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How do project management competencies change within the project management career model in large Chinese construction companies?

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Abstract

Due to the increasing complexity and flexibility of business activities, project-based organizations have become common. In such organizations, project management competencies, which refer to a collection of knowledge, personal attitudes, skills, and relevant experience, are core assets that must be taken seriously. Formalized project management career paths have been widely implemented in the construction industry. However, most recent studies treat project management competencies as static constructs and fail to consider their dynamic changes as a career path advances. To fill this gap in the literature, this study conducted an empirical examination of project management competencies integrated with a career model for the construction industry. First, key project management competencies are identified through a literature review. Then, a project management career model for large Chinese construction companies is developed based on an empirical investigation of six large Chinese construction companies from various sectors. Moreover, a quantitative analysis is performed to explore how these competencies dynamically change as position levels rise in the career model. The research findings indicate that significant differences in project management competencies exist at different levels of the career model. However, the distribution remains steady at different project management position levels for conceptual and organizational competencies, human competencies, and technical competencies.

Keywords: Project management competencies; Career model; Change of competencies; Construction industry

1. Introduction

The complexity and flexibility of business activities drive project management in an organization to develop products, services, processes and marketing activities in many industries (Crawford et al., 2013; Turner et al., 2008). In such project-based organizations (PBOs), the knowledge, capabilities, and resources of the firm accumulate through the execution of major projects (Whitley, 2006). As a result, overall business success in PBOs is closely associated with the project success of the organization (Ekrot et al., 2016). Project management competencies, which refer to a collection of knowledge, personal attitudes, skills and relevant experience that lead to project success (ICB-IPMA, 2006), have been regarded as one of the most important factors affecting project success (Ekrot et al., 2016). Project management competencies are core assets in

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PBOs that must be taken seriously. Currently, there are numerous studies on project management competencies, but they mainly focus on their antecedents (Ekrot et al., 2016; Ramazani and Jergeas, 2015), profiles (Ahadzie et al., 2014; Bredillet et al., 2015; Chen et al., 2008), and consequences (Carvalho et al., 2015; Hanna et al., 2016; Joslin and Müller, 2015; Meng et al., 2015) as well as the matching relationships with different project types (Müller and Turner, 2010). However, most of the existing literature treats project management competencies as static constructs and fails to take their dynamic features into consideration (e.g. Dziekoński, 2017; Hanna et al., 2016). Project management competencies change as a career path advances as experience is continuously gained and the content of one's work changes. How project management competencies change over time, however, remains unclear.

In this study, our focus lies in the process by which project management competencies change as a career path advances. Because projects are the prevalent structure for organizing a firm's business activities, project management is increasingly regarded as a profession with specific competency requirements rather than temporary managerial assignments (Bredin and Söderlund, 2013). For individuals, project management provides a means to escape mundane operations and move into management (McKevitt et al., 2017). However, pursuing a project management career can be challenging, as it often involves high levels of uncertainty and job pressure (El-Sabaa, 2001; Gällstedt, 2003; Hodgson et al., 2011). These negative factors hinder the motivation and retention of project managers. A formalized career path for project management can be an effective approach to resolving these issues, as such a career path can provide project managers with a sense of occupational identity and create a link between a project manager's career pursuits and the organization's need for project management competencies (Bredin and Söderlund, 2013). A formalized career path for project management has also been implemented in many industries (Hölzle, 2010). However, the study of project management career paths is still in its infancy. More studies are needed that focus on the project management career models that can motivate employees to engage in project management and retain project management talent; thus, the question of how to develop project management careers for project managers needs to be thoroughly explored.

Because construction projects are the core business activities of the construction industry, PBOs and project management career models are prevalent in construction firms. This study mainly focuses on the construction industry. First, the key and general project management competencies were identified through a literature review. Second, due to the absence of a project management career model for the construction industry in the literature, we developed a career model through a multi-case study involving six large Chinese construction firms across a variety of sectors. On this basis, we conducted a quantitative study to identify how these competencies change within the developed career model. The study therefore addresses two key research questions:

(1) What is the project management career model in large Chinese construction companies?

(2) How do project management competencies change as a project management career path advances?

Our study explores project management competencies from a new perspective and aims to advance research on project management competencies and career models. The results are not only conducive to developing project management career models and cultivating project management competencies for construction firms but also benefit individuals engaging in project management in their career path.

2. Points of departure

2.1. Career, career path and career model

Career is often defined as “the evolving sequence of a person's work experience” (Arthur, 2014). Indeed, the term “career” can be subdivided into the subjective career and the objective career (Bredin and Söderlund, 2013). The subjective career describes an individual's subjective feelings about gaining experience, progressing, career development and satisfaction, while the objective career refers to objective descriptions of sequential jobs. Hence, a career path can be separated from a career, as a career path represents an objective sequence of jobs instead of an individual's subjective feelings about those jobs (Schein, 1996; Hölzle, 2010; Bredin and Söderlund, 2013). This paper focuses on a formalized career path for project management in construction companies and the changes in required competencies on such a path. Thus, this study draws attention to the objective career rather than the subjective career. Furthermore, this study is concerned with a generalized and formalized path for a project management career instead of how a project manager experiences his/her project management career life. This formalized path is a generalized or idealized route for advancement within project management (Bredin and Söderlund, 2013) or the organizational frame for the creation of project management career opportunities (Hölzle, 2010). To clarify the differences, the term “career model” is used to represent a formalized path for advancement during a career (see also Tremblay et al., 2002; Bredin and Söderlund, 2013). To be more specific, individuals experience multiple position levels as they advance along a career path. Thus, the career model is composed of the multiple levels of project management positions.

2.2. A new career path for project management

Because projects are increasingly used as an organizational form, project management is regarded as a profession with specific competency requirements rather than a temporary managerial assignment (Bredin and Söderlund, 2013). Project management is considered a specialized role within a career, in contrast to managerial and technical careers (Tremblay et al., 2002). It provides individuals with a means to move into management (McKevitt et al., 2017) and a platform to learn new skills and demonstrate their talents (Crawford et al., 2013). However, pursuing a project management career can be

challenging, as it involves high levels of uncertainty and job pressure (Bredin and Söderlund, 2013). According to boundaryless career theory, individuals exert more control in their personal career development and are less limited by traditional boundaries, such as physical and psychological mobility, professions (Clarke, 2013; Li, 2018). Although these boundaries become blurred, individuals still must have sufficient motivation to either cross the boundaries or not cross them (Rodrigues et al., 2016). Thus, to keep individuals engaged in the profession of project management, they need enough motivation, including not only higher income but also occupational identification (Rodrigues et al., 2016), opportunities to learn new skills and knowledge (Ekrot et al., 2016), development opportunities (Bredin et al., 2013), and roles that enable them to demonstrate their talents (Crawford et al., 2013). For example, Crawford et al. (2013) noted the importance of project managers' individual abilities to take advantage of challenging roles and activities available within their organization, especially when they gain new skills and knowledge. Otherwise, they may choose to take roles elsewhere for opportunities to apply their new learning (Benson and Mohrman, 2004). More generally, the position of project manager is viewed more as a stepping stone to a higher-ranked position in an organization (Parker and Skitmore, 2005). This leads to substantial losses of project management experience and knowledge for many organizations, especially given that project management competency has become an increasingly critical competitive resource in the modern and increasingly complex business context.

A career model plays a key role in an incentive system to attract, retain, and develop employees engaging in project management, as career opportunity is the factor most directly related to turnover intentions, and opportunity provides employees with the motivation to achieve and a reason to stay (Hölzle, 2010; Ling and Loo, 2013). Bredin and Söderlund (2013) recommended that organizations implement project management career models for the following reasons: to build and attract project management competencies, generate commonalities for communication among project managers, ensure transparency in development opportunities and provide recognition for the profession. A favorable career model design for project managers should keep a balance between organizational interests with respect to the needed resources and individual interests with respect to career development. Hölzle (2010) investigated 20 companies that have implemented project management career models and constructed a conceptual framework. The results indicate in the career models, different skill levels and more experience is generally required at higher levels. Madter et al. (2012) revised Hölzle's model and argued that the transition from one level to a higher level should not be viewed as natural progress but as a non-successive process that implies a fundamental change in strategic perspective. Bredin and Söderlund (2013) conducted empirical research on the career models of project managers and found that project management career models and project classifications exist in many firms, but they are not always explicitly integrated. The project management career model is clearly increasingly accepted in a variety of industries, but the research on it is insufficient. Hölzle (2010) developed a conceptual framework for the project management career model, and Madter et al. (2012) further enriched the model with organizational accountability, but its validity is uncertain (Carvalho et al., 2015).

