International Journal for Quality Research 16(1) 147–162
ISSN 1800-6450

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Article info:
Received 15.08.2021.
Accepted 17.12.2021.

UDC – 005.336.3
DOI – 10.24874/IJQR16.01-10

APPLICATION OF INTEGRATED MODEL FOR MORE EFFICIENT PROJECT MANAGEMENT

Abstract: *Project management concept has become an indispensable approach, especially when it comes to investment projects characterized by great complexity, huge investments, long duration, a number of participants during execution as well as other parameters. All current principles of project management rely on principles, knowledge and experience in quality management and risks. On the other hand, modern business doing is characterised by strong competition, decreased market share of enterprise, uncertainties and other issues. Contemporary solution for the problems is in integration of business activities. CIPM (Computer Integrated Project Management) is contemporary concept for development of business system which offers direction for problem solution using a computer (part of marking Computer) for integration (par of marking Integration) project management (Project Management). Enterprise gets more efficient by applying CIPM.*

Keywords: *Project management; Quality; Risk; CIPM.*

1. Introduction

Projects have been managed since ancient times, particularly big and complex projects several thousands years old, such as Egyptian pyramids or Roman infrastructural objects (roads, aquaducts…). Participants in such hystorical projects and a ceartin number of people who performed function of management had a totally different relationships and commitments compared to present day model of project management. They often were not aware that they were participants in a process that nowadays we refer to as project management.

Today an important factor of business success in project management refers to application of international standards. Besides other factors of business strategy, it is quality that assures updated level of project management and a better positioning is achieved on global and national level.

Project risk is uncertain event or condition which, if it happens, has positive or adverse effect to at least one of project goals, such as time, costs, scope or quality (wherein purpose of project goal is time so as the project is executed according to aforehand agreed time schedule; wherein purpose of project goals is costs so as the project is executed within aforehand agreed costs etc.). Risk may be caused by one or more than one reasons, but if a risk does occur, it may have one or more than one effects (Popović, 2020).

1.1 Notion for project and its definition

The term project implies realization of a new undertaking in risky and uncertain conditions, competition for required resources, in limited time period, with fixed price and required

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quality. Project is a temporary endeavour undertaken to create a unique product, service or result (Project Management Institute, 2013). From historical point of view projects as certain approach in project management exist for centuries. The earliest forms of modern project management may be found during Industrial revolution.

Basic goal of planning from the beginning is to define priority goal by project draft and to manage its level to the maximum, while other goals should reach optimal level (Popović, 2020).

Project management represents scientifically based and in practice confirmed concept by which, with help of appropriate methods of organization, planning and control, a rational harmonization of all required resources and coordination of required activities are done in order to execute particular project most efficiently (Jovanović, 2002). Concept of project management is successfully applied in execution of investment projects where effects of this concept implementation are very clearly expressed and substantially great. It is very well known that implementation of modern investment projects are characterised by great complexity, huge costs, long duration, great number of participants and other parameters (Jovanović, 2001). Core processes in project management are: initiating, planning, executing, controlling and closing. These processes have occurred with various intensity in all project phases and they most often overlap.

Main characteristics of environment are constant changes which concurrently represent threat, but on the other hand, also possibilities which may bring competitive advantages to organizations. Basic efficacy of each organization is in following changes and executing adequate changes within its business. For organization's fast response and for its efficiency in such environment characterized by constant changes it is necessary to develop model of enterprise integration based on computer integrated project management.

A Project is time defined endeavor to produce a unique product, service or some other result. Each project must have a clearly defined beginning and end. Project ends when it becomes clear that goals of project are accomplished or upon conclusion that project goals could not or would not be reached. Project also may be terminated if client (buyer, sponsor) wants to suspend project. Apart from projects duration, being short or to last for years, as we have already mentioned in the introductory part, projects have their end. Project refers to work on something that has not existed before and that differs from results effected in similar projects. Though iterative factors may be present in various projects, it does not change their quality of singularity.

1.2 Project quality management

Project management by definition is determining the desired goals and defining the necessary actions for their successful achievement within the limits of maximum compliance of the use of all necessary resources (materials, workforce, financial happiness, timequality, etc.) (Popović, 2020). Although project quality management is closely integrated with other aspects of project management, there are several aspects that are unique in this effort.

According to (Gvozdenović & Adelsberger, 2014) unique elements of project quality management include:

- Focus on quality-based requirements. Ensure that all quality and compliance standards for which the project is responsible and by service users and other leading shareholders are identified.
- Focus on requests for additional values. Work to understand the demands, which often remain unspoken unless you investigate (inspect) them, which go behind basic functional requirements and will have the greatest impact on the

level of customer satisfaction in the final solution.

- Focus on product/service and process. Quality management equally relates to quality of products (goods and services) and the quality of the process, especially the project management process.
- Focus on verification. Set a game plan to ensure that all requests to the satisfaction of the relevant shareholders will be met.

