Michelle Burger, Basie Verster & Benita Zulch

The construction project manager in South Africa: Analysis of industry-specific knowledge

Peer reviewed and revised

Abstract

Construction project managers in the built environment come from various backgrounds and knowledge bases; therefore, the project managers' project management set may differ. The type of knowledge required to improve CPD training of project managers thus needs to be determined. This would raise the knowledge levels needed for built environment project managers. The aim of this article is to determine the knowledge needed for the successful management of projects within the built environment.

Industry-specific guidelines for construction project management (PMBOK and SACPCMP) were obtained and analysed. Expert interviews were conducted with experienced specialists (n=10) who held a senior managerial position within project management in the built environment. A case study and email questionnaires (n=40) were also analysed to determine the type of knowledge required. Data analysis was done using Microsoft Excel 2003®.

Three areas of knowledge were identified, namely project management knowledge, industry-specific knowledge and knowledge through experience. Of these, industry-specific knowledge was considered the most important, although all three were very important. Project management knowledge areas essential to project managers included the nine PMBOK knowledge areas from the PMI PMBOK guide, 4th edition 2008, four additional PMI Construction extension to the PMBOK areas, experience as well as built environment-specific knowledge. This study was limited to the nine knowledge areas and did not include stakeholder management as the tenth area. The results from all three test methods (interviews, questionnaires and a case study) indicated that knowledge was essential for effective leadership, trust and communication within a project. Without knowledge, these organisational factors were compromised and project success could be negatively affected.

Dr Michelle Burger, Programme Leader BSc and Hons Real Estate, Department of Construction Economics, University of Pretoria, PO Box 2573, Brooklyn Square, Pretoria, South Africa, 0081. Phone: 082 418 2833, email: <michelle.burger@up.ac.za>

Prof JJP (Basie) Verster, Research fellow, Department of Quantity Surveying and Construction Management, PO Box 392, Bloemfontein, University of the Free State, 051 4308264, email: <info@vbvqs.co.za>

Dr Benita G. Zulch, Programme Director, Department of Quantity Surveying and Construction Management, PO Box 392, Bloemfontein, University of the Free State, 051 4013849, email: zulchbg@ufs.ac.za

It is concluded that the knowledge needed for the management of projects within the built environment had to include industry-specific knowledge pertinent to the built environment. The knowledge required does not currently appear in a single document, and it is recommended that a new document or set of required skills be established.

Keywords: Construction project management, built environment, industry knowledge, project management knowledge, experience, type of knowledge required

Abstrak

Projekbestuurpaaie is gewoonlik deur verskeie agtergrond en kennisbasisse, dus mag projekbestuurders se kennisstel verskil. Die tipe kennis wat benodig word om VPO-opleiding van projekbestuurders te verbeter, moet bepaal word. Dit sal die kennisvlakke wat bou-omgewing projekbestuurders benodig, verhoog. Die doel met die artikel is om die benodigde kennisvlakke van 'n projekbestuurder in die bou-omgewing vas te stel.

Industriespesifieke konstruksieprojekbestuurriglyne (PMBOK en SACPCMP) is verkry en geanaliseer. Spesialis onderhoude is met ervare spesialiste (n=10) wat 'n senior posisie in die bou-omgewing beklee, gehou. 'n Gevallestudie en epos vraelyste (n=40) is ook ontleed om die tipe kennis wat benodig word te bepaal. Data-analise is gedoen deur Microsoft Excell 2003® te gebruik.

Die drie kennisareas is projekbestuurkennis, industrie-spesifieke kennis en kennis deur ondervinding. Van die drie areas, is industrie kennis as die belangrikste gereken, alhoewel almal belangrik was. Projekbestuur kennisareas wat belangrik is vir projekbestuurders sluit die nege PMBOK kennisareas van die PMI PMBOK 4de uitgawe 2008 in, en vier addisionele areas van die PMI Konstruksie uitbreiding tot die PMBOK, kennis deur ondervinding en industrie-spesifieke kennis in. Die studie was beperk tot die nege kennis areas en het nie belanghebbendesbestuur as tiende area ingesluit nie. Die resultate van al drie toetsmetodes (onderhoude, vraelyste en 'n gevallestudie) wys op die belangrikheid van kennis vir leierskap, vertroue en kommunikasie tydens 'n projek. Sonder kennis word hierdie organisasiefaktore benadeel en kan projeksukses negatief beïnvloed word.

Dit is bevind dat die kennis wat 'n projekbestuurder in die bou-omgewing benodig industrie-spesifiek binne die bou-omgewing moet wees. Daar bestaan nie tans een dokument wat die totale kennisstel bevat nie. Dit word aanbeveel dat 'n nuwe dokument of stel van vereiste kennis/vaardighede saamgestel word.

Sleutelwoorde: Konstruksieprojekbestuur, bou-omgewing, industriekennis, projekbestuurkennis, ondervinding, tipe kennis benodig

1. General introduction

Construction project managers in the built environment come from various backgrounds and knowledge bases. Some have thorough industry-specific knowledge, while others have limited or no construction knowledge. The type of knowledge a project manager in this industry requires, needs to be determined in order to establish whether their knowledge set fits the set that is needed in the built environment.

2. Aim and objectives of the research

The research aims to determine what type of knowledge is needed for a construction project manager in the built environment. The aim is to compile a knowledge set for construction project managers in the built environment. This knowledge set may prove useful for future training and education of construction project managers, and may increase the effectiveness of the project and the likelihood of project success.