2.3. Project management competencies

Project management competency is a demonstrated ability to perform activities exceptionally within a project's dynamic environment that lead to the expected outcomes based on defined and accepted standards (Crawford and Arch, 1997). Project management competency has a direct or indirect impact on the success of projects (Ahadzie et al., 2009; Carvalho et al., 2015; Tabassi et al., 2016). Therefore, the profile of project management competencies has also drawn attention from scholars. For example, El-Sabaa (2001) investigated the personal characteristics, traits and skills of effective project managers in Egypt. The findings indicate that there are 18 critical competencies that can be summarized in three categories: human skills, conceptual and organizational skills, and technical skills. Müller and Turner (2010) investigated the leadership competency profiles of successful project managers, including intellectual, managerial and emotional competencies. Liyana Othman and Jaafar (2013) contended that honesty, integrity, alertness, quickness, energy, toughness, decision-making ability and self-confidence are attributes that project managers are expected to possess. Hanna et al. (2016) modelled project management competency using a mathematical approach to quantify the importance of different competencies. Omar and Fayek (2016) identified 41 required competencies for project management and divided them into functional and behavioral competencies. Based on the literature review, we summarized the project management competencies using El-Sabaa's (2001) framework, as shown in Table 1.

Specifically, personal traits such as credibility, honesty, integrity, empathy, dependability, energy and enthusiasm are not included in Table 1. These competencies refer to inherent traits and are required for all employees, not just individuals engaging in project management. They are essential attributes for virtually any job (Hanna et al., 2016). This study mainly focuses on the skills and knowledge competencies for project management that can be learned and improved through training or practice. Therefore, personal traits are excluded from Table 1.

The project management competencies shown in Table 1 are not constant in the project management career model. On the one hand, in line with boundaryless career theory, employees now have control over their career, and they can seek opportunities to develop their competencies and value their employability over job security. Thus, the project management career model should support their competency development and provide them opportunities to learn and use new skills and knowledge. On the other hand, competencies are related to the content of jobs. With advancement on a project management career path, the work scope, power and responsibility change. Obviously, individuals at higher positions always have a greater work scope and must cope with more uncertainty and

Table 1
Project management competencies.

Categories	Competency	Definition	Source
Conceptual and organizational competencies	Conceptual thinking	The ability to see the big picture of the project through the identification of patterns or interconnections between situations that are not obviously related	Divine et al. (2008), El-Sabaa (2001), Hanna et al. (2016), Müller and Turner (2010)
	Information seeking	The ability to seek information about people, issues or the project situation, externally or internally	Dainty et al. (2005)
	Analytical thinking	The ability to understand a situation by deconstructing it or by tracing the implications of a particular situation in a causal way	Dainty et al. (2005), Hanna et al. (2016)
	Client orientation	Meeting clients' needs, which can be an end user within the project manager's own organization or an external party	Ahadzie et al. (2008), Dainty et al. (2005), Hanna et al. (2016)
	Organizational awareness	Understanding the power relationships within the organization and in the organizations with whom the manager interfaces	Dainty et al. (2005), Madter et al. (2012)
	Vision and imagination	Knowing the strengths and weaknesses of a project; thus, the manager can look ahead and establish the direction for a project by developing a vision of the future	Hanna et al. (2016), Müller and Turner (2010)
	Results orientation	Focusing the project team on key objectives to obtain the optimum outcome for all parties involved	Hanna et al. (2016), Trivellas and Drimoussis (2013)
	Organizing	The ability to organize project staff and integrate and allocate project resources effectively	Ahadzie et al. (2014), El-Sabaa (2001), Müller and Turner (2010)
Human competencies	Communication	The ability to communicate with all types and levels of people effectively, such as good oral and written communication skills	Ahadzie et al. (2014), Chen et al. (2008), Edum-Fotwe and McCaffer (2000), El-Sabaa (2001), Müller and Turner (2010)
	Impact and influence	An individual's ability to obtain support for a course of action or to influence the views of other stakeholders	Dainty et al. (2005), Fisher (2011), Hanna et al. (2016), Müller and Turner (2010)
	Flexibility	The ability to adapt and work flexibly within a variety of situations with different individuals or groups.	Ahadzie et al. (2008), El-Sabaa (2001), Stevenson and Starkweather (2010)
	Self-management	The ability to remain composed, restrain negative actions, and cope well, even when confronted with stressful situations	Dainty et al. (2005), Fisher (2011), Trivellas and Drimoussis (2013)
	Building relationships	The ability to build and maintain good relationships with the client, subcontractors, the local authorities, etc.	Ahadzie et al. (2014), Chen et al. (2008), Hanna et al. (2016), Pant and Baroudi (2008)
	Negotiating	The negotiation skills of the project manager are necessary for changes in projects' scope, cost, scheduling objectives, contract terms and conditions and resource availability.	Edum-Fotwe and McCaffer (2000), Trivellas and Drimoussis (2013)
	Teamwork	Showing a genuine desire to work cooperatively as part of a team	Chen et al. (2008), Clarke (2010), Fisher (2011), Hanna et al. (2016)
	Empowering	Giving people the opportunity for group members to participate in decision making	El-Sabaa (2001), Müller and Turner (2010)
	Mobilizing	Mobilizing the mental and emotional energy of subordinates	El-Sabaa (2001), Fisher (2011), Hanna et al. (2016), Müller and Turne (2010)
	Conflict management	The ability to handle conflicts and crises during construction projects	Ahadzie et al. (2008), Clarke, 2010, Fisher, 2011, Trivellas and Drimoussis, 2013
Knowledge and technical competencies	Financial and commercial knowledge	Basic financial knowledge and familiarity with construction costs and budgets	Crawford (2005), Edum-Fotwe and McCaffer (2000), Hanna et al. (2016)
	Knowledge of project management	Knowledge of project management, such as time, quality and cost management	Ahadzie et al. (2014), Chen et al. (2008), Edum-Fotwe and McCaffer (2000), Hanna et al. (2016)
	Knowledge of contracts	Basic knowledge of contracts, such as drafting and tendering	Ahadzie et al. (2008), Crawford (2005)
	Construction knowledge	Understanding construction methods, processes, and procedures	Ahadzie et al. (2008), El-Sabaa (2001), Hanna et al. (2016), Stevenson and Starkweather (2010)
	IT skills	Skills and knowledge in the use of computers, such as project management software, spreadsheets, and CAD	Edum-Fotwe and McCaffer (2000), El-Sabaa (2001)
	Legal knowledge	Knowledge of the laws and regulations in the construction industry, such as design standards and construction standards	Edum-Fotwe and McCaffer (2000), Hanna et al. (2016)
	Knowledge of risk management	Knowledge of risk management measures for construction projects	Ahadzie et al. (2008), Hanna et al. (2016)

complexity, which results in different competency requirements (Müller and Turner, 2007, 2010). Therefore, project management competencies should change with advancement on a formalized career path. However, it is still unclear how such competencies change.

3. Methodology

This study aims to investigate how project management competencies change within a career model. Due to the complexity of this research object, the research process can be

divided into two parts. Part one aims to develop a career model for project management in large Chinese construction companies. To improve the understanding of the project management career models Chinese construction companies have adopted, a multi-case study involving six large Chinese construction companies across various sectors was conducted. For each company, we conducted interviews with two practitioners to collect information about its project management career model. Finally, a generalized career model was developed using these results integrated with existing studies on project management career paths.

