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Development of a project management performance enhancement model by analysing risks, changes, and constraints

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Subject review

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Development of a project management performance enhancement model by analysing risks, changes, and constraints

Results obtained by studying project performance and project management success rates are presented in the paper. The current context of construction project management practices applied in the Republic of Croatia, with principal challenges and factors influencing project management success in practical settings, is explained. A detailed comparative analysis of worldwide research focusing on project performance and project management success rates is given. A model aimed at enhancing project management performance levels by combining three organisational roles, i.e. strategic role, project-oriented role and operational role, is developed.

Key words:

project, project management, success, risks, changes, constraints, verification, forcing

Pregledni rad

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Razvoj modela za poboljšanje uspješnosti upravljanja projektom analizirajući rizike, promjene i ograničenja

U radu se prikazuju rezultati istraživanja uspjeha projekta i uspjeha upravljanja projektom. Objašnjen je aktualni kontekst upravljanja građevinskim projektima u RH, s glavnim izazovima i utjecajima na uspjeh upravljanja projektima u praksi. Dana je detaljna komparativna analiza svjetskih istraživanja uspjeha projekta i uspjeha upravljanja projektima. Kroz povezivanje tri organizacijske uloge, strateška - projektna - operativna, razvijen je model za potporu povećanja uspješnosti upravljanja projektom.

Ključne riječi:

projekt, upravljanje projektima, uspjeh, rizici, promjene, ograničenja, kontrola, forsiranje

Übersichtsarbeit

Mladen Radujković, Mariela Sjekavica

Entwicklung eines Modells zur Verbesserung des Erfolgs im Projektmanagement aufgrund der Analyse von Risiken, Veränderungen und Einschränkungen

In dieser Arbeit werden Resultate von Untersuchungen des Erfolgs von Projekten und des Projektmanagements dargestellt. Der aktuelle Kontext der Führung von Bauprojekten in Kroatien hinsichtlich der wichtigsten Herausforderungen und Einflüsse auf den Erfolg des Projektmanagements in der Praxis wird erläutert. Es wird eine detaillierte Vergleichsanalyse weltweiter Untersuchungen zum Erfolg von Projekten und des Projektmanagements gegeben. Durch die Verknüpfung von drei organisatorischen Rollen, der strategischen, der projektbezogenen und der operativen, wird ein Modell zur Unterstützung der Verbesserung des Erfolgs im Projektmanagement entwickelt.

Schlüsselwörter:

Projekt, Projektmanagement, Erfolg, Risiken, Veränderungen, Einschränkungen, Kontrolle, Zwang

1. Introduction

The sector of civil construction sector has always been oriented toward operation through projects, and so it is not surprising that the results of all participants are greatly dependent on project success. Everything that has until recently been considered successful is now being re-examined in the light of current uncompromising business objectives constantly calling for bigger, faster, and better. That is why development of project management is highly significant for successful realization of construction activities. In its vision 2020, the International Project Management Association (IPMA) places emphasis on "promoting project management competence throughout society to enable a world in which all projects succeed" [1]. This is a strong message to the profession and to each individual, the focus being on constant improvement of individual competences and contribution to project success, and hence to business results and, ultimately, to prosperous development of the community as a whole. Croatian civil engineering and general public have received another two strong messages related to this issue. In fact, the *Act on Physical Planning and Building Tasks and Activities Official Gazette 78/15* of 25 July 2015 regulates project management activity and specifies obligation of each public investor to appoint project manager for investments into construction of infrastructural and other facilities in the total value of more than HRK 10.000.000,00 (VAT exclusive), and for investment in the construction of buildings in the total value of more than HRK 50,000,000.00 (VAT exclusive) [2]. Conditions to be met by project managers are also specified in this Act [2]. The second important message comes from the European Union. In the new application form for capital projects (and these are construction projects), the part "Major Project: European Regional Development Fund / Cohesion Fund: Investment in Infrastructure / Investment in Production" defines in Section A4 the capacity of the body competent for project implementation, and this through technical, legal, financial and administrative capacities. At that, the evidence of capability for successful implementation of projects is required as well as the information on the number of persons that have indispensable professional competence. Within the current operational periods, potential users of non-refundable funds are required to form "project implementation units" as one of criteria for applying for and implementing projects eligible for EU co-financing, provided always that the proposed activities constitute a financially acceptable project expenditure.

While the role of project managers - as recognised internationally through standards, significance and practical importance - is a relatively recent news in our practice [3], project managers have been recognised on the international scale for quite a long time, as being one of unavoidable factors for project success [4]. That is why these regulatory incentives offer a great opportunity for improving project management performance in Croatian civil construction sector, which is known for its excellent technical capabilities in all specialties, although it still lags behind international practice and achievements in terms of organisation and management.

2. Project orientation in business and society

The present day world is the world of projects in which there is practically no single person or organisation or society that is not involved in one or several projects. People are continuously looking for changes that will harmonize, improve or develop their living and working conditions. Each change is in fact a project, and the project trigger is a need, problem or idea. That is why a project can be defined as a tool through which some opportunities are converted into benefits for an organisation or community. The benefit is the result of project success and successful project management.

Project management is defined as a collection of knowledge, skills and techniques that directs project activities toward realisation of project objectives [5]. It is a bridge between an idea/need/problem, regarded as a project instigator, and the project objectives, defined through fulfilment of a need, resolution of a problem, or realisation of an idea as a measure of project success. Successful management greatly contributes to the project success, and it is hence important for the practice and research [6-10]. In internet search, the word projects has about 2.5 billion hits, project success about 500 million, project management about 220 million, and project management success about 50 million (Internet, 2015).

A well known US-based Fortune Magazine predicted that the position of project manager will be a key occupation in the twenty-first century [11]. According to international research [12, 13], about twenty percent of gross domestic product is currently being spent on capital projects. It is reported in AEIS 2010 that about € 8,600 per inhabitant will be spent for large-scale projects in 2016 [13]. In 2008 the Anderson Economic Group predicted that about 33 million persons will be directly employed in project-related industries in 2016, about 33 % of which will be the persons newly employed since 2006. The growth of new employments in the project management segment is estimated at about 1.2 million annually. At the same time, it is expected that many employees that started their career in the field of project management in 1970s and early 1980s will be retired, and so a great generation shift will influence about 60 % of project-oriented companies [14]. Research conducted in Germany [15] on the sample of five hundred companies shows that the proportion of projects in company revenues amounted to about 27 % and that significant investments in projects are made up to the level of 38 % of revenues. According to working hours spent on projects in 2013, the total project work is estimated at about 35 % or about € 877 billion. Such analyses with an estimate of project industry proportion in business or GDP have not been made for Croatia.

