customer presence in estimation process, frequency of revision of estimates and reasons of revision of estimates. All these categories are presented in the following section.

2.1. Most used Estimation technique

AP1, AP2, AP3, AP6, AP10 and AP14 use Planning Poker while AP1, AP2, AP9 and AP12 use User stories/Points technique for estimation. AP9 describes estimation process used in his company in following way

"We use relative estimates ("story points") mainly with planning poker, but also with wide band delphi to speed up the estimation process. As the project starts, the actual progress ("story points/hour", "story points/iteration") of the project is fed back into the estimates".

AP2 also use hours based estimation technique for individual tasks. AP4 uses work breakdown structure for estimation. He told us about the method "there's very different practices throughout the company, but the primary "official" method is project breakdown + weighted effort estimation in hours. In certain departments (mine for example), the main technique is comparison to previous work, typically down at a project class or functionality class level".

AP5 uses following three estimation techniques:

a) Analogy.
b) Poker game.
c) Expert judgment.

AP7 and AP14 use work break down structure while AP7 also use Expert judgment and analogy approach. AP8 do estimation in following way, "we have Excel sheets, which contains estimation for different known tasks/modules, so we then try to estimate what (standard) modules are needed and in what amount. The end the excel sheet will give a coarse sum of estimation."

AP11 use various techniques for estimation. According to him these includes

a. Top-down and Bottom-up;
   i. Parametric estimate;
   ii. Expert judgment (Delphi);
   iii. Analogy / comparison estimating;
   iv. Three point estimation;
b. We also use agile estimation techniques (i.e. Planning Poker) when appropriate. Example: Used to estimate business value.

AP13 uses Planning poker by using "Gummy bear" estimation.

2.2. Team involvement is estimation

According to AP1 and AP11 everyone in team (management, testers, developers, designers etc.) is involved in estimation. According to AP2 "the team is the only ones allowed to vote or have an opinion. In addition we have the product owner(s) there to aid in understanding".

According to AP9 and AP5 whole team is involved in estimation. AP5 thinks that "team involvement" is important because they are also accountable for this.

According to AP3, AP6, AP12, AP13 and AP14 developers are responsible for doing estimation.

AP6 told us that while estimating although product owner is present to answer questions but he is not allowed to suggest estimates. "a team of technical architects" does estimation according to AP4. While according to AP7 "sometimes Project Manager only" does estimation, sometimes bid team (project manager + IT-Architect) is also involved in estimation.

According to AP10 "initial estimation is done by the solution architects and development lead. Verification is done by the development teams".

2.3. Drawbacks of different techniques used in estimation

According to AP1"estimations are less accurate at start-up but gets accurate after. You have to be careful being not too much optimistic". AP5 told us "team requires experience" while AP2 think that teams need to be stable over time otherwise estimates won't really give much value.

The drawback of breakdown technique according to AP4 is "the breakdowns/hours techniques simply produce too much error. Comparison to previous work is much more accurate, but off course depends on the fact that a class of work and functionality has been done before. First time, the risk is high. All ignore the team composition, which I find in average is a very strong factor for limiting of estimation error – but on the other side in a service organization is very unlikely that the teams are kept the same or even similar across projects".

AP6 feels that during estimation "the presence of the product owner can make it difficult to discuss technical issues. The product owner can influence estimates".

AP7 told us the drawback for not involving whole team is that

"If only project manager does the estimation, one cant has ownership from development team".

P12 also think same. According to him then "it is hard to make whole group think that estimates are correct". AP9 thinks that "in some instances, we spend more time discussing the scope than what's meaningful" AP14 also said it is "time consuming".

AP10 told us "it [Right estimation] requires a fairly good understanding of the solution and the technological environment which is hard to obtain in an early phase of the project".

AP13 thinks that estimation can't be 100% certain.

2.4. Involvement of customer/Product Owner in Estimation

Whether the customer/product owner is involved in estimation or not, the interview data suggests a mixed trend. Most participants believe that customer is involved and should be involved in estimation process, while some were of the view that he shouldn't be involved in estimation.

AP1, AP2, AP5, AP7, AP10 and AP11 involve customer/product owner in estimation process.

According to AP10 "customer contributes with explanations and clarifications".

AP9 explains it as "the customer is not involved in setting the actual numbers, but is available to explain details and answer questions".

According to AP3, AP6, AP8, AP12, AP13 and AP14, customer is not involved in estimation only supplier does estimation. According to AP6 the reason for not involving customer is that "the development team attempts to estimate without influence from the product owner/stakeholders".

While AP8 states reason for not involving customer is that "because customers are non-IT people most of the time".

AP12 told us that although customer is not involved in estimation but "customer can react and say that this is more expensive than expected. Then discussion can lead to revised estimates and scope".

AP4 thinks that whether the customer is involved or not, it really depends on the situation.

2.5. Frequency of Revision of Estimates

According to AP1, AP3, AP5, AP11, AP14 estimates are revised very often. AP1 revise user stories every week, while according to AP4 "Estimates are revised at least thrice before being approved".

AP10 revise estimates within 4-6 months. AP6 don't revise overall estimates however they used to revise them personally "whenever we log work on our task, and as a group during the daily stand-up meeting".

According to AP7 "we always do a re-estimation after each phase for the following phase. This will be the basis for a go/no go decision where the customer can choose to continue the project or stop it/select another vendor. For smaller things it is regular change management process".

AP9 after estimates are done don't revise them until new requirement is added, "we feed actual progress back into the estimates after each iteration. We give estimates for new requirements as they are added. We seldom adjust the "story point" estimate for any requirement, as this would hide information".

AP12, AP13 told us that once estimated they don't revise estimates often. According to AP8: "No, once we estimate we don't revisit estimates during development. Sometimes we compare end effort vs. original estimation to see if we can do any improvements to the excel sheet".

2.6. Reasons of revisions of estimates

According to AP1 and AP3 estimation is revised if it is felt that initial estimates are inaccurate.

According to AP2: "Since the scale is relative, things can change from time to time. Also, we might later realize that parts of a story has already been implemented as part of something else".

AP4, AP9 and AP14 think that revision of estimates is done "every time new information/requirement is collected or a change is made to the overall approach/architecture to the project".

AP5 revise estimates at sprints, product releases and project level decision gates. Accuracy and uncertainty will vary, so estimates needs to be revised.

AP6 told us that revision of estimates should be done very often so, that the team can keep check on their progress and they can make sure that they are on schedule.

AP7 revise estimates when switching from smaller scope to larger scope is done. While according to AP8 "to full fill customer demand revision of estimation is done".

According to AP10 revision of estimates is done "because of new priorities, new insight in the technical environment of the solution and new insight in the actual functional area".

AP12 thinks that you need to revise estimates again and again "if you have built in trust with the customer then try to avoid estimate too early".

2.7. Reasons for inaccurate estimates

According to AP1, AP2, AP14 "too much optimistic behaviour" is responsible for inaccurate estimates. AP12 thinks that future predictions carry risk, humans with too much optimistic behaviour can skip risk.

AP3, AP4, AP5, AP7 and AP10 had common point of view that Lack of knowledge and experience can cause in wrong estimation.

AP1 also thinks that "If you misjudge technologies being involved that can arise integration problem".

According to AP2: “Uncertainty, and uneven knowledge of the people doing estimates. Lack of common history in the team, vague stories is main reasons for inaccurate estimates”.

A P4 told us number of factors that lead a team to wrong estimation. These includes:

a. Lack of deep understanding of the functionality details.
b. Lack of deep understanding of the existing dependent systems.
c. Lack of experience with the project/functionality class.
d. Not considering organizational and nontechnical factors.
e. Time limits (especially with time boxed processes like RFP/RFQs).
f. Competitive pressure.
g. Team changes which impact productivity.

AP5 considers lack of experience and requirement complexity and requirement creep (new requirements are discovered when project scope is matured) as most common reasons that can cause wrong estimation.

While AP6 thinks that “too big tasks, too vague requirements, changing requirements, technical difficulties” as important impediments.

AP7 consider following reasons for inaccurate estimates:

a. Lack of experience from similar projects.
b. Project Manager is not handling scope properly.
c. The customer is not able to prioritize.
d. As supplier you don’t understand business goals.

AP8, AP13and AP14 told us that quick estimates and having too little information (If details are missed) reason for inaccurate estimates. AP9 explains the reason for wrong story point in estimation as follows “overall, story point estimates are never inaccurate, as the actual number of hours per story point is based on actual progress. But some requirements have a wrong “story point” estimate. This most often happen because we misunderstood the requirement or because we spend a long time analysing the requirement during implementation”.

AP11 told number of reasons for inaccurate estimates, which are as follows:

a. Knowledge level of system complexity.
b. Knowledge level of requirements.
c. Knowledge level of complexity.
d. Skill level (estimation skills and implementation skills).
e. Changing preconditions.
f. Un-clear definition of done for the estimation elements.
g. Wrong granularity of estimation elements.
h. Unclear preconditions for estimation elements.

3. Summary of Interview Data

Following are the important findings from interview analysis.

3.1. Most widely used estimation technique

From interviews data it was found that planning poker was most widely used estimation technique. Some companies were using User stories/Points mainly with planning poker and wide band Delphi. Other estimation techniques that are used commonly includes parametric estimate, expert judgment (Delphi), analogy / comparison estimating, three point estimation, work breakdown structure +weighted effort estimation in hours.

3.2. Who does estimation?

Almost all of the participants believe that everyone in team (management, testers, developers, designers etc.) is involved in estimation. Team involvement is important because they are also accountable for this. In some companies the customer is also present during estimation but he is not allowed to suggest estimates. Sometimes initial estimation is done by the solution architect and development lead. Development team does verification.

Estimations are less accurate at start-up because right estimation requires a fairly good understanding of the solution and the technological environment, which is hard to obtain in an early phase of the project, but it gets accurate with passage of time. The reasons of inaccurate estimates include, too much optimistic attitude, inexperienced or unstable teams. The drawback of breakdown technique is that it produces too much error.

Participants believe that correct estimation requires whole team involvement in estimation process, because if only project manager do the estimation, he can't have ownership from development team. However drawbacks of this technique include time consuming, hard to make whole group think that estimates are correct.

3.3. Involvement of product owner in estimation

Whether customer is present or not during estimation process, the answer showed us a mixed trend. Almost half of the participants told us that customer is involved and he should be involved while other half were of the view that he shouldn't be involved in estimation.

The reason for not involving customers are that customers are non-IT people and development team attempts to estimate without influence from the product owner/stakeholders. Participants believe that sometimes the presence of the product owner can make it difficult to discuss technical issues. The product owner can influence estimates. However, customer can react and say that this is more expensive than expected. Then discussion can lead to revised estimates and scope. One of the respondent believes that whether the customer is involved or not, it really depends on the situation.

3.4. Frequency of revision of estimates

Most of the companies revise estimates often, but how frequently do they revise, it varies. Some revise user stories every week; some do this within 4-6 months, while some do re-estimation after each phase for the following phase. While some revise estimates if new requirement is added. Some participants don't revise overall estimates however they used to revise them personally. Only few participants revealed that they don't revise estimates often.

3.5. Reasons of revision of estimates

Participants revealed that estimates are revised when it is felt that initial estimates are inaccurate. It may be revised because of the reason when parts of a story has already been implemented as part of something else or if new information/requirement is collected or a change is made to the overall approach/architecture to the project. Revision of estimates is also necessary, so that team knows how much progress they are making and if they are on schedule. Sometime estimates are revised because of addition of new priorities, new insight in the technical environment of the solution and new insight in the actual functional area.

3.6. Reasons of inaccurate estimates

Participants believe that there are number of reasons for inaccurate estimates. However important one includes:

a) Too much optimistic behaviour,
b) Future predictions carry risk,
c) Lack of knowledge and experience or Un-experienced personnel,
d) If you misjudge technologies being involved that can arise integration problem,
e) Uncertainty,
f) Lack of common history in the team,
g) Vague stories,
h) Time limits (especially with time boxed processes like RFP/RFQs),
i) Competitive pressure,
j) Team changes, which impact productivity,
k) Requirement complexity and Requirement creep (new requirements are discovered when project scope is matured).

4. Discussion and Analysis

From interviews, it is found out that planning poker is most widely used estimation technique. According Ceschi and Silliti, the most widely technique used in agile development projects is expertise-based approach. In this approach, developers use past projects or iterations to produce estimates for current project (Ceschi, Sillitti et al. 2005). Some companies are using User stories/Points mainly with planning poker and wide band Delphi. Other estimation techniques that are used commonly include parametric estimate, expert judgment (Delphi) and analogy / comparison estimating, three point estimation, work breakdown structure and weighted effort estimation in hours.

Expertise-based estimation approaches are most widely used techniques according to literature (Elssamadisy and Schalliol 2002; Lippert, Becker-Pecbau et al. 2003; Grossman, Bergin et al. 2004). My study is also in contrast to study by (Ceschi, Sillitti et al. 2005) claimed “40% used function points estimation on their agile projects”.

Almost all of the participants believe that everyone in team (management, testers, developers, designers etc.) were involved in estimation. Team involvement is important because they are also accountable for this. Sometimes, solution architects and development lead do initial estimation. Development teams do verification. This is in accordance with Agarwal et al. who suggest to that if you want project estimates to be correct and accepted then it is very important to involve developers, customers and managers in estimation (Agarwal, Kumar et al. 2001).

While estimating, whole team needs to be involved because if only project manager does the estimation, one can't have ownership from development team. This is in accordance with Beck (1999) who suggests developers should do the estimation of the user stories in agile methods because only this way they will feel themselves responsible for working on those particular tasks that they have estimated (Beck 1999). This is also in accordance with schalliol (2002) who says, "in terms of management control, each developer takes responsibility and ownership for the stories that they estimate and so management involvement is less of an issue as in traditional development" (Schalliol 2002). Research has proved that estimation accuracy becomes higher if development team and estimators does estimation and estimation becomes less accurate if it is done only by a senior executive or a staff member from a different department (Lederer and Prasad 1992; Jurison 1999). However, with this way this task can become time consuming task and it is very difficult to make whole group to think alike.

Participants told us that in some companies the customer is also present during estimation but he is not allowed to suggest estimates. This is in accordance with Williams (2003), who suggest that during estimation process, customers should be involved so, that if developers are feeling any difficulty they can ask them for more clear definition. (Williams 2003). If customers remain present during estimation process then it can help to have smooth communication channel and it is more likely to produce correct estimates (Williams 2003). If customers are unwilling to maintain close communications and relationship this be a serious threat to agile projects. As a result, there are more chances of estimates to get wrong. So, customers should be available during estimation process to help team in making confusing stories clear (Paulk 2002).

Most of the companies revise estimates often, but how frequently do they revise it varies. Some revise user stories every week, some do this within 4-6 months, while some do re-estimation after each phase for the following phase, some revise estimates if new requirement is added. This is in accordance with Abrahamsson and Lev, according to them; if estimation is performed at very beginning of every iteration then it is more likely that developers will become more expert in estimating. (Abrahamsson 2003; Levy 2003). Some participants don't revise overall estimates however they used to revise them personally. Only few participants told us that they don't revise estimates often.

Estimates are revised in cases if it is felt that initial estimates are inaccurate. It may be revised because of the reason when it is felt that parts of a story has already been implemented as part of something else or if new information/requirement is collected or a change is made to the overall approach/architecture to the project. Revision of estimates is also necessary so that the team know how much progress they are making and if they are on schedule. Sometime estimates are revised because of new priorities, new insight in the technical environment of the solution and new insight in the actual functional area. Although participants are also using expertise-based approach for estimation but according to Ceschi, et al. (2005) since every project that uses agile methods is unique therefore it is hard to rely on expertise-based approaches of estimation (Lippert, Becker-Pecbau et al, 2003).

Recommendations

We recommend iteration-based estimation. In agile projects, the process of adding and removing requirements keeps on going during the whole project lifecycle. It is important to define requirements on per iteration basis. It will help in two ways. First it will help to prevent drafting wrong requirements and therefore minimizes risk. So, decisions will be made with passage of time when more information becomes available. Secondarily, it will help to get feedback and based on that feedback any kind of adjustments will be made during the process of development process. These will help to improve the product and ultimately will help to produce the product that will be according to users needs and expectations. It is in accordance with (Thorup and Jensen 2009).

We propose that developers should always be involved in estimation process, as they will feel them responsible for right or wrong estimates. This is in accordance with our interview findings. But there can also be one drawback that Although it is very good approach that developers do the estimation but there could rise one problem that the assignment of control to the developers in estimating their own tasks can cause inaccuracies if the developer is pressured into underestimating their tasks in order to indulge managers or customers. This can also lead to reluctance in exposing what may appear to be poor estimating skills or even poor development capabilities.

We believe that during estimation project manager/developer should avoid reliance on past project estimation. The need of historical data for estimations could be a problem for many projects due to lack of experience with software projects. So, it is not always possible to rely on past estimations.

