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Comparison of research and industry views on project managers' competencies

Abstract

Purpose-The success of projects clearly relies on project management personnel and particularly on project managers. Their performance and capacities are based on the achieved competencies. This study aims at addressing possible discrepancies between the views arising from the research results and standards of practice related to project managers' competencies.

Design/methodology/approach-For reaching the aim of the study, a comprehensive literature review, covering previous studies and related standards of practice was conducted, and analyses of competencies in the studies and standards of practice containing the rank of competencies based on frequency of appearance were developed.

Findings- The findings are proposing four discrepancies between the results of previous studies and standards of practice: i) Commonly existing/missing competencies ii) Uneven priority of some competencies in the view of researchers versus standards of practice, iii) Uneven degree of consensus on the importance of competencies, and iv) Research results are more context-oriented than the standards of practice. In addition, 98 project managers' competencies were identified, from which 68 were qualified as weighty ones. Moreover, a categorization of project managers' weighty competencies was developed. Finally, a list of competencies of relevance for different project types and their targets is presented.

Originality/value-The findings of this study provide a contribution with respect of present knowledge over project managers' competencies by recognizing certain discrepancies between research results and standards of practice. Another contribution of the study is the comprehensive list of competencies together with considerations of their relevance in different project contexts and in different project types.

Key words: Project manager, Competency, Project management standards

Article type: Research paper

Introduction

Project management personnel and particularly project managers play the most important role in project success of all human resources, and the competencies of project managers are their main tool in meeting the expectations and realizing project goals (Beer et al., 1990; Brown and Eisenhardt, 1995; Crawford, 2000; Crawford, 2005; Geoghegan and Dulewicz, 2008; Karpin, 1995; Katz and Allen, 1985; Pinto et al., 1995; Smith et al., 1984). A study conducted by Toney (2001) showed that the project managers have direct influence over 35-47 per cent of project success (Toney, 2001). Additionally, an industry research by Gartner proved that insufficient project managers' competency accounts for 60% of project failures (Maclinnis, 2003). Müller and Turner (2007) also proved the positive correlation between the project manager's leadership competencies and project success (Müller and Turner 2007). The importance of project managers' competencies in their effectiveness and subsequently in project success has led to a vast amount of studies which have produced new research-based understanding and also some standards of practice in this subject. Whereas the logic of research work and the preparation of standards of practices are somewhat different, it seemed possible that there may be some discrepancies between the gained research results and the content of the standards of practice. Some of these studies and standards of practice have addressed project managers' competencies in general and some other studies have focused on a specific context or project type to find competencies of relevance for project managers. Conceptually, discrepancy means one or more differences between two things that should be the same. Therefore, the probable discrepancies in the scope of this study are expected to be found in the degree of consensus on identified and important competencies. Notwithstanding studies which have been undertaken till now, there still are some gaps in this regard of which the first one is related to the mentioned discrepancies and the second one is about considering appropriate contexts of identified competencies in the literature which have been largely ignored by research community. By building on foundational research work and standards of practices on project managers' competencies, the present study aims at fulfilling the mentioned gaps by answering the following questions:

- Are there discrepancies between research results and standards of practice addressing competencies of project managers?
- What are the appropriate contexts of identified competencies in the literature?

This paper is structured in four sections. First, the summary of literature review on project managers' competencies is presented, including provided definitions and categorizations by different standards of practice, also addressing previous studies in this area. Second, research methodology is explained. Third, analysis of literature review in result section follows. Finally, a discussion is provided over the obtained results and implications of the study.

Research background

The competence of the project managers is in itself a factor in successful delivery of projects and on the other hand, the project managers need to have competency in those areas that have the most impact on successful outcomes (Crawford, 2000). Abraham et al. (2001) also defines competency as a range of different characteristics, behaviors, and traits that are required for effective job performance (Abraham et al., 2001). According to another definition, ICB.4 (2017) stated that individual competence is the application of knowledge, skills and abilities in order to achieve the desired results (ICB4, 2017). PMCD.3 (Project Manager's Competency Development framework) also mentioned that competent project managers consistently apply their project management knowledge and personal behaviors to increase the likelihood of delivering projects that meet the stakeholders' requirements

(PMCD.3, 2017). In this paper, the adopted definition is that competency means the capability to use skills, knowledge and personal characteristics that enhance the efficiency and effectiveness of project managers in their job performance and subsequently increase the likelihood of project success.

Standards of practice in the area of project managers' competencies

ICB, APM Body of Knowledge, PMBOK and Project Manager Competency Development framework (PMCD) are those standards of practice which have paid attention towards project managers' competencies. Hence, these standards of practice and frameworks present different competencies of project managers and of course categorizations of those, and address the project managers' competencies in a more general perspective. ICB.4 introduces 28 competencies of project managers in three groups of people, practice and perspective (ICB.4, 2017). In other categorization by project management competency development framework (PMCD), 16 mentioned competencies of project managers are divided into two group, performance and personal competencies. The APM standard is another reference that considers 11 competencies in two groups, interpersonal and professional. PMBOK Guide also introduced a framework titled PMI Talent Triangle which considers three types of project managers' skills. Details of the mentioned categorizations are presented in Table 1.

Table1. Categorization of project managers' competencies by different standards of practice

Project managers' competencies		
Standard/framework	Cluster/group	Competency
ICB.4	People	(1)Self-reflection and self-management (2)Personal integrity and reliability (3)Personal communication (4)Relationships and engagement (5)Leadership (6)Teamwork (7)Conflict and crisis (8)Resourcefulness (9) Negotiation (10)Result orientation
	Practice	(1)Project design (2)Requirements and objectives (3)Scope (4)Time (5)Organization and information (6)Quality (7)Finance (8)Resource (9)Procurement (10)Plan and control (11)Risk and opportunity (12)Stakeholders (13)Change and transformation
	Perspective	(1)Strategy (2)Governance, structure and processes (3)Compliance, standard and regulation (4)Power and interest (5)Culture and values
PMCD.3	Performance	(1)Project integration management (2)Project scope management (3)Project time management (4)Project cost management (5)Project quality management (6)Project human resource management (7)Project communication management (8)Project risk management (9)Project procurement management (10)Project stakeholder management
	Personal	(1)Communicating (2)Leading (3)Managing (4)Cognitive ability (5)Effectiveness (6)Professionalism
APM	Interpersonal	(1)Communication (2)Conflict management (3)Delegation (4)Influencing (5)Leadership (6)Negotiation (7)Teamwork
	professionalism	(1)Communities of practice (2)Competence (3)Ethics framework (4)Leading and development
PMI Talent Triangle(PMBOK)	(1)Technical project management skills (2)Leadership (3)Strategic and business management skills	

Besides the given information by standards of practice about project managers' competencies, a substantial amount of research has been conducted by different researchers from 1959 to 2018 which is addressed in the following.

Evolution of research on project managers' competencies

Studies on the subject of project managers' competencies can be traced back to a paper by Gaddis (Gaddis, 1959) and another Harvard business review article by Lawrence and Lorsch, in 1967, titled

'The Integrator'. Since then, several studies have been conducted on the subject of project managers' competency. A study conducted by Powers (1987) identified a group of managerial competencies which were characteristics of superior performance. These competencies were grouped into 18 competencies through cluster analysis and into four larger clusters including goal and action management, directing subordinates, human resource management and leadership (Powers, 1987).

Edum-Fotwe and Crawford conducted studies to explore more details of project managers' competencies in construction projects and correlation of project managers' competency with project success (Crawford, 2000; Edum-Fotwe and McCaffer, 2000). Then, Shenhar conducted a study 'one size does not fit all projects: exploring classical contingency domains' in 2001; he stated that a specific project type should affect the selection of project managers, project team members and skill development needs. In other words, Shenhar's finding on the importance of contingent thinking was the starting point of considering appropriateness of project managers' competencies and project type. Moreover, several studies were conducted by Abraham et al. (2001), El-Sabaa (2001), Ruuska and Vartiainen (2003) and Kasvi et al. (2003), addressing critical and important competencies of project managers as well as efficiency and effectiveness of project managers in their role, and competencies such as leadership, communication, goal-orientation, problem solving, decision-making, teamwork and cooperation and conceptual thinking identified in result of those studies (Abraham et al., 2001; El-Sabaa, 2001; Kasvi et al., 2003; Ruuska and Vartiainen, 2003).

Addressing the success and effectiveness of project managers in terms of their competencies followed by other researchers such as Dainty et al. (2004), Cheng et al. (2005), Gillard and Price (2005), Brill et al. (2006) and Suikki et al. (2006), and new competencies such as analytical thinking, flexibility, adaptability, and ethics were also identified in addition to those already mentioned.

Some researchers such as Serpell and Ferrada (2007), Ahadzie et al. (2008) and Isik et al. (2009) focused on the required competencies of project managers in the engineering projects particularly construction ones, and they also addressed the role of complexity in identifying important competencies of project managers (Serpell and Ferrada, 2007; Müller and Turner, 2007; Mutijwaa and Rwelamila, 2007; Patanakul and Milosevic, 2008; Chen et al., 2008; Ahadzie et al., 2008; Bosch-Rekveldt et al., 2009; Isik et al., 2009; Müller and Turner, 2010). The appropriateness of project managers' competencies with the project type was taken into account by Muller and Turner (2007, 2010), showing a positive correlation of project managers' competencies with project type, and they also identified important leadership competencies in the types of areas of engineering and construction, IT and organization and business, and showed that almost always emotional competencies contribute to project success. These studies confirmed Shenhar's (2001) finding on the necessity of matching the project type and project managers' competencies.

Crawford (2010) conducted a study to explore important competencies of project managers for managing change, and identified eight competencies including leadership, stakeholder management, planning, choosing/developing the team, communication, decision-making and problem-solving, cultural skills and project management skills. The findings of another study conducted by Stevenson and Starkweather (2010) revealed that preferred IT project management competencies for successful project management are leadership, the ability to communicate at multiple levels, verbal and written skills, attitude and the ability to deal with ambiguity and change. A research conducted by Ehsan et al. (2010) showed that project managers' competencies are positively correlated with project success

which confirmed the findings of Müller and Turner (2010) about positive correlation of project managers' competencies and project success.

In a more specific manner, engineering field and particularly construction projects the needed project managers' competencies have been studied in different countries. In result of these studies, some new competencies such as contract management, logical thinking, conflict management, honesty and integrity and alertness and quickness were identified (Dogbegah et al., 2011; Fisher, 2011; Lee et al., 2011; Klendauer et al., 2012; Zhang et al., 2013; Jabar et al., 2013; Hwang and Ng, 2013; Othman and Jaafar, 2013; Trivellas and Drimoussis, 2013; Ahadzie et al., 2014; Panas et al., 2014). In the same period, two different focused studies conducted by Chipulu et al. (2013) and Radu (2014) addressed the competencies that the project stakeholders and employers of project managers expect them to possess or obtain. The findings of these two studies identified new project managers' competencies and also revealed interesting differences between the competencies required by employers and those promoted by the academic community (Chipulu et al., 2013 and Radu, 2014).

The more recent studies conducted between 2015 and 2018 suggest that focus on investigating and identifying project managers' competencies in engineering projects, particularly construction type, (Omar and Fayek, 2016; Takey et al., 2015; Tabassi et al., 2016; Blixt et al., 2017; Crayon et al., 2017; Dziekoński, 2017; Abdullah et al., 2018; Kostalova et al., 2018; Shah et al., 2018) and organizational context (Brière et al., 2015 and Loufrani and Saglietto, 2016) has been continued. Meanwhile, some researchers have addressed general aspects of project managers' competencies. These efforts have produced competencies having relevance for all types of projects (Liikamaa, 2015 and Ekrot et al., 2016). The results of these studies cover the findings of previous ones, which tried to address project managers' competencies, but some new competencies such as seeking information and stress management are seen among their findings. The synthesis of all mentioned competencies in the standards of practice and previous studies are presented in the results chapter.

Methodology

Theoretical framework

The first stage of the research focused on different appearances of competencies and relating analysis. Generally, this viewpoint is based on the ontology of concepts (Lundqvist et al., 2011). Ontological perspective towards competencies has been utilized by different researchers to look at the competency from its different aspects and restructuring competencies based on their nature. This restructuring generally comprises clustering competencies for generic and specific purposes. For instance, Spencer and Spencer (1993) identified, defined and clustered 20 competencies into six categories based on their nature where they were characterized by motive, trait, self-concept, knowledge and skills of the human resource. Zwell (2000) also utilized ontological perspective toward competencies where 36 competencies, based on their nature, were categorized into five clusters including task achievement, relationship, personal attribute, managerial, and leadership.

The second stage of the research focused on project managers' context-specific competencies where the contingency theory based analysis is used as a main viewpoint for studying the possible dependencies between various project contexts and project managers' competencies. The classic contingency theory view on organizations asserts that "different external conditions might require different organizational characteristics, and that the effectiveness of the organization is contingent upon the amount of congruence or goodness of fit between structural and environmental variables"

(Shenhar, 2001, p 395). Based on the ideas of classic contingency theory and its 'one size does not fit all' approach, Shenhar (2001) elaborated contingency thinking in the context of projects suggesting that "the specific project type should affect the selection of project leaders, project team member and skills development needs" (Shenhar, 2001, p 412). It can also mean that different project types need project managers with specific competencies; the contingency perspective which was employed in this study to answer the second question.

Phases of research

As a first step an extensive literature study was carried out including both project management standards of practice and previous studies on project managers' competencies. Then, the investigation of the relevant standards of practice was carried out through identifying mentioned competencies of project managers in ICB.4, PMCD.3, PMBOK and APM standards of practice. After investigating the mentioned standards of practice and findings mentioned on project managers' competencies, a list of all 58 presented competencies by standards of practice was prepared (Table 1). In this study, the identified competencies with more than one appearance qualified as weighty competencies and competencies with only one appearance qualified as notable ones. Subsequently, a synthesis of identified competencies in the content of standards of practice was prepared (Table 2) for two main purposes: first, identifying weighty competencies and ranking them based on their frequencies of appearance. Second, to reach a list of all mentioned competencies by standards of practice by excluding similarities.

Then, ScienceDirect and the Emerald databases were chosen to find relevant previous studies in the subject of project managers' competencies. The following keywords were used for searching: project managers' competency and project management competency. The search ended up in 72 relevant papers after excluding irrelevant papers based on analysis of abstracts and full texts. The analysis of those resulted in a master list (a matrix of competencies with their references). Next, the competencies in this list were studied further by grouping those having clear equivalence. Analyzing those papers led to identifying mentioned competencies of project managers in the previous studies. Following, their frequency of appearance provided the basis for their ranking (Table 3).

When targeting the first research question, possible discrepancies between research results and standards of practice were discovered (Table 4 and 5). Table 4 is based on the main viewpoints of previous studies and standards of practice on project managers' competencies. Table 5 was developed through comparing the presented competencies in the previous studies (Table 3) and standards of practice (Table 2). This comparison was made based on the similarity or sameness in title or meaning of the competencies listed in Table 2 and 3. Accordingly, three categories, representing the found discrepancies, were developed. These categories include (i) the competencies, with the same or similar meaning or title, present both in the standards of practice and previous studies, (ii) the competencies present only in the previous studies, and (iii) the competencies present only in the standards of practice. Next, the identified and ranked competencies in Tables 2 and 3 were merged to form a synthesized list of project managers' competencies (Table 7). This list presents also the ranking of competencies based on their total frequency of appearance. Additionally, a new categorization of project managers' weighty competencies (those with more than one appearance) was developed (Table 8). This was developed for structuring weighty competencies and it includes four categories (personal, performance, perspective and interpersonal). This categorization was carried out in two steps. First, a comparison was made in terms of the meaning and skill match between the project managers' weighty

competencies identified in this study and the presented competencies and their categories by standards of practice. Then, the categories (personal, interpersonal, perspective, and performance), best representing the weighty competencies, were selected based on the made comparison in the first step. These selected categories are a combination of the presented categories (Table 1) by the standards of practice for project managers' competencies.

