Understanding the most critical skills for managing IT projects: A Delphi study of IT project managers

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ABSTRACT

The skill requirements for project managers in information technology (IT) projects have not been widely studied in the past, especially in terms of their relative importance. We addressed this gap in the literature by conducting a Delphi study with 19 IT project managers (PMs). Among the list of 48 skills identified, our panelists selected 19 skills as being the most critical for IT PMs and then ranked them based on their relative importance. Follow-up interviews were conducted with selected panelists to gain insights into the importance of the top-ranked IT PM skills. We compare our results with two previous studies of IT PM skills and discuss the implications for research and practice.

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1. Introduction

Information technology (IT) projects continue to suffer from a high rate of failure. In 2009, The Standish Group International [1] reported a "marked decrease in project success rates," with 44% of all IT projects being delivered late, over budget, and/or without meeting the requirements; and an additional 24% being either canceled prior to completion or delivered but never used. Managing IT projects to a successful outcome requires overcoming a multitude of different risks that are encountered along the way. In a study of IT project risks conducted by Schmidt et al. [2], the "lack of required knowledge/skills in the project personnel" was ranked as one of the top five risks that can affect the success of an IT project. Wateridge [3] argued that the skills of IT project managers (PMs) are critical to the success of IT projects and that organizations should focus on developing these skills for the successful execution of IT projects. In a subsequent study, Verner and Evanco [4] found evidence supporting Wateridge's argument when they sought to identify the practices that led to successful software development projects. The findings from a survey of 101 practitioners indicated that the project manager's communication skills, ability to manage staff members, and ability to control the

project had positive and significant correlations with the success of the project [4].

Because particular IT PM skills appear to be highly correlated with project outcomes, it is critical to understand the skills required to be an effective IT PM. Having a ranked list of these skills, in order of their relative importance, would be beneficial in several ways: (1) it would help companies to hire or select effective PMs who demonstrate higher competence in the skills that are viewed to be the most critical for IT projects, (2) it would help companies and educators to tailor their career development and training to address the most important IT PM skills, and (3) it would help IT PMs to prioritize their own training and development given limited time and resources.

To date, there have been only a handful of studies that have examined IT PM skills [5–7]. Moreover, there has been no systematic attempt to discern the relative importance of these skills. Thus, there is still a need for more exploratory work not only to identify the important IT PM skills but also to determine their relative importance in a rigorous manner. The purpose of our research is to address this gap in the literature by conducting a Delphi study, which will allow us to both identify and rank the most important IT PM skills. For the purposes of our research, we conceptualize IT projects broadly to include the following: software development, system integration, IT procurement, maintenance, infrastructure, network, and IT security projects. The remainder of our paper is organized as follows. First, we review the prior research on identifying important skills for information systems professionals in general and for IT PMs in particular. Then, we discuss the research methodology used in this study. Next, we

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present and discuss our findings, and compare our results to two previous studies that sought to identify IT PM skills. Finally, we conclude with a discussion of the implications for research and practice.

2. Background

While many studies have been conducted on the skill sets required in the information systems (IS) field, they have tended to focus either on IS professionals as a general group or on subspecialties other than IT PMs (e.g., systems analysts). For example, based on a content analysis of job advertisements in four major newspapers over a 20 year period, Todd et al. [8] examined how job requirements changed over time for programmers, IS managers, and system analysts. They found that the requirements for programmers (technical knowledge) and IS managers (business knowledge) were quite stable over time, but the requirements for system analysts had shifted toward a greater emphasis on technical knowledge. Lee et al. [9] investigated the critical skills required for IS professionals including programmers, technical specialists, business/system analysts, end-user support, operators and data entry clerks. They found that organizations placed more emphasis on interpersonal/management skills, business functional knowledge, and technology management knowledge as opposed to technical knowledge. In a subsequent study, Gallivan et al. [10] conducted a content analysis of IT job advertisements posted in Computerworld, the Atlanta Journal Constitution, and Monster.com to analyze the trends in skill set requirements for IT professionals. Consistent with the results reported by Todd et al. [8], they found that there was still a strong demand for IT professionals with technical skills. While the above studies have contributed to our understanding of what skills some IT professionals are expected to have, they do not provide any real insight into the specific skills sets required by IT PMs.

Starting in the late 1990s, however, a few studies have emerged that either specifically focus on IT project managers or include IT PMs in their sampling process. Drawing upon a questionnaire developed by Green [11], which was designed to assess the importance of 18 behavioral skills for system analysts, Jiang et al. [5] conducted a survey of 118 IT PMs. While a ranked list with the relative importance of these skills was obtained, there were two important limitations to this study. First, the study was designed around a list of skills associated with system analysts and not IT PMs. Second, the study only investigated behavioral skills and did not consider other skills that might be important for IT PMs.

El-Sabaa [12] conducted a two-stage study focusing on project managers. In the first stage, based on interviews with 85 PMs from various public and private organizations, he identified 18 skills that are important to project managers. These skills were clustered into three categories: (1) human skills (e.g., communication and delegation), (2) conceptual and organizational skills (e.g., planning and organizing), and (3) technical skills (e.g., knowledge of tools and technology). In the second stage of the study, 126 project managers from information systems projects, electricity projects, and agricultural projects rated each of the 18 skills, and these were converted into percentile scores for the three main categories. The results were consistent across all three sectors: human skills were identified as the most important, followed by conceptual and organization skills, and then technical skills. A key limitation of the El-Sabaa [12] study, however, is that the skills and skill categories were based on project managers in general, rather than on IT PMs in particular. Thus, despite the fact that some IT project managers were included in the pool of respondents, it does not provide a comprehensive list of skills specific to IT PMs.

Using the Repertory Grid Technique, Napier et al. [6] interviewed 19 practicing IT PMs and elicited 46 IT PM skills grouped into 9 skill categories, which were believed to be associated with successful IT PMs. The nine skill categories included the following: planning and controlling, general management, leadership, communication, team development, client management, system development, problem solving, and personal integrity. In addition, four different IT PM archetypes (general manager, problem solver, client representative, balanced manager) were identified based on the different combinations of skill categories that the participants used to describe the ideal IT PM [6]. One major strength of the Napier et al. [6] study was that it focused specifically on IT PMs and the researchers began with a clean slate, allowing them to provide the first comprehensive list of skills associated with successful IT PMs. However, due to the limitations of the repertory grid approach, they were not able to systematically rank the relative importance of the skills identified in their study.

Most recently, Skulmoski and Hartman [7] conducted a study on the "soft competencies" of IT PMs. Two rounds of qualitative interviews were conducted with 21 participants including technical and supervisory project team members and senior management. Seven competency categories with 61 individual skills were obtained after the first round of interviews. During the second round, 15 subjects were asked to allocate 25 points across the skills listed in each of the skill categories (this step was taken for each project phase). The points allocated were intended to indicate the relative importance of each skill by project phase. The primary contribution of Skulmoski and Hartman's [7] study was the insight that different skills are needed for each phase of an IT project: effective questioning/generating feedback for the initiation phase; project management skills and knowledge along with consensus building for the planning phase; ability to get along/being a team player for the implementation phase, and writing skills, sharing information and credit for the closeout phase. By the authors' own admission, "the ranking survey results are not the principal output" of their study [7, p. 74]. Indeed, because the number of skills varied (from 8 to 17) across the seven skill categories identified by Skulmoski and Hartman [7] and the same number of points (25) were allocated to each category (regardless of the number of skills), two skills that obtained the same number of votes but belonged to different categories cannot be assumed to be of equal importance. This limitation is significant and may have biased their ranking results, indicating the need for further research to rank the importance of IT PM skills in a more rigorous fashion.