3. Organisational roles and project management documents

The study of organisational roles and project management documents is conducted to analyse current practices and select the areas in which a contribution to better performance can be



Figure 2. Formation of project organisation structure [17]

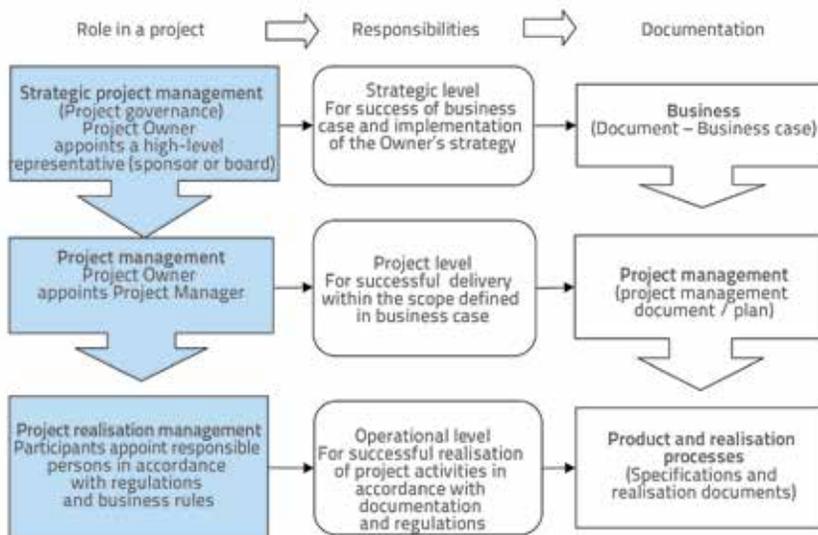


Figure 3. Three key project roles, responsibilities and documentation

project sponsor or project board, project level represented by the project manager and project management team, and operational level represented by implementation team managers. The operational level implies the role of a contractor / supplier who is authorised to realise the work in the scope of project deliverables. These contractors are engaged for a short term and are focused on their own interests and tasks assigned to them in the scope of their contract, and on the respect of regulations and standards used in their profession. They are fully aware that they will realize their objective through successful supply of deliverables. Each participant from this group appoints a responsible person (chief designer, construction manager, chief supervising engineer, etc.) who becomes a member of a broader project team and cooperates with the project management team. At the project level, the focus is on the overall project objectives and deliverables. Project management activity is aimed at organising participants and processes in accordance with project objectives and terms specified in the project owner's business case. These terms *inter alia* define management of project activities and supply of

project deliverables [16] as related to the purpose, expected benefit, scope, project owner's needs, alternatives, costs, time, quality, function, organisation, standards, etc., through which the project management success and its contribution to project success is measured. Strategic level (governance) is focused on the needs and strategy of the project owner who – taking into account three aspects: its own possibilities, opportunities to be seized, and desired benefits – asks for the change that will improve ongoing and operational standing of its organisation, and also the living conditions for the people residing in the community in which it operates. This level is totally oriented toward the success of the project. Main objectives are implementation of the business case, allocation and approval of resources, providing assistance and support to the project [16], and making key strategic decisions and solving problems and conflicts that can not be solved by project manager.

In each project, there are three types of documents, i.e. documents related to the business in the scope of which the project is implemented, documents related to project management, and documents related to the product or service created through the project and its implementation. The highest place in hierarchy is reserved to business documents providing management and implementation guidelines and framework, thus justifying the business venture undertaken in form of a project. The documentation related to the product that is the subject of project delivery deals with the qualitative, regulatory, technological, organisational and other aspects, conditions and properties of project delivery (structure). It involves the work of specialists from many areas who conduct research, give approvals, and conduct design work, construction work, supervision, testing, assembly work and all other activities that are needed for the realisation of a particular part of the project. They are focused on their participation objectives, and on the contract and tasks within the project, and are therefore not concentrated on the overall project venture. The management documentation is prepared in form of written concept or project management plan which are not much represented in our practice, and so it would be wrong to assume that the project manager and its team are working ad hoc and exclusively on the basis of their own interpretation and judgement, on the case to case basis, without using developed methods, tools, standards and competencies of the project management profession.

Table 1. Relationship between successful, challenged and failed projects – "CHAOS Report" [21]

Result/year	2004	2006	2008	2010	2012
Successful	29 %	35 %	32 %	37 %	39 %
Failed	18 %	19 %	24 %	21 %	18 %
Challenged	53 %	46 %	44 %	42 %	43 %

3.3. Success-oriented project management

The beginnings of the modern project management can be traced back to the late 1950s. Over the past fifty years the project management profession has been marked by dynamic development as evidenced by improvement of competence elements, standards, methodologies, special applications, good practice rules, and many tools and techniques, all of which has greatly contributed to an enhanced performance in this field. Today we can definitively state that the profession, international practice and standards of project management are fully in place. Nevertheless, one of continuing project-related problems is the knowledge about poor performance and substandard achievement of initial goals, especially as related to the respect of project costs and deadlines. Numerous sources (World Bank, Standish Group, PricewaterCuppers (PWC), Independent Project Analysts (IPA), KPMG, etc.) confirm that significant problems are still encountered in the implementation of projects, and PWC claims in this respect that 86 % of projects do not reach at least some of their objectives relating to the budget, scheduling, content, quality and benefits [18]. According to a study made by Standish Group the relationship between successful, challenged and failed projects has changed only slightly over the past decade [19], table 1.