The main goal of project management, in addition to minimizing time, costs and optimal spending of resources, is to realize the project in the requested quality. This means that at every stage of project management, project quality management must be paid appropriate attention in order that the service user receive the service he really requested. Project quality management is not imposing some special activities on the project that have nothing to do with it. Quality management is part of the project management process, which ensures that the realization of the project is carried out without deviating from the prescribed standards.

1.3 Project quality management principles

There are seven key quality management principles arising from a proactive management philosophy, in whose center is customer, and which are in line with other project management practices. Using these principles, the project manager keeps quality requirements in accordance with the project and key shareholders and gives the project the best chance to ensure the expected quality.

- Identify goals. This is a critical first step in this process. Verify that you have also determined the customer's expectations for quality as part of the process of collecting requests as well as expectations of quality compliance that other key shareholders require, whether thay are internal control departments or external compliance agencies. This is the most common reason why quality expectations are not met, because goals have never been fully determined.
- Plan the quality. Quality is planned, not checked whether it exists. As soon as you determine the quality requirements, then you must decide how to satisfy these requirements. When you have clearly identified quality goals, you can assemble a complete approach to the project, allocate resources and assign the necessary tasks to give yourself the best opportunity to meet quality expectations. In one form or another you need to document and e-mail your quality management plan on the project. This is often achieved using quality management planning documentation, which is part of your overall project plan.
- Find the appropriate formula. As with other project management processes, use the appropriate level of accuracy and acting according to the regulations to meet the needs of the project. In other words, align investments in terms of quality procedures with risk levels and other critical success factors. For example, whether the project has to produce a zero-defect product that has to undergo FDA validation review or whether the project is more usable in a natural "fast and dirty" initial phase.
- Set expetations. This principle focuses on two key aspects. First of all, make sure that the customer's quality expectations are in line with the needs of the project and with the approach to take in terms of quality management. And secondly, if the effort (time, cost) to meet quality requirements is in conflict either with the project plan or budgetary constraints, then you must enable compromise through risk analysis

scenarios that will result in prioritizing quality management efforts or result in adjusting the critical balance of success factors.

- Stay focused on the buyer. The philosophy of managing the quality of the overall project highlights the customer experience. This means to perform things such as defining requests from customer's perspective, asking the right questions to disclose other requirements that will affect customer's perception of the final solution, validity from the perspective of the service user, and also clear communication why "other" quality requirements must be met.
- "Believe, but check it out". This is a tangible principle of managing the entire project "don't assume anything, i.e. do not start from assumption". Whether it's a job intended for a project team member, supplier or another external party, always perform some level of verification to ensure that work pack that comes out of work meets the targeted end of work criteria.
- It's all up to yous! The project manager has the ultimate responsibility for the quality of the project. While many aspects of quality management are organizational by nature, and you need the support of senior managerment in order to be sustainable, you are still responsible for the criteria of quality success, such as for the entire project (Raković, 2007).

2. Processes in project management

The modern age is the essence of project management successfullness and it represents maintenance of balance in the "vicious" triangle – cost, quality and execution time. In order to successfully keep this balance, it is necessary that after the initiation of the project, it begins its life cycle through the design process upon previously precisely fefined procedure valid for all objects of the same type.

Within framework of complex conditions of doing business, project management is a complex and responsible task. There is a number of approaches in project management, all of them with objective that starting from an idea to final realization of project objective ensure its execution within set time schedule, budget and prospective objective.

Pproject management processes can be organized into five groups of one or more processes each: initiating processes, planning processes, executing processes, controlling processes and closing processes. These processes (process groups) are not discrete, instantaneous events but appear with variable intensity in all project phases and often overlap (Figure 1) (Project Management Institute, 2013).

Project and particular phase of project are defined by initiating group processes. At initiating the project a feasibility study is obligatory to be done in order to define whether the project is feasible at all.

The planning process, in order to achieve balance, is a very important phase in the life cycle of the project. The planning process itself is very complex and consists of several subphases, and during this time the project manager is closest to the key parameters about the project aiming to bringthe truth and project certainty closer. Project manager deals with the exchange of project information and negotiation during the planning phase and through the following phases in the project's life cycle. Planning can be defined as: detrmining all activities, their duration and necessary resources and determining dynamics of their realization in accordance with the scheduled completion

deadlines of the entire project or individual stages. Quality planning implies determining quality standards relevant to the project and determining how to meet them (Popović, 2020).

Objectives define planning processes and objectives are more precisely defined, and selection of the best alternative courses of activities is done in order to maintain objectives due to which the project is initiated.

Executing processes include coordination of people and other resources according to the project plan and creating product or service as a result of project or project phase.