While the studies described above contribute to our understanding of the skills that may be important for IT PMs to possess, there are two important gaps in the literature that we seek to address. First, there has been only a very limited effort to determine the relative importance of various IT PM skills [7] and the work that has been done suffers from serious methodological limitations. Second, there has been few attempts to understand why particular skills are viewed as being of paramount importance and how their perceived importance may be affected by particular contextual factors (e.g., project size, project complexity, project risk, and project type). Furthermore, there has been no attempt to understand how the skills that are considered to be the most important for IT PMs can be acquired or developed. This study aims to overcome the limitation of prior studies and to address these important knowledge gaps by answering the following research questions:

RQ1. What are the most important skills for an IT project manager to have?
RQ2. What is the relative importance among these skills?
RQ3. How can we explain the importance of the top IT PM skills?

3. Research methodology

To address RQ1 and RQ2, we needed input from experts in the field with years of experience in managing IT projects. Because the task at hand involved both identifying the relevant skills and determining their relative importance, we chose the Delphi method [13]. The Delphi method is a group decision-making process where, through iterative feedback, the opinions of a panel of experts are elicited and consensus is reached. The method has been used in a wide variety of disciplines including public administration [14], social work [15], operations management [16], and information systems [17–19], to name just a few. The Delphi method begins with the selection of domain experts to form a panel. Each panelist is then asked to provide input regarding the problem area of interest. The inputs from the panelists are collected and then aggregated into a list of unique items. These items are then presented back to the panelists for ranking. The mean rank for each item is then computed, and the ranked list is presented to each panelist along with his/her original rankings for comparison purposes. This ranking process continues in an iterative fashion until an acceptable level of group consensus is reached.

3.1. Data collection and analysis – the Delphi method

Data collection and analysis for the Delphi study was based on the approach recommended by Schmidt [13]. Specifically, we followed a three-phase process involving brainstorming, narrowing down, and ranking, as shown in Fig. 1. Data were collected directly from the panelists via e-mail. The first and second phases (brainstorming and narrowing down) were each conducted within a 2-week time frame, while the third phase (ranking) was conducted over a 6-week period because multiple rounds of ranking were involved.

A total of 19 IT project managers were recruited through the Atlanta chapter of the Project Management Institute (PMI). A convenience sampling approach was followed, but at the beginning of the first phase, we collected demographic information to ensure that each panelist had sufficient experience in leading IT projects. Table 1 presents the demographic profile of our panel. Our panelists had an average of 12 years of experience managing IT

Table 1
Demographic profile of the panel.

Demographic variable	Panel profile
Gender	
Male	14
Female	5
Average years of IT PM experience	12
Number of IT projects managed	
1–5	3
6–10	2
11–15	4
16–20	4
More than 20	6

projects (with a range from 5 to 25 years of IT PM experience). Most panelists had managed eleven or more IT projects. Thus, we deemed the panel to have the requisite experience to provide informed opinions regarding essential IT PM skills. As shown in Table 2, our panelists had experience with a variety of different types of IT projects. Nearly all of our panelists had experience with software development and systems integration projects and 6–10 of our panelists had experience with IT procurement, maintenance, infrastructure, network, and IT security projects. Thus, we believe that the panel profile reveals both breadth and depth.

After collecting the demographic information and confirming that the panelists had sufficient expertise in IT project management, we conducted a brainstorming round to elicit as many IT PM skills as possible. Each panelist was asked to submit at least six skills that s/he considered to be necessary for successfully managing IT projects, along with a brief description of each skill. We received responses from all 19 panelists, who together generated a total of 115 skills. Two of the authors worked together to group the relevant skills and create skill categories. Each skill was typed onto a separate piece of paper and placed on a large table, allowing us to physically move them around as we attempted to organize them into meaningful categories based on the descriptions provided by the panelists. During this process, duplicate skills were identified, and skills with vague descriptions were set aside for discussion. Then, all three authors worked together on each category of skills, comparing the grouped skills and confirming duplicates to finalize the list of unique skills. The
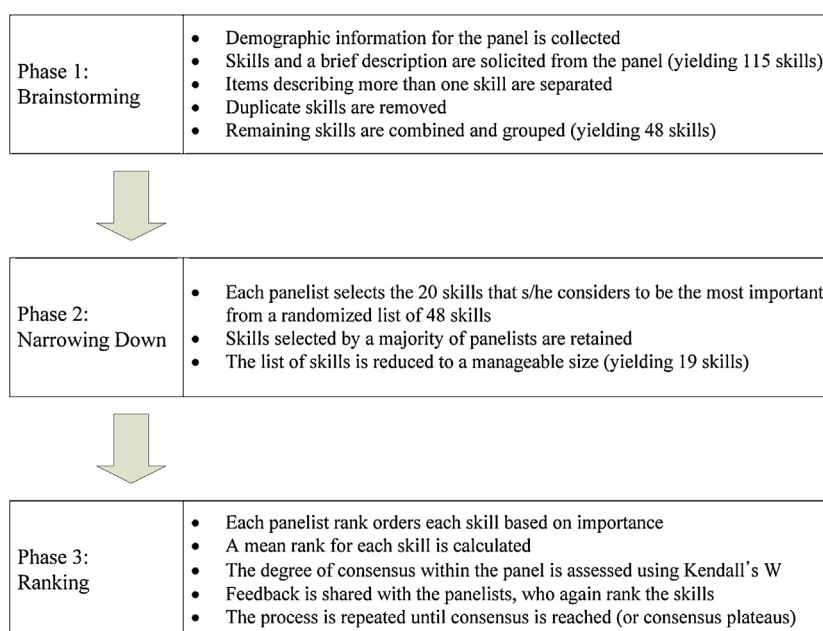

Phase 1: Brainstorming	• Demographic information for the panel is collected • Skills and a brief description are solicited from the panel (yielding 115 skills) • Items describing more than one skill are separated • Duplicate skills are removed • Remaining skills are combined and grouped (yielding 48 skills)
Phase 2: Narrowing Down	• Each panelist selects the 20 skills that s/he considers to be the most important from a randomized list of 48 skills • Skills selected by a majority of panelists are retained • The list of skills is reduced to a manageable size (yielding 19 skills)
Phase 3: Ranking	• Each panelist rank orders each skill based on importance • A mean rank for each skill is calculated • The degree of consensus within the panel is assessed using Kendall's W • Feedback is shared with the panelists, who again rank the skills • The process is repeated until consensus is reached (or consensus plateaus)

Fig. 1. A description of the Delphi study approach.

Table 2
Respondent involvement in various types of IT projects.

Panelist	IT project type						
	Software development	System integration	IT procurement	Maintenance	Infrastructure	Network	IT security
1	X	X	X	X	X	X	
2	X	X		X	X	X	
3	X						
4	X	X	X	X	X	X	
5	X	X			X	X	X
6	X						
7		X	X	X	X	X	X
8	X	X	X				
9	X	X	X	X			
10	X	X	X	X	X	X	X
11	X	X	X	X	X		
12	X	X					X
13		X					
14	X			X			
15	X	X					X
16	X	X		X			
17	X	X			X		
18	X	X		X			
19	X	X					X

skill categories and their descriptions are shown in Table 3 along with the skills contained within each category. For duplicate skills, the most common description or the one that best described the skill was selected through discussion. The wording provided by the panelists was used wherever possible and editing was minimized to preserve the intended meaning. At the end of this phase, a list of 48 unique skills was created (shown in Appendix A).