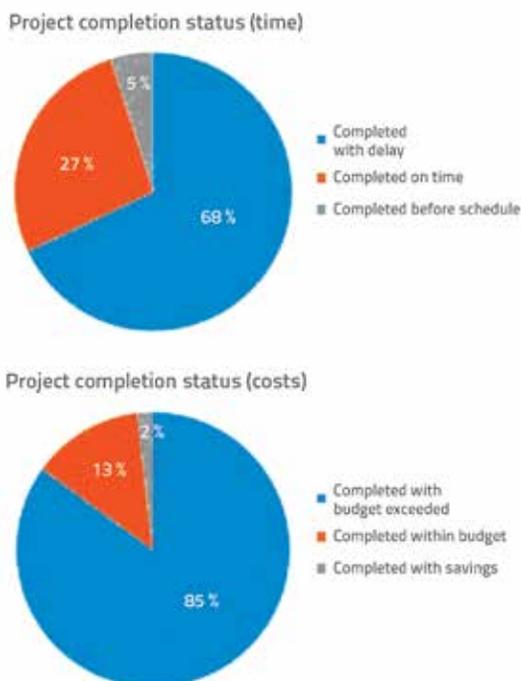


Figure 4. Results obtained by multi-year study of completion of construction projects in Croatia [17]

According to the KPMG report, about 70 % of organisations has had at least one unsuccessful project in the course of last year, while independent researchers from IPA state that large-scale projects or mega-projects have a full or partial failure rate of up to 65 % [21]. Construction projects are not an exception to this trend as they in fact greatly contribute to this negative statistics. A research conducted in Croatia reveal a considerable deviation from the initially planned cost and time objectives [17], Figure 4. Considerable and continuous problems in project deliverables and performance may initially seem confusing, especially when considered in the light of constant and evident development of the project management profession. The causes of constant project realisation problems can be analysed from two perspectives. The internal perspective reveals inadequate use of tools developed by the project management profession. The second perspective is related to project owners imposing increasingly challenging project objectives (e.g. extra short completion times), or to the lack of completed project vision followed by frequent changes during the project realisation stage. Success-oriented project management has to be firmly based on:

- Requirements specified in project owner's business case, i.e. on the contribution to the success of a project
- Regulations and standards related to the area in which the project is implemented
- Competences and good practice of the project management profession, meeting the success criteria
- Satisfied stakeholders who realize their goals and interests through the project, and especially satisfied project owner and local community in which the project is being realised
- Proper documenting of project management activities, with constant monitoring and control of project constraints, risks and changes.

Based on the approval given by project owner, the project manager and the project management team conduct project management activities. Their competences are crucial for successful management [9]. If projects were not regularly exposed by risks, changes and constraints, their tasks would be much simpler as the initial project schedule would constantly be realized, and the way toward success would be much less precarious. In this context, a significant component of a successful project management is a continuous management of project-related risks, changes and constraints [20]. At that, the project manager and the management team have to have a work plan or document according to which they conduct their activities (Figure 3). This is the "project management document" that is often referred to as the "project management concept paper"

or "project management plan". This document is prepared before the start of the project and is constantly updated to document what has been done on the project. It shows main activities of the project manager and its team, i.e. all project management activities. This document can be structured as follows:

- General information about the project
- Business case or feasibility study conclusions
- Brief description of the project objectives, problems to be solved, project owner's needs or ideas, connections to the project owner's strategy
- List of documents defining project scope and project deliverables, by components and total
- Hierarchical graphical presentation of components forming project deliverables (WBS)
- Project management team members, individual competencies, roles and responsibilities (OBS)
- Project organisation structure, roles and responsibilities, decision-making
- Project participants, analysis of interests, stakeholder management plan
- Time schedule with key resource requirements, phases, main milestones
- Cost plan and cash flow on the project, financing plan
- Procurement, supply and logistics plan for the project, engagement of suppliers and contractors
- Analysis of key project risks, risk management plan
- Initiation, approval, and administration of changes in the project
- Analysis of constraints hindering realization of the project
- Processes and methodology to be applied in project management, tools
- International project management standards and the parts used on the project
- Analysis and conclusion regarding best practice examples from similar projects
- Methods for monitoring and control of project realisation, metrics, progress reports, future trends, special analysis reports
- Communication on the project (internal and external), resolution of conflicts and disputes
- Use of information technologies and computer applications in project management

- Procedure for starting the project or a project phase, project closure procedure
- Project administering and documenting procedures and methods
- Other, as needed

4. Overview of literature on project success and project management success

The study of literature was conducted using key words "project success" and "project management success" by searching six best known data bases without using filters. The selected data bases include scientific research results: Web of Science, Google Scholar, Science Direct, Emerald, Current Contents and Scopus. After a detailed analysis of a huge number of results, the search engine singled out 39 relevant articles that directly describe these key words and that have already been cited, or the authors have been identified as significant researchers of the terms "project success" or "project management success". Publications from journals "International Journal of Project Management" and "Project Management Journal", relevant for the field of project management, were also thoroughly checked.

4.1. Linking project success and project management success

In scientific literature relating to the field of project management, two basic concepts are closely related to the term success: project success and project management success. Although these two concepts have certain similarities, they also present some differences [22-25]. An overview of research conducted so far reveals that there is a solid link between the project success and project management success [23, 26, 27]. It is however noted that the project management success is just one dimension of project success [28, 29]. According to [24], successful project management contributes to project success with 60 % and satisfaction of stakeholders with 56 %. On the other hand, yet another study claims that (despite the proven statistical link between the project success and project management success) there is about 55 % of unexplained variance in project success that depends on factors other than

Table 2. Difference between project management success and project success [18, 23, 30-34]

Project management success	Project success
Focus: Short-term and specific organisational goals	Focus: Long-term goals and project owner's organisational needs
Successful project delivery – ready for use	Successful business case – benefit for project owner
Internal focus on the way the project is managed	Focus on the project's effects on the organisation, i.e. on the community being the owner of the project
Evaluation through traditional performance criteria, e.g. time, cost and quality	Evaluation through all-comprising criteria and final outcome of the project – benefit during service life of the project
Efficiency is an internal and short-term dimension during preparation and implementation of the project	Efficiency and effectiveness, internal and external, long-term and short-term dimensions, during all phases and especially through the service life of the project
Three dimensions: time, costs, quality and short-term perspective	Fourth dimension: project benefits and long-term perspective

Table 3. Successful project-management elements that contribute to project success

Successful project-management element that influences project success
1. PROJECT MANAGER AND HIS/HER TEAM
Total competencies of Project Manager [3, 30, 35, 36, 37]
Project Managers' Emotional intelligence and professional conduct. "Soft" management elements [4, 9, 38]
Project Managers' management style [36]
Project team members [6, 39]
Application of knowledge and skills by project manager and team members and their coordination [9, 35, 38]
2. ORGANISATIONAL COMPONENT
Organisational structure [38]
Organisational maturity [40]
3. APPLICATION OF PROJECT MANAGEMENT METHODOLOGY AND STANDARDS
Project management tools and techniques [8, 18]
Planning and monitoring software, Request analysis, Lessons learned, Statement on the scope of project, CPM, CBA, Risk management, Contract management [41]
Project management standards [9, 42]

successful management [6]. It can therefore be concluded that the project management success is a significant contributor to project success, but that other factors also influence project success significantly. The difference between the two concepts can be seen in the literature overview (Table 2).