3. Project management in the built environment

The built environment in South Africa is a large industry that consists of both building and civil engineering construction. Companies want to optimise profit. This holds true in the built environment as in other industries. Therefore, companies need to manage and finalise projects as effectively and efficiently as possible. Project managers play a vital part in the successful completion of projects. They are closely involved from inception through to completion. They are thus key players in the success of projects and the financial gain that companies stand to make.

The aim is to keep the project within time, scope, and cost and according to the expected quality (Kerzner, 2013: 1-10; Burke, 2013). Effective project management will help complete the project as it was planned, thereby meeting companies' aim of attaining goals and being as efficient as possible (Daft, Kendrick & Vershinina, 2010). To increase the possibility of project success, project management and the project manager are important factors (Chordas 2008: 66-69; Kerzner, 2013: 1-10; Trebilcock, 2007: 40).

3.1 Project managers

Construction project managers in the built environment have various backgrounds and knowledge bases. These managers are from fields not only within the built environment such as construction management, engineering, town planning, and quantity surveying, but also beyond the built environment. The common ground among these managers is that they are all involved in project management and have a certain knowledge base of project management as a discipline. Project management is a profession that is governed internationally by institutions, associations and councils and for which a body of knowledge has been developed (Klastorin, 2004: 18; Davis & Pharrow, 2003: 3-4). Regulating bodies such as the PMI (Project Management Institute) have project management members from

various fields (PMI, 2015), while others are industry specific. The South African Council for the Project and Construction Management Professions (SACPCMP, 2015: Online) is an industry-specific example, focusing on the built environment. This is a statutory body that requires all practising project managers to register (SACPCMP Management Bill, 2000: 2, 8-9).

The profession of project management offers training courses as well as degrees at institutions such as universities to educate future project managers. The education provided is either generic project management or industry specific. What needs to be evaluated is the required knowledge that is essential for a project manager in the built environment. The knowledge that is needed to effectively and productively manage projects has to be clear (Dinsmore, Kloppenborg & Opfer, cited in Morrison, Brown & Smit, 2006: 39; Cooke-Davies & Arzymanow, 2003: 471-478; Shenhar, 2008: 2).

3.1.1 Knowledge and organisational factors

Knowledge has an influence on the organisational elements of leadership, communication and trust, as well as on the specific terms used in a built industry project. This is supported by research by Berry, Verster & Zulch (2009: 12-15), Butler & Cantrell (as cited in Robbins, 1996: 357) and Culp & Smith (1992: 68-69). These organisational elements are addressed as they accentuate the importance of industry-specific knowledge and how it influences project success. Kerzner (2013) states that organisational factors such as leadership, communication and trust contribute to and influence project management in the built environment and contribute to effective and successful project management.

3.1.1.1 Project leadership

Construction project managers should have some leadership role to fulfil in order to be a good leader (Kerzner, 2013). Leadership contributes to project success (Heldman, 2006). Leaders need to be competent (Culp & Smith, 1992: 68-69) and require technical knowledge, interpersonal skills and project management skills (Culp & Smith, 1992: 68-69). Without knowledge, a project managers' leadership will be affected, as leaders give vision and motivate people. This takes place through effective leadership while managing projects (Heldman, 2006). However, effective communication is essential in order to motivate others.

3.1.1.2 Project communication

A project manager needs to communicate effectively (Heldman, 2011) in order to be a leader (Burke, 2013). There is a difference between communication and effective communication. Communication is the receiving and understanding of information, whereas effective communication is the receiving, understanding and subsequent acting in a desirable manner (Goetsch, 2004: 66-67). Good communication is one of the key factors necessary for team performance, effective project management and successful projects (Chiocchio, 2007). However, effective communication depends on knowledge (PMBOK, 2004). A project manager needs to know what questions to ask and be able to interpret what is being said by the professional team. Therefore, knowledge of the industry instruments is essential for a construction project manager (Berry, Verster & Zulch, 2009). This leads to good communication. The credibility of a project manager's communication leads to trust.

3.1.1.3 Project trust

Trust is an essential element of a project and impacts on a project's success. It is, therefore, important to understand how it develops and where it comes from (Romahn & Hartman, 1999: 1).

Robbins (1996) states that trust is based on five dimensions, namely integrity, competency, consistency, loyalty and openness. Competency includes technical and interpersonal knowledge and skills. This once again highlights that a project manager needs to have knowledge in order to be trusted by team members. Trust has an influence on effective communication (Romahn & Hartman, 1999: 1), and communication is essential for successful project management (Chiocchio, 2007: 97). It is very important to have trust within a project to ensure a successful project. It is important for a project manager to improve the ability to communicate, organise, build teams and provide leadership (Birkhead, Sutherland & Maxwell, 2000: 101).

3.2 Types of knowledge

There are two schools of thought on the type of knowledge required by project managers, namely generic or industry specific (Besner & Hobbs, 2008: 16-33; Cadle & Yeates, 2001: 358). Those who support the generic school of thought believe that project management is transportable across different industries. It infers that all that is needed for a project manager to be successful is the project toolkit. This implies that technical knowledge about the industry in which the project manager operates is not important (Turk, 2007: 25). By implication, this

means that a construction project manager does not need technical knowledge of the built environment, but that he can rely solely on project management knowledge.

The industry-specific school of thought regards a project manager's knowledge of the industry of the project they are managing as very important. The one common denominator between the two views is project management. The industry-specific view believes that both industry knowledge and project management knowledge should be mandatory for all project managers (Turk, 2007: 25).