Conclusion

From interview findings it was found out that planning poker was most widely used estimation technique and its users seems find it very interesting and helpful. Some companies were using User stories/Points mainly with planning poker and wide band Delphi. Other estimation techniques that are used commonly includes parametric estimate, expert judgment (Delphi), analogy / comparison estimating, three point estimation, work breakdown structure +weighted effort estimation in hours. Everyone in team (management, testers, developers, designers etc.) are involved in estimation. Customer is not involved in estimation process in most of the companies. Reasons of inaccurate estimates are many but too much optimistic behaviour is most common among all reasons.

Our recommendations include Iteration based estimation, because it will help to minimize risk and will give room to more adjustments. Developer must be involved in estimation. But it should be kept in mind that assignment of control to the developers in estimating their own tasks can cause inaccuracies if the developer is pressured into underestimating their tasks in order to indulge managers or customers. This can also lead to reluctance in exposing what may appear to be poor estimating skills or even poor development capabilities.

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THE DYNAMICS IN THE MONITORING AND CONTROL OF RISK MANAGEMENT IN PROJECTS

Wolfgang Tysiak, University of Applied Sciences Dortmund, Germany[1]

Abstract

If there are uncertainties in a project, let it be in durations, in quality or in costs, you have to work with probability distributions. PERT, for example, uses beta distributions to calculate durations that are described by only three values (optimistic duration, most probable duration, and pessimistic durations). PERT then determines the critical path by taking into account the expected durations and builds the convolution of the densities along the critical path.

The main problem in this procedure is the fact that if you deal with probabilities, you do not have a unique critical path anymore. As a result additionally the whole controlling process becomes more complex. This is also the case even if you use other approaches than PERT (e.g. Monte Carlo simulation), because you permanently have to update the individual realizations and calculate the new estimates for the remaining part. Hence over time you have an ongoing process of changing consequences for the remaining part of the project. In fact you can compare this whole process to R&D projects and moreover use the tools that are involved there.

In this contribution we will look at a fictitious project, execute a Monte Carlo simulation in advance, then assume realizations and analyse the consequences to the distributions of the remaining tasks.

Key words: *project management, risk management, monitoring and controlling of risks*

JEL code: G32

Introduction

In every project there is the need to implement some kind of risk management (cf. [1], [2], [3]), which normally contains the following phases:

(1) risk management planning,
(2) risk identification,
(3) qualitative risk analysis,
(4) quantitative risk analysis,
(5) risk response planning, and
(6) risk monitoring and control.

As always, this has to be seen as a chain or circle that you permanently have to work through. But as a chain, this process is as weak as its weakest link. So if you are not able to identify the really crucial risks, there is nothing to analyse. If you are not able to evaluate risks and therefore cannot plan how to respond in an adequate way, you cannot handle the risks.

The risk management plan defines the roles and responsibilities, the risk budget, the methodologies etc. in the beginning. Therefore you can see this as setting the infrastructure of

[1] Corresponding author – e-mail address: Wolfgang.Tysiak@FH-Dortmund.de, telephone: +0049-(0)231-755-4996

the risk management process. The next steps are the risk identification process and the qualitative and quantitative risk analysis. Especially in the steps (3) and (4) some analytical/statistical methods have to be used because you have to work with uncertainties and therefore with densities and distributions.

Risks in projects can occur in different dimensions, such as time, costs, quality etc. A risky event that may happen is normally characterized by two aspects: The probability of occurrence and the impact that is a consequence out of this event. Both aspects possess probability distributions that have to be estimated. But already at this stage we can deduce that a planning process never can forecast the exact realization of such an event, if only distributions are estimated.

Let us now assume that the steps (1) to (3) have already been done, look a little more into the details of step (4), skip step (5), and look predominantly to the consequences for the risk monitoring and controlling phase.

A fictitious project

In this contribution we will only consider uncertainties related to time. A commonly used approach to deal with this is PERT (cf. [3], [4]), but as previously shown (cf. [5], [6], [7]) there are some known disadvantages of this method. We will mention them here, but also show how to overcome them by using Monte Carlo simulation (cf. [8], [9]). Let us start with the project plan given in Figure 1.

Activity	Predecessors	OD	MD	PD
A	-	2	3	4
B	-	3	6	9
C	-	2	5	10
D	-	4	6	9
E	A, B, C	3	7	10
F	C, D	2	7	9
G	E	2	3	4
H	E, F	3	6	8
I	F	3	6	9
J	F	2	7	10
K	G, H, I	2	6	8
L	I, J	3	5	8

Fig 1. **A fictitious project plan**

We do not want to discuss the PERT approach here in detail (e.g. the assumption of beta distributions), because this is well documented in the common textbooks. The basis of the PERT approach is the critical path, calculated with the expected values, and the convolution of the distributions along this critical path that leads to a normal distribution with the given expected values and standard deviations. In order to give an impression of the structure of the project and because in the following parts we will several times look at the “criticality” of the individual activities, the net and the critical path that is used for the PERT approach is shown here (cf. fig. 2). Additionally the graphs of the resulting distributions of the total duration of the project are drawn (cf. fig. 3).

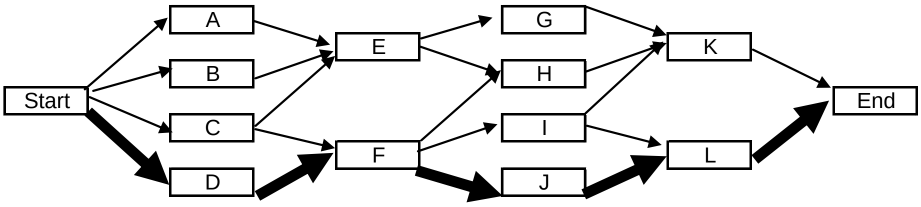

Fig 2. **Net and critical path (used in PERT)**

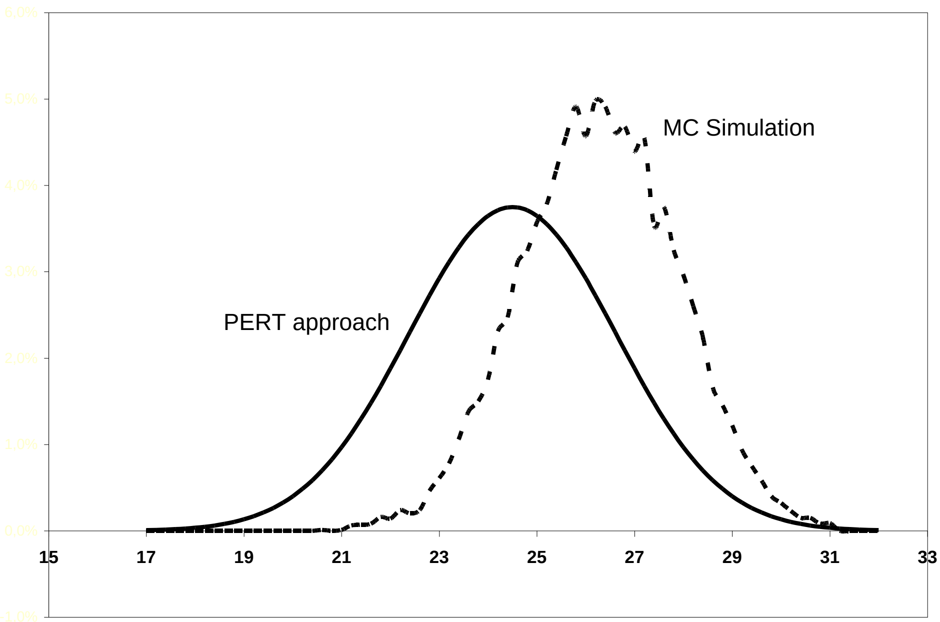

Fig. 3. **Distribution of the total duration of the project Comparison of the results of the Monte Carlo and the PERT approach**

As it is easily seen (cf. fig. 3), the PERT approach underestimates the real risk. The reason for this is the fact that if you deal with distribution, there no longer exists a unique critical path and consequently the whole PERT approach fails. Within the project you will find activities that are totally uncritical (0%) or critical (100%). But the most common case will be that there is a probability between zero and one that an activity becomes critical (cf. fig. 4). For this reason we use the term “critical field” instead of “critical path”. By comparing fig. 2 and fig. 4 we see that the critical activities in the PERT approach not necessarily coincide with the activities with the highest probabilities to become critical in the Monte Carlo approach.

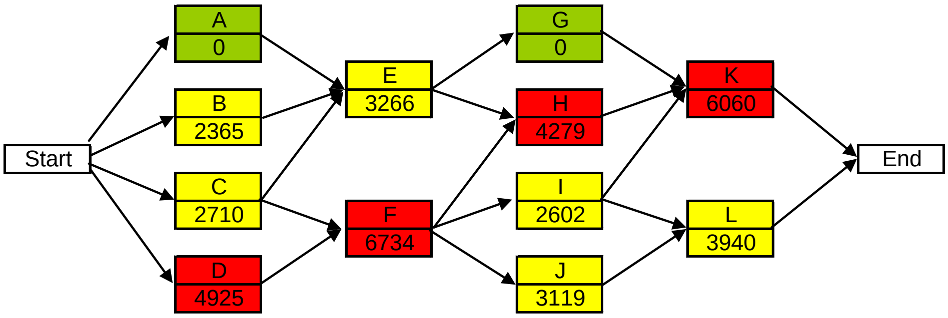

Fig. 4. **Number of times that an activity belongs to the critical path (N = 10,000)**

In the beginning, when the activities A to D can be started in parallel, A can never be critical, B and C with probabilities between 20% and 30%, whereas activity D (with a probability of 50%) is the activity with the highest probability to become critical. If you compare these probabilities with the parameters OD, MD, and PD in fig. 1, you recognize that the probability of being critical not only depends on PD, but on the whole shape of the distribution. Here is a first hint for further research: What happens if we assume other distributions?

A simulated monitoring and control process

Let us now look what happens in the case of different realizations in the first phase. As we have already seen (fig. 4), activity A will never be critical. But what are the consequences if one of the activities B, C, or D determines the end of the first phase (c.f. fig. 5)?

				expected	**assumed realization**		
	OD	**MD**	**PD**	**duration**	**β**	**γ**	**δ**
A	2	3	4	3	3	3	3
B	3	6	9	6	**8**	6	6
C	2	5	10	5.3333	5.3333	**8**	5.3333
D	4	6	9	6.1666	6.1666	6.1666	**8**

Fig. 5. **Three different scenarios for the realizations in the first phase**

Figure 5 gives an overview over the assumed scenarios β, γ, and δ. They are created by choosing the expected values first and then altering the durations of B, C, and D to become the highest value. Intuitively one would assume that if B, C, and D determines the duration of the first phase that they automatically become critical. But this is not the case! We have to keep in mind that the critical path is determined by the retrograde/backward calculation from the earliest start/end time to the latest start/end time of an activity. Therefore the fact whether an activity is critical or not can only be judged after this whole fore- and backward calculation (cf. fig. 6 – 8). (Here some analogies to the Wagner-Whitin approach in dynamic lot sizing can be found.)

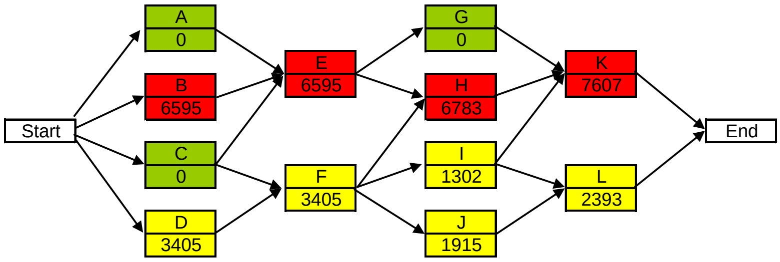

Fig. 6. **Critical path for scenario β**

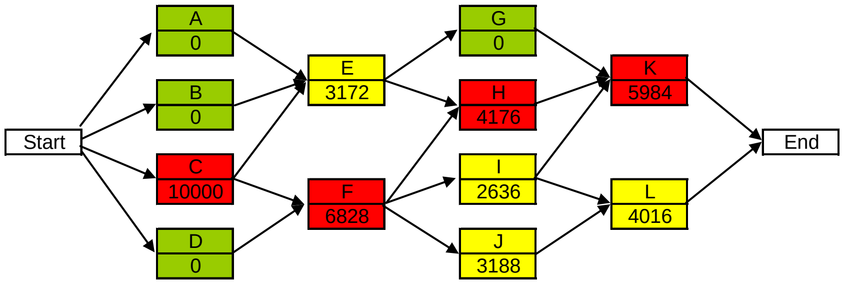

Fig. 7. **Critical path for scenario γ**

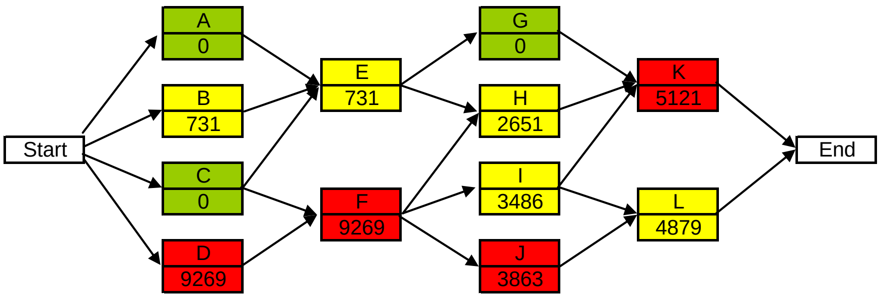

Fig. 8. **Critical path for scenario δ**

Comparing the three critical fields of the scenarios you can see that:

- the activity that determines the end of the first phase is not necessarily critical with a probability of 100%
- activity K has the highest probability to become critical right before the end of the project in every scenario, whereas it does not belong to the critical path of the PERT approach
- in scenario β the set of activities with the highest probabilities to be critical is totally disjoint to the critical path of the PERT approach.

Although the three scenarios β, γ, and δ lead to different critical fields, the three resulting distributions for the whole duration of the project are quite similar. Fig. 9 and fig. 10 give a short impression of this. As can be seen again, the PERT approach dramatically underestimates the result of the initial Monte Carlo simulation (24.5 versus 26.3). If you contrast the parameters of the initial Monte Carlo simulation with the three scenarios, you recognize that the means increase whereas the standard deviations decrease. But this just demonstrates that the duration in the first phase was fixed (lower standard deviation) and that a quite high value (higher mean) was chosen for that. The order of the means (mean β < mean δ < mean γ) corresponds to the order how often the dominant activity is critical.

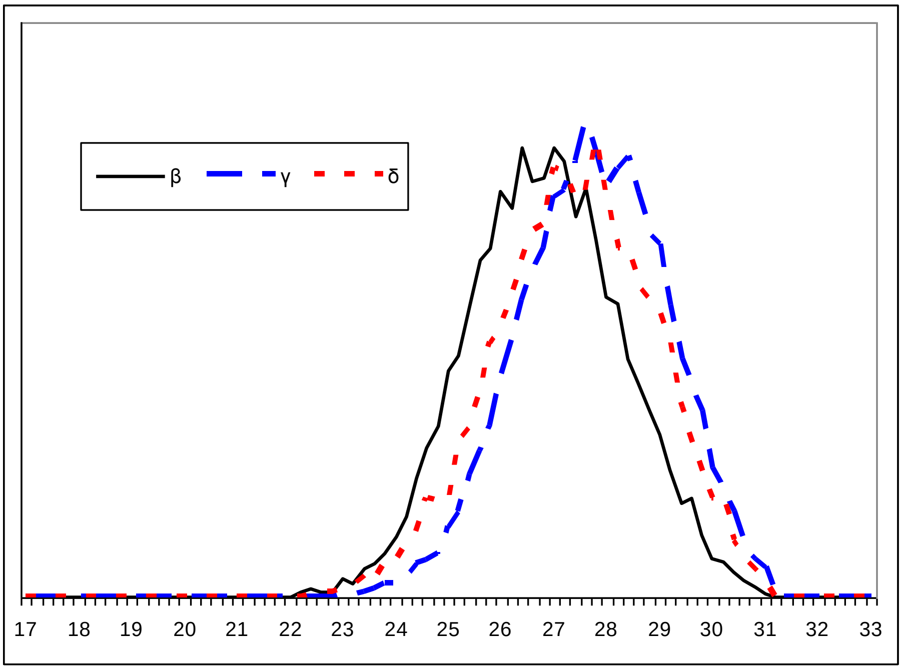

Fig. 9. **Distributions of scenarios β, γ, and δ**

	Mean	**Standard deviation**
PERT	24.50	2.128
Initial Monte Carlo	26.30	1.606
Scenario β	26.82	1.464
Scenario γ	27.78	1.433
Scenario δ	27.39	1.536

Fig. 10. **Means and standard deviations of the different distributions**

Conclusions and Remarks

If one understands the monitoring and controlling process within a project mainly as the comparison between the nominal/target/planned values and the actual/performance values – as it is often seen – this leads to a totally wrong approach as soon as uncertainties are assumed: Then there are no fixed target values. Introducing uncertainties, probabilities, distributions etc. means a change of paradigm: This cannot be handled by further acting as having mainly a deterministic approach and just adding some “risk features”, as it is done for instance in PERT.