The most significant elements for successful project management, i.e. the elements that contribute to project success and hence act as a link between the two successes (project success and project management success), are analysed in this study. The result of the analysis is presented in Table 3 where elements are divided according to influence groups. Successful project management includes numerous activities that have to be realized to enable handover of the project delivery [24, 43]. On the other hand, project success is more focused on business results, benefits, sustainability, and user satisfaction [25]. It is therefore more difficult to deliver a successful project than to deliver a successful project management [31]. If the project is successful with an unsuccessful management, this is an indication that in the long run this unsuccessful management is not of decisive importance for this type of project [26], but also that even greater project benefits could have been realized if the project management were successful [44]. In case the management is successful and the project is unsuccessful, then the business case or business venture concept is inadequate or wrong [26].

Both types of success are analysed in more detail in the following two subsections and this through thorough examination and study of research results published over an extensive period of time.

4.2. Project success

Despite many years of research and numerous publications in scientific literature, a consensus on the definition of the term "project success" has still not been achieved [30, 45, 46]. It can be concluded from research published so far that project

success is a highly complex category [34, 43, 47-51] and that its perception has been changing over time. According to the study of relevant literature, four distinct periods can be differentiated: **The first period** of development of ideas on project success can be dated back to 1960s. At that time, the project was considered a success if it was completed on time, within the budget, and in accordance with quality specifications, i.e. it was the project delivered within the so called "iron" or "golden" management triangle. Successful project management was considered equal to project success. Over time, this approach was proven to be inadequate, as it could not provide explanation for many unsuccessful projects that satisfied the "iron triangle" criterion, nor could it explain the success of those that did not meet the mentioned criterion.

The second period (from 1980s to 1990s) is the time in which the experts started to make distinction between project success and project management success. The iron triangle is considered as a measure of success in project management, while project success is related to the success in the products/ services created by the project and in market value of success. The success criteria include satisfaction of interested parties, project owner and user in particular, and market success criteria such as return on investment, profitability, market share, and reputation are proposed. The complexity of the terms "project management success" and "project success" is visible through a variety of classification proposals presented in this respect: management success and product success criteria, micro and macro criteria, objective and subjective criteria, project success proper and market-related project success, etc.

The third period (from 1990s to 2000s) focuses on project success but includes some additional project attributes which take into account the project's influence on the organisation and its operation, and on the medium-term and long-term benefits that the project is expected to bring to the owner. Models developed in this period anticipate multidimensionality

Table 4. Development of project success models

Project Success Criteria (PSC)	Features
1. IRON TRIANGLE CONCEPT	
Time, money, quality [52]	- widely accepted and known - emphasis on implementation - project success = project management success
2. SUCCESS AS TWO- OR THREE-DIMENSIONAL CATEGORY	
Project management success: time, money, quality, management process, satisfaction of stakeholders Project product success: client's strategy, user satisfaction, profitability, market share [46]	- Emphasis on planning and implementation - Project success = project management success + project product success
Short-term criteria: time of delivery, money, quality, scope, safety Long-term criteria: time after implementation, satisfaction of stakeholders, usefulness, functioning [53]	Project success = short-term and long-term dimension with multicriteria analysis
Objective criteria: time, money, safety, environment Subjective criteria: quality, functionality, satisfaction of stakeholders [54]	Project success can be measured via objective and subjective criteria
Project success: quality, time, money, knowledge,.... Market success on private projects: profitability, return, market share, repute-related competitive edge, user satisfaction [55]	Success of private and public projects differs in the market success dimension
Project management success: time, money, quality Product success: user success, functional requirements, technical specifications Market success: return and profit, market share, repute, competitive edge [56]	
Project success + success of project management process + success consistency through several projects [22]	
Cost, time, quality + client satisfaction [45]	- Success of construction projects: Management success measured with iron triangle + overall project success measured with satisfaction of stakeholders
Time, cost, technical specifications + client satisfaction, satisfaction of stakeholders [57, 58]	
Cost, time, quality, technological properties + satisfaction of stakeholders, clients and users, productivity [49]	
3. SUCCESS AS A MULTIDIMENSIONAL CATEGORY	
Technical, economic, behavioristic, business, and strategic dimensions of success [47]	- Emphasis on the entire life cycle of the project - Project success = project management success + product success + benefits for the organisation + benefits for wider surroundings
Technical, financial, educational, social and professional dimensions of success [49]	
Satisfaction of users, end-users, suppliers, project team, and other stakeholders, iron triangle, user requests, fulfilment of purpose, specific project criteria [43]	
Iron triangle: time, cost, quality Product: maintenance, reliability, value, quality of use Benefits for the organisation: improved efficiency and effectiveness, higher profits, strategic objectives, learning Benefits for stakeholders: user benefit, profit for contractors and key suppliers, project team satisfaction, personal development, professional learning, influence on society and environment [51]	
Time, money, quality, health, safety, environment, user satisfaction [59]	Success of construction projects
Time, cost, quality, safety, satisfaction of participants in the project, user satisfaction, environmental protection, commercial value [60]	
4 dimensions: preparation for provision of services, provision of services, strategic contribution, public repute [61]	Success of PPP/PFI projects
Organisational perspective: productivity of resources, learning Project perspective: implementation time, user satisfaction Personal perspective: personal growth, personal satisfaction [62]	

Table 4. Development of project success models - continued

4. SUCCESS AS A CONTEXTUAL CATEGORY
Project success and project-success criteria may vary to a great extent and are dependent on the following variables:
• Phase of project life-cycle at the time of assessment [37, 47, 50, 63]
• Perspective of individual stakeholders [29, 31, 37, 46, 53, 54, 57, 63, 64]
• Type of project (features, complexity, etc.) [28, 31, 34, 43, 61]
• Public or private project [61, 65]
• Culturological perception of success [66]
Successful projects are convergent – not only in the sense of convergence of interests (political convergence), but also as to convergence in achieving consensus about final project objectives (cognitive convergence) [48].
Project success is a series of stories about the project that explain project events and serve to place emphasis, give credit or scorn participants and approaches, so as that an organisational knowledge about the project can be created. These stories are not final, and are dependent on project stakeholders and events [64].
Project success is an accepted idea the acceptance of which actually occurs when a sufficiently influential social group succeeds in imposing, convincing or persuading through negotiations other social groups that the project will be successful [67].
Success is the result of evaluation of relevant social groups that form their story about the project as a legitimate version of perception [68].

of project success: short-term and long-term success, strategic influence on the parent company, and social political, economic, environmental and educational dimensions. Holistic multi-dimensional models of project success are developed by examining the project in a wider setting (organisational, strategic, political, environmental, social, technical-technological, etc.).