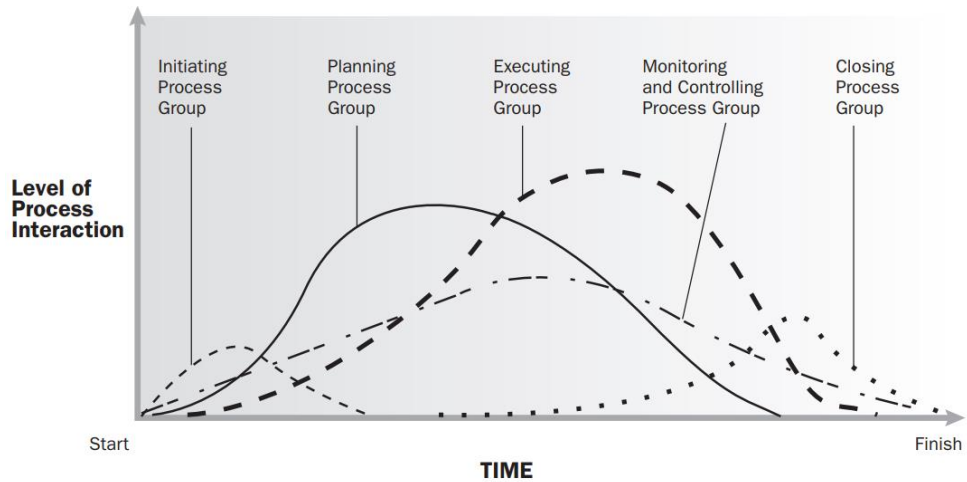

Figure 1. Process Groups Interact in a Phase or Project

Controlling process includes comparison of executed and planned performances and undertaking corrective measures to achieve desired outcomes in case they substantially deviate from projected ones.

Project closing process includes formal acceptance of the project or a phase of the project and leading the same to the desired closing. These processes interact with each other and also interact with processes in other areas of knowledge. Each process can involve the efforts of one or more individuals or groups of individuals based on the needs of the project. Each process generally occurs at least once at each stage of the project.

According to Project Management Institute (2013) there are ten separate Knowledge Areas in project management. A Knowledge Area represents a complete set of concepts, terms, and activities that make up a professional field, project management field, or area of specialization. Five process groups of management and three knowledge areas are presented in Table 1 (PMI, 2013).

All current principles of project management rely on principles, knowledge and experience in quality management and risks. Namely, quality management for project ensures prospects for project objectives to be fulfilled, and risk management ensures the prospects to reach their maximum in conditions of uncertainty of internal and external environment. Such an approach in project management contains within itself all elements of proactive management, ie. endeavors to decrease uncertainties of realization well in advance by having impact on internal and external environment. Naturally, besides these two areas of management there is a number of others, like e.g. time management, human resource management, suply management etc.

Table 1. Project Management Process Group and Knowledge Areas of Project Integration, Risk and Quality Management

Knowledge Areas	Project Management Process Groups				
	Initiating Process Group	**Planning Process Group**	**Executing Process Group**	**Monitoring and Controling Process Group**	**Closing Process Group**
4. Project Integration Management	4.1 Develop Project Charter	4.2 Develop Project Management Plan	4.3 Direct and Manage Project Work	4.4 Monitor and Control Project Work 4.5 Perform Integrated Change Control	4.6 Close Project of Phase
8. Project Quality Management		8.1 Plan Quality Management	8.2 Perform Quality Assurance	8.3 Control Quality	
11. Project Risk Management		11.1 Plan Risk Management 11.2 Identify Risks 11.3 Perform Qualitative Risk Analysis 11.4 Perform Quantitative Risk Analysis 11.5 Plan Risk Responses		11.6 Control Risk	

Quality management in a project does not involve imposing any particular activities in project, that are not related to the project. On the contrary, it is about activities usually done for project's objectives to be fullfilled, that are realized in such a way to satisfy user (Raković, 2007). Success of a project, ie. fullfillment of its objectives and gaining project's product of good quality depends on a number of factors, primarily on the quality of its management. To get project's product with required characteristics and quality as end result of project execution, it is essential for the whole process of its realization to be performed implementing current concepts and standards in a distinguished way. By implementing standards in investment projects all necessary conditions are obtained for project's good realization and implementation of principle for quality contained in ISO 9000 in all phases of project life cycle. By following the principles possible problems and deficiencies during project realization are enabled to be eliminated, employing positive experiences from prevoius similar projects, improving synchrinozation of work of all participants in construction that leads to fullfillment of desired objectives. Atmost fullfillment of requirements would be reached and a balance would be obtained among invested financial funds, resources and time. Likewise, highly specialized human resources would be enabled to participate, educated for good project management.