3.2.1 Project management knowledge (generic)

Project management knowledge can be viewed as a toolkit. This toolkit is used and transported to any industry, regardless of the project manager's knowledge of the industry being managed. The PMI Project Management Body of Knowledge (PMBOK) 4th edition identified and listed nine generic knowledge areas. The PMI PMBOK 5th edition of 2015 listed ten knowledge areas, with stakeholder management being a new addition (PMBOK, 2015). The research was, however, based on the 4th edition, as the 5th edition was not yet available at the time the research was conducted. The nine knowledge areas are integration management, scope management, time management, cost management, quality management, human resource management, communication management, risk management, and procurement management (PMBOK, 2008).

The PMI Construction extension to the PMBOK identified four extra areas that have been stipulated in the guide, namely financial management, claims management, environmental management, and safety management (PMI Construction PMBOK, 2008: Online).

This indicates that the PMI agrees that a generic approach to the construction industry dsoe not suffice. Publishing a PMI Construction extension to the PMBOK acknowledges the need for further industry knowledge areas. This suggests that industry knowledge is essential for a construction project manager.

3.2.2 Industry-specific knowledge

As stated in the PMBOK (2008), construction project managers need industry knowledge, project management knowledge and general management knowledge in order to be effective in their job. This adds to the efficiency and effectiveness of the management of construction projects. This is also supported by Ashworth & Hogg (2007: 379-380) who state that construction project managers need industry

knowledge in order to effectively do certain tasks. This may include developing a project strategy, evaluating tenders, coordinating design processes, and participating in contractor selection (Ashworth & Hogg, 2007: 379-380).

The SACPCMP also supports the importance of industry knowledge. They note that, in order to be able to conduct the projects effectively, a construction project manager needs to have certain competencies, namely project management competencies and technical competencies (SACPCMP, 2015: Online).

Table 1 lists the four areas provided by the SACPCMP and reflects the required knowledge within these areas.

Table 1: Technical knowledge of a construction project manager

Technical knowledge areas	*Required knowledge*
Knowledge of construction science	Understanding structures
	Understanding construction and building sciences
	Understanding construction and building finishes
	Knowledge of building materials
Knowledge of construction processes	Site, plant and equipment
	Formwork systems
	Quality management
	Health and safety management
	Environmental management
	Organisational/Management structures
	General building sequences
	General output and production factors
	Basic knowledge of building trades
Knowledge of design processes	Sequence of design processes
	Time required for design processes
Knowledge of financial and cost factors	Financial processes
	Cost of construction

(SACPCMP, 2015: Online)

In addition to the PMI Construction extension to the PMBOK 4th edition, the suggested knowledge areas set out in the SACPCMP guide may offer further insight into an essential industry knowledge set (SACPCMP, 2015: Online). As reflected in Table 1, these four SACPCMP knowledge areas are construction science, finance and cost, construction process, and design process.

3.3 Suggested knowledge set

The importance or not of industry-specific knowledge in project management has been widely discussed (Cadle & Yeates, 2001: 358; Webb, 1994: 55; Wirth, 1996: 10). Kerzner (2013) emphasises the necessity of industry knowledge, stating that one of the skills that both project and programme managers need is technical skills. Technical expertise is necessary to evaluate technical concepts and solutions, to communicate effectively in technical terms with the project team, and to assess risks and make trade-offs between cost, schedule and technical issues. Kerzner (2013) states that this is the reason why, in complex problem-solving situations, many project managers need to have an engineering background. Project managers working in construction need to have knowledge of the construction industry (Ashworth & Hogg, 2007: 381-384).

An effective project manager needs to have general management and interpersonal knowledge, project management knowledge (Declerk, Eymery & Crener, cited in Pettersen, 1991: 100; Pacelli, 2004: 54), as well as technical knowledge and experience (Kerzner, 2013: 1-15; Lee & Sweeney, 2001: 16; Petterson, 1991: 99). A combination of these knowledge areas is essential in order to effectively manage a project.

The aim of this article is to determine what knowledge is needed. This may add to the tailoring of CPD courses that can help improve the knowledge base of project managers in the industry. It may also add value to the curriculum planning of construction project management degrees. The findings also indicate the importance of professional qualifications and what knowledge should be required. Subsequently, this will improve the quality of project management and thus the outcome.

4. Research

In this study, interviews, questionnaires and a case study were used as empirical research methods. The research was undertaken in the actual environment and not in a laboratory or under simulated conditions. The respondents were people who work in the built environment and who are involved with project management. The research strategy was both quantitative and qualitative.

4.1 Sampling method

Questionnaires were compiled and distributed to a control group. Incorporating a control group is one way of increasing the validity of a study (Leedy & Ormrod, 2010: 226). The control group gave feedback that was used to adjust and improve the questionnaire before circulating it to the respondents. The respondents were built environment professionals who are in close contact with project management. The questionnaire consisted of two sections. Section A used a checklist to answer general questions and section B used the Likert scale as well as open-ended questions that investigated what knowledge is essential. The Likert scale consisted of five categories. Weighted averages were drawn from the data received from the Likert scale.