A project is usually characterized by items as “uniqueness” or “complexity” and hence you have to accept uncertainties in your project parameters. But this leads necessarily to totally different techniques to apply. Let us just mention here project management in specific applications like software engineering (cf. [10]) or R&D (cf. [11], [12]), where the use of uncertainties is inevitable.

If you accept uncertainties in your project this has in most cases consequences for the whole monitoring and controlling process. This is quite obvious because planning and controlling are always very strongly connected. The main problem is that you cannot have planned values that have to be controlled; moreover you have permanently to check the sequels of the actual values. This task therefore should be supported by a model (e.g. Monte Carlo simulation model) that could easily show the influences of the actual data and offers deeper insights into the dynamics within a project plan.

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PROJECT RISK MANAGEMENT DOCUMENTATION EVALUATION METHODS

Juris Uzulans, University of Latvia, Latvia[1]

Abstract

The project risk management documentation is an important part of the project management. However, there is no single, universally accepted project management theory, and there are no generally accepted project management documentation analysis methods.

The aim of the study is to analyse the use of quantitative and qualitative methods for analyse project risk management documentation. Several quantitative and qualitative methods were used for analysis publicly available project risk management documentation (project risk management plan, and risk register) in the Internet.

Result of the study was able to clarify that it is not possible to use a single method for significant result, qualitative methods is more appropriate for use. For project risk management documentation studies, it is recommended to use more than one method and to compare the obtained results of the study.

Key words: *risk, project, evaluation, project risk management, documentation*

JEL code: M00

Introduction

The aim of the research is to assess one of the project risk management documents – the risk register project by conducting the comparison between the risk register described in the theoretical project management literature and the risk registers publicly available in the Internet. In the research the author has used the “Project Management Body of Knowledge” (PMBoK) by Project Management Institute editions of year 2000 (PMBoK, 2000), 2004 (PMBoK, 2004), 2008 (PMBoK, 2008) and 2013 (PMBoK, 2013) as samples of the theoretical project management literature sources.

30 risk registers were selected which corresponded to the following criteria:

1. Publicly available in the Internet with an identifiable address,
2. Risk register can be associated with its publisher, i.e., in the risk register there is the information for identifying the risk register as the publisher’s project risk register or it can be unanimously identified as the publisher of the risk register,
3. Risk register contains information which can be identified as project risk information.

The “Project Management Body of Knowledge” of the Project Management Institute represents one of the best known project management methodologies and it has 5 official editions. One of the knowledge areas of project management discussed in all editions is project risk management. The phases of the project risk management process in all editions except year 1996 edition are as follows: to plan risk management, identify risks, perform risk analysis (qualitative and quantitative), plan risk responses and monitor and control risks (In year 2013

[1] Corresponding author – e-mail address: jouris@latnet.lv, telephone: +371-29283194

edition “monitor and control risks” has been replaced with “control risks”). The risk management process phases presented in year 1996 edition are risk identification, risk quantification, risk response development, and risk response control. In year 1996 edition there is no risk register that is why year 1996 edition is not used within the research.

Theoretical substantiation of the research

In all editions, except the one of 1996, there is a risk management definition. In year 2000 edition the risk register is equivalent to the term “risk response plan”. The risk response plan contains all identified risks, including description, cause, probability of occurring, impact(s) on objectives, proposed responses, owners, and current status (PMBoK, 2000; p.207). Year 2004 edition does not use the term “risk response plan” and the risk register is defined as “the document containing the results of the qualitative risk analysis, quantitative risk analysis, and risk response planning. The risk register details all identified risks, including description, category, cause, probability of occurring, impact(s) on objectives, proposed responses, owners, and current status. The risk register is a component of the project management plan.” (PMBoK, 2004; 373). A similar definition of the risk register is presented by year 2008 edition of PMBoK, except the last sentence in year 2004 definition (PMBoK, 2008; 439). In year 2013 edition the risk register is defined as “a document in which the results of risk analysis and risk response planning are recorded” (PMBoK, 2013; 560).

Similarly, in all editions except year 1996 the risk register is different in each phase of the risk management process, the most complete content of the risk register is described in the phase of the risk response planning. In year 2000 edition the term ‘risk register’ is used only 3 times, the edition used the term ‘risk response plan’. The content of the risk response plan definition does not coincide with the risk register contents described in the manual and contains identified risks, their descriptions, the area(s) of the project (e.g., WBS element) affected, their causes, and how they may affect project objectives, risk owners and assigned responsibilities, results from the qualitative and quantitative risk analysis processes, agreed responses including avoidance, transference, mitigation, or acceptance for each risk in the risk response plan, the level of residual risk expected to be remaining after the strategy is implemented, specific actions to implement the chosen response strategy, budget and times for responses, and contingency plans and fall-back plans (PMBoK, 2000; 143).

In year 2000 edition the term ‘risk register’ is not used at the end of the risk management phases, but rather the kind of information present about risks at the end of a phase is described, at the end of the risk identification phase there is the risk and triggers (PMBoK, 2000; 133), at the end of the qualitative risk analysis phase there is the risk ranking, list of prioritized risks, list of risks for additional analysis and management, and trends in qualitative risk analysis results (PMBoK, 2000; 136, 137), at the end of the quantitative risk analysis phase there is a prioritized list of quantified risks, probabilistic analysis of the project, probability of achieving the cost and time objectives, and trends in quantitative risk analysis results (PMBoK, 2000; 139), at the end of the risk response planning phase there is the risk response plan, residual risks, secondary risks, contractual agreements, and contingency reserve amounts needed (PMBoK, 2000; 143, 144), but the end of the risk monitoring and control phase features the updating of the risk response plan as well as the creation of the risk database (PMBoK, 2000; 146).

Like in year 2000 edition, in year 2004 edition the contents of the 'risk register' definition does not coincide with the contents described in the manual. In year 2008 edition the content of the risk register is less comprehensive than in year 2004 edition. At the end of the risk identification phase the risk register contains the list of identified risks and list of potential responses (PMBoK, 2008; 288). In year 2013 edition at the end of the risk identification phase the risk register coincides with that in year 2008 edition. (PMBoK, 2013; 327). In year 2012 edition at the end of the quantitative risk analysis the register coincides with year 2004 and 2008 editions (PMBoK, 2013; 341). At the end of the risk management phase of planning risk responses the risk register is similar to that of year 2004 and 2008 editions; year 2013 edition, compared to editions of 2004 and 2008, does not contain points 1 and 3; there is a new addition – trigger conditions compared to point 6 in year 2004 and 2008 editions, there is no point like point 8 in year 2004 and 2008 editions (PMBoK, 2013; 347, 348). In the control phase of the risk management process the risk register is updated, no information is added that had not been there before (PMBoK, 2013; 354).

It can be concluded that in all editions, except the edition of 1996, the content of the risk register has changed and the risk register is the most comprehensive in year 2014 edition.

We must point out that under the description of the risk register content at the end of the risk management process phases in year 2013 edition there is a note that the risk register contents may be pre-established, but not mandatory. (PMBoK, 2013; 333, 341, 348, 354). At the end of the phase of planning risk responses the number of components in the risk register or columns, if the risk register is in the form of a column, cannot be unanimously identified in the first point of the listing. For example, the first point of the risk register content listing in year 2000 edition reads as follows: "Identified risks, their descriptions, the area(s) of the project (e.g., WBS element) affected, their causes, and how they may affect project objectives" (PMBoK, 2000; 143), similar to year 2004 and 2008 editions. While the first two points of the listing ("identified risks" and "their descriptions") are unanimous, the third one is not ("the area(s) of the project (e.g., WBS element) affected"); neither is the fourth one as it is not clear if the fourth point ("their causes") refers to risks or the area(s) of the project, the fifth one is not unanimous either as "project objectives" is not defined as a term with a certain content. In all PMBoK editions the risk management chapter attributes cost, schedule, scope, and quality objectives to a project (PMBoK, 2000; 136, PMBoK, 2004; 245, PMBoK, 2008; 281, and PMBoK, 2013; 318). Simultaneously in other PMBoK chapters project objectives can also be "customer satisfaction" (PMBoK, 2000; 56),"business, technical" (PMBoK, 2004; 111), however, in year 2013 edition of PMBoK there is "one or more project objectives such as scope, schedule, cost, and quality" (PMBoK, 2013; 310), taking into account the meaning of 'such as', still other project objectives are possible. Unanimous is just the first point of year 2013 edition "Risk owners and assigned responsibilities" (PMBoK, 2013; 348).

Neither can we unanimously interpret another point of the risk register – "Results from the qualitative and quantitative risk analysis processes" (PMBoK, 2000; 143), "Outputs from the Qualitative and Quantitative Risk Analysis processes, including prioritized lists of project risks and probabilistic analysis of the Project" (PMBoK, 2004; 264) or "Outputs from the Perform Qualitative Analysis process (Section 11.3), including prioritized lists of project risks" (PMBoK, 2008; 305).

Table 1 summarizes the information about the number of the risk register content elements at the end of the risk management phases.

Table 1

Numbers of the risk register content elements at the end of the risk management phases

	Plan risk mana-gement	Iden-tify risks	Perform risk analysis (qualitative)	Perform risk analysis (quantitative)	Plan risk respon-ses	Monitor and control (or control risks)
Year 2000 edition	--	2	4	4	8	1
Year 2004 edition	--	4	6	4	13	--
Year 2008 edition	--	2	7	4	12	--
Year 2013 edition	--	2	5	4	10	--

However, the consideration of the risk register contents in accordance with the risk management process phases cannot provide for unanimous determination what the risk register is like at the end of the qualitative and quantitative analysis phases. For example, at the end of the risk identification phase in year 2000 edition one of the risk register content elements is “triggers” (PMBoK, 2000; 133). All together in year 2000 edition “triggers” is mentioned 6 times, twice in the definition of the term, twice in the risk identification phase, once in the description of the risk management process and once in the risk response planning phase under the planning tools. However, at the end of the risk response planning phase the term “triggers” is not included in the risk register contents (PMBoK, 2000; 143), however, in year 2004 edition in the end of the risk register identification phase does not contain “triggers”, but at the end of the risk response planning phase there are “Symptoms and warning signs of risks’ occurrence” (PMBoK, 2004; 264) which corresponds to the PMBoK definition of “triggers”.

There is a similar situation in year 2004 edition with the “root causes of risk”, which is mentioned four times, once in the risk identification phase, once in the risk qualitative analysis phase in connection with the risk categories and once in chapter 12 “Project Procurement Management”. Similarities can also be drawn with year 2008 edition where in the risk qualitative analysis phase a component of the risk register is the “List of risks requiring response in the near-term”. The “List of risks requiring response in the near-term” is mentioned only once and it cannot be unanimously concluded which next risk management phase the list of risks refers to. Consequently, the author believes that the most appropriate in the PMBoK risk register contents is the risk register at the end of the risk response planning phase. The risks register components by PMBoK edition are summarized in Table 2.

The author believes that the PMBoK risk register contents cannot be unanimously identified by comparing different PMBoK editions which is justifiable as the PMBoK authors’ understanding about the risk register contents can change. However, the risk register contents at the end of the risk management process phases cannot be unanimously identified within one PMBoK edition either. At the same time the PMBoK risk register contents can be identified and compared to the risk registers used in the research.

Table 2

Risks register components by PMBoK edition

Risk register part	2000 ed.	2004 ed.	2008 ed.	2013 ed.
Identified risks, their descriptions, the area(s) of the project (e.g., WBS element) affected, their causes, and how they may affect project objectives	*			
Identified risks, their descriptions, area(s) of the project (e.g., WBS element) affected, their causes (e.g., RBS element), and how they may affect project objectives		*	*	
Risk owners and assigned responsibilities	*	*	*	*
Results from the qualitative and quantitative risk analysis processes	*			
Outputs from the Qualitative and Quantitative Risk Analysis processes, including prioritized lists of project risks and probabilistic analysis of the project		*		
Outputs from the Perform Qualitative Analysis process (Section 11.3), including prioritized lists of project risks			*	
Agreed responses including avoidance, transference, mitigation, or acceptance for each risk in the risk response plan	*			
The level of residual risk expected to be remaining after the strategy is implemented	*			
Agreed-upon response strategies		*	*	*
Specific actions to implement the chosen response strategy	*	*	*	*
Symptoms and warning signs of risks' occurrence		*		
Triggers, symptoms, and warning signs of risks' occurrence			*	
Trigger conditions, symptoms, and warning signs of a risk occurrence				*
Budget and times for responses	*			
Budget and schedule activities required to implement the chosen responses		*	*	*
Contingency plans and fallback plans	*			
Contingency reserves of time and cost designed to provide for stakeholders' risk tolerances		*		
Contingency plans and triggers that call for their execution		*	*	*
Fallback plans for use as a reaction to a risk that has occurred, and the primary response proves to be inadequate		*	*	*
Residual risks that are expected to remain after planned responses have been taken, as well as those that have been deliberately accepted		*	*	*
Secondary risks that arise as a direct outcome of implementing a risk response		*	*	*
Contingency reserves that are calculated based on the quantitative analysis of the project and the organization's risk thresholds		*	*	*

Research synopsis

The research comprised the analysis of 30 risk registers. The selection of registers was made in November, 2013 with the Google search engine by requesting “project risk register” and the first 10 web pages with the search results were examined. Taking into account that the aim of the research was not to find regularities in the risk registers, no assessment was made concerning the general set of risk registers and the kind of the selection. The author believes that 30 risk registers constitute a sufficient number for comparing the selected registers with the risk register described in PMBoK.

Among the selected risk registers there were 29 pdf (Adobe Reader) and one xls (Microsoft Excel) format documents. All registers are designed as a table with columns about the project risks. In several registers at the beginning of the table or in a separate table there is additional information, for example, about the project, explanation about the register completion or about the column values. The supplementary information was not used in the research. The minimum number of columns is three, maximum is 25, the most common number of columns is 14 in eight registers. There was no risk register which would completely coincide with another register. All together in the risk registers there are 374 columns and 279 original column titles. In one register there were two different tables with a different number of columns – the table with the biggest number of columns was chosen because the column titles coincided and in the biggest table there were columns, which could not be found in the smallest table. In the Microsoft Excel format table 12 columns are hidden. In the hidden columns there is information about the influence by the kind of it. For the research purposes the author used the table without the hidden columns. In one register there are two tables, the title of one of which contains the term “draft”, in the research the other table was used where a part of the title is “risk register”.

The comparison of information between the 30 registers and the risk register described in PMBoK was complicated due to the diversity of the column titles. In the research the information present and absent un the 30 risk registers compared to the risk register described in PMBoK according to the PMBoK risk register at the end of the risk response planning phase of the risk management process. The columns which refer to the risk management and control phase were not analysed. To make the comparison easier, with regard to the diversity of the column titles, the risk registers were grouped according to the number of columns – up to 5 columns, 2 registers, from 7 to 12 columns, 14 registers, from 14 to 19 columns, 10 registers and more than 20 columns, 4 registers.

In 27 risk registers there are columns where there is the risk number or code as the identifying information of the specific risk of the risk register, 4 risk registers do not have the column with the same kind of information, one register has 2 columns with risk numbers, columns have 12 different titles, the title “No” coincides in 8 registers, however, the titles of 8 register columns are unique, i.e., only in one of the registers, 5 titles, including the title “No” coincide in more than one register of the risk register columns. The number of the risk register columns is not connected with the existence of the columns where there is the risk number or code. The columns where there is the risk number or the code are not present in the risk registers with 3, 8 (2 registers) and 14 columns. In 15 registers the numbers with one or more signs are used, in two registers it is not possible to establish what kind of information there is in the column. In 9 risk registers the code is used with which not only the ordinal number of the risk in the register is identified, but also the additional information, the so-called risk category in

6 risk registers. The author believes that this is a significant difference between the risk registers described in PMBoK editions and real project registers. The identification of a concrete risk by its number or code, risk number or the use of the code in other, non-project risk management documents, can relieve the management of risks in projects.

In all risk registers there is a column which contains the information on risks. However, there are substantial differences among risk registers. In one column there can be several kinds of information, for example, the risk title and description. The statistics about the columns containing the information on risks is summarized in Table 3.

Table 3

The statistics about the columns containing the information on risks

Column contents and titles	Number of risk registers with the respective column	Total number of columns in registers with the respective column
Risk name (Risk, Risk/Event, Title, Risk Title, Risk/Opportunity Name, Description, Effect/Risk description)	10	7, 8, 9, 11, 21, 23 columns once un 14 columns 4 times
Risk name and risk category	1	20 columns once
Risk name and description	4	14 columns 2 times, 21 un 23 columns once
Risk description	16	3, 5, 12, 25 columns once, 7 columns 2 times, 8 columns 5 times, 11 columns 2 times, 14 columns 3 times
Risk description and cause	2	12, 14 columns twice
Category (Category, Risk Category, Risk Type)	10	5, 8, 11, 21 columns once, 12 columns twice, 14 columns 4 times
Cause of risk	4	14, 25 columns once, 23 columns 2 times
Risk consequence	3	7, 11, 22 columns once
Risk owner (Risk Owner, Ownership, Risk Owner (person), Risk Owner (Name & Position)	18	8 columns 4 times, 9, 10, 11, 12 columns once, 14 columns 6 times, 15, 19, 21, 23 columns once

It can be found that at the end of the risk identification 30 risk registers differ from the one described in the PMBoK. The column containing the information on the risks is present in all risk registers as it is the critical feature to identify the document as a risk register. It coincides with the PMBoK risk register. The risk category is present in 10 risk registers. The PMBoK term ‘risk categories’ is used as one of the risk management tools and there are no unanimous indications the risk register must contain the information about the risk category. Although the risk owner is present in the risk registers of all the PMBoK editions, from the 30 risk registers only in 17 ones there is a column with the risk owner.