For answering the second question, project managers' competencies of relevance for different project types or contexts were identified based on the literature study (Table 9). Figure 1 presents the process map of research.
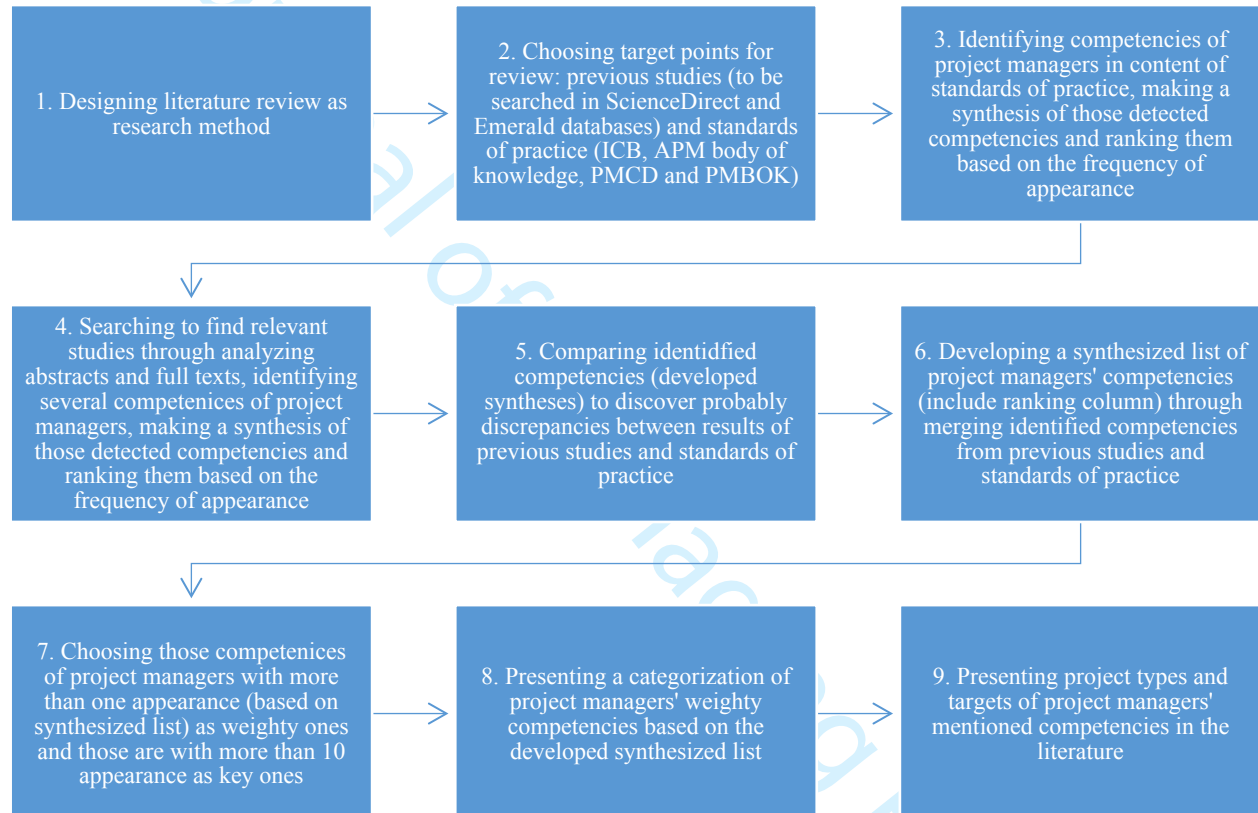
1. Designing literature review as research method	2. Choosing target points for review: previous studies (to be searched in ScienceDirect and Emerald databases) and standards of practice (ICB, APM body of knowledge, PMCD and PMBOK)	3. Identifying competencies of project managers in content of standards of practice, making a synthesis of those detected competencies and ranking them based on the frequency of appearance
4. Searching to find relevant studies through analyzing abstracts and full texts, identifying several competenices of project managers, making a synthesis of those detected competencies and ranking them based on the frequency of appearance	5. Comparing identidfied competencies (developed syntheses) to discover probably discrepancies between results of previous studies and standards of practice	6. Developing a synthesized list of project managers' competencies (include ranking column) through merging identified competencies from previous studies and standards of practice
7. Choosing those competenices of project managers with more than one appearance (based on synthesized list) as weighty ones and those are with more than 10 appearance as key ones	8. Presenting a categorization of project managers' weighty competencies based on the developed synthesized list	9. Presenting project types and targets of project managers' mentioned competencies in the literature

Fig.1. The research process

Results

Project managers' competencies in the standards of practice

As a result of analyzing the competencies in the standards of practice, a synthesis of 58 found competencies was developed together with their ranking (Table 2). Findings show that leadership, communication, resource management, teamwork, conflict management, negotiation, project scope management, project quality management and project cost management together with five other competencies are 14 competencies that have been mentioned in the standards of practice more than once. These competencies are considered as the weighty ones. There seems to be a degree of consensus among standards of practice about their relevance for project managers in general.

Table 2. Project managers' competencies in the standards of practice

Competency	References (frequencies)	Rank	Competency	Reference (frequencies)	Rank
Leadership	(ICB.4, APM, PMBOK, PMCD.3)	1	Result orientation	(ICB.4)	4
Communication	(ICB.4, APM ,PMCD.3)	2	Project design	(ICB.4)	
Resource management	(ICB.4, APM ,PMCD.3)		Requirement and objectives	(ICB.4)	
Teamwork	(ICB.4, APM)	3	Organization and information	(ICB.4)	
Conflict management	(ICB.4, APM)		Change and transformation	(ICB.4)	
Negotiation	(ICB.4, APM)		Governance, structures and processes	(ICB.4)	
Project scope management	(ICB.4, PMCD.3)		Cultures and values	(ICB.4)	
Project quality management	(ICB.4, PMCD.3)		Compliance, standard and regulation	(ICB.4)	
Project cost management	(ICB.4, PMCD.3)		Managing	(PMCD.3)	
Project procurement management	(ICB.4, PMCD.3)		Cognitive ability	(PMCD.3)	
Project integration management	(ICB.4, PMCD.3)		Effectiveness	(PMCD.3)	
Project risk management	(ICB.4, PMCD.3)		Professionalism	(PMCD.3)	
Project stakeholder management	(ICB.4, PMCD.3)		Influencing	(APM)	
Strategic and business management skills	(PMBOK, ICB.4)		Delegation	(APM)	
Self-reflection and self-management	(ICB.4)	4	Ethics framework	(APM)	
Personal integrity and reliability	(ICB.4)		Learning and development	(APM)	
Relationship and engagement	(ICB.4)		Technical project management skills	(PMBOK)	

Research -based project managers' competencies

As a main result of analyzing previous studies, 381 titles representing competencies were identified. The similarities between those provided a basis for a synthesis which includes 94 titles that are later termed as competencies (Table 3). Appendix 1 presents the references for each competence. As a result of ranking competencies based on their frequencies of appearance, it became evident that 64 competencies out of the 94 identified ones have been mentioned in the previous studies more than once (see Table 3 for details). So, it can be concluded that these are among project managers' weighty competencies in the viewpoint of the research community. Among those 64 identified weighty competencies, there are only six competencies, namely communication, leadership, teamwork and cooperation, flexibility, problem solving and goal orientation with more than 10 appearances in the previous studies. These are project managers' key competencies in the viewpoint of the research community. The following table (Table 3) presents project managers' competencies in the viewpoint of the research results.

Table 3. Project managers' weighty and notable competencies in the viewpoint of the research results

Competency	Freq	Rank	Competency	Freq	Rank	Competency	Freq	Rank
Communication	22	1	*Customer focus*			Spontaneity	1	14
Leadership	15	2	*Strategic direction*			Positive regard		
Teamwork and cooperation	12	3	*Information seeking*	4	11	Mobilization		
Flexibility			*Initiative*			Delegation of authority		
Problem solving	11	4	*Negotiation*			Knowledge of using tools and techniques		
Goal orientation			*Proactivity*			Skills in the use of computer		
Developing others	10	5	*Self-assessment*			Understanding methods, process and procedures		
Impact and Influence			*Self-control*			Sharing credit for success		
Analytical thinking			*Managing group process*			Self-awareness		
Stakeholder management	9	6	*Team selection*			Tendering		
Cost management			*Conscientiousness*	3	12	Operation management		
Resource management	8	7	*Behavioral competencies*			General business management		
Quality management			*Project knowledge*			Interdependency management		
Decision making			*Interpersonal understanding*			Multi-tasking		
Time management			*Relationship building*			Being courageous		
Experience	7	8	*Commitment*			Cognitive capability		
Planning			*Personal competence*			Judgment		
Risk management			*Efficiency orientation*			Accountability		
Conflict management			*Diagnostic of concepts*			Social comprehension		
Ethics			*Sensitivity*			Intuitiveness		
Team management	6	9	*Knowledge management*			Ability to formulate goals		
Creativity			*Directiveness*			Professionalism		
Conceptual thinking			*Continues improvement*			Management		
Project management			*Vision*	2	13	Positive outlook		
Technical competencies			*Estimating*			Learning oriented		
Knowledge of construction work	5	10	*Emotional resilience*			Empathy and Aspiration		
Change management			*Project integration management*			High energy level		
Self-confidence			*Assertiveness*			Information technology skills		
Procurement management			*Trustworthiness*					
Scope management			*Stress management*					
HSE			*Organizational awareness*					
Motivation			Alertness and quickness	1	14			
Cultural skills			Perceptual objectivity					

Freq: Frequency of appearance
Italic: weighty competencies (with more than one appearance)
Non italic: notable competencies (with one appearance)
Number of listed competencies: 64 (weighty)+30 (notable)= 94

Discrepancies between research results and standards of practice

The results show that there are four discrepancies between research results and standards of practice in terms of project managers' competencies. It was expected to see results of previous research and standards of practice addressing project managers' competencies with high similarity. This similarity was expected to be present for example about identified and weighty competencies and consensus (the same or similar viewpoints) on those identified and weighty competencies. The first discrepancy is that some competencies such as contract management, stress management and analytical thinking are missing in the standards of practice, as can be seen in Table 5. The second discrepancy is the qualitative mismatch between research results and standards of practice. This means that while there exists some consensus in the research results regarding the priority of some competencies such as goal orientation, decision-making and problem-solving, there is no corresponding consensus in the standards of practice. The third discrepancy is about the uneven degree of consensus (number of the same or similar viewpoints) in quantitative terms between research results and standards of practice. This approach produced list of weighty and key competencies. The fourth discrepancy comes back to main viewpoints of prior studies and standards of practice towards project managers' competencies. In other words, researchers not only have addressed project managers' competencies in general, but also have investigated appropriate competencies of project managers in different project types as well as the effects of those competencies on project success (see Table 9). In contrast, standards of practice have mainly taken into account project managers' competencies in a general manner and there are a few specific considered contexts in content or extensions of those standards of practice.

On the other hand, there are also some similarities between research results and standards of practice in the area of project managers' competencies. The first common point in this regard is that both standards of practice and literature have tried to address different dimensions of project managers' competencies such as personal and behavioral, and subsequently tried to discover new dimensions in that regard or update current knowledge, as can be seen in new versions of standards of practice and published papers. The second common theme deals with the competencies which have been mentioned in both of them (see Table 5). The last identified similarity is that standards of practice and previous studies have both agreed on the importance of project managers' competencies on their performance, though it seems that, as stated already, previous studies have moved further and addressed weighty competencies of project managers in different project contexts as well emphasized competencies' effect and implications on project success. These identified discrepancies (Table 4) can be useful for developers of standards of practice and research community.

Table 4. Discrepancies between research results and standards of practice over competencies of project managers

1. **Some competencies are missing** in the standards of practice
2. **There is a mismatch between research results and standards of practice** concerning priority of some project managers' competencies
3. **There is uneven degree of consensus over importance of some project managers' competencies** between research results and the standards of practice
4. **Research results are more context-oriented than the standards of practice** over project managers' competencies

The following table (Table 5) shows the discrepancies between previous studies and standards of practice in terms of present and non-present competencies.

Table 5. Discrepancies between result of research and standards of practice in terms of present and non-present competencies

The competencies present both in the standards of practice and previous studies	Communication, Leadership ,Stakeholder management, Goal orientation, Cost management , Developing others, Teamwork and cooperation, Resource management, Planning , Risk management, Conflict management, Impact and Influence, Quality management, Procurement management, Technical competencies, Scope management, Strategic direction, Ethics, Cultural skills, Negotiation, Self-control, Relationship building, Change management, Project integration management, Efficiency orientation, Delegation of authority, Cognitive capability, Professionalism, Management
The competencies present only in the previous studies	Flexibility, Problem solving, Analytical thinking, Decision making, Time management, Experience, Team management, Creativity, Conceptual thinking, Project management, Knowledge of construction work, Self-confidence, HSE(health, safety and environment), Motivation, Customer focus, Information seeking, Initiative, Proactivity, Self-assessment, Managing group process, Team selection, Conscientiousness, Behavioral competencies, Project knowledge, Interpersonal understanding, Commitment, Personal competence, Diagnostic of concepts, Sensitivity, Knowledge management, Directiveness, Continues improvement, Vision, Estimating, Emotional resilience, Assertiveness, Alertness and quickness, Trustworthiness, Stress management, Perceptual objectivity, Spontaneity, Positive regard, Mobilization, Knowledge of using tools and techniques, Skills in the use of computer, Understanding methods, process and procedures, Sharing credit for success, Self-awareness, Tendering, Operation management, General business management, Interdependency management, Multi-tasking, Being courageous, Judgment, Accountability, Social comprehension, Intuitiveness, Ability to formulate goals, Organizational awareness, Organizational awareness, Positive outlook, Learning orientation, Empathy and Aspiration, High energy level, Information technology skills
The competencies present only in the standards of practice	Requirement and Objectives; Organization and information; Governance, structures and processes; Compliance, Standard and regulation

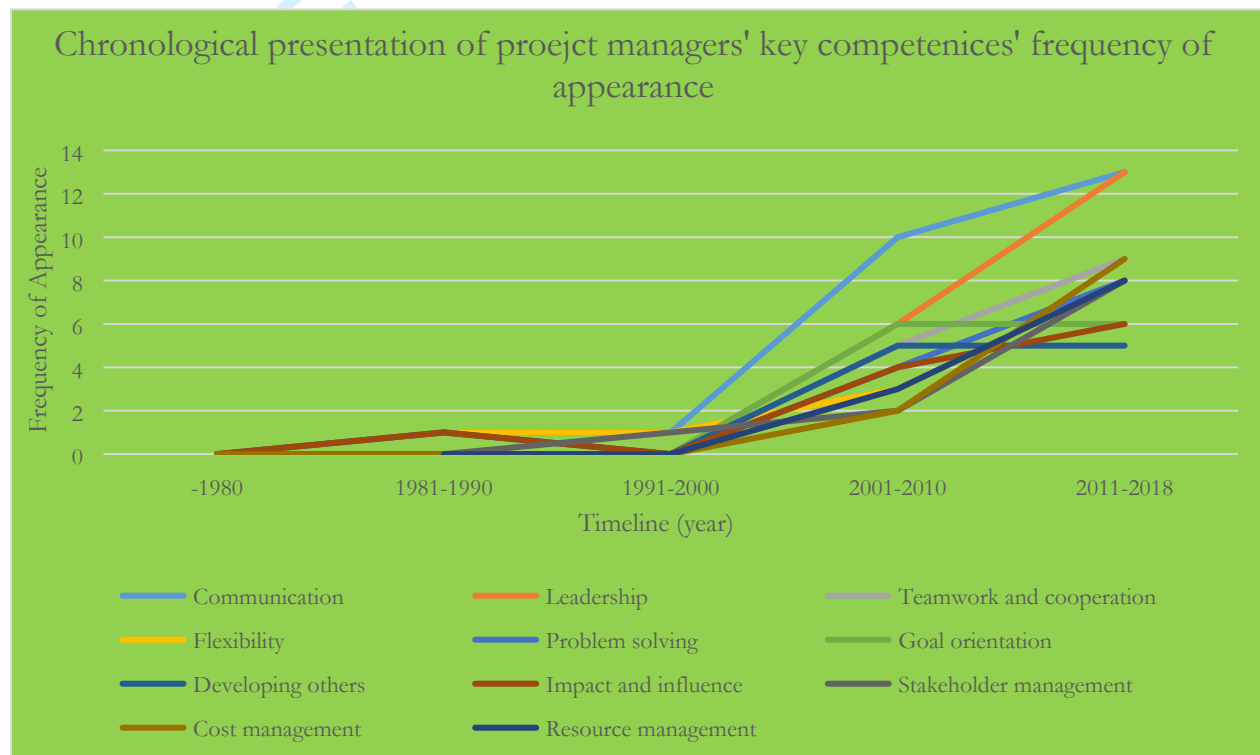*A synthesized list of project managers' competencies*

The identification and ranking of competencies present in the previous studies and related standards of practice led to development of a synthesized list of project managers' 98 competencies (Table 7). This list was developed through merging the identified competencies from previous studies and standards of practice. The following table (Table 6) presents the overall picture of the findings from the standards of practice, research results and, finally, the gained results (synthesized list).