It was decided to include a project as case study. A project run by a project manager with project management knowledge but without sufficient industry knowledge was selected. The case study was selected as it complied with the selection criteria and the author had contact with the professional team. The project within the built environment was managed by a construction project manager without adequate industry knowledge. This offered an opportunity to view the impact on a project, should the project manager lack industry-specific knowledge. Several instances that occurred and were directly linked to industry knowledge were analysed. Lastly, interviews were conducted with senior professionals working in the built environment. Large reputable companies were contacted to request their participation in the research. Once the companies accepted, the interviewees were selected based on their extensive knowledge and expertise regarding project management within the built environment. The data gathered was then perused, categories were identified and data placed within these categories from which conclusions were drawn.

4.2 Sample size

Ten interviews were conducted with expert specialists. One case study and forty questionnaires were analysed. The use of multiple research methods added to the validity of the sample size.

4.3 Data collection

Organisations that have established a name in the industry as professional experts were earmarked as possible sources of information and opinions for the interviews. The interviewees all held qualifications and registrations within project management. The city and address of

the organisations were determined. The interviews were planned, a date was set to meet and individual interviews were conducted. All discussions were recorded and used as the interview data. In order to distribute and collect data from the questionnaires, email addresses were obtained from professionals in the built environment. Selected professionals were invited to participate. The Leedy and Ormrod (2010: 194) list of guidelines for compiling questionnaires was followed. The questionnaire, along with a cover letter explaining the research request, was sent to the prospective respondents. For the case study, the contact person and contact details were obtained. This person discussed the project. All the discussions and emails exchanged were noted. It was also determined how the data would be interpreted. This was a cross-sectional study that was carried out only once (Schoonraad, 2003: 139). The interviews were conducted within two weeks and questionnaires were sent out and returned within a two-month period.

4.4 Response rate

The questionnaire response rate was 57%. Therefore, according to statistical indicators, this response rate could be accepted as valid. Ten interviewees were contacted and asked to participate. All ten agreed to take part in the research. The interviews were conducted with a separate group to the group that answered the questionnaires.

4.5 Data analysis and interpretation of findings

A 5-point Likert scale was used to obtain the opinions of the respondents and to analyse the results. Likert scales need a minimum of two categories and a maximum of eight or nine (Neuman, 1997: 159; Leedy, 2010: 189). For the purpose of analysis and interpretation, the scale measurement between 1 and 5 was used. Likert-type or frequency scales are designed to measure attitudes or opinions. In this research, these ordinal scales measure levels of not important/ very important. The scales were 1 'not important', 2 'fairly important', 3 'important', 4 'very important' and 5 'critically important'. This scale from 1 to 5 was used to calculate weighted averages. The data were captured using Microsoft Excel 2003® and then analysed using the SPSS program. The findings were then reviewed against the literature review. This was used in order to make deductions and increase the understanding of the required knowledge for project management in the built environment.

It was decided to use various research methods such as a case study, questionnaire and interviews in order to increase the validity and

reliability of the study. This ensured that the research did not rely on a single set data procurement method and allowed for comparison between the three sets of data. Close attention was paid to maintain a reliable and valid research process and feedback.

4.6 Limitations

It must be noted that this study focused on the 9 PMBOK knowledge areas from the PMI PMBOK guide 4th edition 2008 and not the 5th edition. Therefore, this study was limited to the 9 PMBOK knowledge areas and did not include stakeholder management as the 10th area.

5. Results

The results were analysed according to the type of knowledge and evaluated in each case using questionnaires, interviews and a case study.

The PMI construction extension to the PMBOK areas and the SACPCMP knowledge areas were reviewed in order to interpret the similarities and the gaps within the PMI construction extension and the SACPCMP, respectively. The findings of the in-depth perusal of the PMI construction extension to the PMBOK and SACPCMP showed the following shortcomings, as displayed in Table 2.

Table 2: Construction PMBOK and SACPCMP knowledge areas

Construction PMBOK knowledge areas	*SACPCMP*	
Integration management	Construction science	Understanding structures
Scope management		Understanding building science
Time management		Understanding building finishes
Cost management		Knowledge of building materials
Quality management	Construction processes	Site plant and equipment
Human resource management		Formwork
Communication management		Building sequences
Risk management		Output and production factors
Procurement management		Knowledge of building trades
Safety management	Design processes	Sequence of design processes
Environmental management		Time required for design processes
Financial management	Financial and cost	Cost of construction
Claims management		

It is clear from Table 2 that the construction-specific knowledge areas in the PMBOK do not overlap with the SACPCMP knowledge areas. The required knowledge set of a construction project manager was compiled.

Financial management is the only similar technical area listed. The PMI construction extension lists claims management, health and safety management and environmental management that are not listed by the SACPCMP. The SACPCMP listed construction science, construction processes and design processes that were not listed by the PMI construction extension.

5.1 Types of knowledge

The questionnaires, interviews and case study all indicated that the knowledge set a project manager in the built environment requires is a combination of project management knowledge, industry knowledge and knowledge through experience. The findings from the three research methods (interviews, questionnaires and a case study) are discussed below.

5.1.1 Knowledge through experience

One of the interviewees indicated that the company for which he works sets the benchmark at 10 years' industry experience as sufficient. Less than 10 years was regarded as possibly too little. Should a candidate only have 2 years' experience, for instance, this would not suffice.

The questionnaire respondents supported the importance of knowledge through experience. Table 3 shows how the questionnaire respondents rated the importance of experience in the field of the built environment in order to be successful.

Table 3: Importance of work experience in the built environment

Responses	*1 = Not important 5 = Critically important*					
	1	*2*	*3*	*4*	*5*	*Total*
Percentage of total	0	2.5	2.5	52.5	42.5	100
Average rating	4.35					

The weighted average is 4.35. Of the respondents, 52.5% regarded experience as very important and 42.5% as critically important. All interviewees indicated that experience is important. One company regarded experience as so imperative that they required project

managers to have ten years' industry experience before being appointed as construction project manager. The case study also supported the importance of knowledge through experience.