The fourth period (from 2000s to the present time) is marked by the idea on the use of different criteria for public and private projects, and by a growing number of scientific opinions stating that the project success is a context- and time-dependent variable and, at that, various authors present different attributes influencing the project success estimation results (evaluator's opinion, i.e. opinion of an interested party, project phase, success evaluation time, culturological perception of success, project type, and project complexity). Some authors even go so far as to try to explain success of a public project as a matter of social or political perception or statement formulation, rather than as a factual category and, at that, they do not mention the project success criteria.

An overview of the most significant positions with regard to project success and success criteria, i.e. the elements according to which a particular project is classified as successful or unsuccessful, is given in Table 4. This table shows that some authors do not fit into the time frame defined in this section as they bring together or encompass several ideas, as can be seen in their models.

Several significant conclusions can be made based on the investigation of project success:

- The evaluation of project success has evolved considerably from the traditional success measurements based on timely completion, completion within budget and according to quality specifications; in fact, several other criteria have been added in the meantime so that today this evaluation is a complex and multicriterial category that has to be accurately defined for each particular project, for its owner and for the community in which the project is to be realised.

- Project evaluation is defined as a converging point or cross-section of empirical facts and perceptions of interested groups. The approach used for the evaluation of success is not the same for public and private projects. The evaluation of private projects is primarily based on empirical facts, financial indicators in particular, while in case of public projects the primary significance is given to benefits for the community, and to the community's perception about the project.
- The evaluation of project success can change over time, or depending on the evaluator, or under the influence of external changes, which is legal but, in any case, the evaluation must be based on professional analysis, and on the needs expressed by the project owner and the community in which the project deliverables will be used. Finally, a successful project is the project that has generated long-term benefits that can be expressed in terms of money, problem solutions, satisfaction of needs, and promotion or positive perception, which is defined in project objectives.

4.3. Project-management success

Many different approaches can be used in the study of success of project management activities [7]. Just like in considerations relating to project success, some authors consider that the project management success should be measured through the traditional "iron triangle" – time, cost and quality [27, 45]. Other authors add an additional parameter: fulfilment of requests of interested parties – stakeholders (model forming a parallelogram/rectangle) [58, 69, 70]. In addition to these four dimensions of successful management, the diamond model also includes organisational benefits, while pyramidal models also add the project-purpose realisation criteria, and elements relating to a wider project context. The success in project management can also be measured through integral quality-management models [69] and project management maturity models that usually define five levels of qualification in the

Table 5. Development of project-management success models

<i>Project Management Success Criteria (PMSC)</i>	
1. IRON TRIANGLE MODEL	Cost, time, quality / scope [27, 45, 52] Cost, time, quality / human resources [22]
2. PARALLELOGRAM MODEL	Cost, time, quality, satisfaction of stakeholders [23, 58, 69, 70]
3. DIAMOND MODEL	Cost, time, quality, satisfaction of stakeholders, organisational benefits [42, 51]
4. PYRAMID MODEL	Time and budget, scope, quality, benefits, purpose [10] Time, budget, quality, technical, financial, educational, social and professional elements [71]
5. TRIANGLE MODEL FOR MEGAPROJECTS	Balance of key project-context elements: vision, strategy, alliances, interests, management, support, approval, ... Balance of project objectives and community interests: business objectives, local community objectives, long-term environmental sustainability objectives are harmonised with each other Balanced project management style: efficient control of project implementation, versus continuous forcing of project implementation [72]
6. PROJECT MANAGEMENT EFFICIENCY ESTIMATION MODEL	Leadership, personnel, politics and strategy, partnership and resources, project life cycle management process, key indicators for realization of project management [69]

Table 6. Hierarchical levels and key themes for development of the project management model

Hierarchical level / Theme	1. Strategic	2. Project	3. Operational
Task	Management of company / organisation as a project portfolio	Project management	Organisation of execution (design, supervision, construction, review, manufacturing and supply, testing, etc.)
Objectives	Strategic objectives	Project objectives	Target objectives for project parts
Responsibility	For the company / organisation and for the project	For project management	For realization of particular project activities
Responsible role on the project	Project owner represented by the company management, i.e. by a representative of the management (project sponsor or board)	Project manager and project management team	Authorized persons appointed by contractors or suppliers (designer, supervising engineer, site manager, etc.)
Time frame	Long-term, in accordance with objectives of the company / organisation	Medium-term, within the planned project preparation and realisation deadlines	Short-term, according to completion times of activities specified in the contract
Key elements	Strategy, Opportunities / possibilities, Changes, Benefits	Management Objectives, Content, Participants, Processes (time, costs, quality, etc.)	Delivery (Technical documentation / profession-related standards, laws and regulations, Contract, etc.)
Success criteria	Successful project (planned benefits from the project regarded as business venture)	Successful project management (project delivery within specified time frame)	Successful realisation (contract and payment)

preparation and implementation of projects, from chaos to the totally optimised management processes [18, 35]. The study of available literature reveals that the project management successfulness is also a complex theme, and that the need and benefits reaped from project management activities are indisputable. At that, debates on projects management benefits still remain open, and views vary from one investigation to another [69]. An interesting definition is provided by Alderman and Ivory (2011) who define project management success as the achievement of convergence

about common understanding of the set of project objectives [48]. Several significant conclusions can be made based on investigation of project management success:

- Project success and project management success should be regarded as two distinct but connected categories, where the project management success greatly contributes but does not guarantee by itself the success of the project. The sooner the project management is included in the project, the greater will be its positive contribution to the success of the project.