Table 6 .Titles representing project managers' competencies

	Standards of practice	Research results	Synthesized list of project managers' competencies
Total 1	58	381	98
Total 2	34	94	
Notable	20	30	30
Weighty	14	64	68
Total 1: found competencies Total 2: synthesized competencies			

The synthesized list presents also competencies' ranking according to their total frequency of appearance in both previous studies and standards of practice. Appendix 1 includes also references. According to Table 7, communication, leadership, teamwork and cooperation, flexibility, problem

solving, goal orientation, developing others, impact and influence, stakeholder management, cost management and resource management are project managers' 11 key competencies (with more than 10 appearances in the previous studies and standards of practice) among the 68 identified weighty competencies (Table 7) *in viewpoint of the literature* (research community and standards of practice) which contribute to project success more than other identified competencies in this study. These key competencies of project managers have been focused by research community much more than other competencies. In addition, they have continuously been important and demanding since 2001, as their appearance trend can be seen in the following figure (Figure 2). Therefore, these competencies can be considered as project managers' core competencies in general (for all project types and targets). The following Figure shows the appearance trend of project managers' key competencies during recent decades.

Fig. 2. Chronological presentation of project managers' key competencies' frequency of appearance

The developed list of project managers' competencies creates a new insight towards addressed project managers' competencies by standards of practice and research community from 1959 to 2018. This provided list can also be considered as a useful reference for future studies in this field. The following Table 7 shows the synthesized list of project managers' 98 competencies.

In addition, definition of the listed competencies in Table 7 can be seen in Appendix 2. Moreover, Appendix 3 presents timewise distribution of these competencies. Accordingly, it looks obvious that while during recent two decades the frequency of appearance of the weighty competencies grew, the more was their demand and importance. In other words, timewise distribution of weighty competencies' frequency of appearance showed that importance and demand of them have been continuous since 2001, and therefore their appearance in literature do not belong to a specific and limited period of time.

1
2
3

Table 7. List of project managers' competencies mentioned by previous studies and standards of practice from 1959 to 2018.

Competency	Freq	Rank	Competency	Freq	Rank	Competency	Freq	Rank
Communication	25	1	*Motivation*	5	11	Alertness and quickness	1	15
Leadership	19	2	*Customer focused*	4	12	Perceptual objectivity		
Teamwork and cooperation	14	3	*Information seeking*			Requirement and objectives		
Flexibility	12	4	*Initiative*			Organization and information		
Problem solving			*Self-control*			Governance, structures and processes		
Goal orientation			*Relationship building*			Compliance, standard and regulation		
Developing others			*Project integration management*			Spontaneity		
Impact and Influence	11	5	*Proactivity*	3	13	Positive regard		
Stakeholder management			*Self-assessment*			Mobilization		
Cost management			*Managing group process*			Knowledge of using tools and techniques		
Resource management			*Team selection*			Skills in the use of computer		
Analytical thinking	10	6	*Conscientiousness*			Understanding methods, process and procedures		
Quality management	9	7	*Behavioral competencies*			Sharing credit for success		
Risk management			*Project knowledge*			Self-awareness		
Conflict management			*Interpersonal understanding*			Tendering		
Ethics			*Commitment*			Operation management		
Decision making	8	8	*Efficiency orientation*			General business management		
Time management			*Personal competence*			Interdependency management		
Planning			*Diagnostic of concepts*			Multi-tasking		
Experience	7	9	*Sensitivity*			Being courageous		
Technical competencies			*Knowledge management*			Judgment		
Procurement management			*Directiveness*			Accountability		
Scope management			*Continues improvement*			Social comprehension		
Team management	6	10	*Vision*	2	14	Intuitiveness		
Creativity			*Estimating*			Ability to formulate goals		
Conceptual thinking			*Emotional resilience*			Positive outlook		
Project management			*Assertiveness*			Learning oriented		
Change management			*Trustworthiness*			Empathy and Aspiration		
Strategic direction			*Stress management*			High energy level		
Negotiation			*Delegation of authority*			Information technology skills		
Cultural skills			*Cognitive capability*					
Knowledge of construction work	5	11	*Professionalism*			Freq: Frequency of appearance		
Self-confidence			*Management*			*Italic*: weighty competencies (with more than one appearance)		
HSE			*Organizational awareness*			Non italic: notable competencies (with one appearance)		
						Number of listed competencies: 68 (weighty)+30 (notable)= 98		

New categorization of project managers' weighty competencies

Structuring of weighty competencies resulted in four categories that include personal (27 competencies), performance (26 competencies), perspective (8 competencies) and interpersonal (11 competencies) (Table 8). Some of the weighty competencies have been placed in more than one category. The proposed categorization has some differences in comparison with others presented by standards of practice and some of the previous studies. First, this categorization is putting attention on weighty competencies. Second, previous categorizations, particularly those presented by standards of practice, are based on a general viewpoint, and include rather limited number of competencies. The presented categorization is based on research results and standards of practice. The applicability of this categorization can be wider in comparison with previous ones.

Table 8. Categorization of project managers' weighty competencies

Category	Competencies
Personal	(1)Leadership (2)Goal-orientation (3)Creativity (4)Problem solving (5)Teamwork and cooperation (6)Initiative (7)Analytical thinking (8)Decision making (9)Flexibility (10)Self-confidence (11)Conceptual thinking (12)Information seeking (13)Ethics (14)Proactivity (15)Self-assessment (16)Self-control (17)Conscientiousness (18)Sensitivity (19)Directiveness (20)Experience (21) Assertiveness (22) Emotional resilience (23)Diagnostic of concepts (24)Perceptual objectivity (25)Trustworthiness (26)Stress management (27)Cognitive capability
Performance	(1)Cost management (2)Time management (3)Planning (4)Risk management (5)Project knowledge (6)Resource management (7)Quality management (8)Scope management (9) Procurement management (10) Project management (11)Project integration management (12)Managing group process (13)Knowledge of construction work (14)Change management (15)Diagnostics of concepts (16) Technical competencies (17)Estimating (18)Team management (19)HSE (20)Experience (21)Information seeking (22)Knowledge management (23) Professionalism (24)Management (25)Team selection (26)Delegation of authority
Perspective	(1)Strategic direction (2)Developing others (3)Customer-focus (4)Continuous improvement (5)Team selection (6)Efficiency orientation (7)Vision (8) Organizational awareness
Interpersonal	(1)Communication (2)Conflict management (3)Problem solving (4)Negotiation (5)Teamwork and cooperation (6)Impact and Influence (7)Motivation (8)Cultural skills (9)Stakeholder management (10)Team management (11) Interpersonal understanding
Note: numbers do not mean ranking.	

The competencies of project managers for different types of projects and targets

Shenhar (2001) and Müller and Turner (2007, 2010) state that project managers need different kind of competencies to be effective and successful in different kinds of project types. The project types and targets that have drawn the interest of researchers in competency subject are presented in Table 9. Construction, IT, and engineering projects together with other targets and project types, as can be seen, have been addressed by research community to find appropriate and important competencies of project managers. Among the pointed out project types, the largest number of identified competencies is related to construction projects, as can be seen in Table 9. Moreover, industrial employers' expectations of project managers' competencies is also a target that has also been considered by research community to detect appropriate competencies of project managers. Details of presented competencies are provided in the following table (Table 9).

Table 9. Matching different project managers' competencies to different project types/targets

Project type	Project/organization size and/or geographical location	Competencies	Reference
Organizational Change projects	Organizations with 9000-30000 employees	Leadership, Customer focus, Goal orientation, Teamwork, Stakeholder management, Planning, Developing others, Communication, Decision-making, Problem-solving, Cultural skills and Project management	Abraham et al. 2001, Crawford and Nahmias 2010, Trivellas and Drimoussis . 2013
Construction projects	All sizes (small, medium, and big): covering construction projects built around the globe include Asia, Africa, Europe, and America	Resource management, Knowledge of construction work, Teamwork and cooperation, Cost management, Flexibility, Leadership, Communication, HSE, Time management, Quality management, Stakeholder management, Experience, Project management, Ethics, Problem solving, Goal orientation, Impact and influence, Team management, Conflict management, Risk management, Creativity, Decision-making, Procurement management, Initiative, Information seeking, Analytical thinking, Developing others, Scope management, Motivation, Negotiation, Commitment, Conceptual thinking, Planning, Relationship building, Directiveness, Change management, Project integration management, Assertiveness, Self-confidence, Self-control, Tendering, Knowledge management, Operation management, Estimating, General business management, Judgment, Professionalism, Management, Alertness and quickness, Interpersonal understanding, Organizational awareness, Stress management, Ability to formulate goals, Sensitivity, Trustworthiness, Cultural competence, Positive outlook, Consciousness, Learning oriented, Empathy and Aspiration, Emotional resilience, High energy level, having information technology skills	Edum-Fotwe et al. 2000, DAINTY et al. 2004, Cheng et al. 2005, Mutijwaa and Rwelamila 2007, Chen et al. 2008, Ahadzie et al. 2008, Ahadzie et al. 2009, Lee et al. 2011, Dogbegah et al. 2011, Zhang et al. 2013, Hwang and Ng, 2013, Jabar et al. 2013, Panas et al., 2014, Tabassi et al. 2016, Omar and Fayek, 2016, Dziekoński, 2017, Abdullah et al. 2018, Shah and Prakash, 2018, Moradi et al. 2018
Engineering projects (all fields)	Firms ranged in size from 50 personnel to 35,000, and projects ranged $50,000–$500 million.	Analytical thinking, Developing others, Impact and Influence, Motivation, Conscientiousness, Leadership, Conflict management, Cultural skills, Time management, Flexibility, Continues improvement, Proactivity, Decision making, Risk management, Strategic direction	Müller and Turner 2007, Müller and Turner 2010, Fisher 2011, Takey et al. 2015
IT projects	Ranged from 1-9m$ and 20-60 employees	Experience, Team management, Leadership, Communication, Goal orientation, Negotiation, Integration management, Cost management, Scope management and Time management	Patanakul et al. 2008, Stevenson et al. 2010, Klendauer et al. 2012, Moradi et al. 2018
Metallurgical projects	Metallurgical projects in Czech Republic	Analytical thinking, Quality management, Risk management, Resource management, Teamwork and cooperation, Project knowledge, Self-control	Kostalova et al. 2018
International NGO projects	Conducted projects by 18 Canadian NGOs in Africa and Latin America	Adaptability, Management, Communication, Ethics, Change management	Brière et al. 2015
Public service projects	Australian public service projects	Communication, Accountability, Scope management, Change management, Goal orientation	Blixt et al. 2017
Target		Competencies	Reference
Employers' expectations		Industry-specific and generic skills over project management knowledge/expertise, Project management knowledge/expertise over, industry-specific and generic skills, Senior managerial skills, Positive personal traits, Project management methodology experience and professional qualifications, Risk management over a project life cycle, Goal orientation, Communication, Problem solving ,Customer focus, Developing others, Creativity	Chipulu et al. 2013, Radu 2014

Discussion

The world of project managers' competencies is presented both in the standards of practice and by the research results. Four discrepancies were discovered between these two sources. A theoretical origin behind the found discrepancies concerning project managers' competencies can be the ontological one. This is proposing that standards of practice and research efforts with the common goal (restructuring of competencies by clustering them) yields in different results because of differences in understandings the competency concept itself. Consensus on priority of project managers' competencies and the degree of consensus itself were found as two out of those four discrepancies. The main reason of these is that researchers often review the earlier studies in their field and use those results as a basis of their work. As a result of this, the maturity of findings and also consensus on some of those validated results increase gradually, but in the case of standards of practice, it seems that the main target has been the development of a unique solution in terms of content. In developing a new edition of a standard, considering a degree of difference in comparison with other standards of practice is somewhat acceptable, but trying to being totally different will lead to some differences and disagreements in understanding of concepts. After several years of publishing different standards of practice there is still no universal definition of competency. Considering a cooperation atmosphere among standards' of practice providers in developing new editions would cover these gaps.

The other two discrepancies were about missed and common competencies and also context-oriented attitude of the previous studies and the standards of practice toward project managers' competencies. New competencies are often discovered when addressing a specific project type, as different researchers have proved that project type should be taken into account in finding important and/or required competencies of project managers (Müller and Turner, 2007 and 2010; Shenhar, 2001). Missing some competencies and almost ignoring the correlation of project managers' competencies with project type and project success by standards of practice is due to the general attitude of standards of practice towards project managers' competencies. Although, some of the standards of practice such as ICB claim that considering different variables such as project type in presenting competency standards of practice is not possible due to the diversity of standards' of practice users in terms of geographical location and culture, several studies have shown that there is a strong and positive correlation between project managers' competencies with project success and effective competencies on project success are varied in different kind of projects (Toney, 2001; Maclinnis, 2003; Müller and Turner, 2007 and 2010; Shenhar, 2001). Therefore, it seems that considering some changes, as stated here, in providing new editions of project managers' competency standards of practice would increase usefulness and efficiency of those standards of practice.

The most important implication of the discovered discrepancies between research results and standards of practice would be the constitution of a cooperation atmosphere among providers of standards of practice in the area of project manager's competencies to develop a universal standard of practice. This kind of standard of practice not only addresses general aspects of project managers' competencies but also takes into account a context-oriented attitude to include also needed and important competencies of project managers in different project types. Moreover, developing this kind of standard of practice would cover all needed competencies of project managers and would increase consensus on the concept, definition, importance and priority of project managers' competencies. Such a universal standard of practice could also have complementary appendixes for different geographical locations and cultures to increase the generalizability of itself as much as possible.