5.1.2 Project management knowledge

Previous theory revealed that project management knowledge is essential knowledge for effective project management (Declerk, Eymery & Crener, cited in Pettersen, 1991; Pacelli, 2004). The theory was researched and the questionnaire findings are presented in Table 4. This is the respondents' opinion on how important generic project management knowledge is for a construction project manager to successfully manage a project.

Table 4: Importance of project management knowledge in the built environment

Responses	*1 = Not important 5 = Critically important*					
	1	*2*	*3*	*4*	*5*	*Total*
Percentage of total	2.5	12.5	37.5	35	12.5	100
Average rating	3.43					

The research results indicated that project managers should have theoretical project management knowledge. This is supported by the weighted average rating of 3.43. The findings add to the research investigating the knowledge base that a project manager in the built environment should have, indicating the necessity of project management knowledge.

The PMI construction extension to the PMBOK guide lists the nine areas as used in the PMBOK guide 4th edition as well as the four industry-related areas. These four areas are occupational health and safety, environmental management, financial management and claims management. The questionnaire asked respondents to indicate the importance of technical knowledge in order to facilitate the 13 areas. Table 5 lists the 13 areas and summarises the findings.

Table 5: Importance of technical knowledge for facilitation of PMBOK areas

PMBOK knowledge areas	*Weighted averages*
Project integration management	3.82
Project scope management	4.00
Project time management	4.10
Project cost management	4.04

PMBOK knowledge areas	*Weighted averages*
Project quality management	3.83
Project human resources management	3.86
Project communication management	3.79
Project risk management	4.01
Project procurement management	3.56
Occupational health and safety	3.70
Environmental management	3.39
Financial management	3.92
Claims management	4.03
Average rating	3.85

Table 5 shows that areas such as project scope management (4.00), project time management (4.10), project cost management (4.04), project risk management (4.01) and claims management (4.03) indicated that it is very important for a project manager to have technical knowledge. The weighted average for all areas is 3.85 and all areas indicated that technical knowledge is important for successful facilitation.

5.1.3 Industry knowledge

The questionnaires reflected the importance of technical knowledge, as shown in Tables 6 to 9. The four main areas of technical knowledge in the built environment as indicated by SACPCMP were used and tested.

The SACPCMP (2015: Online) indicated that construction science knowledge is important for a construction project manager to have. The subareas of construction science knowledge listed are understanding structures, understanding building sciences, understanding building finishes, and knowledge of building materials. Table 6 shows the findings from the questionnaire and the respondents' opinion regarding the necessity of construction science knowledge.

Table 6: Knowledge of construction science

Responses	*1 = Not important 5 = Critically important*
Understanding structures	3.7
Understanding building sciences	3.83
Understanding building finishes	3.78
Knowledge of building materials	3.55
Total average rating	3.72

Table 6 shows the knowledge area of construction science and each of the four subsections. The weighted average of 3.72 indicates that knowledge and understanding of these items are important.

Results of the case study supported the importance of construction science. The consultants, including the architect, the engineers and the quantity surveyor who worked on the project, stated that the project manager lacked knowledge of construction science and construction processes. The findings are supported by Cadle & Yeates (2001: 358) who state that a project manager must have an accurate understanding of the technical requirements of the project in order to address and meet business needs.

Another area which the SACPCMP indicated as important for a construction project manager to have knowledge of is construction processes. The subareas of construction processes are site plant and equipment, formwork, general building sequences, general output and production factors, as well as basic knowledge of building trades. Table 7 shows the findings from the questionnaire and the respondents' opinion regarding the necessity of construction processes knowledge.

Table 7: Knowledge of construction processes

Responses	*1 = Not important 5 = Critically important*
Site plant and equipment	3.63
Formwork	3.45
General building sequences	4.1
General output and production factors	4.05
Basic knowledge of building trades	3.78
Average rating	3.8

Table 7 displays the findings with a weighted average of 3.8, indicating that knowledge of construction processes is important. Kerzner (2013) states that technical knowledge is needed in order to evaluate technical concepts and solutions. The findings in Tables 6 and 7 reiterate the importance of industry-specific knowledge. Project managers require knowledge of construction science and construction processes.

The SACPCMP indicated that design processes knowledge is important for a construction project manager to have.The subareas of design processes are sequence of design processes and time required for design processes. Table 8 reflects the findings from the questionnaire and the respondents' opinion regarding the necessity of design processes knowledge.

Table 8: Knowledge of design processes

Responses	*1 = Not important 5 = Critically important*
Sequence of design processes	3.98
Time required for design processes	3.9
Total average rating	3.94

Table 8 clearly reflects data indicating that knowledge of the design process is important. The weighted average is 3.94.

The fourth area is knowledge of cost and financial factors. The SACPCMP indicated that this is also important knowledge for a construction project manager to have. The questionnaire findings are reflected in Table 9.

Table 9: Knowledge of financial and cost factors

Responses	*1 = Not important 5 = Critically important*
Cost of construction	4.33

The data in Table 9 indicates a very high weighted average of 4.33. Knowledge of financial cost and factors is very important. This knowledge area corresponds with one of the four PMI Construction extension to the PMBOK areas (occupational health and safety, environmental management, financial management and claims management).