In the second phase, a randomized list of the 48 skills identified from the brainstorming round was sent to each panelist; each was asked to select the 20 most important skills for an IT project manager. A short description of each skill was presented to ensure that the panelists would have a common understanding of what each skill encompassed. The purpose of the second phase was to narrow down the list of 48 skills to a more manageable number for the final ranking phase, as suggested by Schmidt [13]. A total of 17 responses were received from the panel (89.5% response rate) for this phase. Only those skills that were selected by over half of the panelists were retained for the ranking phase. The initial list of 48 skills was reduced to 19 through this process. Table A1 lists the 19 skills that were judged by our panelists to be the most important, and Table A2 lists the skills that were not retained for ranking.

The third phase focused on ranking these 19 skills and involved multiple rounds. For the first ranking round, the ordering of the skills was based on the percentage of panelists who selected each skill in the previous phase. For the subsequent rounds, the skills were ordered by mean rank. The panel was asked to rank each skill in order of its importance relative to other skills, and tie ranks were not allowed. During the first round, the panelists were also asked to provide a brief explanation of the reasoning behind their top ranked skill. At the end of each round, Kendall's coefficient of concordance (W) was calculated to assess the degree of consensus among the panelists [13]. Subsequent rounds of ranking continued until either (1) the panel obtained a reasonable degree of consensus or (2) the degree of consensus leveled off in two consecutive rounds.

3.2. Data collection and analysis – panelist interviews

To address RQ3, we conducted two rounds of semi-structured interviews with six panel members who were willing to participate after the Delphi rankings had been completed. The purpose of these interviews was to gain an in-depth understanding of why IT project managers considered particular skills to be more important than others. More specifically, the panelists were asked to

elaborate on the following: (1) why the top five skills emerged as being so important for managing IT projects, (2) contextual factors (e.g., project size, complexity, risk, type, and project management process groups) that might affect the perceived importance of a particular skill, (3) how the top five skills could be effectively acquired and developed, and (4) which skills were ranked relatively lower than expected and why. The interviews were conducted over the phone, and each one lasted approximately 35–45 min. A semi-structured interview protocol (Appendix B) was used as a guide and at least two of the researchers participated in each of the interviews. Each interview was recorded after gaining permission from the panelists.

All of the interviews were transcribed for subsequent analysis. Repeated readings of the transcripts were made to familiarize ourselves with the interview data. During this process, we also identified those phrases that were the most relevant to the question asked. These phrases were summarized and organized by question for each of the panelists. Then, all of the phrases were consolidated into one document to compare and identify similarities, differences, and any potential contradictions between the panelist responses. We clustered similar responses together to form a general response for each question, and returned to check the original transcripts to ensure that the general response was representative of the panelists who were interviewed. Additionally, we identified those responses that deviated from the general response because they could provide additional insights into explaining the importance of particular skills. The process was iterative and involved moving back and forth between our analyses and the data. The results of the analyses are presented in Section 4.2.

4. Results and discussion

In this section, we present the results of our study, organized into three subsections. First, we present the Delphi study ranking results that address RQ1 and RQ2. Second, we present and discuss our findings from the follow-up interviews with the selected panelists, which address RQ3. Finally, we compare the list of IT PM skills that surfaced in our study against the list of skills identified by Napier et al. [6] and Skulmoski and Hartman [7].

4.1. Ranking results (RQ1 and RQ2)

Table 4 presents the mean ranks and Kendall's W for each ranking round (Phase 3) in our Delphi study. In the initial ranking

Table 3
Summary of skill categories.

Skill category	Description	Skills
Team management	Team management includes those skills that are required as an IT PM for effectively leading and managing project members within and across different teams. Competent IT PMs need to not only provide leadership, but also to motivate and empower their team members to successfully execute the project.	• Ability to motivate team members • Ability to empower future leaders • Celebrating accomplishments • Leadership • Collaboration • Ability to bridge diverse teams • Virtual team skills
Business domain knowledge	Business domain knowledge encompasses the skills that IT PMs need to work effectively with their business partners. An effective IT PM needs to understand the overall context of the project, in addition to how the project will affect the business and the stakeholders.	• Ability to understand the business domain • Ability to identify stakeholders • Business skills • Knowledge of the end product • Ability to document process • Strategic thinking
Communication	Communication involves the skills required to communicate effectively with those involved in the project. This skill category also includes listening, which is critical for understanding expectations and identifying the issues that arise during the course of the project.	• Verbal communication • Written communication • Listening • Ability to construct persuasive arguments
People skills	People skills are required to maintain good relationships with those who are associated with the project. This skill category includes understanding the perspectives of the different stakeholders involved in addition to managing conflicts and exerting influence over people.	• Relationship building • Understanding the psychology of people • Conflict management • Good people skills • Negotiation
Technical	Technical skills refer to skills that are normally associated with being an IT developer. This skill category includes technical knowledge as well as knowledge of the development methodologies, processes, and techniques used to develop IT systems.	• Technical skills • Development methodology skills
Project management	Project management includes skills that are relevant to managing the various aspects of IT projects. Competent IT PMs need the ability to effectively plan, monitor and control the project while managing the scope, resources and risks to ensure that the project is completed on time and within budget. This skill category also includes knowledge and experience of the tools and techniques used in project management.	• Scope management • Project planning • Time management • Resource utilization • Closing the project • PM tool skills • Project chartering • Cost management • Risk management
Personal characteristics	A competent IT PM has particular personal characteristics that may be beneficial to the execution of a project. In this category, we grouped those personal characteristics that may be inherent in nature, but can still be nurtured.	• Sense of humor • Patience • Ability to handle stress • Seeking consensus • Persistence • Cooperation • Attention to detail
Organizational	Organizational skills include the ability to organize and coordinate project activities and resources. These skills are required by project managers to manage task dependencies and deadlines and include the ability to multi-task.	• Organization • Multi-tasking
Problem solving	Problem solving includes those skills that are necessary for identifying, analyzing and solving the problems that arise during the course of a project.	• Analytical skills • Research skills
Professionalism	Professionalism refers to the values and qualities of an IT PM that communicate integrity and commitment to quality.	• Credibility • Commitment • Focus on quality • Professional skills

round, we received a total of 13 usable responses (68% response rate) from our panelists. A Kendall's W of 0.38 indicates a weak degree of consensus among the panelists [13]. Thus, we conducted a second ranking round with two forms of controlled feedback: the mean rank for each skill from the first round of ranking and the reasons provided by the panelists for their top choice. Again, we received a total of 13 usable responses. The Kendall's W for this round increased to 0.43, but this still represented a relatively low degree of consensus, and thus a third ranking round was undertaken. Once again, the panel was provided with the mean rank of each skill from the second round. A total of 15 usable responses were received from the panelists (79% response rate) and the Kendall's W increased again to 0.66, which indicated that a moderate degree of consensus had been reached among the

panelists [13]. At this point, we decided not to conduct any further rounds because the feedback from some of our panelists indicated that they were not inclined to continue the exercise further and we had already reached an acceptable level of consensus.

To determine whether any skill rankings were particularly controversial, we examined the standard deviations associated with the mean rankings of the 19 skills after round three. As shown in Table 4, all of the standard deviations were between 1.45 and 4.90 with the exception of the 16th ranked skill (attention to detail). This result suggests that the ranking of most skills was not particularly controversial and that the moderate level of consensus reached by the Delphi panel was not the result of sharp disagreements over the ranking of particular skills.

Table 4
Intermediate and final ranking results.