Moreover, context-specific competencies were identified (Table 9). These findings show that different project types require project managers with the specific competencies. It can also mean that there are qualitative dependencies between different competencies of project managers and contexts which seems to be in line with the fundamental part of contingency theory for projects (Shenhar, 2001) where there are dependencies between the project type and selection of project leaders and team members and their skills. Accordingly, the project managers' identified context-specific competencies in this study and the given arguments concerning those findings can be supported by contingency theory for projects.

The identified context-specific and key competencies present another contribution of this study for practice. The senior managers as well as the HR department of project-oriented companies need to be aware of project managers' key competencies which can be considered as a necessity for their superior performance. Consequently, paying attention to these key competencies can help decision makers in companies to hire or select the right person as their project manager. Moreover, project managers' context-specific competencies (Table 9) provide more detailed information on project manager's competencies in specific project types which can also be taken into account by managers of project managers in the different types of the project. These key and context-specific competencies, together, can be considered as a competency model for companies and their decision makers which deal with hiring, selecting, or managing project managers.

Conclusions

This study aimed at studying possible discrepancies between results of previous studies and standards of practice on project managers' competencies, and identifying relevant competencies of different project types based on previous studies. According to the gained results, it can be concluded that there are certain discrepancies between the research based results and standards of practice. Those discrepancies include i) Commonly existing/missing competencies ii) Uneven priority of some competencies in the view of researchers versus standards of practice, iii) Uneven degree of consensus on the importance of competencies, and iv) Research results are more context-oriented than the standards of practice. It looks possible that partial explanation of this is relating to differences in understandings the competency concept itself.

Communication, leadership, teamwork and cooperation, flexibility, problem solving, goal orientation, developing others, impact and influence, stakeholder management, cost management, and resource management were identified as project managers' key competencies. Development of a synthesized list of project managers' 98 competencies is another main result of this study. Also it was found that 68 out of those 98 competencies can be classified as weighty competencies with respect of their appearance and likely importance for the success of project. Furthermore, a new categorization of project managers' weighty competencies was developed.

In addition, it can also be concluded that project managers need different competencies in different project types, as already stated by different researchers (for instance, Müller and Turner, 2007; Shenhar, 2001). It also seems that construction and IT industry as well as engineering projects have been in research focus more than the other sectors and project types.

The findings of this study are providing knowledge contribution by revealing certain discrepancies between research results and standards of practice which can lead to new insights for project managers, researchers and providers of standards of practice. Another contribution of this study is the presented comprehensive list of project managers' competencies and clarification about appropriate project types

of mentioned competencies by research community. As the limitation of this study, it is acknowledged that critical views and discussions over project managers' competency research have been largely dismissed, and such approaches can be potential areas for further research.

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Appendix 1. Detailed version of Tables 3 and 7

Competencies and Refereed Studies	Number of repetition
Communication (Crawford, 2000; Abraham et al., 2001; EI-Sabaa, 2001; Muller and Turner, 2007; Bikfalvi et al., 2009; Crawford and Nahmias, 2010; Dogbegah et al., 2011; de los Ríos et al., 2014; Brière et al., 2015; Liikamaa, 2015; Blixt and Kirytopoulos, 2017; Shah and Prakash, 2018; Cheng et al., 2005; Ruuska and Vartainen, 2003; Brill et al., 2006; Chen et al., 2008; Hwang and Ng, 2013; RADU, 2014; Omar and Fayek, 2016; Dziekoński, 2017; Powers, 1987; Gillard and Price, 2005; ICB.4; APM; PMCD.3)	25
Leadership (Abraham et al., 2001; Dainty et al., 2004; Cheng et al., 2005; Bikfalvi et al., 2009; Crawford and Nahmias, 2010; Chipulu et al., 2013; de los Ríos et al., 2014; Brière et al., 2015; Liikamaa, 2015; Tabassi et al., 2016; Omar and Fayek, 2016; Moradi et al., 2018; Bosch-Rekveldt et al., 2009; Fisher, 2011; Zhang et al., 2013; ICB.4; APM; PMBOK; PMCD.3)	19
Teamwork and cooperation (Dainty et al., 2004; Cheng et al., 2005; Abraham et al., 2001; de los Ríos et al., 2014; Omar and Fayek, 2016; Dziekoński, 2017; Kostalova et al., 2018; Lee et al., 2011; Zhang et al., 2013; Ahadzie et al., 2008, Ahadzie et al., 2009; Shah and Prakash, 2018; ICB.4; APM)	14
Flexibility (Cheng et al., 2005; Liikamaa, 2015; Takey and de Carvalho, 2015; Omar and Fayek, 2016; Dziekoński, 2017; Dainty et al., 2004; Shah and Prakash, 2018; Omar and Fayek, 2016; Brière et al., 2015; Powers, 1987; Gillard and Price, 2005; EI-Sabaa, 2001)	12
Problem solving (Abraham et al., 2001; EI-Sabaa, 2001; Brill et al., 2006; Crawford and Nahmias, 2010; Jabar et al., 2013; Panas et al., 2014; RADU, 2014; Omar and Fayek, 2016; Dziekoński, 2017; Shah and Prakash, 2018; Moradi et al., 2018)	
Goal orientation (EI-Sabaa, 2001; Ruuska and Vartainen, 2003; Dainty et al., 2004; Cheng et al., 2005; Abraham et al., 2001; Moradi et al., 2018; Muller and Turner, 2007; Klendauer et al., 2012; RADU, 2014; Liikamaa, 2015; Dziekoński, 2017; ICB.4)	
Developing others (Powers, 1987; Gillard and Price, 2005; Chipulu et al., 2013; Muller and Turner, 2007; Muller and Turner, 2010; Crawford and Nahmias, 2010; RADU, 2014; Liikamaa, 2015; Cheng et al., 2005; Omar and Fayek, 2016; APM)	11
Impact and Influence (Dainty et al., 2004; Cheng et al., 2005; Muller and Turner, 2007, Muller and Turner, 2010; Fisher, 2011; Zhang et al., 2013; Omar and Fayek, 2016; Powers, 1987; Gillard and Price, 2005; Lee et al., 2011; APM)	
Stakeholder management (Crawford, 2000; Crawford and Nahmias, 2010; Zhang et al., 2013; Hwang and Ng, 2013; Omar and Fayek, 2016; Abdullah et al., 2018; Moradi et al., 2018; Brill et al., 2006; Lee et al., 2011; ICB.4; PMCD.3)	
Cost management (Lee et al., 2011; Hwang and Ng, 2013; Omar and Fayek, 2016; Dziekoński, 2017; Abdullah et al., 2018; Moradi et al., 2018; Cheng et al., 2005; Mutijwaa and Rwelamila, 2007; Dogbegah et al., 2011; ICB.4; APM)	
Resource management (Muller and Turner, 2007; Tabassi et al., 2016; Mutijwaa and Rwelamila, 2007; Abdullah et al., 2018; Dogbegah et al., 2011; Omar and Fayek, 2016; EI-Sabaa, 2001; Hwang and Ng, 2013; ICB.4; APM; PMCD.3)	
Analytical thinking (Dainty et al., 2004; Cheng et al., 2005; Liikamaa, 2015; Omar and Fayek 2016; Kostalova et al., 2018; Muller and Turner, 2007; Muller and Turner, 2010; Chipulu et al., 2013; Dziekoński, 2017; Powers, 1987)	10
Quality management (Dogbegah et al., 2011; Omar and Fayek, 2016; Crayon et al., 2017; Abdullah et al., 2018; Kostalova et al., 2018; Cheng et al., 2005; Shah and Prakash, 2018; Lee et al., 2011; APM)	9

Competency (references)	Count
Risk management (Dogbegah et al., 2011; Hwang and Ng, 2013; Omar and Fayek, 2016; Crayon et al., 2017; Kostalova et al., 2018; Crawford, 2000; Takey and de Carvalho, 2015; ICB.4; PMCD.3)	
Conflict management (Ahadzie et al., 2008; Ahadzie et al., 2009; Fisher, 2011; Zhang et al., 2013; Hwang and Ng, 2013; Liikamaa, 2015; Dziekoński, 2017; ICB.4; APM)	
Ethics (Brill et al., 2006; Lee et al., 2011; Dogbegah et al., 2011; Omar and Fayek, 2016; Othman and Jaafar, 2013; Dziekoński, 2017; Shah and Prakash, 2018; ICB.4; APM)	
Decision making (Crawford and Nahmias, 2010; Othman and Jaafar, 2013; Panas et al., 2014; Liikamaa, 2015; Takey and de Carvalho, 2015; Omar and Fayek, 2016; Dziekoński, 2017; Moradi et al., 2018)	8
Time management (Ahadzie et al., 2008; Ahadzie et al., 2009; Omar and Fayek, 2016; Abdullah et al., 2018; Shah and Prakash, 2018; Hwang and Ng, 2013; Takey and de Carvalho, 2015; Dziekoński, 2017)	
Planning (EI-Sabaa, 2001; Chen et al., 2008; Crawford and Nahmias, 2010, Hwang and Ng, 2013; Crawford, 2000; Chipulu et al., 2013; Crawford and Nahmias, 2010; Dziekoński, 2017; ICB.4)	
Experience (Fotwe et al., 2000; Othman and Jaafar, 2013; Tabassi et al., 2016; Dziekoński, 2017; Kostalova et al., 2018; Lee et al., 2011; Patanakul and Milosevic, 2008)	
Technical competencies (Benita et al., 2009; Silvius and Batenburg, 2009; Jabar et al., 2013; Takey and de Carvalho, 2015; Crawford, 2000; Shah and Prakash, 2018; PMBOK)	7
Procurement management (Dogbegah et al. 2011; Crayon et al., 2017; Omar and Fayek, 2016; Crawford, 2000; Abdullah et al., 2018; ICB.4; PMCD.3)	
Scope management (Cheng et al., 2005; Omar and Fayek, 2016; Dziekoński, 2017; Moradi et al., 2018; Brill et al., 2006; ICB.4; APM)	
Team management (Patanakul and Milosevic, 2008; Cheng et al., 2005; Chen et al., 2008; Abdullah et al., 2018; Omar and Fayek, 2016; Lee et al., 2011)	
Creativity (Dziekoński, 2017; Shah and Prakash, 2018; RADU, 2014; Moradi et al., 2018; Dogbegah et al., 2011; Omar and Fayek, 2016)	
Conceptual thinking (Dainty et al., 2004; Cheng et al., 2005; Powers, 1987; EI-Sabaa, 2001; Klendauer et al., 2012; Ruuska and Vartainen, 2003)	
Project management (Mutijwaa and Rwelamila, 2007; Crawford and Nahmias, 2010; Chipulu et al., 2013; Jabar et al., 2013; Dziekoński, 2017; Dogbegah et al., 2011)	6
Change management (Brière et al., 2015; Omar and Fayek, 2016; Blixt and Kirytopoulos, 2017; Zhang et al., 2013; Shah and Prakash, 2018; ICB.4)	
Strategic direction (Crawford, 2000; Muller and Turner, 2007; Takey and de Carvalho, 2015; Blixt and Kirytopoulos, 2017; PMBOK; ICB.4)	
Negotiation (Omar and Fayek, 2016; Dziekoński, 2017; Shah and Prakash, 2018; Moradi et al., 2018; ICB.4; APM)	
Cultural skills (Crawford and Nahmias, 2010; Fisher, 2011; Omar and Fayek, 2016; Crayon et al., 2017; Moradi et al.,2018; ICB.4)	
Knowledge of construction work (Chen et al., 2008; Ahadzie et al. 2008, Ahadzie et al. 2009; Jabar et al., 2013; Shah and Prakash, 2018)	
Self-confidence (Powers, 1987; EI-Sabaa, 2001; Gillard and Price, 2005; Liikamaa, 2015; Dziekoński, 2017)	5
HSE (Cheng et al., 2005; Lee et al., 2011; Omar and Fayek, 2016; Abdullah et al., 2018; Shah and Prakash, 2018)	

Motivation (Muller and Turner, 2007; Muller and Turner, 2010; Omar and Fayek, 2016; Dziekoński, 2017; Shah and Prakash, 2018)	
Customer focus (Abraham et al., 2001; RADU, 2014; Dainty et al., 2004; Cheng et al., 2005)	4
Information seeking (Dainty et al., 2004; Cheng et al., 2005; Liikamaa, 2015; Shah and Prakash, 2018)	
Initiative (Dainty et al., 2004; Cheng et al., 2005; Liikamaa, 2015; Omar and Fayek 2016)	
Self-control (Powers, 1987; Omar and Fayek, 2016; Shah and Prakash, 2018; ICB.4)	
Relationship building (Bikfalvi et al. 2009; Chen et al. 2008; Zhang et al., 2013; ICB.4)	
Project integration management (Omar and Fayek, 2016; Moradi et al., 2018; ICB.4; PMCD.3)	
Proactivity (Powers, 1987; Gillard and Price, 2005; Takey and de Carvalho, 2015)	3
Self-assessment (Powers, 1987; Liikamaa, 2015; Omar and Fayek, 2016)	
Managing group process (Powers, 1987; Gillard and Price, 2005; Lee et al., 2011)	
Team selection (Crawford, 2000; Crawford and Nahmias, 2010; Omar and Fayek, 2016)	
Conscientiousness (Muller and Turner, 2007; Muller and Turner, 2010; Shah and Prakash, 2018)	
Behavioral competencies (Benita et al., 2009; Silvius and Batenburg, 2009; Fisher, 2011)	
Project knowledge (EI-Sabaa, 2001; Dziekoński, 2017; Shah and Prakash, 2018)	
Interpersonal understanding (Zhang et al., 2013; Omar and Fayek 2016; Bosch-Rekveldt et al., 2009)	
Commitment (Omar and Fayek, 2016; Moradi et al., 2018; Shah and Prakash, 2018)	
Efficiency orientation (Powers, 1987; Gillard and Price, 2005; PMCD.3)	
Personal competence (Bosch-Rekveldt et al., 2009; Brière et al., 2015)	2
Diagnostic of concepts (Powers, 1987; Gillard and Price, 2005)	
Sensitivity (EI-Sabaa, 2001, Shah and Prakash, 2018)	
Knowledge management (Kasvi et al., 2003; Cheng et al., 2005)	
Directiveness (Dainty et al., 2004; Cheng et al., 2005)	
Continues improvement (Cheng et al., 2005; Takey and de Carvalho, 2015)	
Vision (Muller and Turner, 2007; Bosch-Rekveldt et al., 2009)	
Estimating (Mutijwaa and Rwelamila, 2007; Chipulu et al., 2013)	
Emotional resilience (Muller and Turner, 2007; Shah and Prakash, 2018)	
Assertiveness (Dziekoński, 2017; Shah and Prakash, 2018)	
Trustworthiness(Shah and Prakash, 2018; Omar and Fayek, 2016)	
Stress management (Dziekoński, 2017, Liikamaa, 2015)	
Delegation of authority (EI-Sabaa, 2001; APM)	
Cognitive capability (Bikfalvi et al., 2009; PMCD.3)	
Professionalism (Lee et al., 2011; PMCD.3)	
Management (Lee et al., 2011; PMCD.3)	
Organizational awareness (Zhang et al. 2013; Liikamaa, 2015)	
Alertness and quickness (Othman and Jaafar 2013)	1
Perceptual objectivity (Powers, 1987)	