The probability, influence and value of the columns where there is information on risk analysis is 144, where 35 is the probability of risk, 85 is the influence of the risk and 44 is the risk value. In many risk registers there is more than one column with the information on risk analysis, the maximum number of columns is 17 in the risk register with the total number of columns 25, the minimal number of columns is 1 in the risk register with the total number of columns 3. The minimal necessary number of columns is 3 – probability, influence and value. The number of the risk registers with not less than 3 columns is 27, i.e. 90 %. In 3 registers it can be considered a significant drawback of the risk registers as these risk registers do not contain the information on the project risk analysis. After the risk identification in the project risk management process and risk analysis the minimum number of columns of the risk register should be 4 – the name of the risk, its probability, influence and value. This information is necessary for starting the next phase in the project risk management process – risk management planning.

The risk mitigating measures are present in 26 risk registers, the maximum number of columns with the risk mitigating measures is 6 in the register with 19 columns. Compared to the risk registers where there are less than 3 columns with the risk analysis information, in one risk register there is no risk mitigating measure, in one – there is just one measure and in one risk register with one risk analysis information there are 2 columns with the risk mitigating measures.

Conclusions and recommendations

By analysing just 30 risk registers significant differences can be found between the risk register described in the theory and risk registers of real projects. At the end of the identification phase of the risk management process the coincidence between the described risk register and real project risk registers is high, in all registers the information indicated in all PMBoK editions, except year 2014 one, is present – the name of the risk, risk description, consequences and risk owner. However, this information is not present in all risk registers (see table 3). The coincidence can be considered high only by examining the whole set of the risk registers under the study as there are significant individual differences among the risk registers.

Although the total number of columns with the risk analysis information is big, 144, or 38.5%, there are big differences among the risk registers. In the PMBoK risk register at the end of the risk analysis phase of the risk management process there is no unanimous description of the information in the risk register. The PMBoK term 'risk register' is widely used and it is not possible to conclude unanimously what the right risk register is according to the PMBoK.

As a result of the research it cannot be concluded what the minimum amount of information in the risk register is to make it comply with the risk register described in the PMBoK. The author believes that the PMBoK project management theory is not based on a comprehensive practice, but rather it is the experience of the theory authors as there are no results of the application of scientific research methods – problem, observation, hypothesis, experiment/study, analysis of the results and theory; neither the sufficient interaction between the theory and practice is evident.

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EXPLORING THE SOCIAL POWER IN PROJECT-BASED ORGANIZATIONS: A CASE STUDY OF A HK PUBLIC PROJECT

Hongdi Wang, The University of Hong Kong, Hong Kong[1];

Weisheng Lu, The University of Hong Kong, Hong Kong

Abstract

The construction industry is a typical arena for project-based organizations (PBOs), as construction projects are perplexing and temporary organizations supported by cooperation of various inter-disciplinary project parties. The conditions for successful project delivery depend upon social phenomena. Information circulation and resource sharing among all the project participants, which is embedded in the forms of formal and informal networks, plays very essential role in the delivery process of construction projects. Therefore a social perspective is proposed to analyse the organizational performance of PBOs.

The aim of this paper is to explore the effects of social networks on PBOs, with a case study of a HK public project. Social Networks Analysis (SNA) will be employed to help decipher the social power. A series of formal/informal networks will be mapped and their network properties including density, centrality, and cohesion will be analysed. It will extend our understanding of PBOs in a new perspective. Besides, the paper will be able to support the decision making relating to BIM implementation in the construction industry.

Key words: *Project-based organizations, Building Information Modelling, Social Networks Analysis*

JEL code: L2

Introduction

Recent years, project-based organization (PBO) is popularly adopted to integrate resources from multi-companies or multi-departments to delivery business objectives in various industries, especially in the construction industry, in which inter-disciplinary project parties were organized together to complete large scale and complex construction works under the constraints of contracting. Winch (1989) categorized PBOs into 'intra-firm' and 'inter-firm' organizations. Intra-firm PBOs are still under a single economic unit or firm and are normally governed by hierarchical relations, while, inter-firm PBOs are a coalition of multiple-companies with own diverse business goals and interests (Winch, 1989).

PBOs have the potential to achieve better processes, higher quality, increased respond ability to customers' needs and innovation in collaboration with clients and suppliers, meanwhile they bring new challenges to organizing reconstructing, knowledge management, resource management, and strategic management, as summarized in Lu et. al (2013). In the construction industry, projects are usually carried out in the form of inter-firm PBO, and there has been witnessed a list of long existing problems in the construction project delivery, such as

[1] Corresponding author – e-mail address: kevinwhd@hku.hk, telephone: +852-53959082

fragmentation of workflows/materials, adversarial relationships among project parties, time and cost overrun, and low innovations (Colledge, 2005, Latham, 1994). In a word, the construction industry is a typical arena to investigate inter-firm PBO, and the following discussions will be concentrated in this context, unless specifically mentioned.

With the endeavor to improve PBOs, building information modeling (BIM) gained dramatically rapid development in the construction industry globally. BIM is a digital representation of the building objectives and building process. The information includes and not limited to building geometry, space distribution, quantities and properties of building components, supply chain, project delivery processes, and progress chart. BIM can be applied to improve productivity in terms of design quality, construction plan simulation, supply chain management, and on-site real time project management. BIM has an indirect impact on project performance by overcoming the inherent problems of PBOs, such as improving communication efficiency, recording information or knowledge, encouraging collaboration and innovation, and leading a paradigm shift to the Architecture/Engineering/Construction (AEC) industry (LU et al., 2013).

Meanwhile, the importance of social networks in PBOs is gradually recognized along with the conspicuous development of the relational contracting in various innovative delivery methods in the past half century. There was a pursuit for traditional contracts towards the contractual completeness, covering all the potential contingencies and solutions if possible. Unfortunately, the result turned out to be disappointing that all complex contracts are unavoidably incomplete and the costs for increasing completeness will dramatically augmented after certain efforts and it will not be economizing to continue on doing so. The informal factors, such as culture affinities, preference for high trust and long term relationships, have been notified to have great impact on project performance in the theory of new institutional economics (Williamson, 1975, 1985, Zenger et al., 2002).

The discussions are pointing to one direction that the informal networks, i.e. the networks of the relationships that people form certain function groups and cooperate in an interactive way to accomplish tasks, do matter. Those informal networks are “the central nervous system driving the collective thought processes, actions, and reactions of its business units”, and must be matched with the formal organization, which is the skeleton of a company or a PBO, in order to fully steam the productive engine of the organizations (Krackhardt and Hanson, 1993). Practically, a lot of global governments and AEC companies are investing considerable resources to refine their organizational structures and working processes to materialize the paradigm shift towards BIM and innovative procurement systems, and let the informal organizations thrive.

Using social network analysis, the mystical and complicated relationships can be translated into a series of maps that could be utilized to visualize the informal networks. In the following sections, we first reviewed the theories and applications of social network analysis in the construction industry, and then put forward the hypotheses about the social power in PBOs. Followed by are the methodology and data collection and results section. Results, conclusions and limitations are revealed in the last.

Social network analysis in construction

It is appropriate and also necessary to interpret the PBOs as a combination of formal networks and informal networks. PBOs could be conceptualized as social networks, which consist of a series of actors and the relationships defined on them (Wasserman and Faust, 1994). Nohria and Eccles (1992) suggested that all organizations shall be analysed in the form of social networks with the support of five reasons, which are 1) Organizations are social networks including a set of nodes linked by social relationships; 2) The business environment might be regarded as external networks; 3) The network view could help an organization to learn clearer of its role and position in the market; 4) Actions (attitudes and behaviour) of actors in organizations can best be explained in the context of relationship networks; and 5) The comparative analysis of organizations must take into account their network characteristics. Pryke (2004, 2005, 2012) reviewed the application of SNA in the study of procurement innovation and project management in the construction industry and suggested that the shortfalls of other existing organizational research methods call for the integration of SNA in the context that PBOs are interpreted as a multi-layer of interdependent networks. Chinowsky et al. (2008, 2010, 2012) established the social network model that project organizations could and shall be presented and analysed as social networks.

The three basic components, which are nodes, links and metrics, in a social network graph. A social network graph can be denoted mathematically as SNA triple SN=$< S, G, X >$, where S is the presentation of nodes, G is the presentation of links and X is metrics of the network (Scott, 1987), and Figure 1 is a typical presentation of a network.

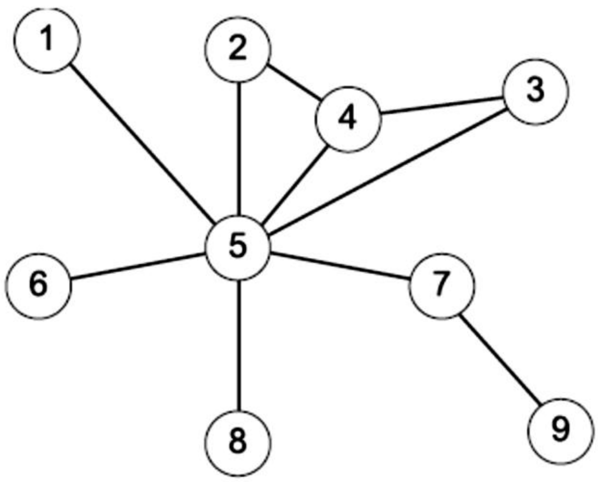

Fig. 1. **A typical presentation of a network**

Nodes are individuals in the network. Links are the relationships defined among the nodes, as shown as lines in Figure 1. Metrics are mathematically presentation of networks, and by using the graph theory key attributes can be obtained from SNA triples, and those have been used in the SNA-based construction management research are Degree, Density, Centrality, Distance, Cohesion, and Clustering (Chinowsky et al., 2010, Li et al., 2011, Balkundi and Harrison, 2006, Pryke, 2012). The following are the introduction of those key attributes and the expectation of their impact on organizational performance.

- Degree is the amount of links connected with certain node. The larger its degree is, the more popular the node usually is;
- Density is a description of the amount of connections in mid of the whole network. A denser network would have a large percentage of the participants who are actively interacting on a regular basis;
- Centrality relates to the power allocation in the network. A highly centralized network would be one where an individual such as the project manager serves as an interface for a high percentage of communications rather than communications being distributed throughout the network;
- Distance stands for transaction cost to deliver required materials and/or information. The longer the distance between two nodes is, the more difficult for miscommunications, and higher barriers between them;
- Cohesion means the extent to which actors are connected directly to each other by cohesive bonds. It is very important to have a cohesive social network to maintain effective communication channels to deal with possible disconnection.
- Clustering is a description of the likelihood that associates of a node are associates themselves. A higher clustering coefficient indicates a greater 'cliquishness', where the working efficiency is expected to be relatively high while the coordination between different cliques shall draw the attention of the managers.

Methodology

Since the translation of PBOs in the construction industry into social networks allows applying SNA, particularly its mathematical methods and visualization function, to study relationships formed by formal contractual constraints and inter/intra organizational structures and informal work-related or work-irrelative social interactions draw a lot interests from both academic and practitioners. In this study, SNA is the core of the methodology. Two steps of data collection are conducted. Firstly, information of contracts within a construction project and periodic interior records are reviewed to map the formal networks. Secondly, a questionnaire is conducted to solicit responses from the individuals with all specialties about whom talks/advices/trusts whom on work related matters, and some interviews are conducted to cross-check the contradicted responses and/or to discuss the power of social networks with key persons in the organization based on their voluntary. Afterwards, data is preceded and analysed using computer program Pajek, which is open source software specially designed for SNA. When maps of social networks in hand and main network characteristics described by key attributes ready, primary results released to key persons in the organization and possible solutions about the organizational problems will be discussed A case study of a HK public project with BIM implementation is used to demonstrate the application of SNA in the construction project management. BIM related questions are included in the questionnaire and interview design.

Sample case

The information of the case project is summarized in the following table.

Table 1

Basic information of the case project

Construction type	Public Housing
Contract Sum	HK $112.9 Million
Location	Kowloon
Duration	4 years
Client	Hong Kong Housing Authority (HKHA)
Gross Site Area (m^2)	12000
No. of flats	990

The project is using a design, bid, and build (DBB) model, which is popular in procuring public projects in Hong Kong. DBB is legally required to be used in HK public projects, since it's relatively simple, competitive, and to ensure tax is properly spent. However, DBB has been criticized for the problems of fragmentation, discontinuity, and ineffective communications. In the case project, BIM has been adopted and implemented in design stage due to the project complexity in the marine environment, but performed not well to guide the construction processes at the construction stage. The case project is purposely chosen for investigating the reaction of social networks of a PBO to BIM implementation, and it's one of the proposed case projects that will be used to compare the impact of social power on construction projects with different construction types and procurement systems.

Data Collection and Results

(1) To map the PBO into social networks

There are many possible ways to collect the data for mapping the networks, such as the use of questionnaires, interviews, participant observations and coding from device-aided communication records (Scott, 1991). The former approaches rely on a personal judgment and are used very frequently to indicate social connections and intimation of individuals within the networks, but are time-consuming. The later approaches are much speedy when the data are second-hand and ready for use. In this study, two approaches are combined together to collect data, one from the internal records of their connections among project parties in the project, and the other collected by survey and interview.

It is discovered that HKHA records a rigorous timesheet, including actors, activities, and time, for each project. This timesheet thus honestly records the work-oriented relationships amongst the parties in this project, and based on which a map of social networks can be produced, as shown in Fig. 2 by using SNA software program Pajek. Hence, a PBO is "translated" into a set of social networks as a new "language" for further analyses. In this approach, the nodes are the companies involved in the project, and the links are the presentation of their communication channels based on working relationship and stakeholder engagement.

Blue nodes represent the individuals of HKHA, and yellow nodes are those of stakeholders rather than HKHA involved in the project.

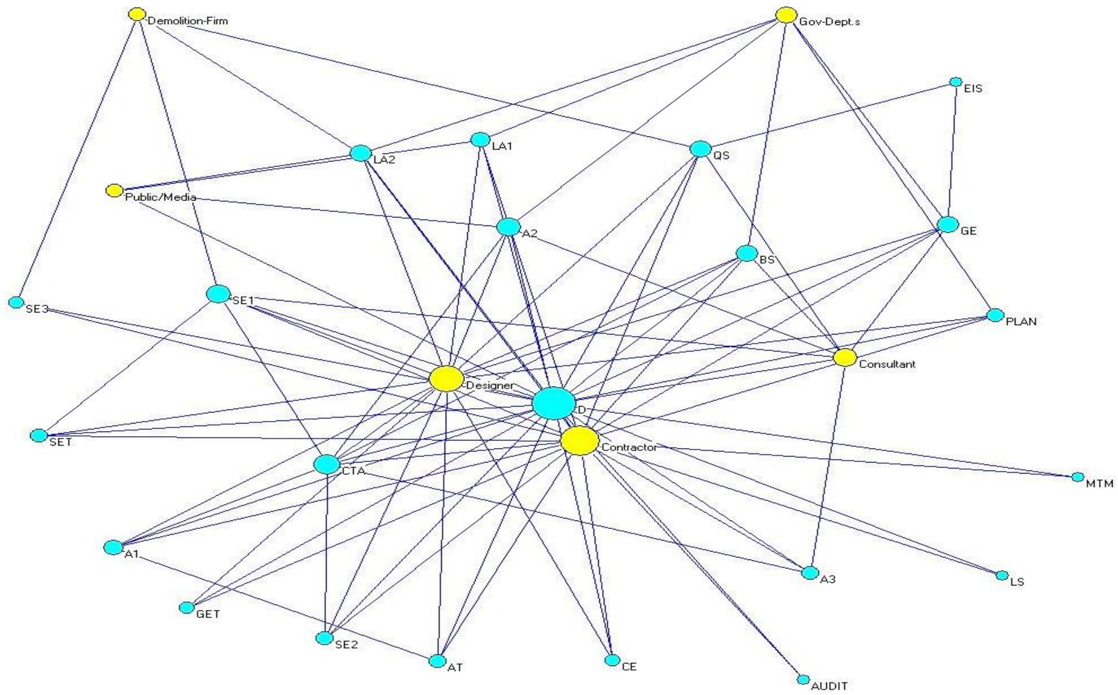

Fig 2. **Social network graph based on internal record of HKHA**

Following the data collection method in Krackhardt and Hanson (1993), a simple series of questions are designed to ask the individuals for their formal or informal interactions with others in the boundary of this project. The following are the questions included but not limited to:

Which descriptions are similar to your job in this project?
Whom do you frequently commutate with in the working hours?
Whom do you go for help or advice as to work-related issues?
Whom do you trust to share your undeveloped opinions on the work-related issues?
Does your job have any relation with BIM?
Whom do you go for help or advice as to BIM-related issues?
To what extent are you satisfied with the work you've done? (BIM-related work?)