Part two focuses on how the project management competencies identified in Section 2 change within the career model developed in part one. We further classify the competencies by absolute and relative importance. On the one hand, high absolute importance refers to high importance of a competency in their job. On the other hand, relative importance refers to the weight of the competency in a comparison among competencies and the unequal contributions of different competencies to project management performance (Hanna et al., 2016). First, a questionnaire was used to collect data about competencies at different levels in the career model. Second, analysis of variance (ANOVA) was used to identify the differences in absolute importance. Third, to calculate the relative importance of the competencies at different levels, a mathematical model was adopted. This process can be treated as a group decision-making process. Each respondent at a given level of the career model gave his/her opinion about the importance of the competencies in the questionnaire. It is necessary to synthesize the opinions of all the respondents at each level to obtain a comprehensive opinion about the relative importance of the competencies. Therefore, the group decision-making model proposed by Liu et al. (2015) was adopted to calculate the relative importance of the competencies. The mathematical model is presented in the Appendix.

4. Project management career models in large Chinese construction companies

In this section, a multi-case study investigating six large construction companies in China to examine their project management career models.

4.1. Investigation of project management career models in large Chinese construction companies

The nature of construction activities means that construction firms are project-based organizations. For this reason, project managers are critical assets in construction firms. To retain and motivate project managers, project management career models have been widely implemented in the construction industry. After preliminary screening and contact, six companies were selected. These companies hold large market shares in different fields and are among the largest construction firms in China. Thus, they are representative of large Chinese construction companies. Specifically, these companies have extended the scope of their businesses to involve not only project contracting but also project investment, design and consultation. Hence, they are comprehensive group corporations. This study only focuses on the subsidiaries whose main business is project contracting. In this sense, the organizations studied in this paper are general construction contractors, while subcontractors, such as labor, equipment and material supply subcontractors, are not included.

We conducted 12 interviews (2 respondents from each company) to investigate the implementation of project management career models. The main questions in the interviews were: (1) Is there a career model for project management at your company? (2) If so, what is the career model? How can an individual become a project manager? (3) Is project manager the highest position in the project management career model at your company? How are there further promotions possible for project managers? The respondents held middle-to-top management positions in project management or human resources management. The interviews were conducted face-to-face or by telephone, and they were recorded. Finally, the recordings were manually converted into text for analysis. Table 2 shows the sample companies and their project management career models.

According to Table 2, formalized career models for project management are ubiquitous in the construction firms studied. The construction firms provide employees with a career model to engage in project management. In addition, with regard to employment contracts, most of the individuals working for these companies are regular employees, and only a few are contract workers.

According to the results of the interviews, the construction companies often have a head office and established branch offices for different districts. Employees are registered in either the head office or one of the branch offices. However, most of the employees are distributed among different construction projects where they work, and they stay on the project site. When a construction project is complete, they begin work on the next project. For the employees who work on construction projects, their work involves project management. Promotions into higher positions in project management are dependent on the projects. Hence, their career paths can be treated as project management career paths, which is the focus of this study. In addition, a small part of the staff of these companies is responsible for seeking new projects and coordinating resources among projects, and these individuals work in office buildings. The content of their jobs is generally constant, and their management style is line management. For the two career paths, in general, no rule forbids individuals from switching from one career path to the other, although such a transformation is rare due to the limited positions in line management.

Fig. 1 illustrates the general organizational structure for construction projects in the companies studied. Because professional subcontractors are not prevalent in China, labor subcontractors only provide construction labor. Thus, general contractors take most of the jobs in construction projects. As a result, the project team of general contractors sets up several departments to manage various aspects of each project. For example, the electrical and mechanical department oversees electrical and mechanical installation. These departments are

Table 2
Overview of the sample companies investigated.

Company	Construction type	Revenue (millions of dollars)	Workforce size	Company description	Description of its project career model
China Petroleum Pipeline Engineering Co. Ltd.	Oil and gas	5000	24,000	Well-known specialized oil and gas storage and transportation project construction company	Existing formal career model with four levels: Project Manager Level 2, Project Manager Level 1, Senior Project Manager, Project Director
China Nuclear Power Engineering Co. Ltd.	Nuclear power	unpublished	6000	The largest nuclear power enterprise in China, involving nuclear power operations management, engineering management and engineering design	Existing, formal career model; levels include Supervisor, Senior Supervisor, Project Manager, and Project Director
China State Construction Engineering Corporation	Building and real estate	149,608	256,000	China's largest real estate construction conglomerate and China's largest housing construction contractor	Existing formal career model for project management, but the further promotion of project managers is integrated with the linear managerial career model
China Railway Construction Co. Ltd.	Railway	98,099	260,000	One of the largest comprehensive construction groups in China	Existing formal project management career model, but the further promotion of project managers is integrated with the linear managerial career model.
China				Communications Construction Co. Ltd	Traffic and infrastructure
67,245	118,765	One of the largest integrated		infrastructure service providers in China	Existing formal career model with three levels: Supervisor, Senior Supervisor, Project Manager
Sinohydro Group Ltd.	Hydropower	37,207	135,000	A subsidiary of Power Construction Corporation of China, which has extensive experience with international construction management projects and management capacity	Existing formal career model, but the further promotion of project managers is integrated with the linear managerial career model

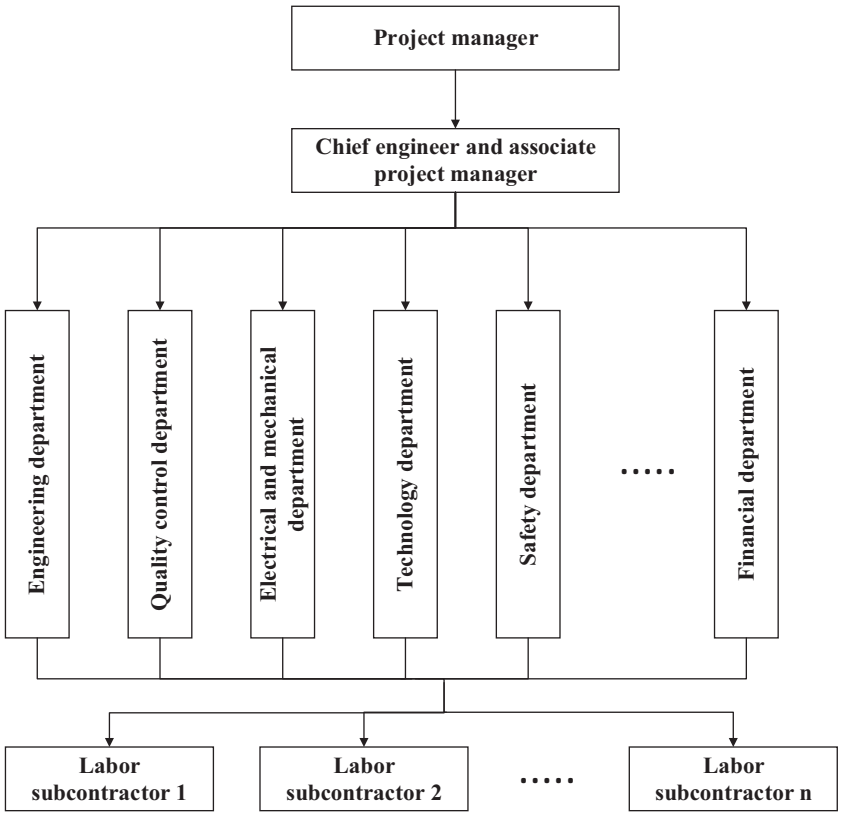

Fig. 1. Organizational structure of construction projects in the studied companies.

supervised by a chief engineer or an associate project manager. The project managers oversee the entire project and manage the chief engineers and associate project managers. The number of departments and associate project managers is related to the project size. A large project generally has more departments and associate project managers than a smaller project.