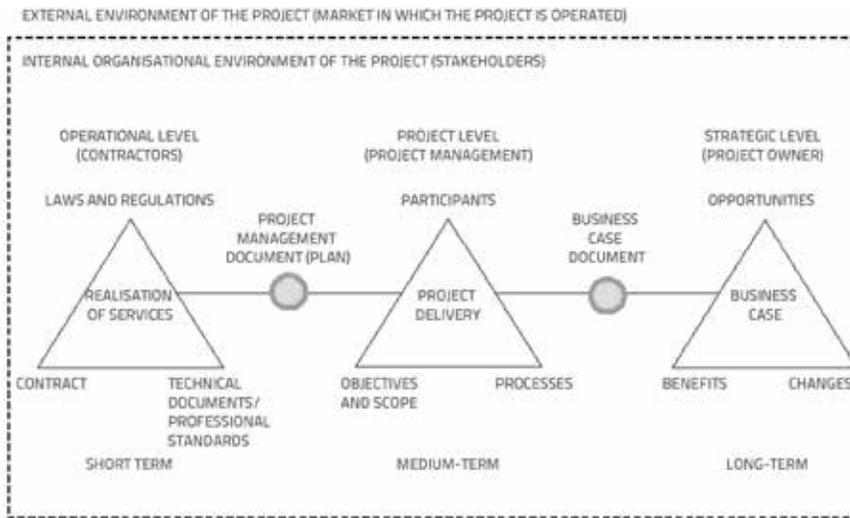


Figure 5. Framework for implementation of project management

- The project manager and his team are responsible for project management, and they have to fully orient the management success toward the project success as the latter is a higher level objective. The competencies of project manager and his team members – together with efficient organisation and documenting – are crucial for success of the management activity.

harmonized action of three organisational levels within the project structure (strategic, project and operational) in accordance with ISO21500 guidelines and hierarchical organisation of the project as explained in Section 3 and in literature overview research (Section 4). The project level is responsible for the success of project management.

- Each project management assessment alternative will include the criterion defined in the "iron triangle" – on time, within budget, at specified quality, to which some other criteria are also added, namely satisfaction of the project owner and stakeholders, and the way the project is realized in its local surroundings.

5. Development of the project management success enhancement model

The development of the project-management success enhancement model is based on the related and

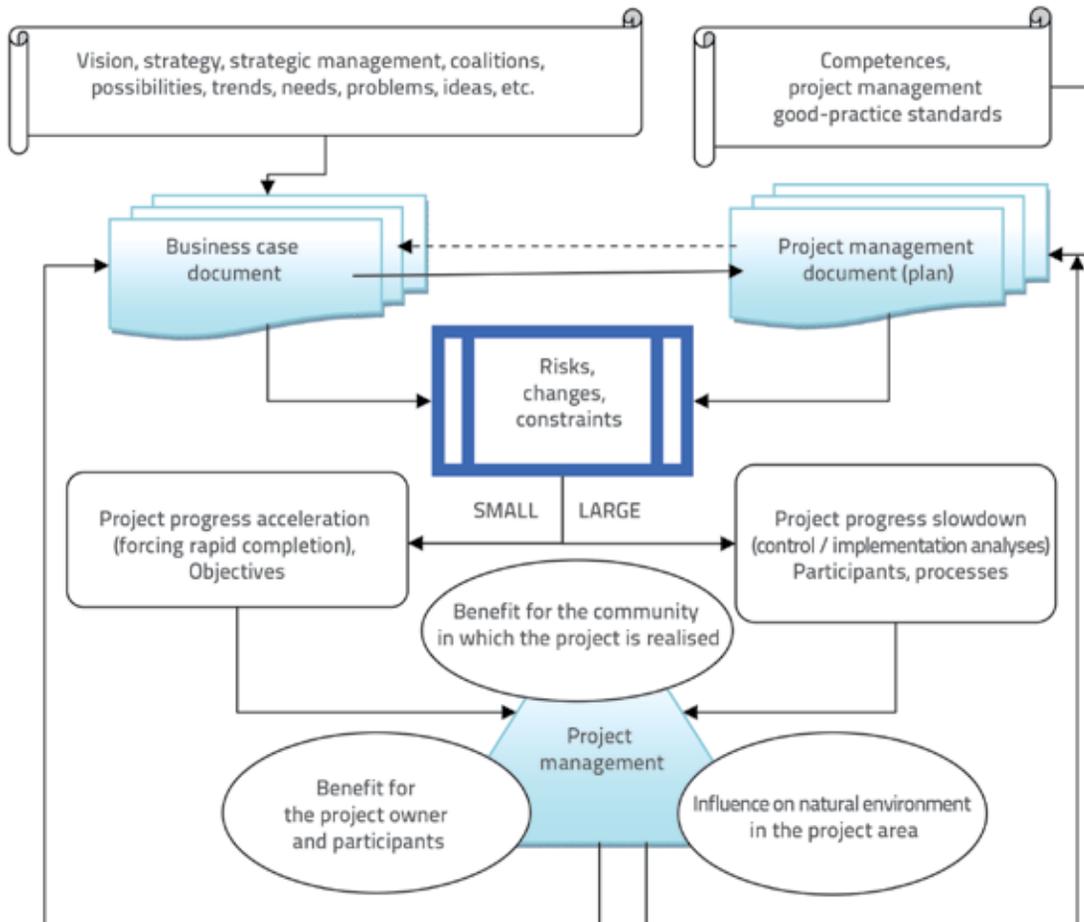


Figure 6. Project management success enhancement model

The described three hierarchical levels are linked together via two key project documents: business case document and project management document (Figure 5). The business case is the framework of the project venture that confirms the strategically justified investment, i.e. the use of resources via implementation of a particular project. The project management document (Section 3.3) links objectives, participants, processes and results via good practices, procedures and management methodologies that are used in the project. These two documents act as a solid link between the three described organisational hierarchical levels and as a means for passing higher level decisions onto the lower level, i.e. they act as guarantors of objectives of the hierarchically higher triangles. What links the three presented triangles (Figure 5) into a single framework is the element immanent to every system: project environment. Operational, project and strategic activities take place within a continuously macro-environment (external environment and micro-environment (internal or organisational environment) within which we have, as a temporary part, a project organisational structure.