Requirement and objectives (ICB.4)
Organization and information (ICB.4)
Governance, structures and processes (ICB.4)
Compliance, standard and regulation (ICB.4)
Spontaneity (Powers, 1987)
Positive regard (Powers, 1987)
Mobilization (EI-Sabaa, 2001)
Knowledge of using tools and techniques (EI-Sabaa, 2001)
Skills in the use of computer (EI-Sabaa, 2001)
Understanding methods, process and procedures (EI-Sabaa, 2001)
Sharing credit for success (Brill et al., 2006)
Self-awareness (Muller and Turner, 2007)
Tendering (Mutijwaa and Rwelamila, 2007)
Operation management (Mutijwaa and Rwelamila, 2007)
General business management (Mutijwaa and Rwelamila, 2007)
Interdependency management (Patanakul and Milosevic, 2008)
Multi-tasking (Patanakul and Milosevic, 2008)
Being courageous (Bosch-Rekveldt et al., 2009)
Judgment (Lee et al., 2011)
Accountability (Blixt and Kirytopoulos, 2017)
Social comprehension (Moradi et al., 2018)
Intuitiveness (Muller and Turner, 2007)
Ability to formulate goals (Dziekoński, 2017)
Positive outlook (Shah and Prakash, 2018)
Learning oriented (Shah and Prakash, 2018)
Empathy and Aspiration (Dziekoński, 2017)
High energy level (Shah and Prakash, 2018)
Having information technology skills (Shah and Prakash, 2018)

Appendix 2. Definition of the competencies listed in Table 7

Definition of the competencies listed in Table 7	
Competency	Definition
Communication	The ability of listening actively, understanding, responding to stakeholders, maintaining lines of communication, ensuring quality of information, and tailoring communication to audience.
Leadership	Providing direction and guidance to individuals and groups. It involves ability to choose and apply appropriate styles of management in different situations.
Teamwork and cooperation	The ability of bringing people together to realize a common objective.
Flexibility	Adapting and responding quickly and effectively to challenging circumstances.
Problem solving	The ability of finding a solution or a course of action for the faced problem or issue.
Goal orientation	Setting, striving to achieve and achieving challenging goals.
Developing others	The ability of perceiving the development needs of others and reinforcing their abilities.
Impact and Influence	The act of affecting the behaviors and actions of others.
Stakeholder management	Systematic identification analysis, planning and implementation of actions designed to engage with stakeholders.
Cost management	The process of estimating and justifying costs in order to secure funds, controlling expenditure and evaluating the outcomes.
Resource management	The ability of defining, acquiring, controlling and developing the resources that are necessary to realizing project outcomes.
Analytical thinking	Understanding a situation by breaking it apart into smaller pieces, or tracing the implications of a situation in a step-by-step casual way.
Quality management	Ensuring that the outputs, benefits, and the processes by which they are delivered, meet stakeholder requirements and are fit for purpose.
Risk management	The ability of identification, assessment, response planning and implementation and control of opportunities and threats around the project.
Conflict management	The ability of identifying and addressing differences that, if left unresolved, could affect objectives.
Ethics	A key requirement of a profession is that individual members should act ethically.
Decision-making	The ability of making the decisions, which will have the most efficiency for the project.
Time management	The ability of developing schedule plan for project and keeping it up-to-date to avoid delays for on time delivery of the project.
Planning	The ability of determining what is to be delivered, how much it will cost, when it will be delivered, how it will be delivered and who will carry it out.
Experience	Having the experience of working in similar project or job.
Technical competencies	The knowledge, skills, and behaviors related to specific domains of project. The technical aspects of performing one's role.
Procurement management	The process of buying or obtaining goods and/or services from external parties.
Scope management	The process whereby outputs, outcomes, and benefits are identified, defined, and controlled.
Team management	The ability of directing a group of people toward achieving common goal(s).
Creativity	The use of imagination or original ideas to create something.
Conceptual thinking	Understanding a situation or problem by putting the pieces together, seeing the large picture.

Project management	Using processes, methods, skills, knowledge and experience to achieve specific project objectives.
Change management	A systematic approach to dealing with the transition or transformation of an organization's goals, processes or technologies through implementing strategies for effecting change, controlling change and helping people to adapt to change.
Strategic direction	The knowledge of and expertise in the industry and organization that enhanced performance and better delivers business outcomes.
Negotiation	The process between two or more parties that aims to balance different interests, needs and expectations in order to reach a common agreement and commitment while maintaining a positive working relationship.
Cultural skills	The individual's approach to influence on the organization's culture and values and the wider society in which the project is situated.
Knowledge of construction	The knowledge, skills, and behaviors related to construction project.
Self-confidence	A person's belief in his or her own capability to accomplish a task.
HSE	Paying attention and having concern for health, safety, and environment of project in which people work.
Motivation	The competency through which managers enhance other's commitment to their work.
Customer focus	Focusing efforts on discovering and meeting the customer or client's needs.
Information seeking	An underlying curiosity to know more about things, people, or issues.
Initiative	A preference for taking action and doing more than is required or expected in the job, which will improve or enhance job results.
Self-control	The ability to keep emotions under control and to restrain negative actions when tempted, faced with opposition from others, or working under conditions of stress.
Relationship building	The ability of building and maintaining personal relationships to get productive collaboration and commitment of others.
Integration management	The processes and activities to identify, define, combine, unify, and coordinate the various processes and project management activities throughout the project.
Proactivity	Proactivity or proactive behavior involves acting in advance of a future situation, rather than just reacting.
Self-assessment	Knowing one's limits and strengths.
Managing group process	Ability to stimulate others to work effectively in a group setting.
Team selection	The careful choice of the best possible individuals from a group of similar people in order to accomplish a common goal.
Conscientiousness	Conscientiousness is the personality trait of being careful, or diligent.
Behavioral competencies	Any behavior attributes and personality traits a person might have, such as knowledge and skill set, which can help determine how successful he/she will be at their future job.
Project knowledge	Understanding methods, process and procedures, the technology required for project.
Interpersonal understanding	The ability of understanding and respecting other opinions, cultures, and interests.
Commitment	The state or quality of being dedicated to the project goal and success.
Efficiency orientation	Focus on delivering project on time, on budget, and based on agreed scope and quality.
Personal competencies	Personal competencies reflect the traits and characteristics that relate to what individual believe, how they think, how and what they feel and how they learn and develop.

Diagnostic of concepts	The ability of understanding concepts.
Sensitivity	An ability to understand what other people need, and be helpful and kind to them.
Knowledge management	A systematic management of information and learning which turns personal information and experience into collective knowledge that can be widely shared throughout an organization and a profession.
Directiveness	The character of being determined in direction of development or success in a project.
Continues improvement	An ongoing effort to improve project outcomes, services, or processes.
Vision	The ability to think about or plan the future with imagination or wisdom.
Estimating	The ability of estimating quantitative amounts required for planning or decision marking in a project.
Emotional resilience	The ability to adapt to stressful situations or crises.
Assertiveness	The ability of being confident and behaving forcefully.
Quickness and alertness	The ability of being alert and quick to perceive warning signals that can eventually lead to serious problems.
Trustworthiness	The ability to be relied on as honest or truthful.
Stress Management	The ability to handle adverse, tiring and stressful issues and situations.
Delegation of authority	The practice of giving a person or group the authority to perform the responsibilities of, or act on behalf of, another.
Cognitive capability	The ability to perform a certain physical or mental task.
Professionalism	The ability of demonstrating commitment to the project, operating with integrity, handling personal and team adversity in a suitable manner, manages a diverse workforce, and resolves individual and organizational issues with objectivity
Management	Management activities that are centered upon matters and things.
Organizational awareness	Understanding and utilizing organizational dynamics in order to achieve objectives.
Perceptual objectivity	Ability to be relatively objective rather than limited by excessive subjectivity or personal biases.
Requirement and Objectives	The ability of establishing the relationship between what stakeholders want to achieve and what the project is going to accomplish.
Organization and Information	The ability of creating a high-performing temporary organization, which also includes the inseparable link between organizational structure and communication processes.
Governance, structures and processes	The understanding of and the alignment with the established structures, systems, and processes if the organization that provide support for projects and influence the way they are organized, implemented and managed.
Compliance, standard and regulation	The way the individual interprets and balances the external and internal restrictions in a given area such as country, company, or industry.
Spontaneity	The ability to express oneself freely and easily.
Positive regard	The ability to express a positive belief in others.
Mobilization	Project manager is able to mobilize the mental and emotional energy of his subordinate.
Knowledge of using tools and techniques	Special knowledge in the use of tools and techniques.
Skills in the use of computer	Having required skills in the use of computer.
Understanding methods, process and procedures	Understanding methods, process and procedures of the project.

Sharing credit for success	Crediting all team or group members' efforts in the case of achieving the planned goal.
Self-awareness	The ability to step back and observe yourself objectively to know your behavior, motivations, feelings, values and desires
Tendering	The ability to handle the process of inviting bids for project and selecting a contractor for carrying out the project.
Operation management	The ability of administrating business practices to create the highest level of efficiency possible within a project organization.
General business management	The ability of understanding business including: marketing, sales, accounting, human resources, finance and logistics, coupled with a strong ability to lead teams, motivate employees, generate revenue and cut costs.
Interdependency management	Managing interdependencies and interactions among projects related to shared milestones, resources, and technology.
Multi-tasking	The ability of doing several things at once.
Being courageous	The ability to act on one's beliefs despite danger or disapproval.
Judgment	The ability to make considered decisions or come to sensible conclusions.
Accountability	The amount of freedom for staff, in a project or environment, to interpret objectives, select and choose how they deliver their work.
Social comprehension	Understanding the social features of the environment in which a project in carried out.
Intuitiveness	Perceiving directly by intuition without rational thought, as a person or the mind.
Ability to formulate goals	The ability of setting SMART (specific, measurable, achievable, realistic, and timely) goals.
Positive outlook	Having positive mental attitude for achieving something.
Learning orientation	Having strong passion for learning.
Empathy and aspiration	The ability to understand and share the feelings of another.
High energy level	Having high energy level for doing a job.
Having information technology skills	Having information technology skills.

Appendix 3. Timewise distribution of project managers' competencies (listed in Table 7)

Competency	Total frequency of appearance	Frequency of appearance over time			
		-1990	1991-2000	2001-2010	2010-2018
Communication	25	1	1	10	13
Leadership	19	0	0	6	13
Teamwork and cooperation	14	1	0	5	9
Flexibility	12	1	0	4	7
Problem solving		0	0	4	8
Goal orientation		0	0	6	6
Developing others		1	0	5	5
Impact and Influence		1	0	5	5
Stakeholder management	11	0	1	2	8
Cost management		0	0	2	9
Resource management		0	0	3	8
Analytical thinking	10	1	0	4	5
Quality management		0	0	1	8
Risk management	9	0	1	0	8
Conflict management		0	0	2	7
Ethics		0	0	1	8
Decision-making		0	0	1	7
Time management	8	0	0	2	6
Planning		0	1	3	4
Experience		0	1	1	5
Technical competencies		0	1	2	4
Procurement management	7	0	1	0	6
Scope management		0	0	2	5
Team management		0	0	3	3
Creativity		0	0	0	6
Conceptual thinking		1	0	3	2
Project management	6	0	0	2	4
Change management		0	0	0	6
Strategic direction		0	1	1	4
Negotiation		0	0	0	6
Cultural skills		0	0	0	6
Knowledge of construction		0	0	3	2
Self-confidence	5	1	0	2	2
HSE		0	0	1	4
Motivation		0	0	2	3
Customer focus		0	0	3	1
Information seeking		0	0	2	2
Initiative		0	0	2	2
Self-control	4	1	0	0	3
Relationship building		0	0	2	2
Project integration management		0	0	0	4

Proactivity		1	0	1	1
Self-assessment		1	0	0	2
Managing group process		1	0	1	1
Team selection		0	1	1	1
Conscientiousness		0	0	2	1
Behavioral competencies	3	0	0	2	1
Project knowledge		0	0	1	2
Interpersonal understanding		0	0	0	3
Commitment		0	0	0	3
Efficiency orientation		1	0	1	1
Personal competence		0	0	1	1
Diagnostic of concepts		1	0	1	0
Sensitivity		0	1	0	1
Knowledge management		0	0	2	0
Directiveness		0	0	2	0
Continues improvement		0	0	1	1
Vision		0	0	2	0
Estimating		0	0	1	1
Emotional resilience	2	0	0	1	1
Assertiveness		0	0	0	2
Trustworthiness		0	0	0	2
Stress Management		0	0	0	2
Delegation of authority		0	0	1	1
Cognitive capability		0	0	1	1
Professionalism		0	0	0	2
Management		0	0	0	2
Organizational awareness		0	0	0	2
Quickness and alertness		0	0	0	1
Perceptual objectivity		1	0	0	
Requirement and Objectives		0	0	0	1
Organization and Information		0	0	0	1
Governance, structures and processes		0	0	0	1
Compliance, standard and regulation		0	0	0	1
Spontaneity	1	1	0	0	0
Positive regard		1	0	0	0
Mobilization		0	0	1	0
Knowledge of using tools and techniques		0	0	1	0
Skills in the use of computer		0	0	1	0
Understanding methods, process and procedures		0	0	1	0
Sharing credit for success		0	0	1	0
Self-awareness		0	0	1	0
Tendering		0	0	1	0

|					
Operation management		0	0	1	0
General business management		0	0	1	0
Interdependency management		0	0	1	0
Multi-tasking		0	0	1	0
Being courageous		0	0	1	0
Judgment		0	0	0	1
Accountability		0	0	0	1
Social comprehension		0	0	0	1
Intuitiveness		0	0	1	0
Ability to formulate goals		0	0	0	1
Positive outlook		0	0	0	1
Learning orientation		0	0	0	1
Empathy and aspiration		0	0	0	1
High energy level		0	0	0	1
Having information technology skills		0	0	0	1