4.2. The project management career models in the investigated Chinese construction companies

With regard to the construction firms' project management career models, we found that although the specific description or name of each project management position is different among the studied construction firms, their career models are quite similar. On the one hand, individuals often start as junior staff in a department, such as a field manager or junior cost engineer. Later, they can become project department supervisors. Next, department supervisors are promoted to chief engineers or associate project managers. Finally, individuals can take charge of a project independently. On the other hand, the promotion of project managers is different among the construction firms. Some firms have established different levels to differentiate the project managers, such as China Petroleum Pipeline Bureau. This study uses the terms "project director" and "program director" to differentiate higher level project managers from normal project managers. "Project director" is used to represent project managers who oversee projects with heavy investment and high complexity, while "program director" is used to represent project managers who oversee multiple projects. "Project managers" are regarded as the highest level in the project management career models of most of the construction firms. There is no formal position of project/program director in these firms. The promotion of project managers is integrated with organizational line management, such as associate branch managers or office managers. Moreover, for some large-scale investment projects or multiple projects, companies nominate organizational line managers who have substantial power and extensive project management experience as project managers. Thus, they play multiple roles and can be regarded as project/program directors. The job descriptions of these levels, including the content of the job and the level of power, are presented in Table 3.

Table 3
Levels of the project management career models.

Levels of the Career Models	Description
Junior staff	Junior staff belongs to a specific department in a construction project and work on a specific job, such as civil construction, electric construction, or safety monitoring. They are on-site managers, junior cost engineers, etc. They are managed by junior supervisors.
Junior supervisor	Compared with junior staff, a junior supervisor oversees a project department such as a technical, financial or safety department or a part of a project such as civil or electric construction. Junior supervisors are directed by senior supervisors.
Senior supervisor	Compared with junior supervisors, senior supervisors have a higher position but still are not responsible for the overall management of a project. They oversee several departments and are responsible for some functional aspects of an entire project, such as acting as the chief engineer or associate project manager.
Project manager	The project manager manages the project for the construction firms and is also fully responsible for the entire project construction.
Project/program director	Compared with the project manager, the project/program director manages large-scale projects with heavier investment or oversees multiple projects. Another difference between project/program directors and project managers is that project/program directors usually play multiple roles and hold both managerial positions in line management and as project managers.

Based on Hölzle's project management career model (Hölzle, 2010) and Madter's model (Madter et al., 2012), we synthesized the interview results and the existing career models in the construction firms into a generalized project management career model. Fig. 2 illustrates that the project management path becomes more difficult and steepens with promotions. Practical project management experience is the most critical requirement to improve individuals' competencies (Edum-Fotwe and McCaffer, 2000). Therefore, project management competencies are improved in a spiral format as more project experience is gained. Organizational accountability also changes with individuals' promotion (Madter et al., 2012).

Specifically, four project management levels in the career model are selected to explore the changes in project management competencies: junior supervisor, senior supervisor, project manager and project/program director. The initial position level of junior staff is not included, as it involves mainly technical work instead of project management. As for junior supervisor level, selecting it can be explained for two reasons. On one hand, due to the complexity of a construction project, departments are always set up to oversee different aspects of project management. For instance, cost department monitors project cost and control the cost. Cost management is a key part of project management, their work can be treated as project management. Therefore, it is reasonable that junior supervisor who oversee cost department belong to project management career path. On the other hand, it is certain that junior supervisors, who involves high-level expertise, can choose not only project management career path but also expert career path. However, in this study, junior supervisor is defined with the position that is in charge of a project department instead of the expertise. Hence, it is more reasonable to include junior supervisor in career path of project management than in expert career path.

5. Changes of competencies within the project management career model

This section utilizes the competencies identified in section 2 and the project management career model developed in section 4 to investigate changes in competencies in the career model. A questionnaire was used to collect the data. Analysis of variance (ANOVA) and the mathematical model proposed by Liu et al. (2015) were used to identify the differences in competencies at different levels of the career model.

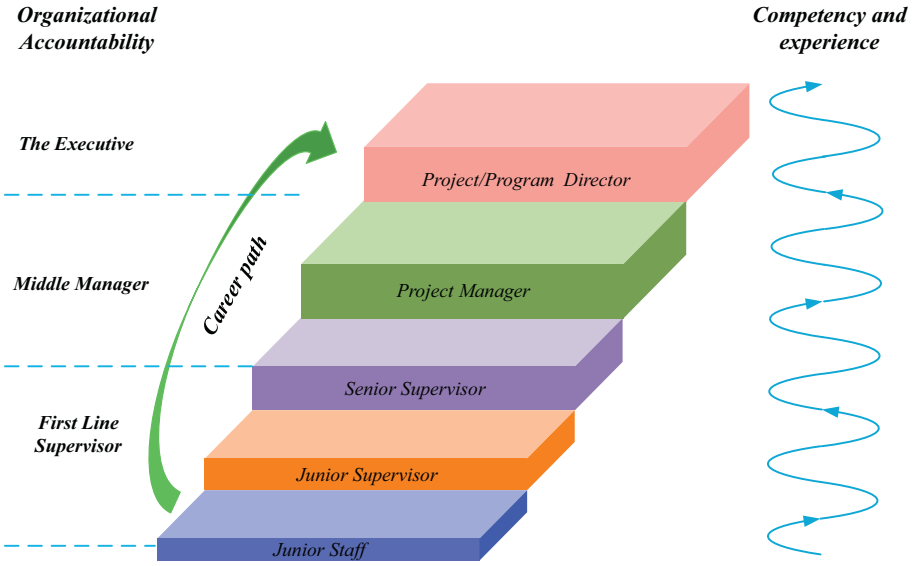

Fig. 2. The project management career model in the investigated construction companies.

5.1. Sampling

Potential respondents were selected from the membership lists of the China Water Engineering Association, the China Architectural Engineering Association, Sinohydro Group, China Railway Group, China State Construction Engineering Corporation (CSCEC), Sinohydro Group Ltd., and China Petroleum Pipeline Bureau. The respondents' demographic information is summarized in Table 4. The respondents are diverse regarding project types and project sizes. For the project management positions, we classified the respondents into the four levels identified above: junior supervisor, senior supervisor, project manager and project/program director. There are respondents from all four levels.

Table 4
Demographic information.

Variables	Category	Number	Percentage
Gender	Male	147	81.22%
	Female	34	18.78%
Level of experience in the construction industry	0–5 years	46	25.41%
	6–10 years	73	40.33%
	11–15 years	30	16.57%
	16–20 years	12	6.63%
	Over 20 years	20	11.05%
Level of project management position	Junior supervisor	86	47.78%
	Senior supervisor	41	22.78%
	Project manager	32	17.78%
	Project/ program director	22	11.67%
Project types (the projects on which the respondents are working)	Transportation	27	14.92%
	Energy	38	20.99%
	Industrial	11	6.08%
	Real estate	31	17.13%
		47	25.97%

5.2. Survey instrument

Two-part questionnaires were used to collect the empirical data. Part one collected basic information, including project type, project scale, the respondent's gender, the number of years of experience in the construction industry and project management position. Part two asked the respondents to estimate the importance of each competency in their job based on the project management competencies summarized in Table 1. A sample item is “How important is ‘Conceptual thinking’ to doing your job well? (To what degree do you need to see the big picture of a project through the identification of patterns or interconnections between situations that are not obviously related in your work?)”. The competency importance estimation uses a Likert scale with 1 to 5 points for each index. A higher score means higher importance for a competency. After the preliminary design of the questionnaire, two experts were invited to review it, and the questionnaires were distributed on a small scale as a pilot study. Based on the responses of the experts and the pilot study, some ambiguous and inaccurate content was corrected to ensure that the questionnaire precisely collected the required information. Finally, the questionnaire was certified to be used for data collection.