The project management success enhancement model is based on successful implementation of the two above mentioned key documents, and is composed of enablers, analytical part, management part and corrective part (Figure 6). The group of individual elements in the project success composition (vision, strategy, coalition, trends, possibilities, etc.) [72] and the total level of project management competencies [1, 16] act as important preconditions and enablers of the project management success. Risks (R), changes (P) and constraints (O) play a key role in the analytical part of the model when the project manager plans and implements the business case document and the project management document. If there were no risks, changes, and constraints, the project management would be very simple, but such projects do not exist [20]. That is why the analysis of these elements directly influences the project manager's actions when choosing priorities or forcing, which accelerates the implementation, or analysis and control, which slows down the implementation, with all time / cost / quality consequences as significant criteria for success. Continuous assessment of the state of risk / changes / constraints in the project, as a commanding tool, is implemented in the context of continuous interaction of interests and influences in the project (business activity, community, environment), which act as corrector of measures that the project manager applies at a certain moment as they define contribution to the success of the project (Figure 6). To improve the project management success according to the presented model, the project manager must maintain the balance among objectives and scope in the mentioned management documents, current state of project risks / changes / constraints, and interests expressed by key stakeholders, i.e. between the influences coming from the wider or closer surroundings of the project. In this way, the project manager firmly connects his actions with the success criteria described in the study of the success-related literature (Section 4.2, 4.3) and controls the "iron triangle of project management

success"; which is always an integral part of evaluation of the project management success.

The analytical part of the project-management model is based on the key role of project risks (R), changes (P) and constraints (O), which together determine the basis for evaluation of each management decision through which the realisation is accelerated or slowed down, realisation costs are increased or reduced and, possibly, the defined quality of project delivery within the designed framework is either increased or reduced (Figure 6). In case of higher risks, changes and constraints, a number of analyses must be made before making a justified decision, which slows down the process (time), but ensures achievement of better results according to the costs and quality criteria. Insisting on rapid realisation shortens the deadlines but in situations characterized by high risks, frequent changes, and unsettled constraint issues, this practice results in questionable outcome with regard to the costs and quality criteria.

The proposed management success enhancement framework is based on understanding of the dynamic correlation between the three above mentioned elements (R, P, O) and on their proper monitoring and verification. In this respect, the approach selected by project manager in the scope of project management can be presented in the following way:

1. Each element (risks – R, changes – P, constraints– O) exhibits a variable intensity of influence during the time of the project, and this influence is represented with the coefficient k_i where "i" obtains the corresponding mark (r,p,o) defining the coefficient. Thus, k_r = risk coefficient, k_p = coefficient of changes, k_o = coefficient of constraints. The value of the coefficient k_i corresponds to the value of the intensity element "i". The intensity of an element may be situated within one of the following three intervals: low (N), intermediate (S) or high (V). In order to make this theoretical presentation more vivid, numerical values are associated with these intervals: low – 1, intermediate – 2, high – 3.
2. During the time of the project the intensity values change, and each of the three above mentioned elements (risks, constraints, and changes) can assume any of the three intensities (low, intermediate or high). As all three elements are always present on the project, there are 3^3 or 27 possible element combinations, as shown in Table 7.
3. Three possible management approaches are described in the preceding text: intensive analysis and implementation control, intensive high-speed realisation (project forcing), and combination of the control and forcing. The decision on which management approach project manager will choose at any given moment will depend on the combination of 3 elements and 3 intensities of each element (R, P, O) / (N, S, V), and so the management approach is a function of the sum of risks, changes, and limitation coefficients: $f(k_i) = \sum_{i=(r,p,o)} k_i = k_r + k_p + k_o$
4. Based on the quantitative analysis of all 27 cases shown in Table 7, and by the summing up of coefficients $\sum k_i$, it can be concluded that the approach involving forcing – accelerated performance (marked in green) is appropriate when $\sum k_i$

amounts to 3 or 4, the combination of analysis/control and forcing (marked in yellow) is appropriate for 5 or 6, while the analysis / control – slower performance according to project conditions requiring caution (marked in red) is appropriate for 7, 8 or 9 (Table 7, columns Σk_i).

5. The most vivid graphical representation of Table 7 is obtained when its rows R (risks), P (changes) and O (constraints) are defined as coordinate axes in the three-dimensional coordinate system RPO. This coordinate system defines the RP, RO and OP planes as clearly shown in Figure 7. Each coordinate axis contains intervals with low (N), intermediate (S) and high (V) values. When element intensities are known, and hence also the intervals in which each of them is situated, the lines can be drawn through boundary values of intervals in the direction perpendicular to the observed coordinate axis, and these lines intersect at appropriate points of the coordinate system RPO. Thus, 27 combinations from Table 7 can be presented as 27 cubes of appropriate colour in a three-dimensional coordinate system RPO. The colour of the cube suggests which management approach should be adopted.

For instance, let us assume that the above project-condition analysis has shown that the level of project risks, changes and constraints is of intermediate intensity (combination 14 from Table 7).

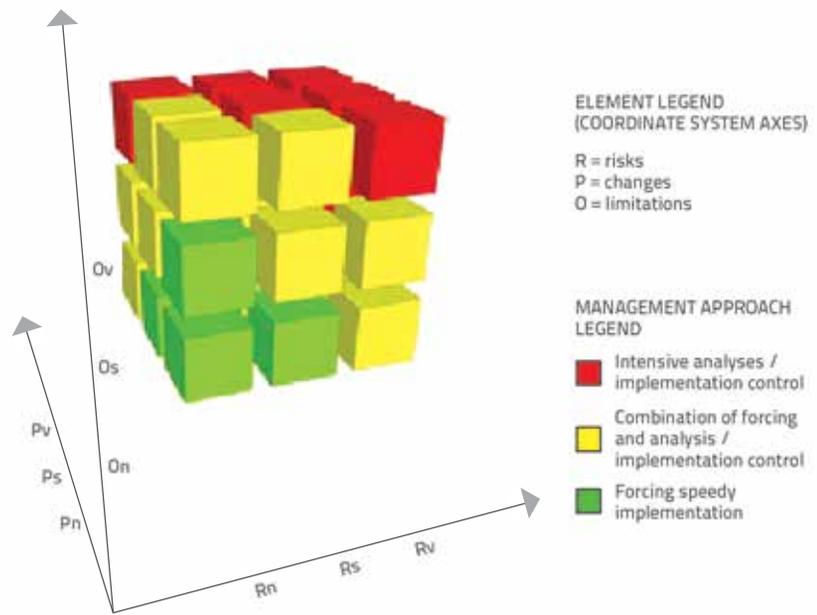


Figure 7. Diagram with 27 intensity combinations for project-related risks, changes and limitations in RPO coordinate system