Skill	Skill category	Round 1 Mean rank	Round 2 Mean rank	Round 3 Mean rank (std. dev.)
1. Leadership	Team management	3.23	2.85	1.67 (1.45)
2. Verbal communication	Communication	5.54	4.00	3.27 (1.75)
3. Scope management	Project management	4.15	5.46	4.20 (2.18)
4. Listening	Communication	6.38	5.62	4.27 (1.71)
5. Project planning	Project management	5.00	6.23	5.33 (2.32)
6. Written communication	Communication	9.69	8.15	7.47 (3.46)
7. Good people skills	People skills	11.15	9.38	7.93 (2.15)
8. Ability to motivate team members	Team management	11.15	9.77	9.60 (4.90)
9. Negotiation	People skills	12.00	10.08	9.80 (3.84)
10. Organization skills	Organizational	12.69	11.08	11.80 (2.85)
11. Time management	Project management	10.08	11.38	11.87 (2.62)
12. Relationship building	People skills	13.15	12.85	12.60 (2.44)
13. Resource utilization	Project management	10.23	12.08	12.67 (3.08)
14. Conflict management	People skills	10.85	12.08	12.80 (2.65)
15. Risk management	Project management	12.00	12.08	13.07 (4.28)
16. Attention to detail	Personal characteristics	10.85	12.38	13.20 (5.11)
17. Cost management	Project management	13.31	14.38	14.87 (4.00)
18. Multi-tasking	Organizational	14.46	14.92	16.40 (4.40)
19. Analytical skills	Problem solving	14.08	15.23	17.20 (3.78)
Kendall's W		0.38	0.43	0.66

Because a moderate degree of consensus was achieved overall, we can have a reasonable level of confidence in the results [13].

One of the most interesting insights that emerges from our study and extends the results of prior studies is the relative importance of not just the individual ranked skills, but that of the skill categories themselves. Of the 10 skill categories we identified, three (technical, business domain knowledge, and professionalism) did not contain *any* skills that our panelists judged to be sufficiently important for ranking. For the remaining seven categories that did contain ranked skills (see Table 5), we examined the number and mean rank of the skills subsumed under each skill category. Our analysis revealed that the project management category contained the greatest number of ranked skills (6), the people skills category contained the second greatest number (4), and the communication category contained the third greatest

Table 5
Relative importance of skill categories based on mean rank.

Skill category (in order of importance)	Ranked skills subsumed (mean rank based on 3rd round results)	Mean rank of skills subsumed in category
1. Communication	Verbal communication (3.27) Listening (4.27) Written communication (7.47)	5.00
2. Team management	Leadership (1.67) Ability to motivate team members (9.60)	5.64
3. Project management	Scope management (4.20) Project planning (5.33) Time management (11.87) Resource management (12.67) Risk management (13.07) Cost management (14.87)	10.44
4. People skills	Good people skills (7.93) Negotiation (9.80) Relationship building (12.60) Conflict management (12.80)	10.78
5. Personal characteristics	Attention to detail (13.20)	13.20
6. Organizational	Organization skills (11.80) Multi-tasking (16.40)	14.10
7. Problem solving	Analytical skills (17.20)	17.20

number (3). When we computed the mean rank of the skills associated with each category, we found that communication was the highest ranked category, followed by team management, project management, and people skills. These results can be seen in Table 5.

4.2. Findings from the follow-up interviews (RQ3)

In the follow-up interviews, we focused on the top five skills identified in our study (leadership, verbal communication skills, scope management, listening skills, and project planning) with the aim of determining why the panelists felt that these skills were so important. Although there were several new skills identified in our study in comparison to prior studies [6,7] (see Appendix C for details), the majority of these skills did not make it to the ranking phase. Thus, we decided to limit our focus to deepening our understanding of the skills that our panelists considered to be the most important (i.e., the top five skills).

We were also interested in any contextual factors that might influence the perceived importance of particular skills as well as the panelists' insights into how such skills could best be acquired or developed. In terms of contextual factors, our panelists did not believe that the type of project (i.e., strategic, transactional, informational, or infrastructure) had any influence on the importance of the critical skills identified in our study. However, the panelists did note differences in skill importance related to size, complexity, risk, and project management process groups. They also noted other factors that could impact skill importance. Table 6 presents a summary of the findings from the follow-up interviews.

4.2.1. Leadership

Leadership was the top ranked skill identified by our panel. As one panelist stated, "The most important contribution a project manager can bring to a project team is leadership. To guide the team on the important things to focus on, in any given phase of the project and to make sure this focus reflects the priorities of the organization." Our panelists also identified leadership as including the following major aspects: providing a vision, demonstrating charisma, and leading by motivating people toward accomplishing the project goals. As one panelist put it, "leadership is setting a clear path, so that the team can follow you, they have an idea where you're going, and why you are going there." Another

Table 6
Summary of the follow-up interviews.

Skill	Reason for importance	Contextual factors (e.g., project size, complexity, risk, and type) affecting skill importance	Methods for obtaining and developing skill
1. Leadership	• Required to share vision of project and provide direction • Necessary for engaging and motivating people toward the goal	• Important across all different contexts, but especially in projects with: - Larger size - Higher levels of risk - Greater complexity - Greater criticality/impact to business	• Mentoring • Experience • Training classes and workshops
2. Verbal communication	• Necessary for providing clear directions and managing expectations	• Important across all different contexts, but especially in projects with: - Larger size - Higher levels of risk - Greater complexity	• Training classes and workshops (e.g., Toastmasters®) • Presentations during team meetings
3. Scope management	• Critical to the success of the project as it directly impacts schedule and cost • Necessary for controlling stakeholders' expectations and project deliverables	• Important in projects with: - Larger size - Higher levels of risk - Greater complexity	• Training classes (e.g., PMI education) • Experience • Mentoring • Improving domain expertise
4. Listening	• Critical for identifying stakeholders and their expectations, problems with projects, and project risks	• Important across all different contexts	• Training classes • Experience • Documenting and communicating message back to original sender • One-on-one coaching
5. Project planning	• Critical to project because it sets the goals (i.e., schedule, budget, and deliverables) of project - Supports the identification of current project status, project targets, and the responsibilities of project members	• Important in projects with: - Higher levels of risk - Greater complexity and larger scope - Larger size - External clients	• Training classes (e.g., PMI education and PMP certification) • Drawing from external resources (e.g., prior projects or subject matter experts)

panelist emphasized that leadership is the ability to motivate different stakeholders to work together toward a common goal.

One reason why leadership is so important is because it is through strong leadership that a project manager motivates his/her team members, which in turn improves the performance of the team. This quality of leadership was repeatedly emphasized by our interviewees. The following was a typical remark from one of our panelists:

Project managers typically do not have formal authority over resources that they need to accomplish project goals. Therefore, they need to use leadership skills to engage and motivate people towards those goals in order to get results.

Considering the importance of leadership and how critical it is to the success of IT projects, we asked our panelists whether and how leadership skills could be acquired. While the majority of our panelists believed that leadership was an innate capability for some people, they also mentioned that it was a skill that could be acquired and improved over time. As one panelist explained, leadership "is a set of attributes, so anybody could obtain good leadership skills, but I think that some people have a talent, and already have those attributes naturally." Experience gained on the job and training classes with an experiential approach to learning were both mentioned as good ways to develop leadership skills. In addition, several panelists emphasized that having a mentor can also be an effective method for acquiring these skills. The following remark was typical:

It helps to have a mentor. There are people who are leaders, that don't know they are leaders, because they are afraid to lead. But once a mentor helps them get over that initial fear of leading, they may find out that somebody will follow me if I say this is where we have got to go.