In order to gain the honesty from the individuals in the project, their responses are ensured to be kept confidential from anyone out of the research team. In particular, their colleagues and upper-level managers are not accessible to the recorded data. And no personal identification will be released in the results or any other way.

Based on the responds from HKHA, communication network and trust network are drawn by Pajek, as shown in the Fig. 3 and Fig. 4. To be clarified that, because the individuals are totally voluntary to join the survey, there are some individuals who prefer not to be part of the research. If A and B both joined the survey, there answers will be cross checked. Once their answers are contradicted, there will be no link between them. If A joined the survey and B did not, there will be a link between them.

Furthermore, the graph in Fig. 4 is the subset of the graph in Fig. 3, since the trust is perceived to be established through long-term interaction.

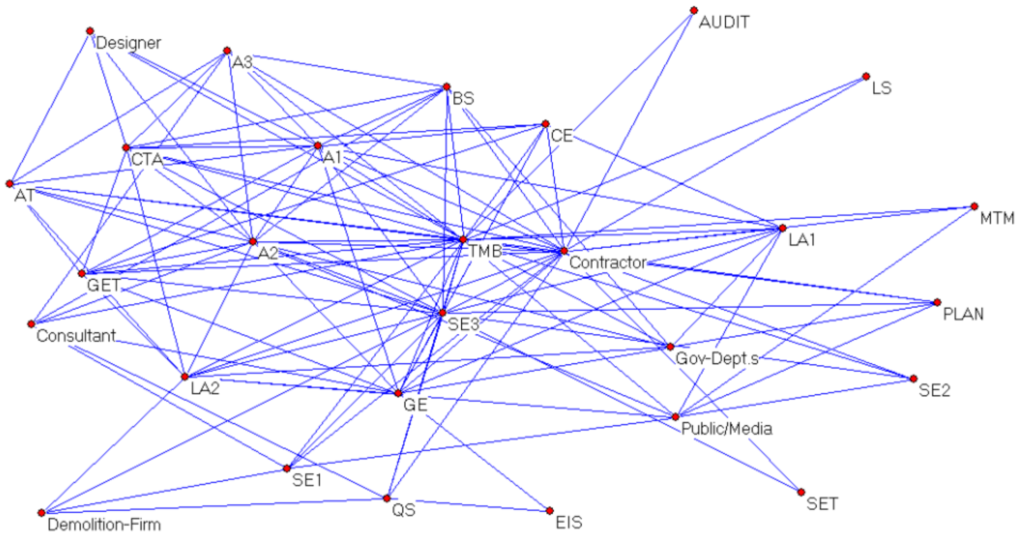

Fig. 3. **Communication network within the case project**

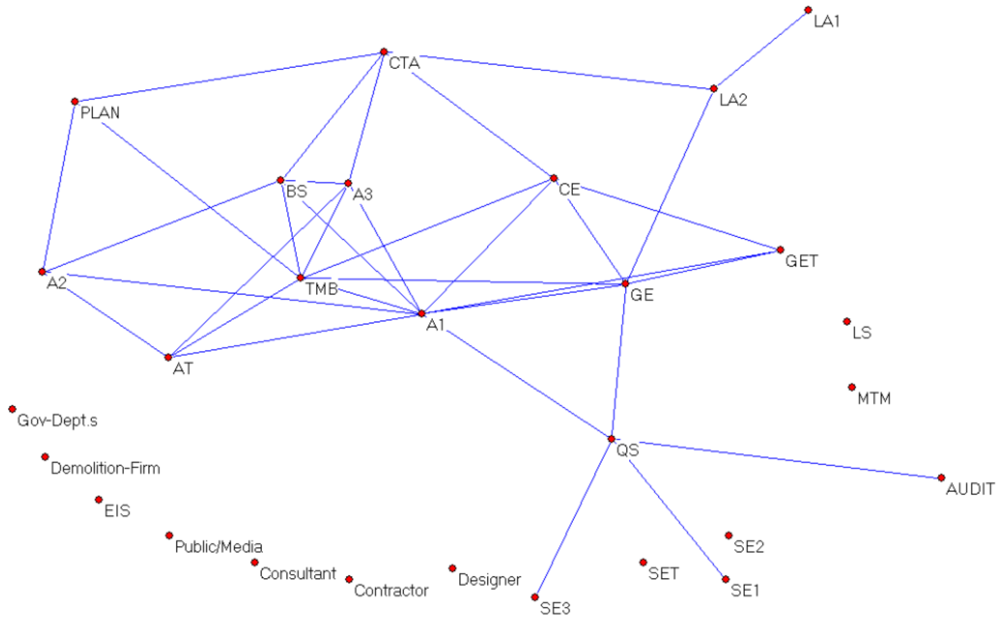

Fig. 4. **Trust network within the case project**

The data collection has been not fully completed yet. As in the two figures of networks above, several individuals, including MTM, SE1, SE2, and SE3, have not responded yet, and parties except HKHA are regarded as external environment.

(2) To measure Density and Centralization

Once the social networks are mapped in graphs, the social network properties such as Degree, Distance, Density, Centrality, and metrics can be obtained.

- Degree of a node is the amount of nodes it connected to by links.
- Distance of two nodes is the shortest paths connecting them.
- Network Density is calculated by dividing the number of existing links by the number of maximum possible links.
- Centralization of a network is a measure of how central its most central node is comparing to all other nodes. There are totally four approaches for the measurement of centralization: Degree, Betweenness, Closeness, and Eigenvector.

The social network properties of the Fig. 2, Fig. 3 and Fig. 4 are shown in Table 2.

Table 2

Network properties

Metrics-Networks		**Fig. 2**	**Fig. 3**	**Fig. 4**
Nodes		28	28	28
Links		88	120	25
Average degree		6.2857	8.571	1.7857
Density		0.2245	0.3061	0.0638
Centralization	Degree	0.7066	0.6154	0.1681
	Closeness	0.7507	0.6564	Nil
	Betweenness	0.3232	0.2192	0.0619
Average distance		1.8889	1.7407	2.0659
Longest distance		3	3	4

(3) To compare and interpret the networks

The work-related network in Fig. 2 is the description of inter- and intra- organization structure of HKHA with the boundary of this case project. The communication network in Fig. 3 is the densest one among the three, since only through the social interactions among the organization members the periodic tasks can be carried out. The trust network in Fig. 4 is a set of the most valuable and strong connections among the organization members.

The difference between the work-related network in Fig. 2 and the communication network in Fig. 3 is small. The ratio of the density/links/average degree between the work-related network in Fig. 2 and the communication network in Fig. 3 is 73.33%, which is relatively high. It indicates the formal organizational structure of HKHA is quite efficient for information/knowledge circulation among the individuals within HKHA and with other parties involved in this case project.

The difference between communication network in Fig. 3 and trust network in Fig. 4 is tremendous. Trust has been noticed to be very important to organizational performance by vast literature, e.g. Axelrod (1984) and Mayer et al. (1995). Low density, low centralization and long distance reveal that there is much space for the organization to improve efficient interpersonal interactions and collaborative culture. In particular, as to the PBO in the construction industry, there is the long existing problem of controversial relationship between different parties, and it's clearly shown in the Fig. 4 that no trust link is connecting to other parties.

As discussed in Krackhardt and Hanson (1993), denser communication network did not guarantee better organizational performance, and the quality of the communication determines, which could be revealed by the trust network. This case project is exactly a typical example.

(4) BIM implementation in the case project

HKHA has established the BIM Center to develop BIM-enabled platform and project delivery procedures, and provides in-house BIM standard in HK, user guide and BIM library components design guide and reference for potential BIM users. There are more than 19 building projects with BIM implementation done or undergoing in HK, under the support of the BIM Center (HKHA, 2012).

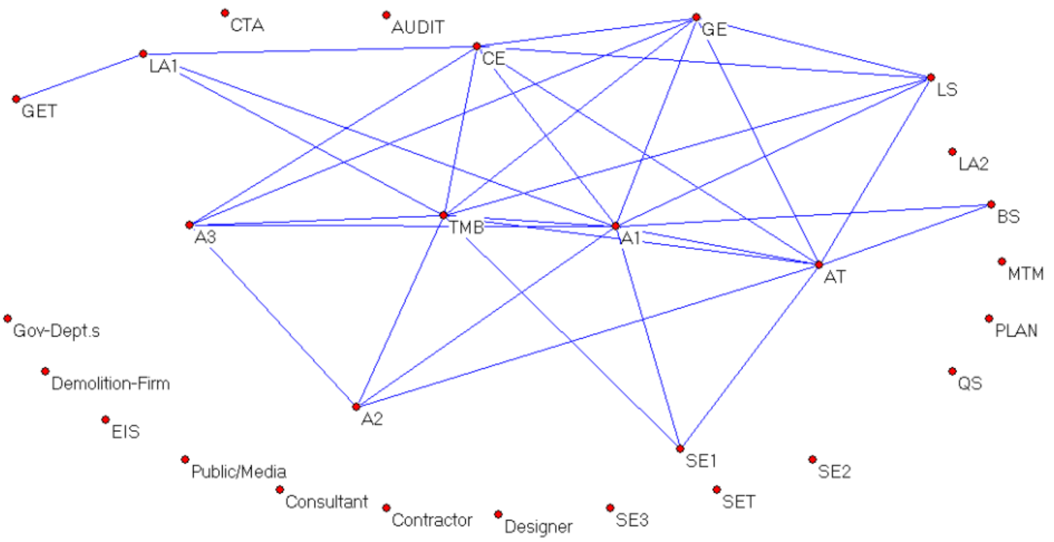

Fig. 5. **Communication network relating to BIM implementation**

As in the case project, there is an interpretative issue discovered between the BIM model and information systems of other contractual parties. The BIM model is supposed to serve as a 3D digital presentation tool for better visualization, simulation, and guidance, but actually the model was transformed into 2D drawings before handing over to the contractor and surveyors. The staffs in the BIM Center, including various professions such as programmer, architect, engineer (SE, CE, GE), and surveyor (QS, GS, LS, BS), are densely interconnected. However, there are no links connecting BIM Center to external individuals or companies. The social network of BIM implementation is mapped as shown in Fig. 5, based on the responses to the specific questions. It reveals the compatibility problem of the different enterprise information systems of different parties in PBOs, especially in the face of new technologies, e.g. BIM in construction.

There is a high level of similarity between the trust network in Fig. 4 and the communication network relating to BIM implementation in Fig. 5. Therefore, it's hypothesized that BIM-enabled platform has a potential to foster a better trust culture between the organization members. A practical thinking is that the highly shared information system of BIM could create a more fair and transparent environment for individuals to collaborate with each other.

Conclusions and Discussions

The multi-organizational governance mechanism of PBO is gaining more popularity in the modern business, particularly in the construction industry. Information circulation and resource sharing among all the project participants in PBOs could be presented in the forms of social networks both formal and informal. It calls for a new social perspective to investigate the organizational efficiency in PBOs.

The aim of this paper is to explore the social power on PBOs, with SNA as the tool to measure the social power. A series of formal/informal networks are mapped in two approaches, with one from archival records and the other from surveying. The network properties including degree, distance, density, and centralization are then analysed. A case study of a HK public project is used for demonstration of how the social power in a PBO is interpreted and affects the organizational performance.

By comparing the work-related network in Fig. 2, the communication network in Fig. 3, and the trust network in Fig. 4 in the graphical and measurable ways, some interesting conclusions are discovered, such as the effective organizational structure for efficient communication, controversial inter-organizational relationship, and the importance of the communication quality.

BIM implementation is recognized as a future for the construction industry, and the inter-operation problem between different project parties' enterprise information systems is discovered to be a big obstacle for the popularization of BIM implementation in the construction industry.

This paper is a very beginning step forwards the demystification of social power in PBOs. It will extend our understanding of how inter-/intra-organizational social interactions among the individuals influence PBOs in terms of their communication patterns and quality, and organizational governance. Besides, the paper points to a direction about how to support the decision making relating to BIM implementation in the social perspective.

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INVESTMENTS IN HUMAN RESOURCE DEVELOPMENT ACCORDING TO CORE COMPETENCIES OF THE COMPANY AND ITS IMPACT ON PROJECT MANAGEMENT IN SOFTWARE DEVELOPMENT COMPANIES IN LATVIA

Uldis Zandbergs, Baltic Computer Academy, Latvia[1];

Aldis Erglis, University of Latvia, Latvia

Abstract

Human resources are most important production factor in software development (SWD) company. Skilled professionals are creators of difference between company success and poor performance of the company. Many researches discover huge difference between most productive people in company comparing with average performance, for example best programmer in Apple is 8 times productive than average in industry (HBR, 2013). This fact illustrates importance of making appropriate investments in human resources, especially in software development industry, because of fast changes in technology and customer needs. In software development industry knowledge become less usable and valuable in very short period of time. Every three years global software technology vendors like Microsoft, IBM and Oracle releases new versions of frameworks, technology platforms and versions of programming languages. Companies need to shape their competencies taking into account technology changes and growing customer needs.

SWD companies need flexible competence model to be able to understand and evaluate current competencies, future needs and gap between today's situation and future perspective. In 1990 C. K. Prahalad (1994) and Gary Hamel (1994) introduced Core Competency model, with intention to help companies build flexible and sustainable competence development model from strategic perspective. Core competency model is management approach how managers could structure competencies in organization. Every company has its unique, core products, services and processes. Acquiring and keeping competitive advantage is main goal for companies (M. Porter, 1996) Core products and processes make competitive advantage. Therefore competencies that company has to sustain product development and processes are core competencies that must be developed. Core competency approach allow companies build competence model that fulfils there criteria: it is not ease for competitors to copy competences, it could be reused in different markets, and it brings more value to customers.

The aim of this paper is to discover principles of investment allocation for human resource development and its possible influence to project management. Research will be conducted as quantitative survey of custom development software managers and experts. This research will contribute to decision making process for investments in human resource development. Research results could be used for HR managers and managers of software development companies and organizations which are planning to implement custom software development projects.

Key words: *core competencies, human resource development, e-learning, HR strategy*

JEL codes: J24, M53, M54

[1] Corresponding author – e-mail address: uldis.zandbergs@bda.lv, telephone: +371 67505090

Introduction

In today's knowledge based economy organizations are mostly project oriented. Software development market in Latvia is quite small and competition in field of custom development projects is intense. Because of market limitations many companies are trying to develop products and services not only for local market but also for export markets. SWD companies need to be focused on competence development because of limitation of available qualified resources and customers on domestic market. Therefore SWD companies must very carefully spend investments for development of resources for certain skill and technologies. Almost all workers in industry are knowledge workers they treat companies to provide more and more possibilities of professional development. Management and HR's are under pressure for right decisions in competence development field. In future companies that will make right decisions in competence development will acquire competence advantage and could better do the following:

- Acquire talented peoples to the company;
- Build better products and processes;
- Create products and services to export markets;
- Deliver more value to customers;
- Manage and deliver projects.

Therefore we could conclude that right investments in development of the competencies in SWD companies have correlation with overall company development and profits.

Authors define hypothesis to test during research:

1. Use of core competencies model will help Latvian SWD companies build flexible and sustainable competence development process.
2. There exists information asymmetry in competence development process, information about competencies is not fully available.
3. Decisions about investments are based on short term planning perspectives of the company.

Methodology

The research is limited to the custom SWD companies in Latvia. Data was collected by questionnaire that included statements about different stages of planning and development of the competencies. Data was collected in fields of competence development approach, responsibility, accounting and formal structure in the software development companies. There were included series of questions about learning methods (e-learning, instructor lead learning) and appraisal methods and testing techniques. Questions divided in 9 groups of questions including separate question group about accessibility of the competencies and usage of competence development information in strategic planning and vice versa.

There were 40 questions included into questionnaire. Most questions were as statements with five possible answers: totally disagree, partly disagree, don't know, partly agree and totally agree. Respondents could choose one of answers.

Nonprobability judgment sample was used in the survey. Authors selected sample of 11 professional custom development software companies. Questionnaire was published online and each respondent received individual e-mail with request to reply on survey.

Results

All companies involved in survey responded to questionnaire. Number of companies participated in survey widely represent SWD industry in Latvia. Almost half of companies participated in survey – 5 (45%) have more than 100 employees, these are quite large companies for Latvian SWD industry.