The questionnaires' findings indicated that technical knowledge is important for the facilitation of the four construction PMBOK knowledge areas. The weighted averages for these areas are 3.92 for financial, 4.03 for claims management, 3.39 for environmental management, and 3.7 for safety management. It is important when compiling the knowledge set that the technical knowledge consists of a combination of construction PMBOK and SACPCMP industry knowledge sets.

All the interviewees indicated that industry-specific knowledge is essential in order for a project manager to do project planning. Quoting interviewee 7: "How is it possible to plan if there is no knowledge of the industry and the project manager doesn't know how everything fits together?" The case study supported the findings.

The fact is thus that project managers working in construction need to have knowledge of the construction industry (Ashworth & Hogg, 2007: 381-384). Techniques that work for one industry do not necessarily work for the next. For instance, techniques derived from the manufacturing industry will often not work in construction. Ashworth & Hogg (2007: 381) state:

> *Ideally therefore, the project manager will already be a member of one of the construction professions. An understanding of the process and the product of construction, and a working knowledge of the structure of the industry, will clearly be advantageous if not essential. The importation of managers with no knowledge of the industry or its workings has drawbacks, and their appointment should be approached with caution.*

There is thus a need for industry-specific knowledge.

5.2 Knowledge affecting organisational factors

The interviews, questionnaires and case study findings were interpreted and indicate the importance of trust, leadership and communication to effectively manage a project. The study presented evidence that revealed a strong correlation between knowledge and trust, knowledge and leadership, as well as knowledge and communication.

5.2.1 Leadership

Leadership contributes to successful projects. Based on the questionnaire findings, the data in Table 10 shows the importance of leadership to increase project success.

Table 10: The importance of leadership to increase project success

Responses	*1 = Not important 5 = Critically important*					
	1	*2*	*3*	*4*	*5*	*Total*
Percentage of total	0	0	0	43.6	56.4	100
Average rating	4.56					

The questionnaire results indicated that all respondents scored the importance of leadership in project management as either 4 or 5 on the Likert scale. This amounts to a very high weighted average of 4.56.

The ten interviewees all indicated that, in their opinion, a project manager needs to be a leader and that leaders require proficient knowledge. All interviewees indicated that leaders need competency in order to be trusted and respected. This adds to the validation of the study. As indicated in previous research by Chiocchio (2007) and Culp and Smith (1992), trust, leadership and communication are all elements needed for project success. These elements are affected by a project manager's knowledge or lack thereof. The knowledge required includes industry-specific knowledge, project management knowledge and knowledge

gained through experience in the industry. All interviewees stated that project managers need to be leaders and leaders need knowledge of the projects they are managing.

The case study analysed a built environment project that had a project manager with insufficient industry knowledge and experience. The project manager in this case study was not regarded as a leader, as he did not instil trust among project team members. They did not trust his expertise as project manager nor his leadership. This was observed through discussions and interviews with the respondents who worked on the project.

5.2.2 Trust

The literature illustrates the importance of trust to ensure project success. The research tested the importance of trust to increase the possibility of project success. The results are presented in Table 11.

Table 11: Importance of trust to ensure project success

Responses	*1 = Not important 5 = Critically important*					
	1	*2*	*3*	*4*	*5*	*Total*
Percentage of total	0	0	13.2	44.7	42.1	100
Average rating	4.29					

Table 11 indicates that it is very important to have trust in order to increase the possibility of project success. The weighted average is 4.29, indicating very important to critically important. This is relevant because knowledge is needed in order to be trusted. Therefore, without the needed knowledge, there will not be adequate trust on a project. The importance of trust supports the need of the requested knowledge.

The questionnaire results emphasised the importance of trust on a project in order to increase the possibility of project success. The weighted average is 4.29 indicating very important to critically important.

All the interviewees stated that a leader needs to be competent in order to gain and retain the respect and trust of followers. A project manager without the required knowledge needed for the specific project is not competent and loses the respect and trust of the project team. This affects time, cost and the quality of a project, thereby impacting on project success.

The case study indicated that there was a lack of trust among team members, due to the project manager's insufficient knowledge

base. This became obvious in discussions with the professional team members who indicated that they did not trust the project manager and that they believed that his knowledge of the industry was not adequate. This was obvious not only from discussions with the respondents, but also from incidences that took place during the project. The mistrust was further aggravated by the project manager's ineffective communication ability.

5.2.3 Communication

Chiocchio (2007) stated that communication is a very important part of project management and necessary to effectively manage projects. The data in Table 12 reflects the questionnaire results for the need for technical knowledge in order to facilitate project communication. It analyses the importance of technical knowledge for effective communication in order to collect and distribute information, for performance reporting and managing stakeholders. Technical knowledge is very important for a project manager to facilitate project communication.

Table 12: Need for technical knowledge to facilitate project communication

Responses	*1 = Not important 5 = Critically important*
Information is collected and distributed	3.83
Performance reporting is done	3.7
Stakeholders are managed	3.85
Average rating	3.79

Table 12 indicates that technical knowledge is important in order to effectively facilitate the collection and distribution of information (weighted average of 3.83), do performance reporting (weighted average of 3.7), and manage stakeholders (weighted average of 3.85). The overall weighted average for the three categories discussed is 3.79. Due to communication being important to project management, it can be stated that it is very important for a project manager to have technical knowledge in order to support effective project management.

The case study revealed that the project manager did not understand what the team members were saying and the implications of what they were saying. Neither did he know what questions to ask. Therefore, he asked the wrong questions. This became obvious in discussions with the team members on separate occasions and based on various incidents.