4.2.2. Verbal communication

Verbal communication skills were the second highest ranked skill identified by our panel. Effective project managers must be able to communicate with various stakeholders to control the project and resolve issues. The following remark from one of our panelists was typical:

I ranked verbal communication skills at the top because other skills can be rendered ineffective if the project manager is unable to accurately and clearly communicate with project stakeholders. Most issue resolution, scope management and risk management activities require this skill to address them successfully.

In terms of acquiring verbal communication skills, the majority of panelists believed that these skills could be acquired, although some people may have more innate talent in this area than others. As one panelist explained:

Some people start out a little bit more developed or gifted... But anybody can improve the skill... It can be taught ... as long as the training involves a lot of practice.

To develop verbal communication skills, all panelists agreed that training classes, workshops, and other opportunities to develop one's capabilities in this area (e.g., Toastmasters®) are effective. However, they also mentioned the importance of practicing through presentations. As one panelist stated:

Finding opportunities to do verbal presentations, practicing it [helps]... Make sure that they use an opportunity to communicate during the status meetings.

4.2.3. Scope management

Scope management was the third highest ranked skill identified by our panel. One major reason for this choice was emphasized

repeatedly by our panelists: scope is critical to project success, and changes to the scope have significant impact on the project. The panelists considered this skill to be critical for PMs to control stakeholder expectations and project deliverables throughout the entire project lifecycle. The following remark by one of our panelists was typical:

> Scope management is the single most important skill for the project manager working on complex projects such as IT systems ... During the project charter there needs to be a high-level agreement on the definition of the project deliverable, and this understanding needs to be constantly maintained and renegotiated as the details of projects are fleshed out.

All of the panelists agreed that scope management is a skill that can be learned through training (e.g., PMI certification courses). However, one panelist also mentioned the importance of mentoring and experience:

> You really need to develop over time the sensitively to these things. Training and mentoring, [are] probably the strongest ways to understand and start gaining the sensitivity. Your mentor has been there, done that, and been burnt by it and understands the real impact and why it's critical. But until you are in the middle of it, and you actually start to see what the impacts of these things are, you don't really know.

4.2.4. Listening

The panelists we interviewed considered listening skills, the fourth highest ranked skill, to be important because they are directly related to identifying and understanding project status and project risks, and to managing stakeholder expectations. As one panelist explained:

> If you can't listen to what is going on from the folks that are reporting to you, and to your customers, then you are going to ultimately miss all the problems, and some of the solutions that emerge throughout the course of events. One of the things that... is often overlooked... [is] the ability to sit down and really listen to people and understand the issues and concerns they are having. [This] allows you to make much more effective and balanced decisions as a leader.

Several panelists provided examples from their own experience regarding the importance of listening skills, most of which involved overlooking problems with the project by failing to listen to their team members. The following was typical:

> Listening to some of my really good technical people and taking the time to listen to the issues they are experiencing [is critical]. By not listening, you might have just missed one of the fatal flaws in the architecture of the project. Unfortunately, it might cause [the project] to fail.

Although one panelist considered listening to be an innate skill, the majority indicated that it is a skill that can be nurtured through training and experience. One panelist shared his experience that "documenting what has been heard and communicating it back to the original sender of the message" can help improve this skill. Another panelist also noted coaching and role-playing as effective methods for improving listening:

> With my team, whenever we have someone who has this challenge [of improving listening], a lot of it is just personal one-on-one coaching. You have to do some role-playing, or walk through a couple of different scenarios to train them in what to look for.

4.2.5. Project planning

Project planning was the fifth highest ranked skill identified by our panel. The majority of the panelists we interviewed repeatedly emphasized that project managers need good planning skills to successfully achieve the goals of a project. As one panelist explained:

> You need to know where you are at in terms of the schedule, when you are going to deliver, and also in terms of your budget. You have to be able to plan out timelines and budget through the end of the project. And the importance of that is... comparing where you are at with a baseline shows you exactly where you are [relative] to where your target is, and it gives the project something to strive for.

In terms of developing project planning skills, all of the panelists indicated that formal training classes and workshops can be very effective. In applying project planning skills, our panelists warned that PMs should never put themselves in the position of creating the project plan without obtaining input from key resources.

4.2.6. Unexpected results (risk management and technical skills)

We also used the follow-up interviews to gain insight into two skills that we expected to rank more highly in our study (risk management and technical skills). Considering the important role of risk management in reducing the failure of IT projects [2,20], we were surprised that it was ranked 15th (out of 19) in our study. Based on the interviews, we found that our panelists believed that IT project risks could be mitigated (at least to some extent) by having good project planning skills. As one panelist stated:

> [Through project] planning, really putting together a good implementation strategy, especially with experienced people, you are usually avoiding risk.

With regard to technical skills, which was not deemed by our panelists to be sufficiently important to be ranked, we found mixed opinions in our follow-up interviews. Most of the panelists interviewed emphasized that the role of the IT PM is to focus on the management activities within projects. They explained that projects could be conducted successfully as long as the IT PM was able to utilize appropriate technical resources (e.g., technically skilled staff within the team), which may explain why the skill was excluded from the ranking phase. The following remarks from two panelists were typical:

> [To be] a good project manager, it is not critical that you have the technical skills, so long as you have the ability to use the resources available.
> I would really rather be focused on management and leadership activities... You need to have good technical people on the team, but you as the leader do not necessarily need to understand all those details.

However, this result does not suggest that project managers should overlook the importance of technical skills in the context of IT projects. As indicated by some panelists, IT PMs need an understanding of the products (e.g., software applications) being delivered by IT projects in addition to a basic understanding of the methodologies and processes required to develop such products. As two panelists put it:

> In order to be able to understand and truly effectively measure where the project's at, that domain expertise in IT is critical. Otherwise, you become more of a project coordinator rather than a project manager... An IT project manager has to have an understanding and be able to quickly adapt, and to draw complex technical solutions together...

Table 7
Minimum requirement of the top five skills for the PMBOK process groups.[a,b]

Skill	Initiating	Planning	Executing	Controlling/monitoring	Closing
Leadership	M–H	H	H	H	H
Verbal communication	H	H	H	H	H
Scope management	L–M	M–H	H	H	L
Listening	H	H	H	H	L
Project planning	M	H	M	M–H	L

[a] L: low level of skill, M: medium level of skill, H: high level of skill.
[b] Requirements are for an IT project of average size and risk.

You need the subject matter experts for the technical details, but you need to be able to understand the project enough to be able to communicate with them intelligently, and recognize when they are telling you something that's not right.

One panelist also told us that IT PMs with technical skills are more likely to be viewed as credible by some project team members.

4.2.7. Level of importance for the skills required for process groups

According to our panelists, the importance of the IT PM skills can vary across the different stages and aspects of a project. As one of the well accepted project management guidelines, the PMBOK recognizes the following project management process groups: initiating, planning, executing, controlling and monitoring, and closing [21]. Having a profile of the required minimum level of key skills needed across these process groups may guide organizations as they align their project managers' competencies with the project requirements. Therefore, we sought input from our panelists during the follow-up interviews to investigate the relative importance of the top five IT PM skills across the different process groups supporting an average sized IT project (Table 7).

Based on the input from our panelists, a high level of leadership skills and verbal communication skills are required across all five process groups. Scope management skills were considered to be more important during the executing and controlling processes. One explanation might be that "scope creep" is most likely to occur during project execution. Because scope changes can dramatically impact the project schedule and cost, scope management skills are needed to closely monitor and control their impact. Project planning skills are the most critical in planning and controlling processes, presumably because these are the processes through which plans are drawn up in detail and adjusted as needed during the course of the project.