5.3. Data collection

To conveniently distribute the questionnaires, we first placed the questionnaire on a professional questionnaire website. Then, we distributed the link to the questionnaire to respondents by e-mail or Wechat (a popular instant messenger software application in China). Respondents could complete questionnaire through the link. A total of 228 questionnaires were collected in two weeks. To ensure the data quality, the collected questionnaires were filtered. A total of 47 questionnaires were eliminated because of invalidity issues, including 38 questionnaires whose time for completion was far less than the average

and 9 questionnaires that had obvious mistakes (e.g., all questions were graded with the same points). As a result, 181 valid questionnaires were obtained. However, a conventional response rate cannot be calculated due to the snowball approach to sampling. In addition, this study employs Cronbach's α coefficient for a reliability test. The results calculated by SPSS 23 show that the Cronbach's α of the questionnaire data is 0.933 > 0.7, which means that the questions on the 181 valid questionnaires were reasonable and that the data were acceptable for further analysis (Mallery, 1999).

5.4. Data analysis

To understand how project management competencies change within a career model, differences in the absolute and relative importance of the competencies by project management level are analyzed in this section.

5.4.1. Demographic information differences

The demographic information for the different project management levels is summarized in Table 5. There are more males than females engaging in construction project management. The proportion of males increases as the position level increases, except at the project/program director level. Equivalently, the proportion of females is lowest at the project manager level. Possible reasons for this result may lie in gender stereotypes and gender bias (Heilman, 2012). For example, Allen et al. (2016) suggested that based on societal expectations, family and relationship goals may be different for women when starting their careers. However, such goals may conflict with required site work in construction projects. Additionally, the slight increase in the proportion of females at the project/program director level could be a result of the higher level of stability compared with project managers. With respect to years of experience in the construction industry, working experience increases markedly as the project management level increases. The results shown in Table 5 are also consistent with the interviews of individuals who oversee construction projects and who have been independently involved in the construction industry for over 10 years. Unfortunately, education information was not collected in the questionnaires.

Table 5
Demographic information differences by project management level.

Level of project management position	Total number	Gender (percent)		The level of experience in the construction industry		
		Male	Female	Min	Max	Average
Junior supervisor	86	73.26%	26.74%	1	3	1.66
Senior supervisor	41	80.49%	19.51%	1	5	2.44
Project manager	32	96.88%	3.13%	2	5	3.13
Project/program director	22	90.91%	9.09%	2	5	4

Note: For the level of experience in the construction industry: 1 = 0–5 years, 2 = 6–10 years, 3 = 11–15 years, 4 = 16–20 years, 5 = over 20 years.

5.4.2. Differences in absolute importance among project management competencies

Project management competencies were rated by the respondents on a scale of 1–5 on the questionnaires. The data from the questionnaires are summarized in Table 6, which shows the score for each competency by project management level. The scores reveal the absolute importance of each competency according to the industry practitioners. A higher scored competency means more importance for doing their job well. On the one hand, at the junior supervisor level, building relationships, communication and teamwork score the highest. For all the senior supervisor, project manager and project/program director levels, communication, teamwork and organizing score the highest. Thus, communication, teamwork and organizing (organizing ranked sixth for junior supervisors) are the most critical competencies at all project management levels.

Table 6
Competencies by project management level.

Competencies	Junior supervisor		Senior supervisor		Project manager		Project/program director	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Conceptual thinking	3.85	0.927	4.12	0.9	4.22	0.751	4.5	0.512
Information seeking	3.78	0.788	4.12	0.954	4	0.916	4.32	0.78
Analytical thinking	3.93	0.794	4.29	0.782	4.22	0.941	4.23	0.922
Client orientation	3.87	0.905	4.02	0.88	4.22	0.792	4.27	0.703
Organizational awareness	3.91	0.821	4.22	0.852	4.31	0.78	4.23	1.066
Vision and imagination	3.74	0.87	3.95	1.139	4.06	0.759	4.09	0.811
Results orientation	3.92	0.8	4.12	0.872	4.38	0.609	4.36	0.79
Organizing	3.93	0.779	4.32	0.722	4.5	0.718	4.59	0.503
Communication	4.16	0.749	4.41	0.741	4.63	0.554	4.5	0.673
Impact and influence	3.78	0.758	4	0.806	4.5	0.622	4.36	0.902
Flexibility	3.85	0.861	4.07	0.905	4.47	0.621	4.23	0.973
Self-management	3.99	0.744	4.17	0.863	4.19	0.592	4.5	0.673
Building relationships	4.23	0.762	4.12	0.927	4.5	0.622	4.41	0.734
Negotiating	3.9	0.921	4.17	0.972	4.41	0.56	4.23	0.922
Teamwork	4.09	0.806	4.37	0.733	4.56	0.564	4.55	0.963
Empowering	3.73	0.887	3.85	0.989	4.25	0.622	4.05	0.899
Mobilizing	3.74	0.739	3.95	0.893	4.16	0.628	4.27	0.767
Conflict management	3.92	0.77	4.07	0.905	4.19	0.738	4.09	0.971
Financial and commercial knowledge	3.48	0.942	3.83	0.863	4	0.718	3.73	1.077
Knowledge of project management	3.77	0.877	4.12	0.748	4.19	0.738	4.18	0.664
Knowledge of contracts	3.8	0.779	3.98	0.935	4.22	0.751	3.82	1.14
Construction knowledge	3.73	0.9	3.98	0.961	4.09	0.856	3.91	0.868
IT skills	3.58	0.913	3.54	0.951	3.5	0.984	3.32	0.995
Legal knowledge	3.67	0.926	3.71	0.901	3.75	0.842	4	0.873
Knowledge of risk management	3.77	0.777	4	0.775	3.97	0.74	4.41	0.796

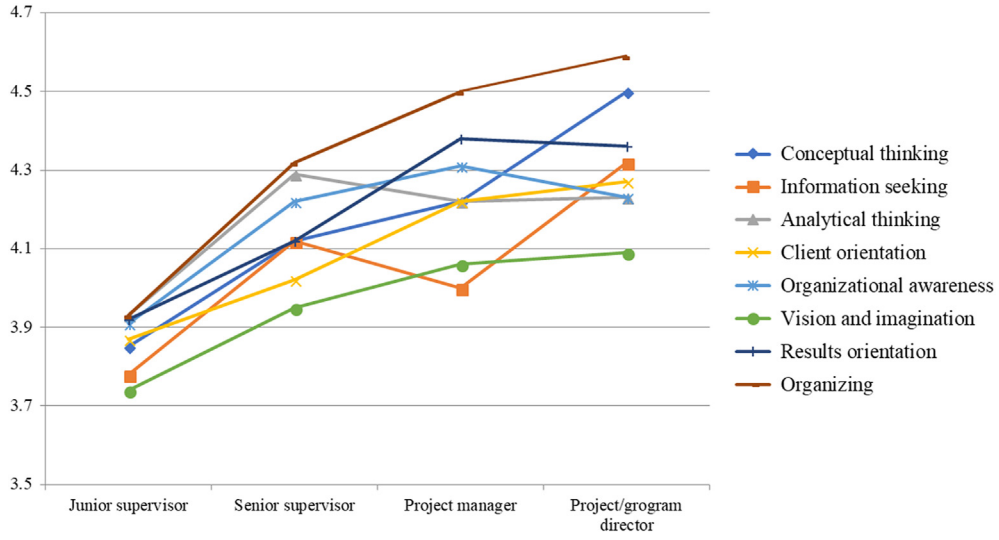

Fig. 3. The change in conceptual and organizational competencies.

On the other hand, for both the junior and senior supervisor levels, financial and commercial knowledge, IT skills and legal knowledge score the lowest. At the project manager level, knowledge of risk management, legal knowledge and IT skills score the lowest. At the project/program director level, knowledge of contracts, financial and commercial knowledge and IT skills score the lowest. Nevertheless, these results are not meant to discourage project managers from pursuing these competencies. In fact, these competencies are still required for construction project management, as their scores are higher than 3 (60% of the full score of 5).