Figure
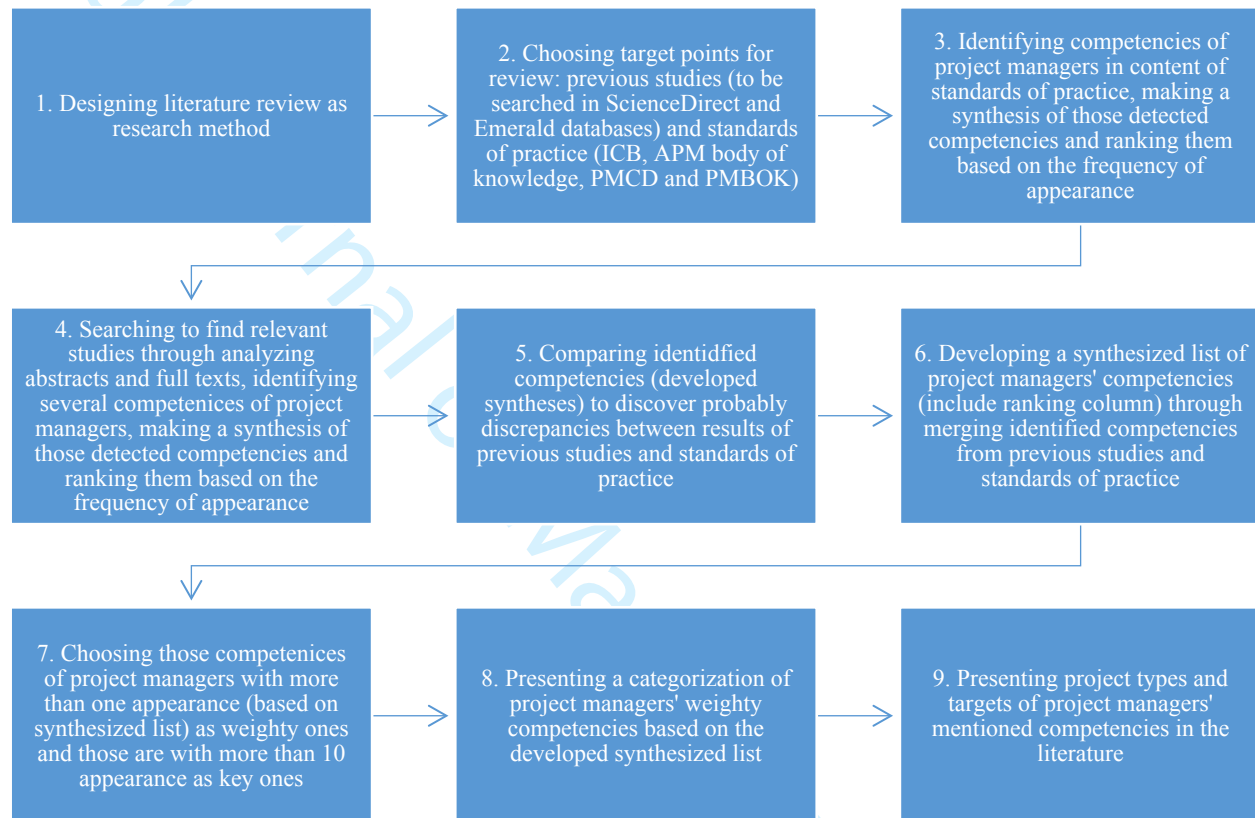
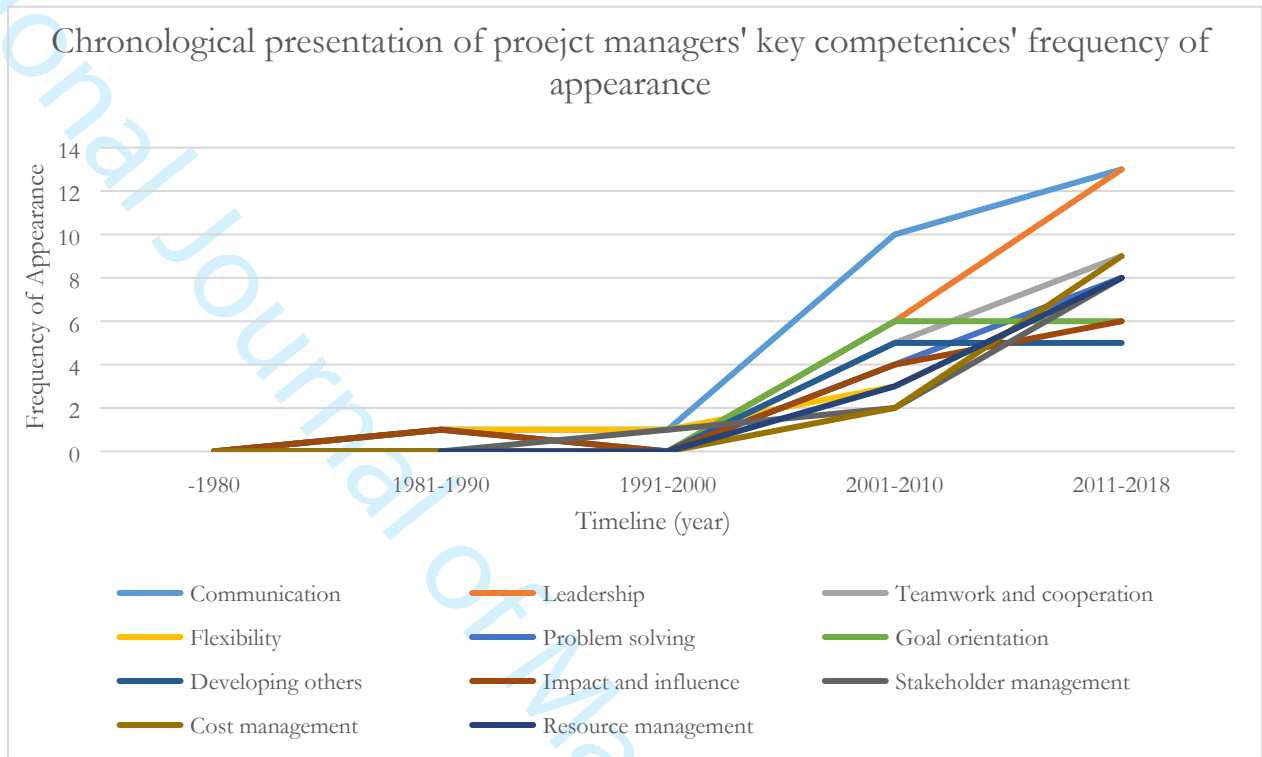
Fig.1. The research process

Fig. 2. Chronological presentation of project managers' key competencies' frequency of appearance

Tables

Table1. Categorization of project managers' competencies by different standards of practice

Project managers' competencies		
Standard/framework	Cluster/group	Competency
ICB.4	People	(1)Self-reflection and self-management (2)Personal integrity and reliability (3)Personal communication (4)Relationships and engagement (5)Leadership (6)Teamwork (7)Conflict and crisis (8)Resourcefulness (9) Negotiation (10)Result orientation
	Practice	(1)Project design (2)Requirements and objectives (3)Scope (4)Time (5)Organization and information (6)Quality (7)Finance (8)Resource (9)Procurement (10)Plan and control (11)Risk and opportunity (12)Stakeholders (13)Change and transformation
	Perspective	(1)Strategy (2)Governance, structure and processes (3)Compliance, standard and regulation (4)Power and interest (5)Culture and values
PMCD.3	Performance	(1)Project integration management (2)Project scope management (3)Project time management (4)Project cost management (5)Project quality management (6)Project human resource management (7)Project communication management (8)Project risk management (9)Project procurement management (10)Project stakeholder management
	Personal	(1)Communicating (2)Leading (3)Managing (4)Cognitive ability (5)Effectiveness (6)Professionalism
APM	Interpersonal	(1)Communication (2)Conflict management (3)Delegation (4)Influencing (5)Leadership (6)Negotiation (7)Teamwork
	professionalism	(1)Communities of practice (2)Competence (3)Ethics framework (4)Leading and development
PMI Talent Triangle(PMBOK)	(1)Technical project management skills (2)Leadership (3)Strategic and business management skills	

Table 2. Project managers' competencies in the standards of practice

Competency	References (frequencies)	Rank	Competency	Reference (frequencies)	Rank
Leadership	(ICB.4, APM, PMBOK, PMCD.3)	1	Result orientation	(ICB.4)	
Communication	(ICB.4, APM ,PMCD.3)	2	Project design	(ICB.4)	
Resource management	(ICB.4, APM ,PMCD.3)		Requirement and objectives	(ICB.4)	
Teamwork	(ICB.4, APM)		Organization and information	(ICB.4)	
Conflict management	(ICB.4, APM)		Change and transformation	(ICB.4)	
Negotiation	(ICB.4, APM)		Governance, structures and processes	(ICB.4)	
Project scope management	(ICB.4, PMCD.3)		Cultures and values	(ICB.4)	
Project quality management	(ICB.4, PMCD.3)		Compliance, standard and regulation	(ICB.4)	
Project cost management	(ICB.4, PMCD.3)	3	Managing	(PMCD.3)	4
Project procurement management	(ICB.4, PMCD.3)		Cognitive ability	(PMCD.3)	
Project integration management	(ICB.4, PMCD.3)		Effectiveness	(PMCD.3)	
Project risk management	(ICB.4, PMCD.3)		Professionalism	(PMCD.3)	
Project stakeholder management	(ICB.4, PMCD.3)		Influencing	(APM)	
Strategic and business management skills	(PMBOK, ICB.4)		Delegation	(APM)	
Self-reflection and self-management	(ICB.4)		Ethics framework	(APM)	
Personal integrity and reliability	(ICB.4)	4	Learning and development	(APM)	
Relationship and engagement	(ICB.4)		Technical project management skills	(PMBOK)	

Table 3. Project managers' weighty and notable competencies in the viewpoint of the research results

Competency	Freq	Rank	Competency	Freq	Rank	Competency	Freq	Rank
Communication	22	1	*Customer focus*	4	11	Spontaneity	1	14
Leadership	15	2	*Strategic direction*			Positive regard		
Teamwork and cooperation	12	3	*Information seeking*			Mobilization		
Flexibility			*Initiative*			Delegation of authority		
Problem solving	11	4	*Negotiation*	3	12	Knowledge of using tools and techniques		
Goal orientation			*Proactivity*			Skills in the use of computer		
Developing others	10	5	*Self-assessment*			Understanding methods, process and procedures		
Impact and Influence			*Self-control*			Sharing credit for success		
Analytical thinking			*Managing group process*			Self-awareness		
Stakeholder management	9	6	*Team selection*			Tendering		
Cost management			*Conscientiousness*			Operation management		
Resource management	8	7	*Behavioral competencies*			General business management		
Quality management			*Project knowledge*			Interdependency management		
Decision making			*Interpersonal understanding*			Multi-tasking		
Time management			*Relationship building*			Being courageous		
Experience	7	8	*Commitment*			Cognitive capability		
Planning			*Personal competence*			Judgment		
Risk management			*Efficiency orientation*			Accountability		
Conflict management			*Diagnostic of concepts*			Social comprehension		
Ethics			*Sensitivity*			Intuitiveness		
Team management	6	9	*Knowledge management*	2	13	Ability to formulate goals		
Creativity			*Directiveness*			Professionalism		
Conceptual thinking			*Continues improvement*			Management		
Project management			*Vision*			Positive outlook		
Technical competencies			*Estimating*			Learning oriented		
Knowledge of construction work	5	10	*Emotional resilience*			Empathy and Aspiration		
Change management			*Project integration management*			High energy level		
Self-confidence			*Assertiveness*			Information technology skills		
Procurement management			*Trustworthiness*					
Scope management			*Stress management*					
HSE			*Organizational awareness*					
Motivation			Alertness and quickness	1	14			
Cultural skills			Perceptual objectivity					

Freq: Frequency of appearance
Italic: weighty competencies (with more than one appearance)
Non italic: notable competencies (with one appearance)
Number of listed competencies: 64 (weighty)+30 (notable)= 94

Table 4. Discrepancies between research results and standards of practice over competencies of project managers

1.	**Some competencies are missing** in the standards of practice
2.	**There is a mismatch between research results and standards of practice** concerning priority of some project managers' competencies
3.	**There is uneven degree of consensus over importance of some project managers' competencies** between research results and the standards of practice
4.	**Research results are more context-oriented than the standards of practice** over project managers' competencies

Table 5. Discrepancies between result of research and standards of practice in terms of present and non-present competencies

The competencies present both in the standards of practice and previous studies	Communication, Leadership ,Stakeholder management, Goal orientation, Cost management , Developing others, Teamwork and cooperation, Resource management, Planning , Risk management, Conflict management, Impact and Influence, Quality management, Procurement management, Technical competencies, Scope management, Strategic direction, Ethics, Cultural skills, Negotiation, Self-control, Relationship building, Change management, Project integration management, Efficiency orientation, Delegation of authority, Cognitive capability, Professionalism, Management
The competencies present only in the previous studies	Flexibility, Problem solving, Analytical thinking, Decision making, Time management, Experience, Team management, Creativity, Conceptual thinking, Project management, Knowledge of construction work, Self-confidence, HSE(health, safety and environment), Motivation, Customer focus, Information seeking, Initiative, Proactivity, Self-assessment, Managing group process, Team selection, Conscientiousness, Behavioral competencies, Project knowledge, Interpersonal understanding, Commitment, Personal competence, Diagnostic of concepts, Sensitivity, Knowledge management, Directiveness, Continues improvement, Vision, Estimating, Emotional resilience, Assertiveness, Alertness and quickness, Trustworthiness, Stress management, Perceptual objectivity, Spontaneity, Positive regard, Mobilization, Knowledge of using tools and techniques, Skills in the use of computer, Understanding methods, process and procedures, Sharing credit for success, Self-awareness, Tendering, Operation management, General business management, Interdependency management, Multi-tasking, Being courageous, Judgment, Accountability, Social comprehension, Intuitiveness, Ability to formulate goals, Organizational awareness, Organizational awareness, Positive outlook, Learning orientation, Empathy and Aspiration, High energy level, Information technology skills
The competencies present only in the standards of practice	Requirement and Objectives; Organization and information; Governance, structures and processes; Compliance, Standard and regulation

Table 6 .Titles representing project managers' competencies

	Standards of practice	Research results	Synthesized list of project managers' competencies
Total 1	58	381	98
Total 2	34	94	
Notable	20	30	30
Weighty	14	64	68
Total 1: found competencies Total 2: synthesized competencies			

Table 7. List of project managers' competencies mentioned by previous studies and standards of practice from 1959 to 2018.

Competency	Freq	Rank	Competency	Freq	Rank	Competency	Freq	Rank
Communication	25	1	Motivation	5	11	Alertness and quickness	1	15
Leadership	19	2	Customer focused	4	12	Perceptual objectivity		
Teamwork and cooperation	14	3	Information seeking			Requirement and objectives		
Flexibility	12	4	Initiative			Organization and information		
Problem solving			Self-control			Governance, structures and processes		
Goal orientation			Relationship building			Compliance, standard and regulation		
Developing others			Project integration management			Spontaneity		
Impact and Influence	11	5	Proactivity	3	13	Positive regard		
Stakeholder management			Self-assessment			Mobilization		
Cost management			Managing group process			Knowledge of using tools and techniques		
Resource management			Team selection			Skills in the use of computer		
Analytical thinking	10	6	Conscientiousness			Understanding methods, process and procedures		
Quality management	9	7	Behavioral competencies			Sharing credit for success		
Risk management			Project knowledge			Self-awareness		
Conflict management			Interpersonal understanding			Tendering		
Ethics			Commitment			Operation management		
Decision making	8	8	Efficiency orientation			General business management		
Time management			Personal competence			Interdependency management		
Planning			Diagnostic of concepts			Multi-tasking		
Experience	7	9	Sensitivity			Being courageous		
Technical competencies			Knowledge management			Judgment		
Procurement management			Directiveness			Accountability		
Scope management			Continues improvement			Social comprehension		
Team management	6	10	Vision	2	14	Intuitiveness		
Creativity			Estimating			Ability to formulate goals		
Conceptual thinking			Emotional resilience			Positive outlook		
Project management			Assertiveness			Learning oriented		
Change management			Trustworthiness			Empathy and Aspiration		
Strategic direction			Stress management			High energy level		
Negotiation			Delegation of authority			Information technology skills		
Cultural skills			Cognitive capability					
Knowledge of construction work			Professionalism					
Self-confidence	5	11	Management					
HSE			Organizational awareness					

Freq: Frequency of appearance
Italic: weighty competencies (with more than one appearance)
Non italic: notable competencies (with one appearance)
Number of listed competencies: 68 (weighty)+30 (notable)= 98

Table 8. Project managers' weighty competencies and their categorization.