Risk management concept in current time of intensive changes gains increasing importance. Information becomes one of the dominant global resources. Risk management becomes integral part not only of business

structures by daily business activities but also indispensable factor of efficiency incorporated at the level of country development. Business entities aiming towards continuous business improvement based on projected approach implement risk management system in their core business processes. Therefore, possibility to recognize and assess the risk from environment, preventive responding and their supervision and channeling to desirable directions represents the essence of the risk management process as a key factor at quality increase in all areas of business (Gvozdenović & Adelsberger, 2014).

Project risk management includes processes dealing with risk management planning, identification, analysis, risk responses, monitoring and project risk control. Most of these processes are updated through the project.

The project's risk management goals are to increase probability and impact of positive events on the project and reduce the probability and impact of unfavourable events for the project (Popović, 2020).

Project risk management processes include the following:

- Plan risk management.
- Identify risks.
- Perform qualitative risk management.
- Perform quantitative risk management.
- Plan risk responses.
- Control Risk.

2.1 Risk management planning

Risk management planning is the process of deciding how to approach and manage risk management activities for a project.

Planning risk management process is important to ensure:

- That the level, type and visibility of risk management are proportionate to both risk and the importance the project has for the organization.
- Sufficient resources and time for risk management activities.
- Level of basis for risk assesment. The risk management planning process should be completed in the early stages of project planning, as it is crucial to successfully execute other risk management processes (Popović, 2020).

The scope of risk management planning determines to what extent risk management planning should be executed for a particular project. Defining the scope of this activity involves analyzing several key elements – some elements are general for the organization, while others are characteristic of each individual project.

The outputs of this analysis establish restrictions on the execution of risk management within the project and provide justification for the requested risk management infrastructure.

2.2 Risk identification

Risk identification determines what risk may affect the project and documents its characteristics. It represents the process of determining, classifying and ranking all of these risky events.

The most common information-techniques are:

- Brainstorming.
- Delphi technique.
- Interview.
- Identification of cause of risk.
- SWOT analysis.
- Ishikawa diagram.

2.3 Qualitatitive risk analysis methodology

Qualitative analysis defines the consequences, probability and degree of risk by levels of importance such as "large", "medium" and "small" and can combine consequences and

probability, and assesses the leve of risk based on qualitative criteria (Gvozdenović, 2009).
The main characteristic of the qualitative method of risk analysis is that it does not attempt to determine precise financial amounts for property value, expected losses and prices of security measures, plus sizes for probability, threats and vulnerabilities, as well as others if used, are not precise absolute amounts. Relative values are used instead. The relative measure of parameters is expressed descriptively to categorise their size by rank. Illustrative example of descriptions of parameter rankings are: negligible, low, medium, large, extreme, important vey important, etc.

The number of rankings on a scale for a parameter is not determined by a rule, but is a choice defined by an organization that uses qualitative method.

Risk analysis is usually conducted using questionnaires or workshops of people involved in different goups, such as security experts, managers of certain sectors in the organization, objects risk owners (property), users, etc.

It is common before first workshop to distribute questionnaires to interested parties. After the questionnaires are filled in, they are used as base for qualitative risk analysis. In workshops, participants identify objects (property) and evaluate its relative value. After that, they will try to determine the threats that may endanger the property, i.e., the goals of that property. The following steps are usually to determine what propery vulnerabilities these threats can take and choosing the security measures. The qualitative method assumes that the weight of a parameter used for risk calculation is given descriptively and ranked on a scale.

2.4 Quantitative risk analysis methodology

Quantitative risk analysis evaluates practical values for consequences and their probabilities, and produces values of risk levels in certain units, defined in development of context (Gvozdenović & Adelsberger, 2014). Quantitative analysis does not always have to be fully possible or desireable due to incomplete data about system or analyzed activities, lack of data, the influence of the human factor, etc. In addition, the necessary efforts to conduct quantitative analysis sometimes do not justify its implementation. In such circumstances, semi-quantitative or qualitative risk analysis by experts and specialists of this observed area, may be the optimal solution.

When it comes to the quantitative approach, it is about using the exact numeric values, i.e., resource values shown in money units. The vulnerability, threats and consequences in this case are seen as so-called “exposure factor (EF) expressed in the percentage of loss of resource value in case of the realization of certain threats. Probablity, which also depends on vulnerability and threats, is usually observed in a specified time interval, and is conducted accordingly, the quantification of fisk for that period of time can be shown with the expression:

$$R = Asset\ Value * Exposure\ Factor * Probability$$

The positive in this approach is that at the end of the analysis we get concrete values expressed in money, i.e., expected loss in case of event realization.

2.5 Planning and risk response

Planning risk responses is a process of developing opportunities and actions to improve prospects and reduce threats to project goals. The key advantage of this process is to deal with risks according to priority and if necessary, inclusion of resources and activities in calculation, schedule and project management. Any risk response requires an understanding of the risk mechanism it refers to. Planning a risk response involves identifying and assigning one person (risk response owner) to take responsibility for

conducting a risk response. The risk response should be appropriate according to the importance of risk, economical in relation to problem solving, realistic within the context of the project, compliant by the stakeholders and owned by the responsible person.