Furthermore, line charts were used to show the change in the absolute importance of project management competencies visually in Fig. 3-5. Regarding conceptual and organizational competencies, Fig. 3 illustrates that the importance of these competencies, as a whole, increases from the junior supervisor level to the project/program director level, although the importance of some competencies decreases or fluctuates lightly. For example, compared with the project manager level, result orientation and organizational awareness are considered less important at the project/program director level. Regarding human competencies, the results in Fig. 4 illustrate that except for mobilizing, all these human competencies increase in importance from the junior supervisor level to the project manager level and then decrease slightly at the project/program director level. In other words, the project manager level has highest human competencies among the four levels. Regarding knowledge and technical competencies, Fig. 5 also illustrates an increase in the importance of these competencies from the junior supervisor level to the project manager level and a slight decrease from the project manager level to the project/program director level. However, two competencies are an exception in this category. The importance of IT skills declines as the level increases in the project management career model, while knowledge of risk management increases and reaches its peak at the project/program director level.

Overall, Fig. 6 illustrates the change in importance of all competencies at different levels. Such change in Figs. 3–6 is

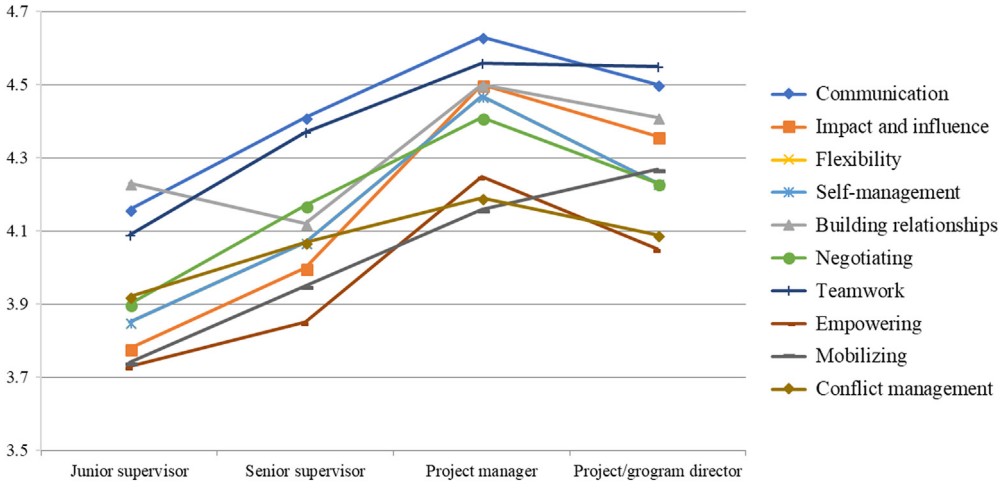

Fig. 4. The change in human competencies.

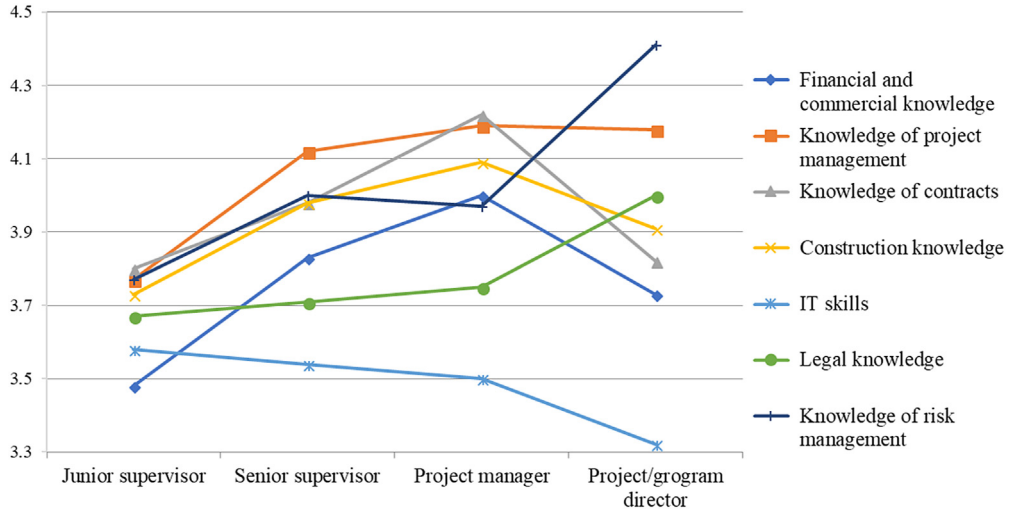

Fig. 5. The change in knowledge and technical competencies.

consistent with the results found in previous studies. For instance, individuals at higher levels of project management are required to handle more complexity and have a wider work scope. Müller and Turner (2010) highlighted that higher competencies are required to manage more complex projects. To handle the increased complexity and uncertainty, conceptual skills are required more, but the trend of importance for technical skills is inverted (Robbins and Coulter, 2012). This result accords with the results in Fig. 3-6, which illustrate that conceptual thinking, information seeking, organizing, analytical thinking, vision and imagination become more important on the path from junior supervisor to project/program director, but IT skills proceed in the opposite direction. However, it is notable that most of the project management competencies increase to the project manager level but start to decrease slightly from the project manager level to the project/program director level. Possible reasons for this result concern in the content of the job and organizational accountability. From the junior supervisor to the project manager level, individuals mainly focus on tasks within projects and are generally involved in few other tasks. However, project/program directors generally hold other managerial positions in addition to project manager. Hence, they are involved in tasks and are accountable to the line management in the organization. This change in job content and accountability may result in a decrease in the importance of project management competencies.

Although Figs. 3–6 illustrate the competency changes within the career model, they fail to demonstrate whether such changes are significant. Therefore, ANOVA was adopted to assess competency differences at different project management levels.

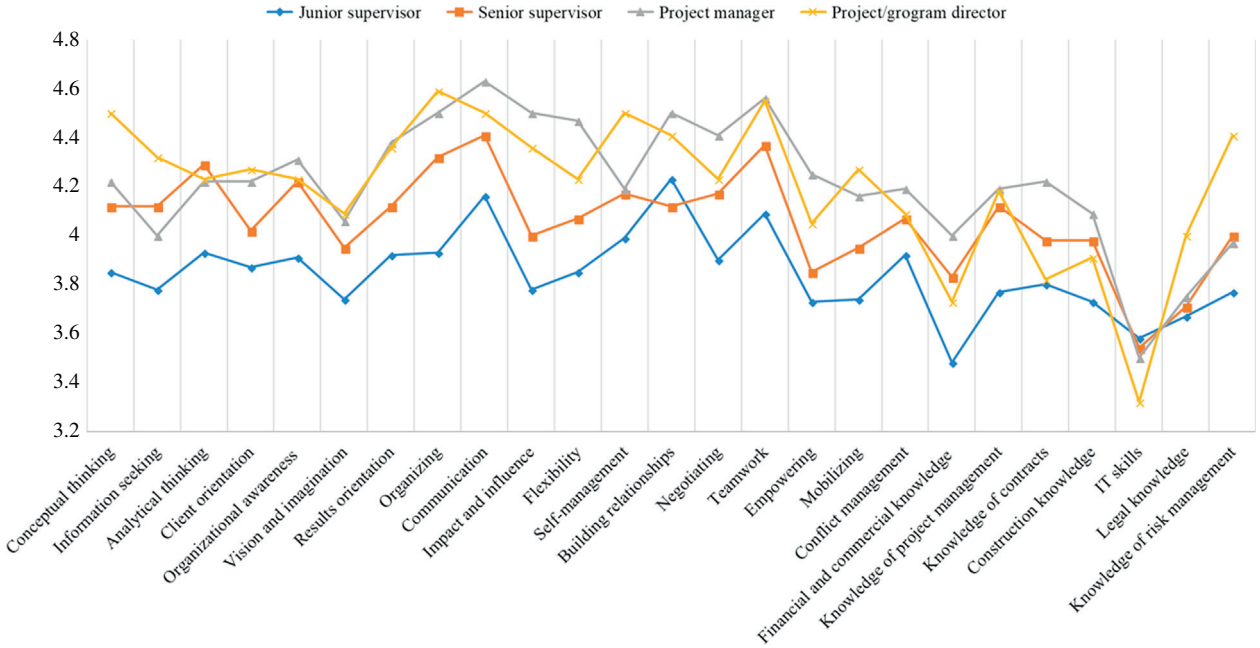

Fig. 6. Project management competencies by career level.