Category	Competencies
Personal	(1)Leadership (2)Goal-orientation (3)Creativity (4)Problem solving (5)Teamwork and cooperation (6)Initiative (7)Analytical thinking (8)Decision making (9)Flexibility (10)Self-confidence (11)Conceptual thinking (12)Information seeking (13)Ethics (14)Proactivity (15)Self-assessment (16)Self-control (17)Conscientiousness (18)Sensitivity (19)Directiveness (20)Experience (21) Assertiveness (22) Emotional resilience (23)Diagnostic of concepts (24)Perceptual objectivity (25)Trustworthiness (26)Stress management (27)Cognitive capability
Performance	(1)Cost management (2)Time management (3)Planning (4)Risk management (5)Project knowledge (6)Resource management (7)Quality management (8)Scope management (9) Procurement management (10) Project management (11)Project integration management (12)Managing group process (13)Knowledge of construction work (14)Change management (15)Diagnostics of concepts (16) Technical competencies (17)Estimating (18)Team management (19)HSE (20)Experience (21)Information seeking (22)Knowledge management (23) Professionalism (24)Management (25)Team selection (26)Delegation of authority
Perspective	(1)Strategic direction (2)Developing others (3)Customer-focus (4)Continuous improvement (5)Team selection (6)Efficiency orientation (7)Vision (8) Organizational awareness
Interpersonal	(1)Communication (2)Conflict management (3)Problem solving (4)Negotiation (5)Teamwork and cooperation (6)Impact and Influence (7)Motivation (8)Cultural skills (9)Stakeholder management (10)Team management (11) Interpersonal understanding

Note: numbers do not mean ranking.

Table 9. Matching different project managers' competencies to different project types/targets

Project type	Project/organization size and/or geographical location	Competencies	Reference
Organizational Change projects	Organizations with 9000-30000 employees	Leadership, Customer focus, Goal orientation, Teamwork, Stakeholder management, Planning, Developing others, Communication, Decision-making, Problem-solving, Cultural skills and Project management	Abraham et al. 2001, Crawford and Nahmias 2010, Trivellas and Drimoussis . 2013
Construction projects	All sizes (small, medium, and big): covering construction projects built around the globe include Asia, Africa, Europe, and America	Resource management, Knowledge of construction work, Teamwork and cooperation, Cost management, Flexibility, Leadership, Communication, HSE, Time management, Quality management, Stakeholder management, Experience, Project management, Ethics, Problem solving, Goal orientation, Impact and influence, Team management, Conflict management, Risk management, Creativity, Decision-making, Procurement management, Initiative, Information seeking, Analytical thinking, Developing others, Scope management, Motivation, Negotiation, Commitment, Conceptual thinking, Planning, Relationship building, Directiveness, Change management, Project integration management, Assertiveness, Self-confidence, Self-control, Tendering, Knowledge management, Operation management, Estimating, General business management, Judgment, Professionalism, Management, Alertness and quickness, Interpersonal understanding, Organizational awareness, Stress management, Ability to formulate goals, Sensitivity, Trustworthiness, Cultural competence, Positive outlook, Consciousness, Learning oriented, Empathy and Aspiration, Emotional resilience, High energy level, having information technology skills	Edum-Fotwe et al. 2000, DAINTY et al. 2004, Cheng et al. 2005, Mutijwaa and Rwelamila 2007, Chen et al. 2008, Ahadzie et al. 2008, Ahadzie et al. 2009, Lee et al. 2011, Dogbegah et al. 2011, Zhang et al. 2013, Hwang and Ng, 2013, Jabar et al. 2013, Panas et al., 2014, Tabassi et al. 2016, Omar and Fayek, 2016, Dziekoński, 2017, Abdullah et al. 2018, Shah and Prakash, 2018, Moradi et al. 2018
Engineering projects (all fields)	Firms ranged in size from 50 personnel to 35,000, and projects ranged $50,000–$500 million.	Analytical thinking, Developing others, Impact and Influence, Motivation, Conscientiousness, Leadership, Conflict management, Cultural skills, Time management, Flexibility, Continues improvement, Proactivity, Decision making, Risk management, Strategic direction	Müller and Turner 2007, Müller and Turner 2010, Fisher 2011, Takey et al. 2015
IT projects	Ranged from 1-9m$ and 20-60 employees	Experience, Team management, Leadership, Communication, Goal orientation, Negotiation, Integration management, Cost management, Scope management and Time management	Patanakul et al. 2008, Stevenson et al. 2010, Klendauer et al. 2012, Moradi et al. 2018
Metallurgical projects	Metallurgical projects in Czech Republic	Analytical thinking, Quality management, Risk management, Resource management, Teamwork and cooperation, Project knowledge, Self-control	Kostalova et al. 2018
International NGO projects	Conducted projects by 18 Canadian NGOs in Africa and Latin America	Adaptability, Management, Communication, Ethics, Change management	Brière et al. 2015
Public service projects	Australian public service projects	Communication, Accountability, Scope management, Change management, Goal orientation	Blixt et al. 2017
Target		Competencies	Reference
Employers' expectations		Industry-specific and generic skills over project management knowledge/expertise, Project management knowledge/expertise over, industry-specific and generic skills, Senior managerial skills, Positive personal traits, Project management methodology experience and professional qualifications, Risk management over a project life cycle, Goal orientation, Communication, Problem solving ,Customer focus, Developing others, Creativity	Chipulu et al. 2013, Radu 2014

Appendix 1. Detailed version of Tables 3 and 7

Competencies and Refereed Studies	Number of repetition
Communication (Crawford, 2000; Abraham et al., 2001; EI-Sabaa, 2001; Muller and Turner, 2007; Bikfalvi et al., 2009; Crawford and Nahmias, 2010; Dogbegah et al., 2011; de los Ríos et al., 2014; Brière et al., 2015; Liikamaa, 2015; Blixt and Kirytopoulos, 2017; Shah and Prakash, 2018; Cheng et al., 2005; Ruuska and Vartainen, 2003; Brill et al., 2006; Chen et al., 2008; Hwang and Ng, 2013; RADU, 2014; Omar and Fayek, 2016; Dziekoński, 2017; Powers, 1987; Gillard and Price, 2005; ICB.4; APM; PMCD.3)	25
Leadership (Abraham et al., 2001; Dainty et al., 2004; Cheng et al., 2005; Bikfalvi et al., 2009; Crawford and Nahmias, 2010; Chipulu et al., 2013; de los Ríos et al., 2014; Brière et al., 2015; Liikamaa, 2015; Tabassi et al., 2016; Omar and Fayek, 2016; Moradi et al., 2018; Bosch-Rekveldt et al., 2009; Fisher, 2011; Zhang et al., 2013; ICB.4; APM; PMBOK; PMCD.3)	19
Teamwork and cooperation (Dainty et al., 2004; Cheng et al., 2005; Abraham et al., 2001; de los Ríos et al., 2014; Omar and Fayek, 2016; Dziekoński, 2017; Kostalova et al., 2018; Lee et al., 2011; Zhang et al., 2013; Ahadzie et al., 2008, Ahadzie et al., 2009; Shah and Prakash, 2018; ICB.4; APM)	14
Flexibility (Cheng et al., 2005; Liikamaa, 2015; Takey and de Carvalho, 2015; Omar and Fayek, 2016; Dziekoński, 2017; Dainty et al., 2004; Shah and Prakash, 2018; Omar and Fayek, 2016; Brière et al., 2015; Powers, 1987; Gillard and Price, 2005; EI-Sabaa, 2001)	12
Problem solving (Abraham et al., 2001; EI-Sabaa, 2001; Brill et al., 2006; Crawford and Nahmias, 2010; Jabar et al., 2013; Panas et al., 2014; RADU, 2014; Omar and Fayek, 2016; Dziekoński, 2017; Shah and Prakash, 2018; Moradi et al., 2018)	
Goal orientation (EI-Sabaa, 2001; Ruuska and Vartainen, 2003; Dainty et al., 2004; Cheng et al., 2005; Abraham et al., 2001; Moradi et al., 2018; Muller and Turner, 2007; Klendauer et al., 2012; RADU, 2014; Liikamaa, 2015; Dziekoński, 2017; ICB.4)	
Developing others (Powers, 1987; Gillard and Price, 2005; Chipulu et al., 2013; Muller and Turner, 2007; Muller and Turner, 2010; Crawford and Nahmias, 2010; RADU, 2014; Liikamaa, 2015; Cheng et al., 2005; Omar and Fayek, 2016; APM)	11
Impact and Influence (Dainty et al., 2004; Cheng et al., 2005; Muller and Turner, 2007, Muller and Turner, 2010; Fisher, 2011; Zhang et al., 2013; Omar and Fayek, 2016; Powers, 1987; Gillard and Price, 2005; Lee et al., 2011; APM)	
Stakeholder management (Crawford, 2000; Crawford and Nahmias, 2010; Zhang et al., 2013; Hwang and Ng, 2013; Omar and Fayek, 2016; Abdullah et al., 2018; Moradi et al., 2018; Brill et al., 2006; Lee et al., 2011; ICB.4; PMCD.3)	
Cost management (Lee et al., 2011; Hwang and Ng, 2013; Omar and Fayek, 2016; Dziekoński, 2017; Abdullah et al., 2018; Moradi et al., 2018; Cheng et al., 2005; Mutijwaa and Rwelamila, 2007; Dogbegah et al., 2011; ICB.4; APM)	
Resource management (Muller and Turner, 2007; Tabassi et al., 2016; Mutijwaa and Rwelamila, 2007; Abdullah et al., 2018; Dogbegah et al., 2011; Omar and Fayek, 2016; EI-Sabaa, 2001; Hwang and Ng, 2013; ICB.4; APM; PMCD.3)	
Analytical thinking (Dainty et al., 2004; Cheng et al., 2005; Liikamaa, 2015; Omar and Fayek 2016; Kostalova et al., 2018; Muller and Turner, 2007; Muller and Turner, 2010; Chipulu et al., 2013; Dziekoński, 2017; Powers, 1987)	10
Quality management (Dogbegah et al., 2011; Omar and Fayek, 2016; Crayon et al., 2017; Abdullah et al., 2018; Kostalova et al., 2018; Cheng et al., 2005; Shah and Prakash, 2018; Lee et al., 2011; APM)	9
Risk management (Dogbegah et al., 2011; Hwang and Ng, 2013; Omar and Fayek, 2016; Crayon et al., 2017; Kostalova et al., 2018; Crawford, 2000; Takey and de Carvalho, 2015; ICB.4; PMCD.3)	

Conflict management (Ahadzie et al., 2008; Ahadzie et al., 2009; Fisher, 2011; Zhang et al., 2013; Hwang and Ng, 2013; Liikamaa, 2015; Dziekoński, 2017; ICB.4; APM)	
Ethics (Brill et al., 2006; Lee et al., 2011; Dogbegah et al., 2011; Omar and Fayek, 2016; Othman and Jaafar, 2013; Dziekoński, 2017; Shah and Prakash, 2018; ICB.4; APM)	
Decision making (Crawford and Nahmias, 2010; Othman and Jaafar, 2013; Panas et al., 2014; Liikamaa, 2015; Takey and de Carvalho, 2015; Omar and Fayek, 2016; Dziekoński, 2017; Moradi et al., 2018)	
Time management (Ahadzie et al., 2008; Ahadzie et al., 2009; Omar and Fayek, 2016; Abdullah et al., 2018; Shah and Prakash, 2018; Hwang and Ng, 2013; Takey and de Carvalho, 2015; Dziekoński, 2017)	8
Planning (EI-Sabaa, 2001; Chen et al., 2008; Crawford and Nahmias, 2010, Hwang and Ng, 2013; Crawford, 2000; Chipulu et al., 2013; Crawford and Nahmias, 2010; Dziekoński, 2017; ICB.4)	
Experience (Fotwe et al., 2000; Othman and Jaafar, 2013; Tabassi et al., 2016; Dziekoński, 2017; Kostalova et al., 2018; Lee et al., 2011; Patanakul and Milosevic, 2008)	
Technical competencies (Benita et al., 2009; Silvius and Batenburg, 2009; Jabar et al., 2013; Takey and de Carvalho, 2015; Crawford, 2000; Shah and Prakash, 2018; PMBOK)	7
Procurement management (Dogbegah et al. 2011; Crayon et al., 2017; Omar and Fayek, 2016; Crawford, 2000; Abdullah et al., 2018; ICB.4; PMCD.3)	
Scope management (Cheng et al., 2005; Omar and Fayek, 2016; Dziekoński, 2017; Moradi et al., 2018; Brill et al., 2006; ICB.4; APM)	
Team management (Patanakul and Milosevic, 2008; Cheng et al., 2005; Chen et al., 2008; Abdullah et al., 2018; Omar and Fayek, 2016; Lee et al., 2011)	
Creativity (Dziekoński, 2017; Shah and Prakash, 2018; RADU, 2014; Moradi et al., 2018; Dogbegah et al., 2011; Omar and Fayek, 2016)	
Conceptual thinking (Dainty et al., 2004; Cheng et al., 2005; Powers, 1987; EI-Sabaa, 2001; Klendauer et al., 2012; Ruuska and Vartainen, 2003)	
Project management (Mutijwaa and Rwelamila, 2007; Crawford and Nahmias, 2010; Chipulu et al., 2013; Jabar et al., 2013; Dziekoński, 2017; Dogbegah et al., 2011)	6
Change management (Brière et al., 2015; Omar and Fayek, 2016; Blixt and Kirytopoulos, 2017; Zhang et al., 2013; Shah and Prakash, 2018; ICB.4)	
Strategic direction (Crawford, 2000; Muller and Turner, 2007; Takey and de Carvalho, 2015; Blixt and Kirytopoulos, 2017; PMBOK; ICB.4)	
Negotiation (Omar and Fayek, 2016; Dziekoński, 2017; Shah and Prakash, 2018; Moradi et al., 2018; ICB.4; APM)	
Cultural skills (Crawford and Nahmias, 2010; Fisher, 2011; Omar and Fayek, 2016; Crayon et al., 2017; Moradi et al.,2018; ICB.4)	
Knowledge of construction work (Chen et al., 2008; Ahadzie et al. 2008, Ahadzie et al. 2009; Jabar et al., 2013; Shah and Prakash, 2018)	
Self-confidence (Powers, 1987; EI-Sabaa, 2001; Gillard and Price, 2005; Liikamaa, 2015; Dziekoński, 2017)	5
HSE (Cheng et al., 2005; Lee et al., 2011; Omar and Fayek, 2016; Abdullah et al., 2018; Shah and Prakash, 2018)	
Motivation (Muller and Turner, 2007; Muller and Turner, 2010; Omar and Fayek, 2016; Dziekoński, 2017; Shah and Prakash, 2018)	
Customer focus (Abraham et al., 2001; RADU, 2014; Dainty et al., 2004; Cheng et al., 2005)	4