4.3. Comparison of our results to previous studies

Based on our literature review, we identified only two recent studies that directly focus on the identification of IT PM skills [6,7]. Napier et al. [6] and Skulmoski and Hartman [7] reported lists of 46 and 61 IT PM skills, respectively. Appendix C compares our findings against those reported in these two studies. While there was considerable consistency between the results that we obtained and those reported by both Napier et al. [6] and Skulmoski and Hartman [7], some differences did emerge. Specifically, in our Delphi study, we identified 16 skills that that did not surface in the Napier et al. [6] study and 14 skills that did not surface in the Skulmoski and Hartman [7] study. Among these, we identified four ranked skills (conflict management, risk management, attention to detail, and multi-tasking) that surfaced in our study but not in Napier et al. [6] and that underscore the importance of the following four skill categories: people skills, project management, personal characteristics, and organizational skills. We also identified four ranked skills (leadership, relationship building, organization skills, and multi-tasking skills) that surfaced in our study but

not in the Skulmoski and Hartman [7] study and that underscore the importance of the following three skill categories: team management, people skills, and organizational skills. For the interested reader, Appendix C provides a more detailed discussion by skill category of the similarities and differences between all of the skills (ranked and unranked) identified in our study and those that emerged in the prior two studies.

5. Implications for research and practice

The findings from this study have implications for both research and practice. While prior research has investigated the various skills that are required for IT professionals, there has been little attention and focus on IT PMs in particular and the skills they need to be successful [5].

5.1. Implications for research

For researchers, this is the first study that not only identifies IT PM skills but also employs a systemic method to rank order these skills in terms of their importance using a rigorous multi-pass group decision-making approach (i.e., the Delphi method). The results obtained in this study both confirm and extend the results from prior research on IT PM skills [6,7]. Specifically, we found a 73% overlap between the skills identified by our Delphi panel and those reported by Napier et al. [6] and a 37% overlap compared with the skills reported by Skulmoski and Hartman [7]. At the same time, our findings indicate that there are some IT PM skills that did not surface in one or both of these studies, but which our panelists judged to be important. These include leadership, relationship building, organization skills, risk management, conflict management, attention to detail, and multi-tasking skills.

By providing a ranked list of the 19 most important IT PM skills, our study provides a useful foundation for future research. The top five IT PM skills identified here were as follows: (1) leadership, (2) verbal communication skills, (3) scope management, (4) listening skills, and (5) project planning. Of particular note is the fact that *none* of the top five skills are technical in nature. None of the 19 IT PM skills deemed to be the most important by our panel were even specific to information technology projects, suggesting that there is a core set of skills that are associated with project management that are just as important for IT PMs to master as for any other type of PM.

5.2. Implications for practice

For practitioners, the results of our study can be put to immediate use in a number of ways. First, practitioners can use the list of 19 IT PM skills as a checklist to aid them in evaluating IT PMs and their capabilities in a more systemic way. Second, companies can use the list to insure that IT PMs are matched with career development and training opportunities that will target the areas where further skill development is needed. This procedure will allow the organization to enhance its IT PM capability by developing more effective project managers.

Practitioners may also find it useful to focus on the more parsimonious list of 10 skill categories and will particularly want to consider the seven categories (see Table 5) that contained ranked skills. Among these, practitioners should focus their attention on the most important skill categories, which include (1) communication, (2) team management, (3) project management, and (4) people skills. By having a list of ranked skills and skill categories, practitioners can focus their limited attention and resources on areas that (1) will improve the hiring or selection of effective IT PMs and (2) will best promote IT PM career development.

Fortunately, there was general agreement among the panelists that we interviewed that most of the core skills can be acquired. However, depending on the specific skill, different training environments may prove to be more effective than others (e.g., mentoring for developing leadership, presentations for verbal communication, etc.). Using the insights provided from our panelists, organizations can direct their limited resources toward the most effective methods for nurturing these core skills that are so essential for developing competent IT PMs. Of course IT PMs need not wait for their companies to invest in training; IT PMs can also exercise their own initiative toward developing the core skills needed to become better at managing IT projects, using the ranked list to prioritize their investments.

Finally, our study provides an indication of when the specific skills are likely to be the most critical. Recruiting competent IT PMs who are well equipped with the core skills identified in this study may serve as an effective risk mitigation strategy for IT projects. Many of the risks (e.g., changing scope/objectives and unclear/misunderstood requirements, to name a few) in IT projects [2,20] are strongly associated with the core skills (e.g., communication skills and scope management). Organizations should recruit and groom IT PMs who are competent in or who can develop the core skills needed to lead successful IT projects, thus reducing the high incidence of IT project failure.

6. Limitations and directions for future research

Before discussing directions for future research, it is appropriate to point out the limitations of our study. First, the findings are based on a limited number of panelists, drawn from a single chapter of the Project Management Institute's membership. Our study had 19 panelists, which is consistent with the other Delphi studies conducted within the IS literature [22]. When using the Delphi methodology, the sample does not have to be representative of the population in a statistical sense [23], but one must still be cautious when generalizing. In spite of this limitation, it is important to note that the panelists who participated in in our study were relatively diverse in terms of their experience with the different types of IT projects (as shown in Tables 1 and 2). Thus, we can be reasonably confident that the skills that surfaced represent a fairly exhaustive coverage of the domain, and we have no reason to believe that the results we obtained are biased in any way due to an overly narrow composition of the Delphi panel.

The second limitation of our study concerns the overall degree of consensus. Our Delphi study resulted in a Kendall's W of 0.66, which, while relatively high compared to other Delphi studies reported in the IS literature [13,17,19,20,22,24,25], is considered to be indicative of moderate consensus. The level of consensus reached in our study may reflect diversity among the panelists in terms of the different types of IT projects and organizational settings that they were the most familiar with. While an additional ranking round might have increased the level of consensus among our panelists, we elected to stop after the third round because we sensed that some panel members were growing fatigued with the exercise, as reflected by the increased number of e-mail reminders that had to be sent out during the final round.

In spite of the aforementioned limitations, we believe that the study not only contributes to both research and practice (as discussed earlier) but also provides a good foundation for future research. One avenue for future research would be to examine how the skills possessed by different IT PMs can affect IT project success. A more nuanced approach might be to examine the extent to which various skills are exercised on IT projects and how this relates to project outcomes. Researchers can also explore how the current environment in which IT projects are conducted is changing the skill requirements of PMs. For instance, project teams are facing more managerial and cultural challenges associated with the growth of offshored IT projects [26,27]. This shift may be the reason why virtual team skills emerged as a new skill in this study. Further investigation of these types of skills is warranted to understand why and when these new skills are critical for IT PMs.

Another interesting extension of this study would be to consider cross-cultural differences. According to project GLOBE [28], leadership attributes are valued differently in various cultures. It may also be that the relative importance of IT PM skills may vary between different cultures. Finally, the current study only addresses the perceptions of IT project managers. However, there are several other stakeholders such as project team members, users, or clients involved in IT projects. Future research could extend the current study by taking into account the perspectives of different stakeholders.

Appendix A

Table A1
Table A2

Table A1
Description of ranked skills (in order of rank).