The project manager was the link between the project team and the client (a large international company). He communicated project information to them. His lack of industry-specific knowledge led to miscommunication during the project. The client asked questions which the project manager was unable to answer. Miscommunication was one of the factors that contributed to the client losing faith in the project, resulting in the project being cancelled.

All interviewees indicated that industry-specific knowledge is important in order for a project manager to communicate. The research feedback revealed that a project manager needs specific knowledge in order to be able to ask the right questions from the project team. The project manager must understand the feedback provided by the project team and be able to communicate the feedback and status to the client. The project manager must also anticipate potential problems, make the necessary decisions and take action in order to prevent the problems. This supports the research by Turk (2007) and Cadle and Yeates (2001). Interviewee 7 stated that project managers have to anticipate potential project problems: "Project managers need to spot a potential problem before it occurs." This is only possible if the project manager has industry-specific knowledge and experience working in the built environment. Interviewee 5 stated that, without the required knowledge, a project manager cannot communicate effectively with the team. He further mentioned that problems with communication impact on the time, cost and quality of a project. Project meetings need to be proactive and goal oriented. To meet these requirements, a project manager needs the required knowledge.

Interviewee 2 stated that knowledge affects the quality of the message communicated by the project manager. The interviewee mentioned that the project manager must lead and know what questions to ask. If the project manager's knowledge about the industry is insufficient, he will not be able to understand the feedback and to make intelligent deductions from the feedback received.

Figure 1 was compiled based on the research findings. It illustrates the elements of the knowledge a project manager needs in order to be able to communicate effectively. As stated by Chiocchio (2007: 97), communication is very important to ensure effective project management.

Figure 1 shows five elements in a circle that are dependent on a project manager's knowledge and subsequently his communication ability. These elements are: asking the right questions, understanding team feedback, communicating feedback to clients, anticipating

potential problems and planning, and taking action to prevent problems. If a project manager is not knowledgeable and an incompetent communicator, these essential elements will not be realised.

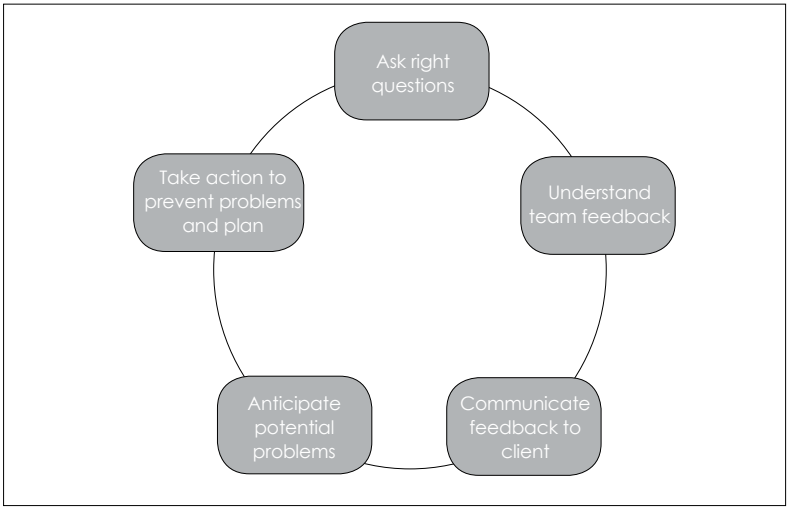

Figure 1: Project manager needs competency in order to communicate effectively
Source: Burger, 2013: 188

Figure 1 indicates that industry-specific knowledge is essential for a project manager. As indicated earlier, a project manager needs knowledge in order to ask the right questions. Figure 1 illustrates that a project manager needs to be competent in order to communicate effectively – to ask the right questions, to understand team feedback, to communicate feedback to clients, to anticipate potential problems and plan, and to take action to prevent problems. The interviews supported this, since the interviewees' feedback supported the need for competency to ask the right questions, understand the feedback that is given, communicate the feedback to the client, anticipate potential problems and take action to plan and prevent problems.

In summary, all respondents interviewed agreed that a project manager needs the required knowledge and experience in order to increase both the effectiveness of project management and the probability of project success.

6. Conclusion and recommendations

Project managers require three types of knowledge in their knowledge set in order to successfully manage projects. This knowledge set needs to consist of project management knowledge, knowledge through experience, and industry knowledge. The project management knowledge areas are the nine knowledge areas set out in the PMBOK 4th edition as well as the four PMI Construction extension to the PMBOK. The nine knowledge areas are based on the PMI PMBOK 4th edition and not the PMI PMBOK 5th edition of 2015, which added stakeholder management as a 10th area. The nine areas are: integration management, scope management, time management, cost management, quality management, human resource management, communication management, risk management, and procurement management. The four areas from the PMI Construction extension to the PMBOK are: occupational health and safety, environmental management, financial management, and claims management. According to SACPCMP, there are four industry knowledge areas along with their subsections that are essential. These four areas are: construction science, construction processes, design processes, and having financial and cost knowledge. These research findings together offer a knowledge skill set that can be used as baseline. This research indicates the type of knowledge required as well as the critical importance of industry-specific knowledge. Further research could test project managers' proficiency levels of the various knowledge fields. Forthcoming research investigates the level of each type of knowledge required and offers a construction project management knowledge model. This will assist in knowing to what knowledge depth project managers need to be educated and trained. The level of knowledge findings will be presented in the near future.