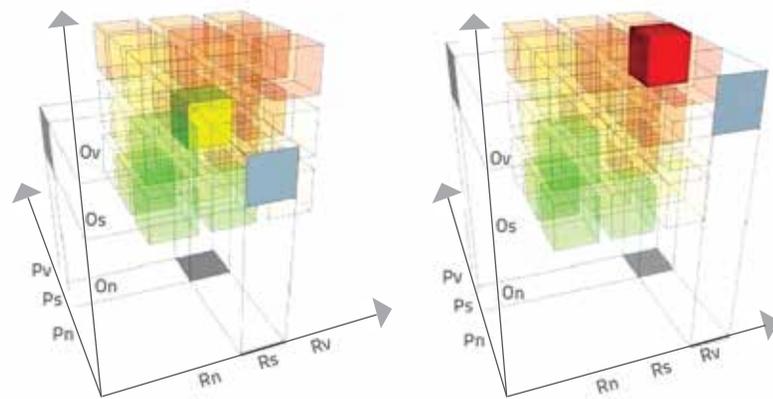


Figure 8. Risks, changes and constraints in 3D coordinate system – examples of project conditions for selection of appropriate management approach

Table 7. 27 intensity combinations for project-related risks, changes and constraints

No.	Intensity			Σk_i	No.	Intensity			Σk_i	No.	Intensity			Σk_i
	R	P	O			R	P	O			R	P	O	
1.	RN	PN	ON	3	10.	RS	PN	ON	4	19.	RV	PN	ON	5
2.	RN	PN	OS	4	11.	RS	PN	OS	5	20.	RV	PN	OS	6
3.	RN	PN	OV	5	12.	RS	PN	OV	6	21.	RV	PN	OV	7
4.	RN	PS	ON	4	13.	RS	PS	ON	5	22.	RV	PS	ON	6
5.	RN	PS	OS	5	14.	RS	PS	OS	6	23.	RV	PS	OS	7
6.	RN	PS	OV	6	15.	RS	PS	OV	7	24.	RV	PS	OV	8
7.	RN	PV	ON	5	16.	RS	PV	ON	6	25.	RV	PV	ON	7
8.	RN	PV	OS	6	17.	RS	PV	OS	7	26.	RV	PV	OS	8
9.	RN	PV	OV	7	18.	RS	PV	OV	8	27.	RV	PV	OV	9

According to $\Sigma k_i = 6$, and based on the principle described in point 4 above, a simultaneous forcing and controlling activity should be applied on this project. From the graphical presentation aspect, if we observe the plane RP and the values of the intermediate intensity interval at coordinate axes R and P, and if we draw lines perpendicular to individual axes through boundary values of these intervals, then we will obtain four intersecting points of these elements by which the surface in the plane RP is defined. Furthermore, if we now observe the coordinate axis O and the values of intermediate intensity intervals in this axis, and if we project the surface defined in the plane RP onto boundary values of the intermediate intensity intervals, then we have in fact defined eight points in the coordinate system RPO that define the cube. This cube is one of 27 possible combinations

shown in Table 7. In this particular case, it is characterized by intermediate values of risks, changes and constraints (and is marked with number 14 and yellow colour in the table) (Figure 8). As already indicated, yellow colour stands for a balanced management approach and involves simultaneous forcing (accelerated realisation) and the conduct of implementation analyses / controls.

The key emphasis in the cube model lies in graphical representation of dynamism in the project surroundings or environment. For instance, if in the given example the intensity of risks and constraints becomes high, while the intensity of change remains intermediate, then the combination RV-PS-OV (24th combination from Table 7) - shown with red cube in Figure 8 - is applied. The red cube suggests that a higher level of caution should be observed by project manager, and that high priority in management activities should be given to the analysis and control.

In other words, if risks are of "intermediate intensity" at some point t of the project cycle, this does not mean that this intensity will not be changed into "low" or "high" at some other future time $t+n$, because the project, viewed in its wider and narrow surroundings, is a living and dynamic system. Similarly, the same change is possible if the intensity of constraints and changes is evaluated. Selection of an adequate management approach is a dynamic function of intensity combinations for all three elements and so, in the scope of project management activities, project manager has to continuously check and harmonize management approaches through which he controls implementation of the project.

6. Conclusion

An increasing number of organisations are currently project oriented or use projects, and their success is dependent on the success of their projects. The study of relevant literature has revealed that each success is a complex category and that the project success and the project management success are related in that the project management success contributes to project success. The project success is defined as a cross-section of empirical facts and perceptions of interested groups and, at that, the approach is different in case of public and private projects and, depending on the evaluator or project environment influences, the evaluation can vary over time. Project manager and his team

are responsible for the success of project management, and they have to regard success of management activities as a function of the project success, which is a higher level objective. In order to enhance success of project management, and hence to improve overall project results, it is highly significant to continuously develop competencies and improve management methods. In the study of a framework for enhancing success of management activities, the focus is placed on project management documents and three hierarchical levels in the organisational structure of the project, and on their connection with the project management success, i.e. with the success of the project. In the proposed project management success enhancement model, the key role is attributed to management of project risks, changes and constraints, which define the style of management under variable conditions dictated by the interests of project participants, and by influences of project environment. If there were no risks, changes, and constraints, the project management would be very simple, but such projects do not exist. That is why these three elements directly influence the style of management giving higher priority either to forcing – acceleration of implementation, or to control – slowing down of implementation, which directly influences the project management success based on the criteria defined through the overview of research focusing on this issue. The project management success can be improved, and hence project results can get better, through development of management frameworks and management models that link key organisational components of management activities. An example of this activity is presented in this study. Its trial application on several projects has contributed to the fulfilment of objectives, particularly with regard to the respect of initially set deadlines and costs, more efficient use of resources, more appropriate management style, communication between the participants, and satisfaction of stakeholders, project owner in particular.

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