2.6 Risk control

Risk control is the process of conducting threat response plans, monitoring established risks, monitoring remaining risks, recognizing new risks and assessing the performance of risk management processes in the entire project. A key advantage of this process is to improve the performance of risk management approaches during the project's life cycle, with continuous optimizing risk responses.

3. Integrated approach in project management

As competiotion increases, importance of project management gains higher significancy. Current conditions in doing business characterize increasingly expressed competition, decreasing of company participation on market, loss of market, uncertainty etc. So, the conditions in doing business get increasingly complex. Contemporary solution for the problems lies in integration of business activities (informations and processes) respecting common business objective of the company (Arsovski et al., 2007). Current market conditions require constant review of business objectives and strategies and fast accommodation to newly arisen conditions. It means that aspect of flexibility has to be incorporated in all levels of management and all business processes. This is the way how business systems become increasingly complex and the need for coordination is increasing, ie. for integration of business activities.

According to Gvozdenović (2009), for integration of risk aspect and quality aspect in project management an original model of integration has been developed whose base is AHP approach (Figure 2). Criteria (aspects) of risk, quality and management of the project are integrated through business processes that are divided into five groups (initiating, planning, executing, control and closing). Each of the mentioned groups (macro processes) may be disintegrated from perspective each of the three mentioned criteria. In this paper these macro processes are integrated taking into account aspect of including all three criteria. Integration of subprocesses are realized by applying information communication technology. Alternatives presented in Figure 2 in this model resulted from using RiskyProject software (Gvozdenović, 2009).

Figure 2. Integration model using AHP approach

Integration of enterprise has a task to improve and fasten production and to improve quality, enable decision-making and create industrial environment, where production will be based on market requirements. Integration concept of enterprise is based on four key terms: computers, integration, production and people.

Many models for enterprise integration may be also used for development of such enterprises based on concept of computer integrated project management.

Computer Integrated Project Management (CIPM) is contemporary concept for development of business system which offers direction for problem solution using a computer (part of marking Computer) for integration (par of marking Integration) project management (Project Management). The term direction is emphasized, because CIPM does not offer ready-made solutions. The main task of modelling is to analyse flow of information, products and energy.

Computer integrated project management CIPM (Computer Integrated Project Management) is integral part of CIE (Computer Integrated Enterprise) concept. Notion CIE was primarily developed as CIM (Computer Integrated Manufacturing), which represents computer integrated production and has further evaluated so that today four notions are used, namely HOCIM, CIE, CAI and CIB. HOCIM (Human Oriented CIM) underlines importance of human resources in creating and usage of CIM system (Arsovski et al., 2007). Notion CIE enlarges scope of application of CIM system from the term Manufacturing that reffers to whole enterprise, to the whole group of producers (corporation) (Arsovski, 1998).

In order to develop CIPM/CIE project management system, a particular contribution was made by the following (Perović, 2003):

- Information system development.
- Personal computers and communication systems development.
- Automatic machine control system development.
- Computer aligned techniques development (CA technique).
- Methods and procedures in managing business systems.

Information technology has become base for development of technology for the last quarter of the twentieth century, together with trend of fast changes, developing at first as a computing technique, and now as global communication technology.

CIPM/CIE system represents integration of management technologies and management skills and software in project management. Mass usage of personal computers together with artificial intelligence created conditions for new approach in management. Artificial intelligence, as a field of informatics, is composed of the following fields: computer vision, automatic programming, experts' systems, phase logic, neural networks, robotics, intelligent computer supported instructions and understanding of speech.

Figure 3 presents model of integration in project management for particular investment project (project of construction of hydro technical supply tunnel) (Gvozdenović, 2009).

The following software packages were used for project of construction of hydro technical supply tunnel: Microsoft Project, RiskyProject and Matlab: Neural Network Toolbox. Microsoft Project is one of the leading software packages for project management and is intended, primarily, for planning, monitoring and controlling of realization of small and medium projects. This programme package enables comprehension of very complex projects through breaking of projects into particular phases and parts or through connecting part of a project or more projects for joint usage of resources and more efficient team work (Courter & Marquis, 2002). This package is used for planning time schedule of realization of the project of construction of hydro

technical supply tunnel by using methods PERT and CPM.

RiskyProject is a software for advanced project management with risk analysis. Risky Project analyses project's schedule with risks and uncertainties, calculates the prospects for project to be completed within set period and budget, and presents results to user in form that is easily readable and understandable (Intaver institute, 2009).