Table 7 shows the ANOVA results. In addition, based on ANOVA results, Fig. 5 illustrates the competencies visually at different levels. According to Table 7, the competency differences mainly lie between the junior supervisor level and the other levels. Compared with the junior supervisor level, the importance of information seeking, analytical thinking, organizational awareness, organizing, communication, financial and commercial knowledge and knowledge of project management is higher for senior supervisors. At the project manager level, the importance of conceptual thinking, organizational awareness, results orientation, organizing, communication, impact and influence, flexibility, negotiating, teamwork, empowering, mobilizing, financial and commercial knowledge and knowledge of project management is higher. At the project/program director level, the importance of conceptual thinking, analytical thinking, results orientation, organizing, communication, impact and influence, flexibility, self-management, teamwork, mobilizing, knowledge of project management, and knowledge of risk management is higher. Therefore, a significant increase in project management competencies is required when an individual is promoted from a junior supervisor to a higher level.

The importance of impact and influence, flexibility and empowering is higher for project managers than senior supervisors. The importance of impact and influence and knowledge of risk management is higher for project/program directors than senior supervisors. Hence, the importance of the competency impact and influence is significantly different between junior supervisors and higher levels. This difference can be explained by the job content. Junior supervisors oversee one or several aspects of a project and focus on internal tasks, such as the quality, schedule or cost management. However, individuals at higher levels are in charge of an entire project, or maybe even several projects. In additional to internal tasks, they must handle more external tasks, such as seeking government approval. As the head of a construction project, they need to address various organizations and seek support from other stakeholders. In this sense, they have more of a need for the impact and influence competency.

Table 7
Competency differences by project management level.

ANOVA competencies	Post hoc Scheffe group differences	ANOVA competencies	Post hoc Scheffe group differences
Conceptual and organizational competencies		Flexibility**	3 > 1***
Conceptual thinking**	3 > 1*		4 > 1(p = .064)
	4 > 1***		3 > 2*
Information seeking*	2 > 1*	Self-management*	4 > 1***
	4 > 1**	Negotiating*	3 > 1**
Analytical thinking	2 > 1*	Teamwork**	3 > 1**
Organizational awareness (p = .058)	2 > 1(p = .055)		4 > 1*
	3 > 1*	Empowering*	3 > 1***
Results orientation*	3 > 1**		3 > 2(p = .056)
	4 > 1*	Mobilizing**	3 > 1**
Organizing***	2 > 1**		4 > 1***
	3 > 1***	Basic knowledge and technical competencies	
	4 > 1***	Financial and commercial knowledge*	2 > 1*
Human competencies			3 > 1**
Communication**	2 > 1(p = .062)	Knowledge of project management*	2 > 1*
	3 > 1***		3 > 1*
	4 > 1*		4 > 1*
Impact and influence***	3 > 1***	Knowledge of risk management**	4 > 1***
	4 > 1***		4 > 2*
	3 > 2**		4 > 3*
	4 > 2(p = .074)		

Notes: * $p < .05$, ** $p < .01$, *** $p < .005$; group coding: 1 = junior supervisor, 2 = senior supervisor, 3 = project manager, 4 = project/program director.

Although most of the project management competencies receive lower importance scores at the project/program director level than at the project manager level, such differences are not significant, except for knowledge of risk management. The difference for knowledge of risk management is related to the complexity and uncertainty faced by project managers and project/program directors. Project/program directors handle projects with high levels of investment and complexity or multiple projects. Such projects are different from normal projects. As a result, project/program directors must manage higher uncertainty and risk, which results in a greater requirement for knowledge of risk management.

5.4.3. Differences in relative importance of project management competencies

The analysis above reveals the changes in the absolute importance of each competency at different levels but fails to indicate the importance distribution of the competencies. Therefore, we employ the mathematical model proposed Liu et al. (2015) to reflect the relative importance that industry practitioners place on different competencies. The results are shown in Fig. 7 (the mathematical model is presented in the Appendix).

Fig. 7 shows that human competencies play the most critical role for managing projects at all position levels. Individuals engaged in project management must mobilize team numbers, manage potential team conflicts and build good relationships with stakeholders to achieve stakeholder satisfaction through all stages of a project. All of these competencies are inseparable from good human skills. Many studies have also highlighted the importance of human competencies to project success (e.g., Clarke, 2010; Pant and Baroudi, 2008; Ramazani and Jergeas, 2015). On the other hand, knowledge and technical competencies have the least influence on project management. This result regarding the weight distribution of the competencies is consistent with El-Sabaa's study (El-Sabaa, 2001).

The weight distributions of the competencies show little difference across the four project management levels, which is inconsistent with our expectation. Fig. 7 reveals that the weights of conceptual and organizational competencies and human competencies increase slightly as the position level increases. In contrast, the weight of knowledge and technical competencies decreases slightly as the position level increases. Nevertheless, the changes are negligible, and the competency

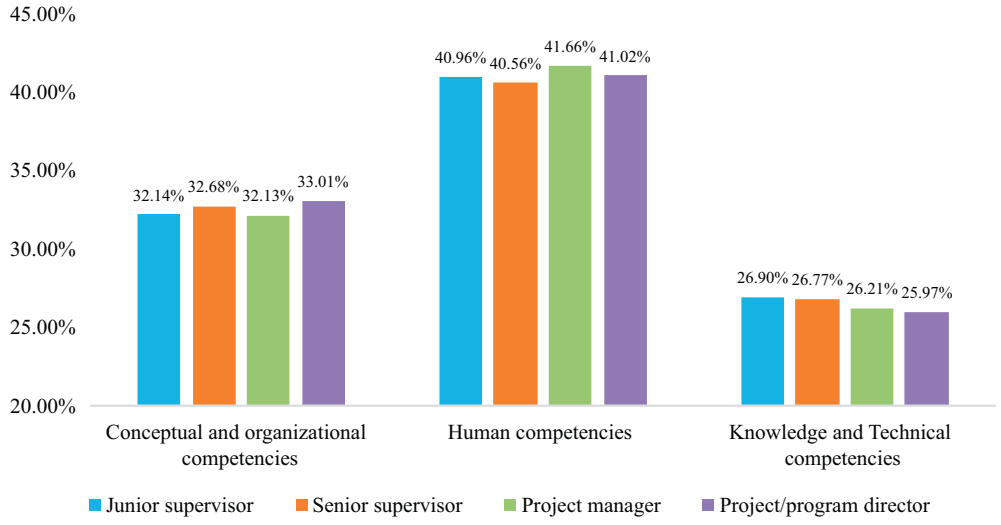

Fig. 7. Weights of competencies at different project management levels.

weights can be considered steady. The relative importance of the project management competencies shows no significant change as the position level increases.

6. Discussion

Because the work scope and focus are different at different project management levels, there should be competency differences across the different project management levels. The results shown in Table 6 and Fig. 2-6 illustrate that the absolute importance of the competencies increases from the junior supervisor level to the project manager level, but the importance starts to decrease slightly from the project manager level to the project/program director level. This change is consistent with a change in job content. More project management tasks are involved as a career path proceeds from the junior supervisor level to the project manager level. However, project/program directors are responsible and accountable for not only project management but also other tasks, such as resource coordination across multiple projects and seeking new projects. Therefore, the project/program director level represents a type of translation process from a project management career to a line management career in construction companies. In addition, the ANOVA results in Table 7 reveal a significant increase in the absolute importance of the competencies from the junior supervisor level to the project manager level, while the differences in the absolute importance of the competencies between the project/program director level and the project manager level are not significant, except for knowledge of risk management. In particular, Table 7 shows that the competency differences lie mostly between junior supervisors and the other levels. During the journey from junior supervisor to project manager, individuals are responsible for larger parts of a project. The increased uncertainty and complexity on this journey requires individuals to develop higher competencies. For example, an engineering department supervisor is only responsible for construction practices, but all other levels are involved in an entire project. Individuals rising from junior supervisor to higher levels face great changes in the scope of their work, which means that they need to show improvement in most of the competencies.