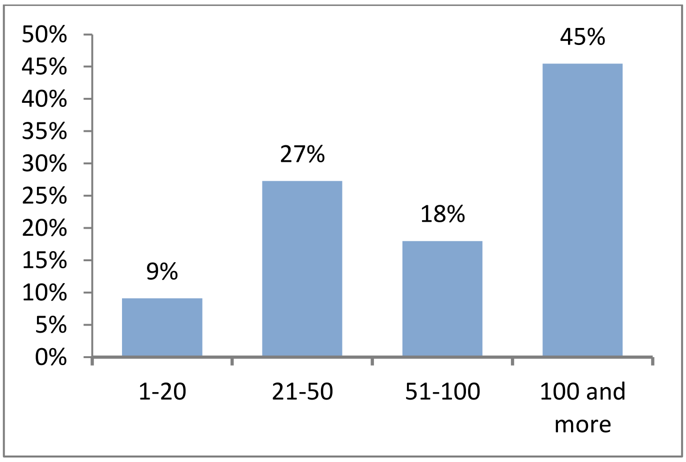

Fig. 1. **Size of the companies**

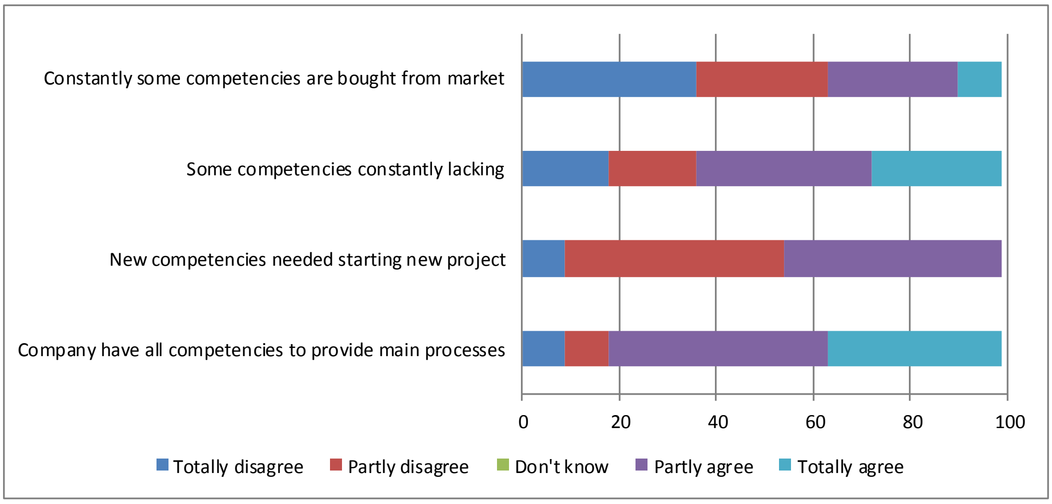

Fig. 2. **Evaluation of competencies**

One of most important factor analyzed in survey is evaluation of competencies in SWD companies. Results conducted by asking questions about self-evaluation and formal evaluation methods like external certification and testing.

To find out formal structure of competence development group of questions asked about accounting and formal process of competences. Results shows that centralized accounting of competencies are strongly prevail over functional unit level. This strongly shows that competence planning and development system is strongly centralized.

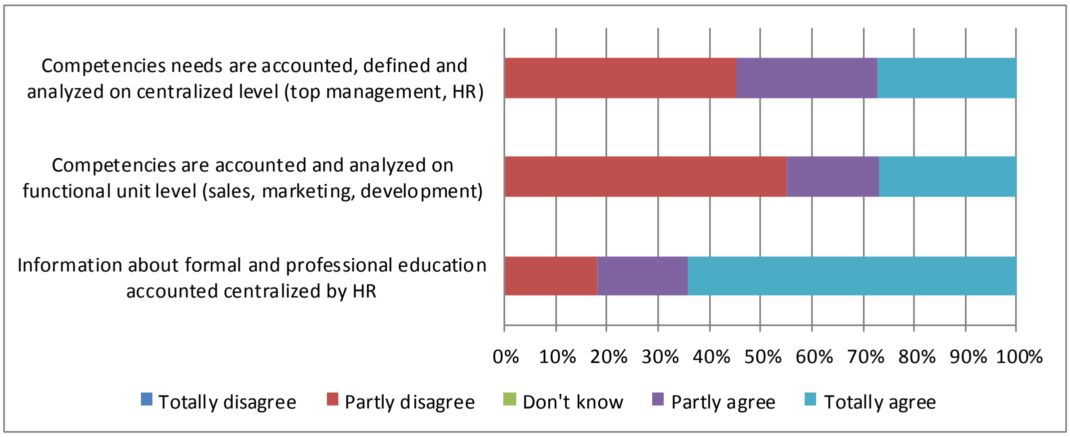

Fig. 3. **Accounting of competencies**

Table 1

Summary of competence development and assessment measures

Question Item	Mean	Median	Standard deviation
Availability of competencies			
Company have all competencies to provide main processes	3.91*	4	1.30
New competencies needed starting new project	2.82	2	1.17
Some competencies constantly lacking	3.36	4	1.57
Constantly some competencies are bought from market	2.45	2	1.51
Accounting of competencies			
Information about formal graduated education accounted centralized by HR	4.27	5	1.19
Information about professional education accounted centralized by HR	4.27	5	1.19
Information about passed tests and acquired certification accounted centralized by HR	4.27	5	1.19
Competencies are accounted and analyzed on functional unit level (sales, marketing, development)	3.18	2	1.40
Competencies needs are accounted, defined and analyzed on centralized level (top management, HR)	3.36	4	1.36

Question Item	Mean	Median	Standard deviation
Competence evaluation and assessment methods and principles			
Evaluation of competencies done by self-assessment and confirm it with superior	3.36	4	1.63
Superior and subordinate discussing competence gap during yearly development interview	3.82	4	1.33
Company on regular basis uses e-learning software to assess and test competence level of employees	2.18	2	1.33
Company uses external service provider to asses gap between existing and needed competence levels	1.73	1	1.01
Company uses external tests form technology vendors (e.g. Microsoft, Oracle, IBM etc.) to asses competence level	3.36	4	0.81
Responsibility for competence development			
Employee is only one who is responsible for competence development (self-development)	2.55	2	1.44
Unit manager is primarily responsible for competence development of an employee	3.91	4	0.70
HR and top management is responsible for competence planning and development (make priorities on competences should be developed)	3.82	4	1.25
Development of competencies done according product or process development needs	3.55	4	1.29
Development of competencies and training			
Company provides possibilities environment for training and employee decides himself what to learn	3.64	4	1.12
Training is planned by unit manager according to training budget	3.73	4	1.27
Training is planned by HR in centralized way	4.18	4	0.87
Training actives are related with needed competencies in upcoming projects	4.18	4	0.87
Most of trainings related to common soft-skill competencies (presentation, communication etc)	2.91	2	1.51
Usually employees attend courses that are in training provider proposed courses	4.36	5	0.92
Training suppliers provides all necessary courses for the company	3.63	4	1.57
Evaluation of competence needs			
There is regularly completed competence survey and discovered core competencies	3.0	4	1.26
Competence needs are allocated to certain product or process	3.82	4	0.98
Competence needs are primarily evaluated according employee contract and job description	3.0	3	1.26
There are assigned certain levels to competencies	4.09	4	0.70

Question Item	Mean	Median	Standard deviation
Use of competence information for strategic planning			
Core competencies are defined in company	3.82	4	1.25
Defined core competencies are aligned and corresponds to current business model and processes	4.00	4	1.10
Core competencies are aligned and corresponds to company goals and plans	3.64	4	1.21
Competence availability is taken into account before developing new products or services	3.82	4	0.98
During new product or service development training for needed competencies are added to training plan	3.91	4	1.30

Discussion

Project management as core competence

All of the SWD companies in Latvia include a position that is necessary for the implementation of their projects. This position is project manager. The research of privileges and work assignments of a project manager in different SWD companies is not part of this paper. A project manager may be a formal middle level manager in a company or they might be a leader of a team without formal managerial rights. What they all have in common is a specific set of skills they need to fulfill their role. This set of skills includes management skills that involve managing of people and processes and expert skills that are specific to software development and the particular industry and the business processes that the software is used for.

We argue that there is a project management competence or rather few competences that together constitute what is expected of a project manager in a SWD company. Those competences include team management, ability to make decisions, and orientation on results as well as knowledge about project management methodologies. For a project manager project management competences would be required at a level that is sufficient for working in a challenging environment often without a help from the higher level management. This is not a basic competence level and requires experience and/or training on part of the successful project manager.

By using their competences project managers create an environment where all the other team members show their competences in turn. If project management competences are not used in the most effective manner the effectiveness of the project team may suffer accordingly. Therefore project management competences are essential to the project team performance. For SWD companies in Latvia that rely on their project teams to implement their projects and generate business and use project managers as the driving force behind their teams it can be argued that project management competences are to be considered one of companies core competences.

Planning and development system of the competencies

Questionnaire starts with question about availability of the competences needed to deliver companies products and services to customers. Companies strongly stated that there is not generally lack of competencies in organization, 82% of respondents stated that they generally have all needed competencies to support main processes in the company, and 64% stated that company don't buy competencies from outside company as well. According to survey 55% of respondents disagree that there is some gap in field of competencies needed to successfully accomplish project, starting new project. That illustrates overall impression about situation of competencies in the company by certain management levels in organization. Despite that 64% of respondents stated that there are some competencies in company that is constantly missing or not at needed level. Contradiction in responses about availability of competencies lies in overall structure of competence development process. This situation based on perception and is partly true because of structure and mechanics in overall competence accounting and development system of the company.

Accounting and planning of competencies is organized in centralized way. All competencies and needs are conducted, planned and managed by HR or executives, 82% of respondents agreed on that statement. This statement strongly supported by answers to questions about responsibility of functional unit managers for competence development where 91% of respondents stated that unit managers are not directly responsible for competence planning and development.

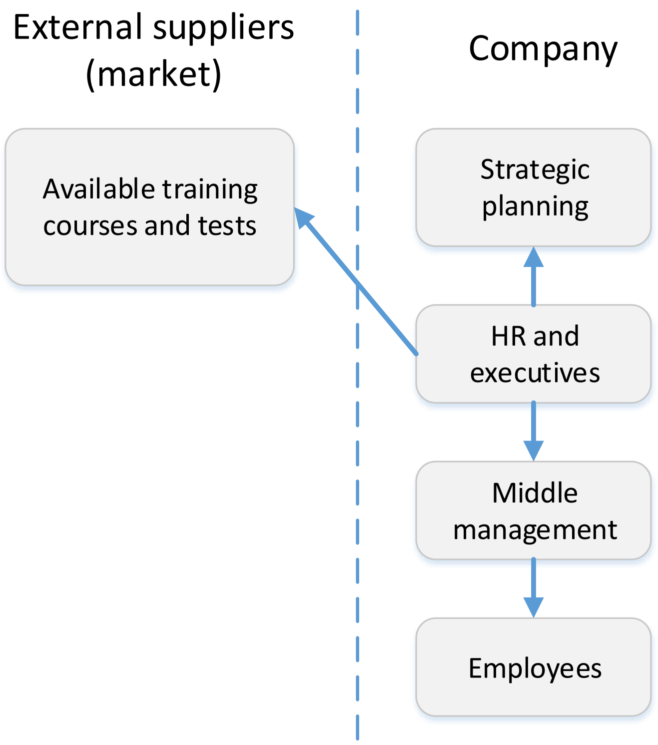

Fig. 4. **Competence planning and development system**

Competence planning and development system in Latvian SWD companies are very centralized and managed by HR and executives. Middle managers are not directly involved in competence development process but in real life are responsible for results of competence development due to performance results of their units and subordinates. Centralized planning system is very suitable with budgeting process and main outcome of competence planning is budget allocation for training activities. Development of the competencies are supply driven and there is no perfect match between training courses available in market and company needs. Companies take available courses and generally don't generate demand for training based on individual competence development needs.

Most important problem that appears is that competencies are rarely tested and evaluated. 73% of the respondents stated that evaluation of the competencies are not done in formal way by testing process. Some kind of evaluation is done once a year during employee development interview. It could not be classified as formal evaluation or testing process. Also companies don't use external testing and evaluation services, 82% stated that companies don't involve external experts and services for evaluation of the competencies.

Evaluation of the competencies is main feedback mechanism that allows to successfully manage and tune overall competence development system. Only with feedback about positive or negative changes in competencies and its levels, management could plan activities that are needed to correct situation. Due to lack of feedback mechanism this system could not work properly, which explains contradictions in answers of respondents about competence availability. There is needed appraisal and testing process that will show efficiency of training suppliers, training courses and investments in competence development and impact to organization performance. Without that kind of feedback, company is under risks to develop wrong competencies, under develop or overdevelop uncritical competencies witch lead to inefficient spending of investments. There is not possible effectively evaluate training suppliers without evaluation of competencies. Also planning could not be performed accurately without precise information about current situation with competencies.

Therefore competence planning process is mostly done based on assumptions and intuition of the HR's and executives which not necessarily represent actual situation and needs. Taking this into account competence development process is far from optimal and is more formally done to conduct some fraction of training activities that must be done according rules of good management but not necessary actual needs. This allow authors to conclude that this kind of competence development system is developed and maintained to support administrative activities such as budgeting but not competence development per se.

Appraisal and testing of the competencies (defining gap between actual and needed competencies)

Most companies indicate that they conduct competence evaluation once a year during a meeting between the employee and the supervisor. Given the dynamics of the business environment and the fact that those companies are involved in the projects that according to their own words are 3 to 6 months long on average the frequency of the competence assessment seems to be inappropriate. There are positive aspects about competence assessment since at least some companies entrust the competence assessment to supervisors that are unit managers. Unit managers are more familiar with the tasks their employees are involved in and may have a better grasp on what competences are needed for their employees.

At the same time it is HR and top managers who have defined the competences in the first place therefore forcing the lower ranked employees into a certain framework of competence evaluation. 45% of the companies have agreed that they are using employee job descriptions for listing of competences which further supports the top down approach and railroads companies into believing what their employees need to be competent in. As a result those companies set up an environment where they rob themselves of a feedback about the effectiveness of the competence evaluation. Top management only receives information about their employees that they themselves have previously agreed to receive.

Most companies would employ HR managers who are educated in certain competence appraisal methods. The same companies have agreed that their human resources are a major part of their competitive advantage. However not all of the companies have realized their own limitations to testing their employees. 27% of the companies that participated in the survey use e-learning solutions to assess and test the competences on regular basis. Only 9% make use of external service providers to assess the gap between existing and necessary competence levels. The other companies are missing on the options of employee competence evaluation. This further makes worse the situation with the feedback about the effectiveness of competence management.

55% of the companies use external tests form technology vendors (e.g. Microsoft, Oracle, IBM etc.) to assess the employee competence levels. This approach lets them standardize the competence evaluation and gives a good common ground to comparing their employees with each other and experts from outside of the company. Some of the technology vendors have also prepared their own lists of competences and skills required from the candidates for testing. This is again convenient since they make clear what a typical owner of technology vendor certificate is capable of. Also these lists are similar to how HR and top management would prepare their own lists of employee competences. Still it forces the employees into standardized training options without paying attention to what competences they already have and without giving a clear indication of how individual employee competences have evolved because of the training.

Matching training programs to actual needs

Survey shows that 54% of the companies make their HR experts plan training of competences and 82% of all the documentation related to competences are in the hands of HR experts. 55% of the companies indicate that unit managers are responsible for training but are limited by the budget that is set by the top management. 54% of the companies allow their employees to train by using the environment provided by the company but at the same time those companies indicate that their HR and top management are responsible for prioritizing the competences. This shows us that training of competences is planned by using top down approach e.g. employees are forced to advance in those competences that are deemed appropriate by the HR and top management. This is not necessary a bad thing considering that top management would be responsible for setting the strategic goals for the company and developing the core competence.

However usefulness of this approach is diminished by the way of choosing the training options. Currently most of the companies (91%) depend on courses provided by external suppliers. More importantly those companies believe that those training options are sufficient. Training options provided by external sources however are not directly linked to core competences of the company requesting the training. Often training providers would not be able to indicate what competences would be developed by attending their training. Therefore although many companies indicate that they have put strong effort into defining their core competences they in fact are not able to build on those core competences by developing them properly.

Few companies use internal training options available to them e.g. mentoring of employees at all levels of experience, company specific tests and training options conducted internally, and knowledge management procedures supporting by competence management. This compromises the usefulness of training as the training options are not configured entirely according to the needs of the company expressed via competences.

Responsibility for investments and Budget allocation principles

As discussed previously evaluation and planning of competencies development needs are done centralized mainly by HR's. Matching of available training courses and actual needs also mainly done by HR's. Available courses are screened in market from certain number of suppliers and planned in overall company budget. Planning of needed training courses mainly done once a year during planning of overall budget, because training investment is part of budget spending. Mainly all courses included in budget are based on needs in upcoming projects, 91% of respondents agreed with this statement. Therefore authors conclude that training planning tend to become fragmented and done according to budgeting process needs not needs in process to fill competence gaps and develop new competencies.