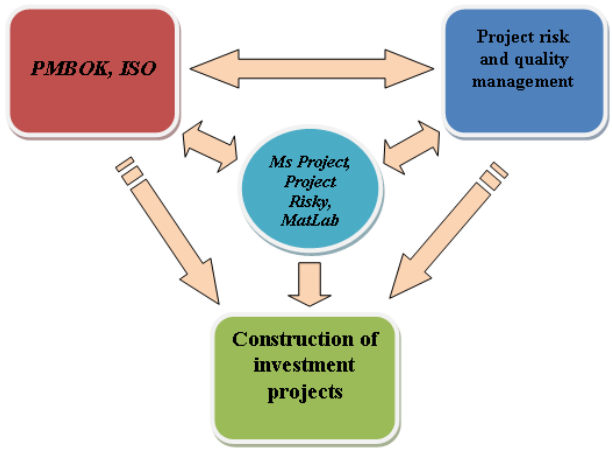

Figure 3. CIPM/CIE model of integration on example of investment project

Matlab is software package intended for solution of mathematical problems, data analyses and visualisation. One of the modules that contains Matlab is Neural Network Toolbox and integrates functions for designing and simulation of neural networks within it (Ćalasan & Petkovska, 1996).

Model of integration contains standards in project management. As main acters in standardization in project management professional associations appear with their members, as well as many other associations. Majority of professional associations created their corpus of knowledge, ie. Document required for defining profession and setting criteria in project management. Important role in project management today in the world has International Project Management association PMI with headquarters in USA and with branches in almost all world countries. PMI was founded in 1969. in New Castle in Pennsylvania (Cagle, 2005). It created the oldest and most frequently used standard in project management Project Management Body of Knowledge, that was amended over the years. Series of standards ISO appeared out of intention to remove the barriers in international trade (goods, services and informations), ie. A requirement appeared for the standards from field of management system to generalize and harmonize. Series ISO 10006 standard obtains instruction on quality management in project.

4. Problems in project management in current (classical) way

Problems in project management in current (classical) way in project management for project of construction of hydro technical supply tunnel may be best presented by Ishikawa chart (Figure 4). These problems refer to: equipment, standards, human factor, inadequate implementattion of appropriate methods and tools, time, geology, floods and financial resources.

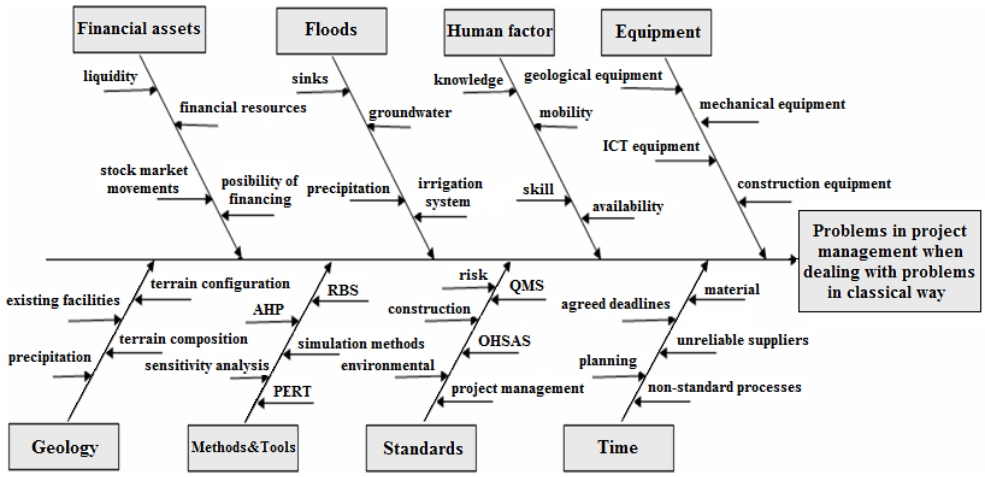

Figure 4. Ishikawa chart for problems of project management in classical way

Problems reffering to equipment, mainly reffer to implementation of IT technology due to the fact that appropriate softwares are not used, softwares that would enable effective project management from risk aspect. The rest of the equipment (construction, machine and geological) are of the same level of performances, as with proposed approach in project management.

In current approach in project management, mainly are analysed standards relating to construction area and partly to project management. The remaining part of standards that refer to QMS, OHSAS, risk management and project management from costs aspect are not used in classical approach, that provokes number of problems in related areas. This is why these aspects are included to a great extent in proposed model.

Problems related to human factor in current approach, basically refer to lack of knowledge and skills in IT field, inadequate people mobility, as well as their availability during particular period of engagement, which has impact on realization of projected deadlines, costs, risks, quality and total project effectiveness.

A part of the problem in classical approach refers to inadequate implementation of appropriate methods and tools. In classical approach, CPM method is mostly used.