However, Fig. 7 reveals that the competency weight distributions are steady at the different project management levels, which indicates stable relative importance of conceptual and organizational competencies, human competencies, and knowledge and technical competencies in the career model. The reason for this result is that the absolute importance of these competencies increases at similar rates as the position level increases. Specifically, knowledge and technical competencies do not decrease as expected. This phenomenon can be explained by the depth and breadth of this competency. Compared with the other levels, junior supervisors require more special knowledge and technical skills related to the scope of their work but less of other types of knowledge. For example, a technical department supervisor needs a high level of construction knowledge but less financial knowledge. However, the increased work scope as the level increases requires individuals to develop a broader range of knowledge. For instance, project managers need comprehensive knowledge, including construction knowledge, financial knowledge and other types of knowledge, but less depth is required. Hölzle (2010) also highlighted that as an individual change from a specialist to being more well-rounded with a rising position level, knowledge and technical competencies decrease in depth but increase in breadth. The decrease in depth is usually mistakenly considered as having less knowledge and fewer technical competencies, but the increase in breadth is ignored. Savelsbergh et al. (2016) found that project managers learn both hard and soft skills from their experiences, which means that improvements in both hard and soft skills are required as the position level increases. Therefore, in the big picture, knowledge and technical competencies are still essential and play a stable role in contributing to project management.

To conclude, the results reveal that as the level increases in the project management career model, the project management competencies must increase overall, with a stable framework of

conceptual and organizational competencies, human competencies, and knowledge and technical competencies.

7. Conclusions and future research

7.1. Theoretical implications

Our findings have significant theoretical implications. This study develops a project management career model through a multi-case study involving six large Chinese construction firms. Project management is increasingly prevalent, as it can efficiently address the growing need for flexibility in dynamic environments. Consequently, project management is viewed as a career path akin to managerial and technical careers. However, research on the project management career path is insufficient. Only limited studies have explored the project management career path from the perspective of theoretical analysis and case studies (e.g., Bredin and Söderlund, 2013; Hölzle, 2010; Madter et al., 2012). Empirical research on the project management career path integrated with competencies has not been examined in prior studies. Therefore, our results enrich the research on how to design and implement a project management career path for these large general construction contractors.

Furthermore, our study also advances project management competency research by exploring project management competencies integrated with a career path. Although project management competencies have been a "black hole" attracting plentiful researchers, it is mainly regarded as a static construct to explore its antecedents, profiles and consequences. For example, a large number of studies have explored project manager competencies, including leadership, emotional intelligence, cognitive abilities and technical skills (Ahadzie et al., 2014; Bredillet et al., 2015). However, the dynamic analysis of project management competencies in the process of a career path is absent. Our findings fill this gap and reveal significant differences in the required competencies at different project management levels.

Moreover, we analyze the competency differences in terms of both absolute and relative importance. Higher absolute importance refers to more importance for doing their job well. Relative importance refers to the weight of the competency, which can provide comparisons of the importance of different competencies and the unequal contributions of different competencies to project management performance. On the one hand, the comparisons of absolute importance at different levels show that the importance of most of the competencies increase from the junior supervisor level to the project manager level, but they decrease lightly after the project manager level. On the other hand, the relative importance distribution of conceptual and organizational competencies, human competencies, and knowledge and technical competencies remains steady as the position level increases.

7.2. Managerial implications

PBOs are prevalent among construction companies. The project management career model can benefit construction companies because it can motivate employees to retain project management competencies by providing them with an occupational identity and promotion opportunities. This study develops a project management career model by surveying six large Chinese construction firms. This career model, derived from empirical research, can provide construction firms with a reference to develop their own project management career models.

Our findings are also meaningful for the development of project management competencies that are key assets for construction companies. First, our results show that human competencies have the most significant influence on project management at all levels, next is conceptual and organizational competencies, and the least influence is knowledge and technical competencies. Therefore, project management training and educational systems should conform to the relative importance distribution of the competencies. Second, the differences in the importance of the competencies at the four levels indicate that individuals at different position levels require different competencies. The competencies required increase as the level increases, but the relative importance distribution of the competencies remains steady. This means that individuals must show overall improvement in conceptual and organizational competencies, human competencies, and knowledge and technical competencies as their position level increases. Specifically, knowledge and technical competencies decrease in depth but increase in breadth as the position level increases. Thus, construction companies should provide employees with opportunities to improve their comprehensive competencies so they can change from specialists to well-rounded project managers. In addition to training, our findings are also beneficial with regard to promotion management, as they can help construction firms assign appropriate employees to project management positions. In addition, the changes in the competencies are conducive to individuals engaging in project management in the construction industry to develop their competencies, enhance their employability and pave their project management career path. In particular, the required project management competencies start to decrease at a higher level than project managers. In this sense, project managers should draw attention to the changes in job content and working mode when project managers are promoted to a higher level.

7.3. Limitations and future research

Some limitations are inevitable in this study. First, this study aims to extend a general project management competency model by integrating a career model. Therefore, this study only investigates generalized competencies for project management rather than detailed skills or knowledge at each position level. In addition, personal traits are not included as competencies in this study because this study only focuses on the skills or knowledge that can be improved through learning or practice. Future studies could enrich the project management competency model by investigating the specific competencies required at each level and including personal traits.

Second, this study developed a project management career model by investigating six large Chinese construction companies. Although they hold large market shares and are representative of the construction industry in China, their career models for project management may not apply to all construction companies. The companies investigated in this study are huge general contractors in China. The construction projects that they contract for are mainly buildings or infrastructure, which often involve high levels of investment. In addition, the career model and organizational structure of construction companies may be different in different countries. For example, professional subcontractors are prevalent in the U.S. Thus, general contractors' project teams in the U. S. are much leaner than the project teams in China. The organizational structure of construction projects is also different between China and the U.S. Therefore, the proposed career model is validated for large Chinese general contractors, but it needs to be examined or revised for other situations.

The work mode is influenced by the culture, especially for project management, which highlights human skills. Therefore, project management competencies may be dependent on cultural background. This study was conducted in a Chinese context and does not involve a cross-cultural sample. Currently, few studies have explored cultural influences on project management competencies. Thus, future studies may benefit from integrating cultural practices into project management competency research.

Appendix

The mathematical model used to calculate the weights of the competencies is as follows.

Suppose $E = \{e_1, e_2, \cdots, e_m\}$ is a set of m respondents at a project management level, $U = \{u_1, u_2, \cdots, u_n\}$ represents the set of $n$competencies, and c_{ij} is the evaluation value provided by respondent e_{ij} for competency u_j. $W = \{w_1, w_2, \cdots, w_n\}$ represents the weights of the competencies, where $w_j > 0$ and $\sum w_j = 1$. We suppose that if a cluster of experts has high consistency with the cluster's overall preference, then the evaluation values provided by the respondents for each competency will tend to have low degrees of discreteness. Hence, in the following, we assign each expert e_i a weight ω_i and subsequently minimize the sum of all the variances of the weighted attributes. Therefore, we obtain an optimization model as follows:

$$\min f(\omega) = \sum {\sigma_j}^2 = \frac{1}{n}\sum_{j=1}^{n}\sum_{i=1}^{m}\left(\omega_i c_{ij} - \overline{c_j}\right)^2 = \frac{1}{n}\sum_{j=1}^{n}\sum_{i=1}^{m}\left(\omega_i c_{ij} - \frac{1}{m}\sum_{i=1}^{m}\omega_i c_{ij}\right)^2 \quad (1)$$

$$\begin{cases} \sum_{i=1}^{m}\omega_i = 1 \\ \omega_i \geq 0, \quad i = 1, 2, \cdots, m \end{cases}$$

Thus, the weights of the ratings are determined using Eq. (1). The weight of each competency is calculated as follows:

$$w_j = \frac{\sum_i \omega_i c_{ij}}{\sum_j \sum_i \omega_i c_{ij}} \quad (2)$$

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