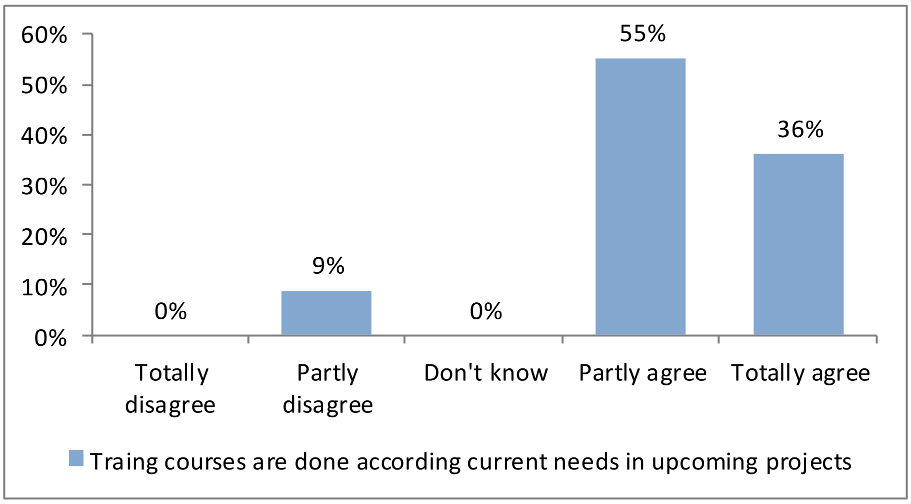

Fig 5. **Training purpose**

Planning of competencies in upcoming projects allow companies more or less precisely forecast actual needs in competencies for period 3 to 6 months, which is almost half of regular budgeting period. If there is done training budget review after half a year it could cover actual needs for competencies. Despite that it could not help understand and evaluate investments in other competencies that are not identified in upcoming projects but could be core competencies of the company. Therefore competence development plan includes only competencies that are needed in upcoming projects. This don't reflect holistic view of competencies and future needs.

Short term competence planning consequences lead to situation where only new competencies are developed but existing competencies that are mostly core competencies of the company are not developed and even evaluated. This creates situation where management and HR could report that competencies generally are developed and investments in training are made according to actual needs. Despite that it is not maintain core competencies of the organization and not sustainable flexible competence management model that allows to use advantages of core competencies approach.

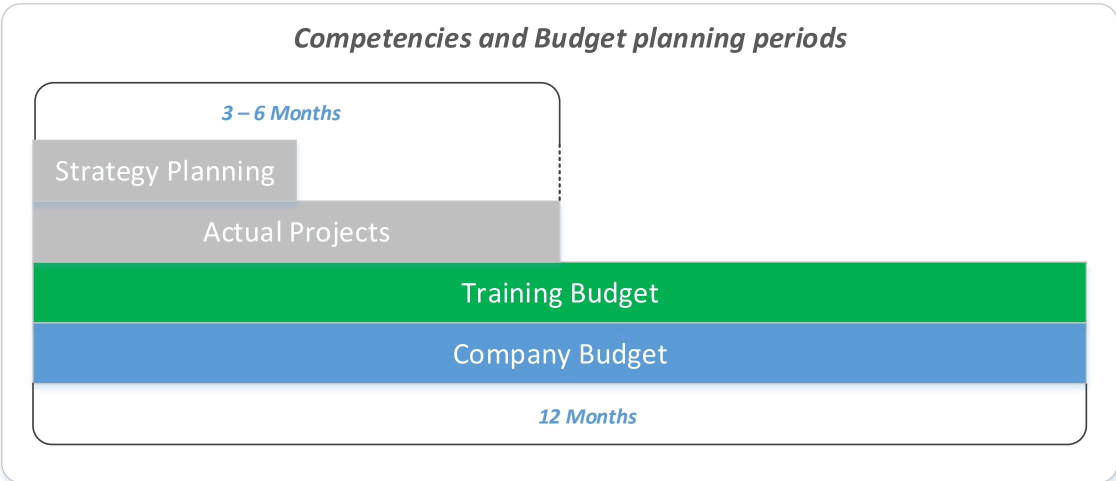

Fig 6. **Budget planning period**

Main responsibility about investments in competence development lies in planning process which is done by HR's and executives as stated earlier. Therefore HR's and executives decide and allocate investments for training. Responsibility for investment allocation is not equally divided between HR's and unit managers or employees. It could cause inefficient spending of budget resources.

Competence appraisal and testing to avoid information asymmetry

Competence planning and development process in Latvian SWD companies is under asymmetric information situation. Due to lack of evaluation and testing process of the competencies, there is no trustable information about competence levels and quality. After some period of time unit managers and employees are better informed about actual competencies, levels and needs. This information is not available for HR's and executives automatically, there is no trustable signals about competencies, and therefore on centralized level planning is done based on assumptions and intuition. Decision making under asymmetric information is influenced by high level of uncertainty and in some cases can't represent actual situation (G. Akreloff, 1970).

To reduce information asymmetry there must be implemented competence appraisal and evaluation process, which is based on formal testing and involvement of external testing institutions.

Impact on Project management

As mentioned earlier project management must be core competence in Software Development Company. Other competencies are not less as important such as programming, testing and analyzing. IT project success depends on several factors and team competencies is one of main factors. Most of software development methodologies includes project manager as separate role but there are some for example Agile, Scrum or XP that propose develop self-organizing teams which requires higher level of organization and changes in organization culture. That means competencies of team members require higher level. Achievement and sustainability of high-level competencies is long-term process that synchronized with rapid market changes on technology field. That requires long-term competence development and planning process that integrated into strategic planning process and linked with operations where actual information about competence gap available. This construction cannot work without feedback mechanisms such as correct information about competence levels and impact on actual work. Which requires assessment process that deeply integrated into planning and development processes.

Taking into account Latvian SWD market size and conditions development companies especially small ones must consider very carefully what kind of technical competencies will be developed and offered to the market. Available competencies usually is factor for decision in witch project, company will participate. From company strategic planning perspective, existing competencies and their levels show exactly what kind of the projects company is able to develop now and in future and what changes needed in competencies for projects in some field that differs from current. Also due to long time that is required for development of technical competencies, development must start some time before project started.

Project managers must have information about competence levels of their team members for better performance of the project. That requires integrated competence development and accounting system, which provide needed information about competencies and levels to all levels of organization starting project managers, line managers and others. Project managers need to be part of feedback mechanism about competencies and levels. There should be procedure of assessment of competencies after every project comparing with project goals stated at the project start.

Strategic planning of the competencies and linking with Core Competencies of the company

Core competencies approach assumes linking main products and processes to the competencies. Development of competencies must be done on strategic level to avoid wrong allocation of financial and time resources. Strategic planning of competencies means development of existing core competencies and maintaining competencies on needed level. Also forecast of needed competencies in future must be done on long term perspective due to reason that development of the competencies take time and it must be implemented in existing or new processes. Therefore on strategic level must be trustable information about current competencies and levels that are connected to the company results.

One of strategic goals Latvian SWD companies is to develop new products for export markets. On export market exists demand for specific competencies and experience. Therefore company needs to understand very well needed competencies and its levels on market and exact or similar competencies in the company. Company needs to classify competencies that are demanded on export markets and develop such competencies in the company for future export activities. On strategic level company needs to analyze export markets taking into account current core competencies.

Core competencies model is possible model that helps analyze alignment of the competencies to performance results of the products and services. That is how core competence model actually could help SWD companies to find out which competencies really company needs to develop and which are actually not critical.

Conclusions

1. Development of competencies is strategic approach that could help Latvian SWD companies to achieve better results on domestic and export markets.
2. Competence planning and development process in Latvian SWD companies is mainly done on operational principles and have short term influence. Investments in competence development are based on short term needs and manager's assumptions and intuition. Therefore it is hard to talk about strategic planning of competencies. If competence development is done only on operational principles, most probably resources spend for competence development will not be focused and some part of resources will be wasted on uncritical activities.
3. Project managers should participate in competence development and accounting process that will help better align resources for competence development and better performance in the projects.
4. Competence development plan must be linked with training budget and actual needs. Therefore there must be constant feedback about acquired new competencies and upgrade of existing competencies to identify gap between existing competencies and needed ones. There must be implemented system that allow managers get trustable information about training budget spending and acquired competencies and levels comparing with competence plan.
5. Development of core competencies of the company to certain level create better opportunity for the company to propose company products and services on export markets.
6. Competencies and competence levels are not evaluated and tested to get trustable information for gap evaluation between needed competence level and existing one. Therefore there is no systematic approach to competence development in Latvian SWD companies. Implementation of core competencies model could help Latvian SWD companies to reduce information asymmetry and link investments in competence development with company results.

7. To reduce information asymmetry there must be implemented competence appraisal and testing process. Otherwise exists risks for inefficient investments in competence development.

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STRATEGIC ISSUES IN MANAGING PERSONNEL: MOTIVATION AND WORK PERFORMANCE CHALLENGES

Biruta Sloka, University of Latvia, Latvia[1];

Laura Kersule, University of Latvia, Latvia

Abstract

The rapid development of modern telecommunication technologies in Latvia has led to struggle and competition in today's telecommunication industry. Telecommunication companies demand that their staff would be educated, creative, efficient, motivated and loyal. Preparation of good practitioners able to perform activities for creation of competitive products and services takes time and huge efforts. Companies are interested to keep their professional staff for the company development. For that efficient motivation ways and means are needed. The purpose of the study was to explore relationships between motivation factors and self-rated job performance; examine factors that are associated with likelihood that employees will engage in effective and efficient business performance. Author compared findings on factors associated with likelihood that employees will engage in effective and efficient business performance and analyzed what are the relationships among – motivation and self-efficacy and self-rated productivity in telecommunication and other industries in Latvia. Research methods used: scientific literature review, survey of employees. The following measures were used to: 1) list of motivators; 2) list of statements on skills, engagement and resources available in company; 3) perceptual performance; 4) demographic profile of sample (age, gender, occupational type and detailed information on position, education, income, and industry). The respondents were asked to use 7-point scale ranging from 1 – inapplicable to 7 – applicable in higher extent to indicate which motivational instruments are applied in current working place. Skills were evaluated in 7-point scale, where 1 – strongly disagree and 7 – strongly agree. For data analysis indicators of central tendency or location and indicators of variability were used, as well as cross-tabulations, multivariate analysis: factor analysis, correlation analysis are used.

Key words: *human resource management; personnel motivation; creativeness of work*

JEL code: M12

Introduction

Motivation is key to the success of obtaining the benefit of skilled employees' performance in a team based environment. There have been continuing efforts among researchers in distinguishing the influential drivers of motivation and performance. Telecommunication industry is one of the most competitive in Latvia, but it is facing also big competition for skilled employees as well as pressure on material compensation. The purpose of the study was to explore relationships between motivation factors and self-rated job performance; examine factors that are associated with likelihood that employees will engage in effective and efficient business performance. Author compared findings on factors associated

[1] Corresponding author – e-mail address: Biruta.Sloka@lu.lv, telephone: +371 67033835

with likelihood that employees will engage in effective and efficient business performance and analyzed what are the relationships among – motivation and self-efficacy and self-rated productivity in telecommunication and other industries in Latvia. There was performed survey of employees in telecommunication industry. Skills were evaluated in 7-point scale, where 1 – strongly disagree and 7 – strongly agree. For data analysis indicators of central tendency or location and indicators of variability were used, as well as cross-tabulations, multivariate analysis: factor analysis, correlation analysis are used.

Theoretical background

There are many findings in academic research related to job motivation. Human potential is boundless, but it requires motivation to excel (Schrader, 1972). The term "motivation" has several definitions. According to Jenkins et al (1982), "motivation is intangible: a hypothetical construct that is used to explain human behaviour." Further, they state that motivation has a direct impact on work performance and can be positively influenced or managed by external factors, such as incentives and rewards. Needs of individuals are often described as being "intrinsic" or "extrinsic" in nature (Sansone and Harackiewicz, 2000). Extrinsic needs are those that motivate an individual to achieve an end result. Extrinsic motivation occurs 'when employees are able to satisfy their needs indirectly, most importantly through monetary compensation' (Osterloh *et at.,* 2002: 64). In contrast to extrinsic needs, intrinsic needs exist when individuals' behaviour is oriented towards the satisfaction of innate psychological needs rather than to obtain material rewards (Ryan and Deci, 2000). Intrinsic is the motivation to "perform an activity for itself" (Van Yperen and Hagedoorn 2003: 340) trying to experience the pleasure and satisfaction inherent in the activity. Intrinsic motivation appears to be self-defined (Loewenstein. 1999) and self-sustained (Deci, 1975) and is fostered by commitment to the work itself. As far as the relationship between intrinsic motivation and work outcome is concerned, intrinsic motivation seems to be a good predictor of work performance. There are some empirical evidences as well on assumption that monetary incentives (or extrinsic motivation) significantly improve task performance (Stajkovic, Luthanss, 2003), (Perry, 2006). However, findings from the reviewing of 72 field studies revealed that work performance improved by 23 percent when monetary incentives were used whereas stimulation with social recognition improved performance by 17 and feedback by only 10 percent. Some interesting conclusions emerged from these studies regarding different fields of activities, for example, combination of financial, non-financial and social rewards produces the strongest effect in manufacturing, whereas for service organizations financial stimulus produces more influential effect than non-financial rewards. The relationships between motivation and productivity can be summarized as that productivity is directly linked to motivation. Suitable approach of motivating employees can be hypothesized as a key contributor to maximizing productivity of the workforce. There are many factors that drive or determine productivity of employees. Productivity has many definitions, including performance factors, production rate, and unit person hour rate. In the real world, however, productivity cannot be achieved only by speed and harder work without adopting better work practices (Banik 1999). Effective performance is a measure of task output or goal accomplishment to meet the daily production targets, both quality and quantity. On the other hand, efficient performance refers to cost-effective goal accomplishments with the realization of high outputs with less input consumed. Job performance is commonly used to evaluate employees effectiveness and efficiency, however, the concept is poorly defined (Indartono, 2010). Efficiency is the ratio of actual output generated to the expected (or standard) output prescribed. Effectiveness is the degree to which the relevant goals or objectives are achieved (Sumanth, 1998. Efficiency improvement does not guarantee productivity improvement. Efficiency is a necessary, but not a sufficient condition for productivity (Sumanth, 1998). Effectiveness and efficiency are necessary in order to be productive. Both of them refer to whether a person performs his/her job well. Motivation issues with interesting approach are examined by Posner (Posner, 2010), by Highhouse (Highhouse, et al, 2007), by Tan (ta et al, 2008). Factors influencing accountability and performance ratings are important issue (Roch, et al, 2007). Work motivation and job satisfaction are on great importance as well (Kamdron, 2005). The findings of theoretical research results are used in current empirical research.

The motivation, especially monetary rather than moral, has proven its influence on the productivity of employees. Research has been conducted over the past 40 years on the relationship between motivation and productivity in different manufacturing industries, however little research has been devoted to this relationship in service industries or public sector where we cannot define objective and even measurable output of an individual or a team (Locke, 2004).

Based on the literature review authors have stated the aim find how important are material factors for employee motivation.

Method and measures in the study

Research methods used: scientific literature review, survey of employees. The study was conducted among 1050 internet users. The study population includes 67% females and 33% males, 54% respondents with higher education, 52% working at current profession more than 7 years, 73% of respondents have no more than 2 companies where they have worked in the last 7 years, 46% of surveyed work in company with more than 50 employees. A questionnaire was distributed to respondents by use of *GfK* web panel service.

The following measures were used to: 1) provide list of motivators; 2) provide list of statements on skills, engagement and resources available in company; 3) perceptual performance; 4) demographic profile of sample (age, gender, occupational type and detailed information on position "specialist", education, income, and industry).

Results of empirical research

Motivators – we adapted slightly shorter version (20 instead of 32; shortened after pilot test). The respondents were asked to use 7-point scale ranging from 1 – inapplicable to 7 – applicable in higher extent to indicate which motivational instruments are applied in current working place

Skills were evaluated in 7-point scale ranging 1 – strongly disagree to 7 – strongly agree to statements like "I feel fully confident on my skills to perform this job according to highest expectations"; 'this is the best job to do", "I help my co-workers with my expertise and knowledge", "I am fully confident on ability to solve problems in my daily work".

Resources were evaluated in 7-point scale ranging 1 – strongly disagree to 7 – strongly agree to statements like “In my job I am provided with technologies for job content”, “In my job I am provided with technical, and other support necessary for job content”, “All necessary management and quality systems are provided in my job”.

Engagement was evaluated in 7-point scale ranging 1 – strongly disagree to 7 – strongly agree to statements like “this company inspires to do the best I can”, “I am ready to go the extra mile to make my company successful”, “the future success of my company means a lot to me”, “I am ready to recommend my company where to work”.