Most often time is the greatest problem in project management in classical way because standard processes, verified suppliers, schedule plans are not used, deadline for completion is arbitrary. By applying proposed procedure the foregoing problems are eliminated or decreased:

- Applying QMS processes are standardized and suppliers verified.
- Built in material is in line with specifications.
- Planning is done in line with the software.
- Deadline for completion is result of optimization of project activities.

Geology factors and floods are characteristics of the system and they may not be essentially influenced by application of proposed concept. Financial means may be partially influenced by applying QMS.

5. Efficiency of proposed model

Efficiency of proposed approach is expressed by ratio between performances in relation to classical approach or in relation to projected values of performances. Efficiency is measured through realized effectiveness and scale of engaged resources. Having in mind that engagement of resources for proposed and current approach is the same, then ratio of

efficiency focuses down to ratio of effectiveness.

By applying model of integration, and results effected from analyses of sensitivity (Figure 5), where all risks reffering to project duration have been identified, costs and quality; component values, effectiveness evaluation and defining of ponders based on previously determined ranks of importance are calculated (Gvozdenović et al., 2012).

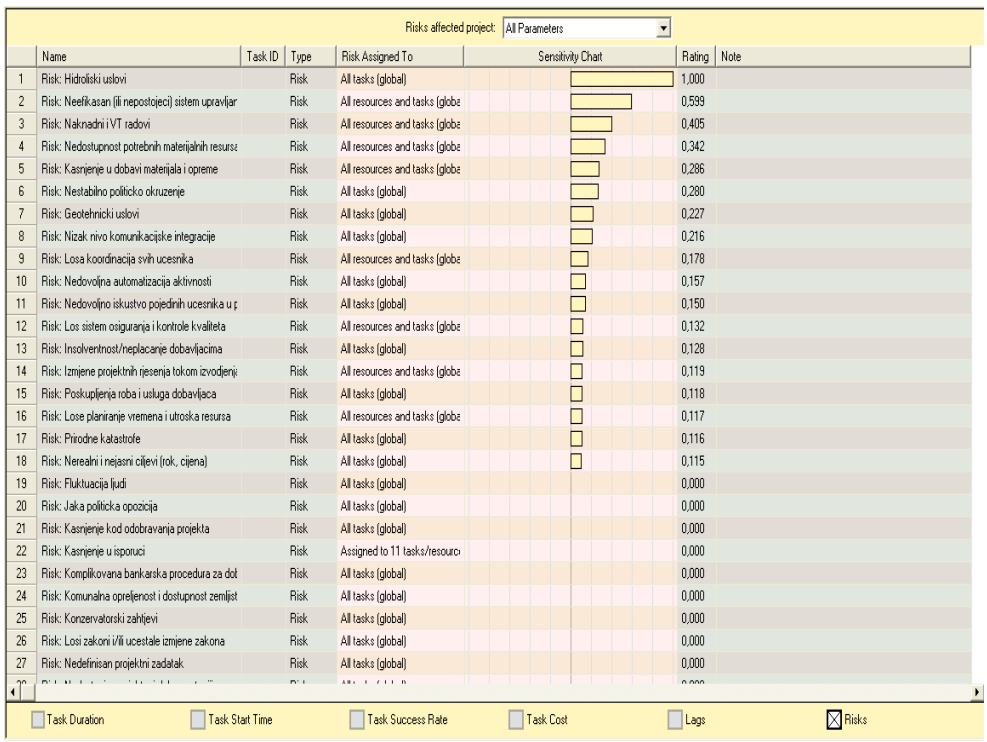

Figure 5. Results of analyses of sensitivity for all project parameters

Efficiency may be calculated in the following way, by applying new approach:

$$E_N = 0.4 \cdot O_{RN} + 0.3 \cdot O_{QN} + 0.3 \cdot O_{UPN}$$

$$O_{RN} = 0.4 \cdot O_{VR} + 0.3 \cdot O_{UR1} + 0.3 \cdot O_{UR2}$$

$$O_{VR} = 0.2 \cdot O_{VR1} + 0.2 \cdot O_{VR2} + 0.2 \cdot O_{VR3} + 0.2 \cdot O_{VR4} + 0.2 \cdot O_{VR5}$$

$$O_{UR1} = 0.2 \cdot O_{UR11} + 0.2 \cdot O_{UR12} + 0.3 \cdot O_{UR13} + 0.3 \cdot O_{UR14}$$

$$O_{UR2} = 0.4 \cdot O_{UR21} + 0.2 \cdot O_{UR22} + 0.4 \cdot O_{UR23}$$

O_{QN},O_{QP}, resulted based on project quality evaluation of completed research.

O_{UPN}, O_{UPP} resulted based on project flow (time) of completed research.