Skills	Description
Leadership	The ability to lead a project team without giving orders and the ability to empower project team members and generate excitement and accountability amongst them. An influential leader can retain a strong team.
Verbal communication	PMs must be able to effectively communicate the status, risks and issues of their project with various stakeholders, and to manage their expectations accordingly.
Scope management	The project manager should work with stakeholders before the project is authorized to define the project scope as the basis for developing an accurate project plan. Scope management is ongoing; the PM can never give anybody everything that they want, and s/he needs to figure out what s/he can safely eliminate.
Listening	Listening closely gives the PM the ability to spot trouble before it happens and to understand the true goals and objectives of the business owners.

Table A1 (*Continued*)

Skills	Description
Project planning	The ability to break down a high level goal and decompose it into logical measurable tasks, plan phases and activities, and create meaningful milestones.
Written communication	PMs should have the ability to write in a manner that is easily understood by people with different communication styles.
Good people skills	The PM must be able to work with and interact with all types of people in all types of situations, including customers, vendors and internal management.
Ability to motivate team members	Projects are completed by people; therefore, all PMs are human resource managers, who must be able to retain and motivate the people involved in the project. A PM must be able to drive the team members toward the project objectives.
Negotiation	Ability to negotiate with stakeholders, project team members and vendors to arrive at a mutually acceptable scope, schedule, cost and risk.
Organization skills	The ability to organize and coordinate the activities of project resources; this ability includes not only organizing information for supporting changes within the project, but also managing stakeholder needs to support the project team's effort.
Time management	The ability to make effective use of time by quickly and effectively prioritizing multiple tasks within a quickly changing environment.
Relationship building	Sometimes PMs do not have direct management authority over their project teams. They need to be able to exert influence over matrixed groups with diverse personal objectives. The ability to build relationships is critical to project success.
Resource utilization	The project manager must garner adequate resources and must know how to manage the assigned resources to execute the work plan successfully.
Conflict management	The people on a project have different goals, objectives, and perspectives, and this often leads to conflict. PMs should have the ability to manage conflicts constructively.
Risk management	A successful manager gathers information pertaining to potential risks to project success and develops a plan to reduce or eliminate those risks.
Attention to detail	Keeping track of deadlines, dependencies and requirements all demand an attention to detail.
Cost management	The ability to forecast costs and be on top of the project budget. A PM must have a handle on the project budget and actual costs incurred in order to bring a project in on budget.
Multi-tasking	This skill is important because many tasks run concurrently, and many steps need to take place in unison. Examples would be ordering hardware during software development cycles, pilots and multi-phased deployments. Projects seldom occur in isolation; the ability to manage different projects for different stakeholders at the same time is important.
Analytical skills	The ability to analyze problems and issues within different stages of a project

Table A2
Description of unranked skills.

Skills	Description
Sense of humor	Humor releases tension and reduces overall stress
Patience	Not every task is done immediately. Patience is a virtue.
Credibility	Without credibility, the PM's ability to motivate and make it through the project will be an impossible task. PMs need to keep their promises and demonstrate a high level of ethics; this will enable team members to focus on their work and to count on the PM to do what they need done; credibility should help with stakeholder management as well.
Ability to handle stress	A PM must be able to handle periods of high stress. Projects do not always go as planned or as budgeted, and the ability to stay calm and collected under pressure is an important skill for a PM because their example sets the tone for the rest of the team.
Consensus seeking	Seeking consensus and agreement to project or program procedures, to a specific solution or to an implementation strategy enhances the proficiency and productivity of the project and program team efforts.
Persistence	When the PM is faced with problems, s/he needs to have the ability to keep digging until s/he finds out what the problem is.
Cooperation	Agreeably assisting others for the benefit of a common goal expedites the project or program work and facilitates knowledge transfer.
Commitment	Focused involvement in the project or program tasks enables the timely, accurate and proficient delivery of quality products and services.
Ability to empower future leaders	A successful PM always grooms the next leader in the ways of the project. Transitioning becomes easy if the PM needs to move away from the project for one reason or another.
Celebrating accomplishments	Praising desired behaviors and performance, and recognizing accomplishments and quality deliverables, motivates individuals and energizes project and program teams.
Collaboration	Willingly engaging jointly to define a solution or produce a product promotes team synergy, effective performance and increased productivity.
Ability to bridge diverse teams	There may be quite a few teams/departments/groups involved in an IT project. The IT PM must have a good understanding of each team's responsibilities, where they overlap, and where they have gaps.
Virtual team skills	In today's global economy, most team members are far-flung. A good PM must be sensitive to members in an expansive set of time zones with unfamiliar international customs, holidays, traditions and work ethics.
Ability to understand the business domain	A PM should have a deep understanding of the business domain and business case for the project.
Ability to identify stakeholders	A PM should have the ability to successfully identify who will be impacted by both the project execution and the end results.
Business skills	A PM should have the ability to look at the business factors that affect the health of the project versus just focusing on the technical components, such as stakeholder politics and changes, cost implications, changing business factors, etc.
Knowledge of the end product	A PM must understand what the end product is, how it works, what it must accomplish, and how it will be used by the customer.
Ability to document processes	This skill involves the documentation of the processes that the project will address along with other processes that intersect or will be influenced by the project.
Ability to construct persuasive arguments	The PM will need to convince people who do not have a full understanding of the entire picture (both technical people without business understanding and business people without technical understanding) about why it's better to go in one direction rather than another.
Understanding the psychology of people	Both the business and the technical people associated with the project are motivated by various factors, many of which are not related to the success of the project. The PM needs to satisfy their motivations enough to keep them happy, while keeping the project on track.
Technical skills	A project manager needs to understand the technology being used well enough to make effective decisions concerning the use of the technology, which technology is appropriate, and how to take advantage of the technology to meet business objectives.

Table A2 (*Continued*)

Skills	Description
Development methodology skills	A project manager needs to be familiar and experienced with various development methodologies and models, such as waterfall, agile methodologies, etc.
Focus on quality	The ability to deliver quality in all phases of the project. The ability to set a quality standard and to make sure that the team delivers to that standard. Includes integration and user acceptance testing.
Closing the project	This skill should be used at the end of a warranty period to close out defects, project deliverables, and key lessons.
PM tool skills	The belief that dedicated project management tools are not important is nonsense. Know and use the PM tools that get the job done.
Project chartering	This skill involves the gathering and consolidating of business requirements, constraints, assumptions, project measures, etc.
Strategic thinking	The ability to look at the overall context of the project and why it is being done. By seeing the big picture, the project manager can make tactical decisions and yield strategic benefits in the subsequent project phases.
Research skills	The ability to gather the most useful and empowering information to support the business case and decision making, and to provide guidance to team members on up-to-date techniques and technology.
Professional skills	The ability to manage professional images within the project. Maintaining professional attitudes, personal appearances and demeanor have a great impact on the success of the project.

Appendix B. Semi-structured interview protocol

(1) Leadership
- Why do you think that leadership emerged as the most important skill for IT PMs?
- How would you define leadership? (i.e., What specific capabilities would leadership entail and how would you know if you had it on an IT project?)
- Do you think that the importance of leadership differs across different contexts (e.g., type of project, size of project, the level of risk associated with the project)? Can you give some examples?
- Can anyone acquire leadership skills or do you think some of us are born with an aptitude for leadership while others are not? Assuming that leadership skills can be acquired, are they something that can be taught in the classroom? Or are they something that can only be learned from experience? How do you think PMs can obtain and develop leadership skills?