Information seeking (Dainty et al., 2004; Cheng et al., 2005; Liikamaa, 2015; Shah and Prakash, 2018)	
Initiative (Dainty et al., 2004; Cheng et al., 2005; Liikamaa, 2015; Omar and Fayek 2016)	
Self-control (Powers, 1987; Omar and Fayek, 2016; Shah and Prakash, 2018; ICB.4)	
Relationship building (Bikfalvi et al. 2009; Chen et al. 2008; Zhang et al., 2013; ICB.4)	
Project integration management (Omar and Fayek, 2016; Moradi et al., 2018; ICB.4; PMCD.3)	
Proactivity (Powers, 1987; Gillard and Price, 2005; Takey and de Carvalho, 2015)	
Self-assessment (Powers, 1987; Liikamaa, 2015; Omar and Fayek, 2016)	
Managing group process (Powers, 1987; Gillard and Price, 2005; Lee et al., 2011)	
Team selection (Crawford, 2000; Crawford and Nahmias, 2010; Omar and Fayek, 2016)	
Conscientiousness (Muller and Turner, 2007; Muller and Turner, 2010; Shah and Prakash, 2018)	3
Behavioral competencies (Benita et al., 2009; Silvius and Batenburg, 2009; Fisher, 2011)	
Project knowledge (EI-Sabaa, 2001; Dziekoński, 2017; Shah and Prakash, 2018)	
Interpersonal understanding (Zhang et al., 2013; Omar and Fayek 2016; Bosch-Rekveldt et al., 2009)	
Commitment (Omar and Fayek, 2016; Moradi et al., 2018; Shah and Prakash, 2018)	
Efficiency orientation (Powers, 1987; Gillard and Price, 2005; PMCD.3)	
Personal competence (Bosch-Rekveldt et al., 2009; Brière et al., 2015)	
Diagnostic of concepts (Powers, 1987; Gillard and Price, 2005)	
Sensitivity (EI-Sabaa, 2001, Shah and Prakash, 2018)	
Knowledge management (Kasvi et al., 2003; Cheng et al., 2005)	
Directiveness (Dainty et al., 2004; Cheng et al., 2005)	
Continues improvement (Cheng et al., 2005; Takey and de Carvalho, 2015)	
Vision (Muller and Turner, 2007; Bosch-Rekveldt et al., 2009)	
Estimating (Mutijwaa and Rwelamila, 2007; Chipulu et al., 2013)	
Emotional resilience (Muller and Turner, 2007; Shah and Prakash, 2018)	2
Assertiveness (Dziekoński, 2017; Shah and Prakash, 2018)	
Trustworthiness(Shah and Prakash, 2018; Omar and Fayek, 2016)	
Stress management (Dziekoński, 2017, Liikamaa, 2015)	
Delegation of authority (EI-Sabaa, 2001; APM)	
Cognitive capability (Bikfalvi et al., 2009; PMCD.3)	
Professionalism (Lee et al., 2011; PMCD.3)	
Management (Lee et al., 2011; PMCD.3)	
Organizational awareness (Zhang et al. 2013; Liikamaa, 2015)	
Alertness and quickness (Othman and Jaafar 2013)	
Perceptual objectivity (Powers, 1987)	
Requirement and objectives (ICB.4)	1
Organization and information (ICB.4)	

Governance, structures and processes (ICB.4)
Compliance, standard and regulation (ICB.4)
Spontaneity (Powers, 1987)
Positive regard (Powers, 1987)
Mobilization (EI-Sabaa, 2001)
Knowledge of using tools and techniques (EI-Sabaa, 2001)
Skills in the use of computer (EI-Sabaa, 2001)
Understanding methods, process and procedures (EI-Sabaa, 2001)
Sharing credit for success (Brill et al., 2006)
Self-awareness (Muller and Turner, 2007)
Tendering (Mutijwaa and Rwelamila, 2007)
Operation management (Mutijwaa and Rwelamila, 2007)
General business management (Mutijwaa and Rwelamila, 2007)
Interdependency management (Patanakul and Milosevic, 2008)
Multi-tasking (Patanakul and Milosevic, 2008)
Being courageous (Bosch-Rekveldt et al., 2009)
Judgment (Lee et al., 2011)
Accountability (Blixt and Kirytopoulos, 2017)
Social comprehension (Moradi et al., 2018)
Intuitiveness (Muller and Turner, 2007)
Ability to formulate goals (Dziekoński, 2017)
Positive outlook (Shah and Prakash, 2018)
Learning oriented (Shah and Prakash, 2018)
Empathy and Aspiration (Dziekoński, 2017)
High energy level (Shah and Prakash, 2018)
Having information technology skills (Shah and Prakash, 2018)

Appendix 2. Definition of the competencies listed in Table 7

Definition of the competencies listed in Table 7	
Competency	Definition
Communication	The ability of listening actively, understanding, responding to stakeholders, maintaining lines of communication, ensuring quality of information, and tailoring communication to audience.
Leadership	Providing direction and guidance to individuals and groups. It involves ability to choose and apply appropriate styles of management in different situations.
Teamwork and cooperation	The ability of bringing people together to realize a common objective.
Flexibility	Adapting and responding quickly and effectively to challenging circumstances.
Problem solving	The ability of finding a solution or a course of action for the faced problem or issue.
Goal orientation	Setting, striving to achieve and achieving challenging goals.
Developing others	The ability of perceiving the development needs of others and reinforcing their abilities.
Impact and Influence	The act of affecting the behaviors and actions of others.
Stakeholder management	Systematic identification analysis, planning and implementation of actions designed to engage with stakeholders.
Cost management	The process of estimating and justifying costs in order to secure funds, controlling expenditure and evaluating the outcomes.
Resource management	The ability of defining, acquiring, controlling and developing the resources that are necessary to realizing project outcomes.
Analytical thinking	Understanding a situation by breaking it apart into smaller pieces, or tracing the implications of a situation in a step-by-step casual way.
Quality management	Ensuring that the outputs, benefits, and the processes by which they are delivered, meet stakeholder requirements and are fit for purpose.
Risk management	The ability of identification, assessment, response planning and implementation and control of opportunities and threats around the project.
Conflict management	The ability of identifying and addressing differences that, if left unresolved, could affect objectives.
Ethics	A key requirement of a profession is that individual members should act ethically.
Decision-making	The ability of making the decisions, which will have the most efficiency for the project.
Time management	The ability of developing schedule plan for project and keeping it up-to-date to avoid delays for on time delivery of the project.
Planning	The ability of determining what is to be delivered, how much it will cost, when it will be delivered, how it will be delivered and who will carry it out.
Experience	Having the experience of working in similar project or job.
Technical competencies	The knowledge, skills, and behaviors related to specific domains of project. The technical aspects of performing one's role.
Procurement management	The process of buying or obtaining goods and/or services from external parties.
Scope management	The process whereby outputs, outcomes, and benefits are identified, defined, and controlled.
Team management	The ability of directing a group of people toward achieving common goal(s).
Creativity	The use of imagination or original ideas to create something.
Conceptual thinking	Understanding a situation or problem by putting the pieces together, seeing the large picture.

Project management	Using processes, methods, skills, knowledge and experience to achieve specific project objectives.
Change management	A systematic approach to dealing with the transition or transformation of an organization's goals, processes or technologies through implementing strategies for effecting change, controlling change and helping people to adapt to change.
Strategic direction	The knowledge of and expertise in the industry and organization that enhanced performance and better delivers business outcomes.
Negotiation	The process between two or more parties that aims to balance different interests, needs and expectations in order to reach a common agreement and commitment while maintaining a positive working relationship.
Cultural skills	The individual's approach to influence on the organization's culture and values and the wider society in which the project is situated.
Knowledge of construction	The knowledge, skills, and behaviors related to construction project.
Self-confidence	A person's belief in his or her own capability to accomplish a task.
HSE	Paying attention and having concern for health, safety, and environment of project in which people work.
Motivation	The competency through which managers enhance other's commitment to their work.
Customer focus	Focusing efforts on discovering and meeting the customer or client's needs.
Information seeking	An underlying curiosity to know more about things, people, or issues.
Initiative	A preference for taking action and doing more than is required or expected in the job, which will improve or enhance job results.
Self-control	The ability to keep emotions under control and to restrain negative actions when tempted, faced with opposition from others, or working under conditions of stress.
Relationship building	The ability of building and maintaining personal relationships to get productive collaboration and commitment of others.
Integration management	The processes and activities to identify, define, combine, unify, and coordinate the various processes and project management activities throughout the project.
Proactivity	Proactivity or proactive behavior involves acting in advance of a future situation, rather than just reacting.
Self-assessment	Knowing one's limits and strengths.
Managing group process	Ability to stimulate others to work effectively in a group setting.
Team selection	The careful choice of the best possible individuals from a group of similar people in order to accomplish a common goal.
Conscientiousness	Conscientiousness is the personality trait of being careful, or diligent.
Behavioral competencies	Any behavior attributes and personality traits a person might have, such as knowledge and skill set, which can help determine how successful he/she will be at their future job.
Project knowledge	Understanding methods, process and procedures, the technology required for project.
Interpersonal understanding	The ability of understanding and respecting other opinions, cultures, and interests.
Commitment	The state or quality of being dedicated to the project goal and success.
Efficiency orientation	Focus on delivering project on time, on budget, and based on agreed scope and quality.
Personal competencies	Personal competencies reflect the traits and characteristics that relate to what individual believe, how they think, how and what they feel and how they learn and develop.

Diagnostic of concepts	The ability of understanding concepts.
Sensitivity	An ability to understand what other people need, and be helpful and kind to them.
Knowledge management	A systematic management of information and learning which turns personal information and experience into collective knowledge that can be widely shared throughout an organization and a profession.
Directiveness	The character of being determined in direction of development or success in a project.
Continues improvement	An ongoing effort to improve project outcomes, services, or processes.
Vision	The ability to think about or plan the future with imagination or wisdom.
Estimating	The ability of estimating quantitative amounts required for planning or decision marking in a project.
Emotional resilience	The ability to adapt to stressful situations or crises.
Assertiveness	The ability of being confident and behaving forcefully.
Quickness and alertness	The ability of being alert and quick to perceive warning signals that can eventually lead to serious problems.
Trustworthiness	The ability to be relied on as honest or truthful.
Stress Management	The ability to handle adverse, tiring and stressful issues and situations.
Delegation of authority	The practice of giving a person or group the authority to perform the responsibilities of, or act on behalf of, another.
Cognitive capability	The ability to perform a certain physical or mental task.
Professionalism	The ability of demonstrating commitment to the project, operating with integrity, handling personal and team adversity in a suitable manner, manages a diverse workforce, and resolves individual and organizational issues with objectivity
Management	Management activities that are centered upon matters and things.
Organizational awareness	Understanding and utilizing organizational dynamics in order to achieve objectives.
Perceptual objectivity	Ability to be relatively objective rather than limited by excessive subjectivity or personal biases.
Requirement and Objectives	The ability of establishing the relationship between what stakeholders want to achieve and what the project is going to accomplish.
Organization and Information	The ability of creating a high-performing temporary organization, which also includes the inseparable link between organizational structure and communication processes.
Governance, structures and processes	The understanding of and the alignment with the established structures, systems, and processes if the organization that provide support for projects and influence the way they are organized, implemented and managed.
Compliance, standard and regulation	The way the individual interprets and balances the external and internal restrictions in a given area such as country, company, or industry.
Spontaneity	The ability to express oneself freely and easily.
Positive regard	The ability to express a positive belief in others.
Mobilization	Project manager is able to mobilize the mental and emotional energy of his subordinate.
Knowledge of using tools and techniques	Special knowledge in the use of tools and techniques.
Skills in the use of computer	Having required skills in the use of computer.
Understanding methods, process and procedures	Understanding methods, process and procedures of the project.

Sharing credit for success	Crediting all team or group members' efforts in the case of achieving the planned goal.
Self-awareness	The ability to step back and observe yourself objectively to know your behavior, motivations, feelings, values and desires
Tendering	The ability to handle the process of inviting bids for project and selecting a contractor for carrying out the project.
Operation management	The ability of administrating business practices to create the highest level of efficiency possible within a project organization.
General business management	The ability of understanding business including: marketing, sales, accounting, human resources, finance and logistics, coupled with a strong ability to lead teams, motivate employees, generate revenue and cut costs.
Interdependency management	Managing interdependencies and interactions among projects related to shared milestones, resources, and technology.
Multi-tasking	The ability of doing several things at once.
Being courageous	The ability to act on one's beliefs despite danger or disapproval.
Judgment	The ability to make considered decisions or come to sensible conclusions.
Accountability	The amount of freedom for staff, in a project or environment, to interpret objectives, select and choose how they deliver their work.
Social comprehension	Understanding the social features of the environment in which a project in carried out.
Intuitiveness	Perceiving directly by intuition without rational thought, as a person or the mind.
Ability to formulate goals	The ability of setting SMART (specific, measurable, achievable, realistic, and timely) goals.
Positive outlook	Having positive mental attitude for achieving something.
Learning orientation	Having strong passion for learning.
Empathy and aspiration	The ability to understand and share the feelings of another.
High energy level	Having high energy level for doing a job.
Having information technology skills	Having information technology skills.

Appendix 3. Timewise distribution of project managers' competencies (listed in Table 7)

Competency	Total frequency of appearance	Frequency of appearance over time			
		-1990	1991-2000	2001-2010	2010-2018
Communication	25	1	1	10	13
Leadership	19	0	0	6	13
Teamwork and cooperation	14	1	0	5	9
Flexibility	12	1	0	4	7
Problem solving		0	0	4	8
Goal orientation		0	0	6	6
Developing others	11	1	0	5	5
Impact and Influence		1	0	5	5
Stakeholder management		0	1	2	8
Cost management		0	0	2	9
Resource management		0	0	3	8
Analytical thinking	10	1	0	4	5
Quality management	9	0	0	1	8
Risk management		0	1	0	8
Conflict management		0	0	2	7
Ethics		0	0	1	8
Decision-making	8	0	0	1	7
Time management		0	0	2	6
Planning		0	1	3	4
Experience	7	0	1	1	5
Technical competencies		0	1	2	4
Procurement management		0	1	0	6
Scope management		0	0	2	5
Team management	6	0	0	3	3
Creativity		0	0	0	6
Conceptual thinking		1	0	3	2
Project management		0	0	2	4
Change management		0	0	0	6
Strategic direction		0	1	1	4
Negotiation		0	0	0	6
Cultural skills		0	0	0	6
Knowledge of construction	5	0	0	3	2
Self-confidence		1	0	2	2
HSE		0	0	1	4
Motivation		0	0	2	3
Customer focus	4	0	0	3	1
Information seeking		0	0	2	2
Initiative		0	0	2	2
Self-control		1	0	0	3
Relationship building		0	0	2	2
Project integration management		0	0	0	4

Proactivity	3	1	0	1	1
Self-assessment		1	0	0	2
Managing group process		1	0	1	1
Team selection		0	1	1	1
Conscientiousness		0	0	2	1
Behavioral competencies		0	0	2	1
Project knowledge		0	0	1	2
Interpersonal understanding		0	0	0	3
Commitment		0	0	0	3
Efficiency orientation		1	0	1	1
Personal competence	2	0	0	1	1
Diagnostic of concepts		1	0	1	0
Sensitivity		0	1	0	1
Knowledge management		0	0	2	0
Directiveness		0	0	2	0
Continues improvement		0	0	1	1
Vision		0	0	2	0
Estimating		0	0	1	1
Emotional resilience		0	0	1	1
Assertiveness		0	0	0	2
Trustworthiness		0	0	0	2
Stress Management		0	0	0	2
Delegation of authority		0	0	1	1
Cognitive capability		0	0	1	1
Professionalism		0	0	0	2
Management		0	0	0	2
Organizational awareness		0	0	0	2
Quickness and alertness	1	0	0	0	1
Perceptual objectivity		1	0	0	
Requirement and Objectives		0	0	0	1
Organization and Information		0	0	0	1
Governance, structures and processes		0	0	0	1
Compliance, standard and regulation		0	0	0	1
Spontaneity		1	0	0	0
Positive regard		1	0	0	0
Mobilization		0	0	1	0
Knowledge of using tools and techniques		0	0	1	0
Skills in the use of computer		0	0	1	0
Understanding methods, process and procedures		0	0	1	0
Sharing credit for success		0	0	1	0
Self-awareness		0	0	1	0
Tendering		0	0	1	0

Operation management	0	0	1	0
General business management	0	0	1	0
Interdependency management	0	0	1	0
Multi-tasking	0	0	1	0
Being courageous	0	0	1	0
Judgment	0	0	0	1
Accountability	0	0	0	1
Social comprehension	0	0	0	1
Intuitiveness	0	0	1	0
Ability to formulate goals	0	0	0	1
Positive outlook	0	0	0	1
Learning orientation	0	0	0	1
Empathy and aspiration	0	0	0	1
High energy level	0	0	0	1
Having information technology skills	0	0	0	1