As productivity is objective measurement it could be quite problematic to measure it subjectively and directly, then we used perceptual performance measurement approach. Among the most commonly accepted theories of job performance are theories from the work of John P. Campbell and colleagues (1990, 1993) who described job performance as an individual level variable. That is, performance is something a single person does. Conceptually task characteristics were closely related to high performance achievement. Autonomy is ability to carry out work freely. Feedback from the job is able to impart information about an individual’s performance (Humphrey et al, 2007). Individually a range of knowledge, skills, abilities, available resources and other characteristics are needed to perform a job. Knowledge of job and technical skills will appear to be essential to effectiveness of job. Whereas Self-efficacy theory employed the understanding the level of employee belief in order to achieve high performance with their actual skills (Gist, Mitchelin, 1992), author formulated question in the survey “I am fully confident on my skills and knowledge to perform this job according to highest standards”). Self-efficacy beliefs function as an important set of proximal determinants of human motivation, affect and action which operate on action through motivational, cognitive and affective intervening process (Indartono, 2010). Bandura (1986, 1997) argues that perhaps the most important determinant of individuals’ decision to engage in performance that exceeds previous level is self-efficacy. Self-efficacy is defined as an individual’s perceptions of their task-related capabilities. The analysed issues are at academic interest world-wide, as well as from different sides analysis are made, including different models of motivation (Seiler, *et al,* 2012), on workplace flexibility are made many researches including role of telework and flexible work schedules (Coenen and Kok, 2014). Different innovative approaches in telecommunication industry are analysed by German researchers (Schaarschmidt and Kilian, 2014). Already a quarter of a century has been devoted to leadership research and different aspects of the issue and researchers team from USA, UK and Korea has performed retrospective analysis (Dionne, *et a*l, 2014).

Taking into account aforementioned, efficient performance was proposed to measure on self-reported scale using 7 point scale asking questions like “adequately completes assigned duties”.

I always achieve my targets in time and in good quality

Job quality and volume that I perform daily usually fits with or even exceeds expectations towards me.

Authors performed factor analysis based on survey data on statements how respondents feel attitude to themselves. For factor analysis rotation was chosen *varimax* method. Calculations were performed by use of statistical software program SPSS. Rotation was performed in 6 iterations with Kaiser Normalization. The results of factor analysis are presented in Table 1.

Table 1

Rotated Component Matrix[a]

	Component			
	1	**2**	**3**	**4**
Competitive salary	.279	***.724***	.154	.156
Additional payments/premiums for team results	.241	***.839***	.025	.088
Additional payments/premiums for individual results	.222	***.817***	.061	.138
Additional social benefits: health insurance covered by employer, pension funds, etc.	.153	***.743***	.061	-.185
Company has good reputation	***.666***	.189	.210	.038
Social security (all taxes paid)	.349	.099	.138	***-.592***
Good and comfortable work conditions (including location, modern equipment, methodologies at work)	***.456***	.391	.327	.013
Understandable internal regulations, procedures and policy	***.672***	.169	.285	-.027
Flexible working time	.288	.295	.115	***.591***
Freedom, autonomy at work	.442	.218	.205	***.583***
Respectable work (possibility to perform significant job)	.264	.348	***.628***	.142
Potentiality to take responsibility	.355	.002	***.646***	.147
Career development	.210	***.666***	.298	.087
Potentiality to acquire new skills and knowledge (personal development scope)	.314	.371	.562	.164
Regular control of my work performance	.104	.094	.579	-.395
Enjoyable colleagues	***.710***	.080	.134	-.050
Interesting job	.284	.230	***.642***	.221
Good cooperation in collective	***.719***	.189	.203	-.043
High requirements	.223	-.052	***.685***	-.243
Chief's competence	***.698***	.252	.239	.043
Appreciation	.479	.459	.360	.178
Feedback on professional performance	***.512***	.442	.351	.144
Fair attitude	***.627***	.404	.202	.185
Clearly stated aims	***.562***	.238	.454	.060
Timely and fenceless communication	***.702***	.322	.246	.135
Chief's support and example	***.699***	.355	.220	.104

Extraction Method: Principal Component Analysis. Rotation Method: Varimax with Kaiser Normalization. a. Rotation converged in 6 iterations.

Source: Author's calculations based on employees survey results, August – September, 2010 (n=1098)
Scale 1 – 7, where 1 – do not agree; 7 – fully agree

On the results of factor analysis author have identified four complex factors on feelings of employees how do they feel in their working place (from 26 statements) and gave them the following complex factor names:

- Work professional aspects factor;
- Pay or emolument factor;
- Work creativity factor;
- Work organisation elasticity factor.

More detailed analysis is performed for work organisation elasticity complex factor. Main statistical indicators (arithmetic mean, mode, median, variance, standard deviation, range, standard error of mean) of organisation elasticity complex factors are reflected in Table 2.

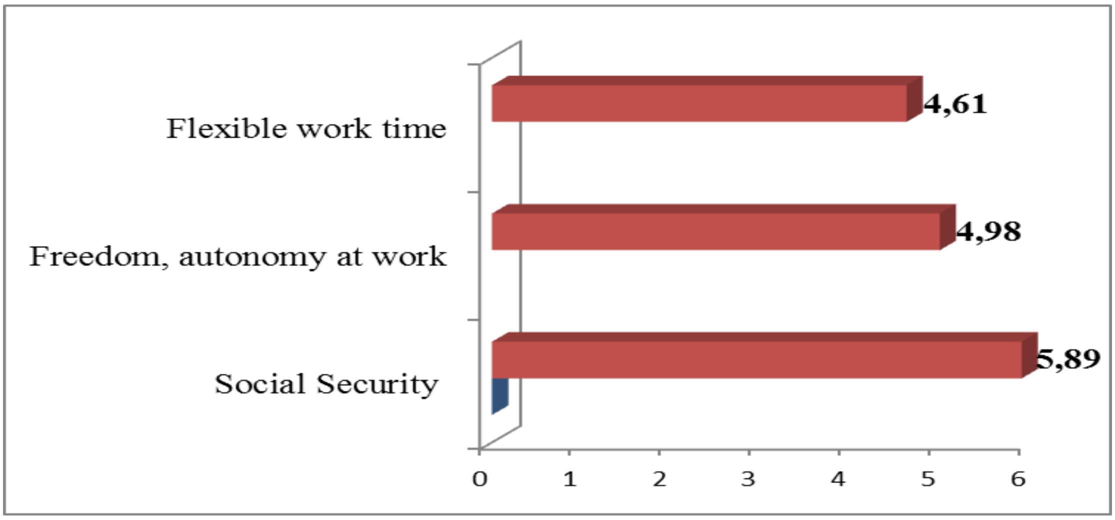
Table 2

Main statistical indicators of *work organisation elasticity* complex factor components

Statistical indicators	Social Security (all taxes paid)	Flexible work time	Freedom, autonomy at work
N Valid	1098	1098	1098
Missing	0	0	0
Mean	5.89	4.61	4.98
Standard Error of Mean	0.052	0.065	0.054
Median	7.00	5.00	5.00
Mode	7	7	7
Standard Deviation	1.727	2.158	1.799
Variance	2.981	4.658	3.236
Range	6	6	6
Minimum	1	1	1
Maximum	7	7	7

Source: Author's calculations based on employees survey results, August – September, 2010 (n=1098) Scale 1 – 7, where 1 – do not agree; 7 – fully agree

The results of survey responses calculations indicated how the respective issues are applied at work of employees: the responses are very different: all grades are given for every statement. Most of employees have indicated that they have possibility to take responsibility – giving the highest evaluation (mode is 7 – gave 31.7% of respondents for the respective factor), as well as highest evaluation is given for interesting job (mode is 7 – gave 29% of respondents for the interesting job factor. Other indicators of central tendency or location show that half of respondents possibility to take responsibility, interesting job, as well as high requirements with less than 6, half of respondents gave evaluations more than 6 (median = 6), for respectable job (possibility to perform significant job) median was 5. There is a big variability for all factor components: all indicators of variability are very big, especially for respectable job (possibility to perform significant job) what is indicated by variance, standard deviation and standard error of mean. Average evaluations the biggest are for possibility to take responsibility and smallest for respectable job (possibility to perform significant job). Average grades of responses by evaluation grades for factor components are included in Figure 1.



Source: Author's calculations based on employees survey results, August – September, 2010 (n=1098)
Scale 1 – 7, where 1 – do not agree; 7 – fully agree

Fig 1. **Average grades of responses by evaluation grades for work organisation elasticity complex factor components**

As the evaluations are so different, it is interesting to know the distribution of views of the respondents. Distributions of all responses by evaluation grades (1-7) for factor components are included in Table 3.

Table 3

Distribution of responses for work organisation elasticity complex factor components

Evaluation	Social Security (all taxes paid)		Flexible work time		Freedom, autonomy at work	
	n	Percent	n	Percent	n	Percent
1	57	5.2	169	15.4	76	6.9
2	32	2.9	81	7.4	61	5.6
3	38	3.5	88	8.0	80	7.3
4	70	6.4	123	11.2	156	14.2
5	90	8.2	138	12.6	208	18.9
6	176	16.0	209	19.0	253	23.0
7	635	57.8	290	26.4	264	24.0
Total	**1098**	**100.0**	**1098**	**100.0**	**1098**	**100.0**

Source: Author's calculations based on employees survey results, August – September, 2010 (n=1098)
Scale 1 – 7, where 1 – do not agree; 7 – fully agree

As the evaluations are so different, it is interesting to know the distribution of views of the respondents by sex as the research done in other countries have indicated differences by sex. Distributions of all responses by evaluation grades (1-7) for factor *Social Security (all taxes paid)* and by sex are included in Table 4.

Table 4

Distributions of all responses by evaluation grades (1-7) for factor *Social Security (all taxes paid)* and by sex

Evaluations	Sex		Total
	Female	Male	
1	28	29	**57**
2	12	20	**32**
3	16	22	**38**
4	31	39	**70**
5	52	38	**90**
6	106	70	**176**
7	440	195	**635**
Total	**685**	**413**	**1098**

Source: Author's calculations based on employees survey results, August – September, 2010 (n=1098)
Scale 1 – 7, where 1 – do not agree; 7 – fully agree

Data of Table 4 indicates that most of female and male respondents gave evaluation 6. Distributions of all responses by evaluation grades (1-7) for factor *Flexible work time* and by sex are included in Table 5.

Table 5

Distributions of all responses by evaluation grades (1-7) for factor *Flexible work time* and by sex

Evaluations	Sex		Total
	Female	Male	
1	124	45	**169**
2	56	25	**81**
3	62	26	**88**
4	78	45	**123**
5	82	56	**138**
6	125	84	**209**
7	158	132	**290**
Total	**685**	**413**	**1098**

Source: Author's calculations based on employees survey results, August – September, 2010 (n=1098)
Scale 1 – 7, where 1 – do not agree; 7 – fully agree

Data of Table 5 indicates that most of female and male respondents gave the highest evaluation 7, the next higher evaluation was for 6. Distributions of all responses by evaluation grades (1-7) for factor *Freedom, autonomy at work* and by sex are included in Table 6.

Table 6

Distributions of all responses by evaluation grades (1-7) for factor *Freedom, autonomy at work* and by sex

Evaluations	Sex		Total
	Female	Male	
1	47	29	**76**
2	43	18	**61**
3	51	29	**80**
4	101	55	**156**
5	135	73	**208**
6	158	95	**253**
7	150	114	**264**
Total	**685**	**413**	**1098**

Source: Author's calculations based on employees survey results, August – September, 2010 (n=1098)
Scale 1 – 7, where 1 – do not agree; 7 – fully agree

Data of Table 6 indicates that most of female respondents gave evaluation 6 and most of male respondents gave evaluation 7.

Distributions of all responses by evaluation grades (1-7) for factor *Social Security (all taxes paid)* and by age are included in Table 7.

Table 7

Distributions of all responses by evaluation grades (1-7) for factor *Social Security (all taxes paid)* and by age

Evaluation	Age						
	Till 18	18 – 25	26 – 40	41 – 50	51 – 62	More than 62	Total
1	0	5	22	16	14	0	**57**
2	0	4	17	9	1	1	**32**
3	1	3	16	11	6	1	**38**
4	0	9	29	21	11	0	**70**
5	0	16	30	24	17	3	**90**
6	0	15	59	61	41	0	**176**
7	0	51	211	208	156	9	**635**
Total	**1**	**103**	**384**	**350**	**246**	**14**	**1098**

Source: Author's calculations based on employees survey results, August – September, 2010 (n=1098)
Scale 1 – 7, where 1 – do not agree; 7 – fully agree

Data indicate that the evaluations are higher for all age groups for the highest evaluation score. It means that respondents from all age groups are interested to have social security and they are interested that all taxes are paid by employer. Distributions of all responses by evaluation grades (1-7) for factor possibility to take responsibility and by age are included in Table 8.

Table 8

Distributions of all responses by evaluation grades (1-7) for factor *Flexible work time* and by age

Evaluation	Age						
	Till 18	18 – 25	26 – 40	41 – 50	51 – 62	More than 62	Total
1	0	8	59	54	48	0	**169**
2	0	4	25	40	10	0	**81**
3	1	9	33	29	16	0	**88**
4	0	13	49	36	24	1	**123**
5	0	19	45	45	27	3	**138**
6	0	17	64	74	50	5	**209**
7	0	33	109	72	71	5	**290**
Total	**1**	**103**	**384**	**350**	**246**	**14**	**1098**

Source: Author's calculations based on employees survey results, August – September, 2010 (n=1098)
Scale 1 – 7, where 1 – do not agree; 7 – fully agree

Data indicate that the evaluations are higher for all age groups for the highest evaluation score. It means that respondents from all age groups are interested to have flexible work organisation. Distributions of all responses by evaluation grades (1-7) for factor *Freedom, autonomy at work* and by age are included in Table 9.

Table 9

Distributions of all responses by evaluation grades (1-7) for factor *Freedom, autonomy at work* and by age

Evaluation	Age						
	Till 18	18 – 25	26 – 40	41 – 50	51 – 62	More than 62	Total
1	0	6	32	26	11	1	**76**
2	0	1	28	23	9	0	**61**
3	1	8	27	26	16	2	**80**
4	0	23	45	49	38	1	**156**
5	0	22	72	67	45	2	**208**
6	0	19	89	78	64	3	**253**
7	0	24	91	81	63	5	**264**
Total	**1**	**103**	**384**	**350**	**246**	**14**	**1098**

Source: Author's calculations based on employees survey results, August – September, 2010 (n=1098)
Scale 1 – 7, where 1 – do not agree; 7 – fully agree

Data indicate that the evaluations are higher for all age groups for the highest evaluation score. It means that respondents from all age groups are interested to have freedom and autonomy at work. Distributions of correlation coefficients for all responses by evaluation grades (1-7) for factors are included in Table 10.

Table 10

Correlation coefficients for all responses by evaluation grades (1-7) for factors

		Social Security	Flexible work time	Freedom, autonomy at work	Age	Sex	How long do You work in the profession	How long do You work at the current employer?
Possibility to take responsibility	Pearson Correlation	1	.042	-.037	-.181**	.091**	.051	.087**
	Sig. (2-tailed)		.163	.219	.000	.003	.090	.004
	N	1098	1098	1098	1098	1098	1098	1098
Flexible work time	Pearson Correlation	.042	1	.571**	.050	.050	.031	.026
	Sig. (2-tailed)	.163		.000	.095	.099	.310	.380
	N	1098	1098	1098	1098	1098	1098	1098
Freedom, autonomy at work	Pearson Correlation	-.037	.571**	1	.137**	-.028	-.006	-.007
	Sig. (2-tailed)	.219	.000		.000	.362	.832	.818
	N	1098	1098	1098	1098	1098	1098	1098
Age	Pearson Correlation	-.181**	.050	.137**	1	-.121**	-.098**	-.128**
	Sig. (2-tailed)	.000	.095	.000		.000	.001	.000
	N	1098	1098	1098	1098	1098	1098	1098
Sex	Pearson Correlation	.091**	.050	-.028	-.121**	1	.455**	.367**
	Sig. (2-tailed)	.003	.099	.362	.000		.000	.000
	N	1098	1098	1098	1098	1098	1098	1098
How long do You work in the profession	Pearson Correlation	.051	.031	-.006	-.098**	.455**	1	.670**
	Sig. (2-tailed)	.090	.310	.832	.001	.000		.000
	N	1098	1098	1098	1098	1098	1098	1098
How long do You work at the current employer?	Pearson Correlation	.087**	.026	-.007	-.128**	.367**	.670**	1
	Sig. (2-tailed)	.004	.380	.818	.000	.000	.000	
	N	1098	1098	1098	1098	1098	1098	1098

* Correlation is significant at the 0.05 level (2-tailed)
** Correlation is significant at the 0.01 level (2-tailed)

Source: Author's calculations based on employees survey results, August – September, 2010 (n=1098) Scale 1 – 7, where 1 – do not agree; 7 – fully agree

Distribution of responses show that evaluations of respondents are very different, it means that employees feel differently related to work organisation elasticity factors, but there are rather many respondents for all statements that give the highest evaluations, especially for factor *Social Security (all taxes paid),* etc. To feel comfortable in work place it is important to have also high ranked material factors and creativity factors, but also work organisation elasticity factors. The evaluations of male and female results do not differ statistically significant.

Conclusions

Work organisation elasticity factors have big importance for motivation of employees.

The results of factor analysis author have identified four complex factors on feelings of employees how do they feel in their working place (from 26 statements) and have named them: work professional aspects factor; pay or emolument factor; work creativity factor; work organisation elasticity factor. Many of employees have evaluated with the highest grades, but most of employees feel that the work organisation elasticity factors related to them personally were on the lowest values, variability of responses was very big, but there is evidence that many of employees feel comfortable with the work organisation elasticity factors: Social security (all taxes paid), flexible work organisation, freedom at work.

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