References list

Ashworth, A. & Hogg, K. 2002. *Willis's practice and procedure for the quantity surveyor*. 11th edition. Oxford: Blackwell Science.

Berry, F., Verster, B. & Zulch, B. 2009. Kommunikasie-volwassenheidsmodel vir die meting van bourekenkundige kommunikasie en kommunikasie-instrumente. *Acta Structilia*, 16(2), pp.1-17.

Besner, C. & Hobbs, B. 2008. Project management practice, generic or contextual: A reality check. *Project Management Journal*, 39(1), pp. 16-33.

Birkhead, M., Sutherland, M. & Maxwell, T. 2000. Core competencies required by project managers. *South African Journal of Business Management*, 31(3), pp. 99-105.

Burger, M. 2013. Project management in the built environment: The need for industry-specific knowledge. PhD thesis. Bloemfontein: University of the Free State.

Burke, R. 2013. *Project management*. 5th edition. Cape Town: ABC Press.

Cadle, J. & Yeates, D. 2001. *Project management for information systems*. 3rd edition. Harlow: Financial Times/Prentice Hall.

Chiocchio, F. 2007. Project team performance: A study of electronic task and coordination communication. *Project Management Journal*, 38(1), pp. 97-109.

Chordas, L. 2008. Solving the puzzle. *Best's Review*, 109(2), pp. 66-69.

Cooke-Davies, T.J. & Arzymanow, A. 2003. The maturity of project management in different industries: An investigation into variations between project management models. *International Journal of Project Management,* 21(6), pp. 471-478.

Culp, G. & Smith, A. 1992. *Managing people (including yourself) for project success*. New York: Van Nostrand Reinhold.

Daft, R.L., Kendrick, M. & Vershinina, N.2010. *Management*. Andover: Cengage.

Davis, T. & Pharrow, R. 2003. *The relationship manager: The next generation of project management*. Brookfield, VT: Gower.

Dinsmore, P.C. 1999. *Winning in business with enterprise project management*. New York: Amacom.

Goetsch, D.L. 2004. *Effective teamwork: Ten steps for technical professions*. Upper Saddle River, NJ: Prentice Hall.

Harris, M. 2005. Project management overview: Ordered chaos. *Financial Mail*. [online]. Available from: <http://free.financialmail.co.za/report05/project05/ aproject.htm> [Accessed 15 December 2011].

Heldman, K. 2006. *Project management jumpstart*. Indianapolis, IN: Wiley Publishing.

Heldman, K. 2011. *Project management jumpstart.* 3rd edition. Hoboken, NJ: Wiley

Kerzner, H. 2013. *Project management*. 11th edition. Hoboken, NJ: Wiley Publishing.

Klastorin, T. 2004. *Project management tools and trade-offs*. Washington: Wiley Publishing.

Lee, D.R. & Sweeney, P.J. 2001. An assessment of influence tactics used by project managers. *Engineering Management Journal*, 13(2), pp. 16-24.

Leedy, P.D & Ormrod, J.E. 2010. *Practical research: Planning and design*. Boston, MA: Pearson.

Morrison, J.M., Brown, C.J. & Smit, E.v.d.M. 2006. A supportive organizational culture for project management in matrix organizations: A theoretical perspective. *South African Journal of Business Management*, 37(4), pp. 39-54.

Neuman, W.L. 1997. *Social research methods*. 3rd edition. Boston, MA: Allyn & Bacon.

Pacelli, L. 2004. *The project advisor: 18 major project screw-ups and how to cut them off at the pass*. Upper Saddle River, NJ: Prentice Hall.

Pettersen, N. 1991. What do we know about the effective project manager? *International Journal of Project Management*, 9(2), pp. 99-104.

Project Management Institute (PMBOK). 2004. *A guide to the Project Management Body of Knowledge (PMBOK guide)*. 3rd edition. Newtown Square, PA: Project Management Institute.

Project Management Institute (PMBOK). 2008. *A guide to the Project Management Body of Knowledge (PMBOK guide)*. 4th edition. Newtown Square, PA: Project Management Institute.

Project Management Institute. 2008. *Construction extension to the PMBOK guide 3rd edition*. Drexell Hill, PA: Project Management Institute.

Project Management Institute. 2015. *Project Management Body of Knowledge*. 5rd ed. Drexell Hill, PA: Project Management Institute.

Robbins, S.P. 1996. *Organizational behaviour*. 7th edition. New York: Prentice Hall.

Romahn, E. & Hartman, F. 1999. *Trust: A tool for project managers*. Proceedings of the 30th Annual Project Management Institute 1999 Seminars & Symposium, Philadelphia, USA, 10-16 October 1999.

Schoonraad, N. 2003. Managing financial communication: Towards a conceptual model. M.Com. thesis. Pretoria: University of Pretoria.

Shenhar, A.J. 2008. Unleashing the power of project management. *Industrial Management*, 50(1), pp. 14-19.

South Africa. 2000. *Project and Construction Management Professions Bill Act, No. 48 of 2000.* Pretoria: Government Printer.

South African Council for the Project and Construction Management Professions (SACPCMP). 2015. Available from: <http://www.sacpcmp.co.za/downloads/policy> [Accessed 30 May 2015].

Trebilcock, B. 2007. Changing face of project management. *Modern Materials Handling,* 62(6), pp. 40-45.

Turk, W. 2007. 21st century project management competencies. *Defense Acquisition and Logistics,* January-February, pp. 22-25,.