The following values resulted out of calculations:

$O_{VR} = 3.2$; $O_{UR1} = 3.3$; $O_{UR2} = 4$; $O_{RN} = 3.47$

$$O_{QN} = \frac{124.4}{52} = 2.39; \; O_{UPN} = \frac{134.4}{52} = 2.6$$

$$E_N = 0.4 \cdot 3.47 + 0.3 \cdot 2.39 + 0.3 \cdot 2.6 = 2.885$$

Efficiency is calculated in the same way by applying current approach.

$$E_P = 0.4 \cdot O_{RP} + 0.3 \cdot O_{QP} + 0.3 \cdot O_{UPP}$$

$O_{VR} = 2.2$; $O_{UR1} = 2.3$;

$O_{UR2} = 3$; $O_{RP} = 2.47$

$$O_{QP} = \frac{100.8}{52} = 1.94;\ O_{UPP} = \frac{121.7}{52} = 2.3$$

$$E_P = 0.4 \cdot 2.47 + 0.3 \cdot 1.94 + 0.3 \cdot 2.3 = 2.26$$

Structure of participation of performances in efficiency by application of new approach is the following: risk 41%, project management 31%, and quality with 28%.

Structure of participation of performances in efficiency by application of current approach is the following: risk 37%, project management 34%, and quality with 29%.

Efficiency relation by application of new and current approach of the values is 1.27, which means that efficiency is increased for 27% by application of new approach in relation to efficiency by application of current approach.

The results of the research imply that it is viable to increase efficiency in project management by application of CIPM/CIE model, ie, by integration of standards for quality infrastructure and informations technology.

6. Conclusion

Nowadays enterprises do business in a very complex and varying conditions that require constant accommodation to turbulent environment, in order to sustain and continue to do business successfully. Adaptation to changes, efficient functioning and development of enterprise is not possible without integrated management.

To integrate risk aspect and quality in project management original model for integration is developed whose core is AHP approach. Criteria (aspects) of risk, quality and project management are integrated through business processes that are divided into five groups (initializing, planning, executing, controling and closing). In this paper these macro processes are integrated from aspect of including all three criteria. Integration of subprocess is realized by applying information communication technologies.

CIPM is current concept of development of business system that offers direction of problem solution by using computer (part marked as Computer) for integration (part marked Integration) project management (Project Management). This integrated management approach for solution of various problems is basic characteristics of modern management.

By application of proposed concept in project management based on integration of risk, quality and project management, management efficiency increased from 2.26 to 2.885, namely increased for 27%.

References:

Arsovski, S., Arsovski, Z., & Kokić, M. (2007). *Management of production and information and communication technology*. Kragujevac: Quality Center, Faculty of Mechanical Engineering.

Arsovski, Z. (1998). *Decision support in the development of CIM system DSS/CIM*. Kragujevac: CIM Center, Faculty of Mechanical Engineering.

Cagle, R. (2005). *Your Successful Project Management Career*. New York: Amacom.

Courter, G., & Marquis, A. (2002) *Project 2000*, translation. Čačak: Computer library SYBEX.

Ćalasan, L., & Petkovska, M. (1996). *MATLAB and additional modules - Control System Toolbox and Simulink.* Belgrade: Micro Book.

Gvozdenović, T., & Adelsberger, Z. (2014). *Proaktive project management*. Vrnjačka Banja: SaTCIP.

Gvozdenović, T. (2009). *Research of Impact of Infrastructural Standards in Quality and Information Technologies on Project Management Efficiency* (Doctoral thesis, Kragujevac, Faculty of Mechanical Engineering).

Gvozdenović, T., Arsovski, S., Rajković, D., Milojević, Z., & Pravdić, P. (2012). Project risk management in process of construction of hydrotechnical supply tunnel. *Journal of Technics Technologies Education Management/TTEM*, *7*(2), 11-17, ISSN 1840-1503

Intaver Institute (2009). *Risky Project Professional 3.1 User's Guide*. Intaver Institute.

Jovanović, P. (2002). *Project management*. Belgrade: Grafoslog.

Jovanović, P. (2001). *Investment management*. Belgrade: Grafoslog.

Perović, M. (2003). *Management, Informatics, Quality*. Kragujevac: Faculty of Mechanical Engineering.

Popović, P. (2020). Strategy development for IMS and risk management under conditions of casual and limited sea resources. *Quality & excellence: magazine for quality and business excellence*, *9*(7/8), 55-59. ISSN 2217-852X.

Project Management Institute (2004). *A Guide to the Project Management Body of Knowledge – PMBOK Guide Third Edition*. An American National Standard ANSI/PMI 99-001-2004, Pennsylvania, USA.

Project Management Institute (2013). *A Guide to the Project Management Body of Knowledge – PMBOK Guide - Fifth Edition*. Retrieved from: https://dinus.ac.id/repository/docs/ajar/PMBOKGuide_5th_Ed.pdf

Raković, R. (2007). *Quality in project management*. Belgrade: Građevinska knjiga..

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