(2) Verbal communication
- Why do you think verbal communication skills emerged as being so important in this study?
- Among the different communication skills (i.e., verbal, listening, and written), why do you think that verbal communication skills were ranked as the most important?
- Do you think that the importance of verbal communication skills differs across different contexts (e.g., type of project, size of project, the level of risk associated with the project)? Can you give some examples?
- Can anyone acquire verbal communication skills or do you think some of us are born with an aptitude for verbal communication while others are not? Assuming that verbal communication skills can be acquired, are they something that can be taught in the classroom? Or are they something that can only be learned from experience? How do you think PMs can obtain and develop verbal communication skills?

(3) Scope management
- Why do you think scope management emerged as being so important in this study?
- Among the different skills related to management and organization (e.g., project planning, organization skills, risk management, cost management), why do you think scope management emerged as the most important?
- Do you think that the importance of scope management skills differs across different contexts (e.g., type of project, size of project, the level of risk associated with the project)? Can you give some examples?
- How do you think PMs can obtain and develop scope management skills?

(4) Listening
- Why do you think that listening skills emerged as being so important?
- Can you give us a concrete example of how listening skills can come into play in an IT project?
- Do you think that the importance of listening skills differs across different contexts (e.g., type of project, size of project, the level of risk associated with the project)? Can you give some examples?
- How do you think PMs can obtain and develop listening skills?

(5) Project planning
- Why do you think that project planning emerged as being so important in this study?
- What tools do you think of when you consider project planning? Do you think of the types of things in PMI's PMBOK?
- Do you think that the importance of project planning skills differs across different contexts (e.g., type of project, size of project, the level of risk associated with the project)? Can you give some examples?
- How do you think PMs can obtain and develop project planning skills?

(6) Other questions
- Why do you think risk management was ranked relatively low compared to the other skills?
- Why do you think that technical skills did not make it into the top 19 skills?
- To what extent is it important for IT project managers to have general knowledge about the nature of IT projects? If so, what about the nature of IT projects is important to know to be successful?

Appendix C. Comparison of our results to previous studies

In this appendix, we compare the skills that surfaced in our study with those reported by two of the previous studies identified in our literature review [6,7]. To investigate the difference between these two studies in a more structured manner, we conducted a comparison using skill categories. We first grouped the skills identified in Napier et al. [6] based on the ten categories identified by our study, and then compared the difference between each category (shown in Table C1). We also looked at the degree to which the number of skills differs in each category between the two studies. To be more specific, we looked at how many skills were held in common and how many skills were unique in each study by category (shown in Table C2).

Overall, we found that there were 32 skills identified that were common to both studies. While there was considerable consistency between the results that we obtained and those reported by Napier et al. [6], there were also 16 skills that surfaced in our

Table C1
Comparison of the skills identified by Napier et al. [6] and this study.[a]

Skill category	Skills	Napier et al. (2009)	This study
Team management	Ability to motivate team members	X	X
	Ability to empower future leaders	X	X
	Celebrating accomplishments	X	X
	Leadership	X	X
	Ability to bridge diverse teams	X	X
	Collaboration		X
	Virtual team skills		X
	Remove roadblocks for team	X	
Business domain knowledge	Ability to understand the business domain	X	X
	Ability to identify stakeholders	X	X
	Business skills	X	X
	Knowledge of the end product	X	X
	Strategic thinking	X	X
	Ability to document process		X
Communication	Verbal communication	X	X
	Written communication	X	X
	Listening	X	X
	Ability to construct persuasive arguments	X	X
	Respond to others	X	
People skills	Relationship building	X	X
	Understanding the psychology of people	X	X
	Good people skills	X	X
	Negotiation	X	X
	Conflict management		X
	Care for employees	X	
Technical	Technical skills	X	X
	Development methodology skills	X	X
	Ability to manage complexity	X	
Project management	Scope management	X	X
	Project planning	X	X
	Time management	X	X
	Resource utilization	X	X
	Project chartering	X	X
	Cost management	X	X
	Closing the project		X
	PM tool skills		X
	Risk management		X
	Facilitate meetings	X	
	Respect project management principles	X	
Personal characteristics	Patience	X	X
	Ability to handle stress	X	X
	Attention to detail		X
	Sense of humor		X
	Consensus seeking		X
	Persistence		X
	Cooperation		X
	Remains flexible	X	
Organizational	Organization skills	X	X
	Multi-tasking		X
Problem solving	Analytical skills	X	X
	Research skills		X
	Confront issues proactively	X	
Professionalism	Credibility	X	X
	Focus on quality	X	X
	Commitment		X
	Professional skills		X
	Does not play politics	X	
	Takes responsibility for errors	X	
	Puts project success before self	X	

[a] "X" denotes that the skill was identified in the study.

Delphi study that were not identified in the Napier et al. [6] study (shown in Table C3). There were also eleven skills identified by Napier et al. [6] that were not identified in our study.

There was a high degree of similarity between the two studies for the team management skill category. Interestingly, virtual team skills emerged as a skill that was unique to our study. We can only speculate as to the reasons for some of these skills surfacing in the present study but not in Napier et al. [6]. As mentioned previously, the increase in IT outsourcing and offshoring has led to more geographically dispersed teams. Under such circumstances, IT PMs will need to be sensitive to team members in different time zones with diverse customs and work ethics, leading to the consideration of virtual team skills as an important team management skill.

Table C2
Difference in skill count by category between Napier et al. [6] and this study.

Skill category	Total number of skills in category	Number of skills in the common (% overlap)	Number of unique skills in Napier et al. (2009)	Number of unique skills in this study
Team management	8	5 (63%)	1	2
Business domain knowledge	6	5 (83%)	0	1
Communication	5	4 (80%)	1	0
People skills	6	4 (67%)	1	1
Technical	3	2 (67%)	1	0
Project management	11	6 (55%)	2	3
Personal characteristics	8	2 (25%)	1	5
Organizational	2	1 (50%)	0	1
Problem solving	3	1 (33%)	1	1
Professionalism	7	2 (29%)	3	2

In the project management category, we found consistency between the two studies for those skills that were ranked in our study. However, we also found several skills that emerged in this study: closing the project, PM tool skills, and risk management. The emphasis on formal project management practices and tools continues to increase, which may explain why PM tool skills surfaced in this study but not in Napier et al. [6]. Additionally, due to the increased complexity, scope, and managerial challenges that arise in offshored outsourcing projects [26,27], managing risk might become more challenging to IT PMs, which may require IT PMs to possess stronger risk management skills.

Under personal characteristics, there were two skills that appeared in both studies among the eight skills, and there were five personal characteristics that surfaced in our study that were not identified in Napier et al. [6]. Taking consensus seeking and cooperation as an example, the increasing number of organizations pursuing IT outsourcing and off-shoring [29] face more challenges related to diversity within teams [30]. Therefore, the ability to seek agreement and assist others might become more desirable to allow IT PMs to manage the diverse perspectives and abilities of the project members. Additionally, attention to detail may be valued by IT PMs to a greater degree. Within a project of greater scope and complexity, IT PMs not only need to see the big picture of the project, but they also need to keep track of the details regarding task dependencies and deadlines.

For the professionalism skill category, items such as commitment and professional skills, surfaced in our study but not in Napier et al. [6]. However, does not play politics, takes responsibility for errors and puts project success before self, which were identified in Napier et al. [6], did not surface in our

Table C3
New skills identified in this study compared with Napier et al. [6].

Skill category	New skills[a]
Team management	Collaboration Virtual team skills
Business domain knowledge People skills	Ability to document process *Conflict management*
Project management	Closing the project PM tool skills *Risk management*
Personal characteristics	Sense of humor Consensus seeking *Attention to detail* Persistence Cooperation
Organizational Problem solving Professionalism	*Multi-tasking* Research skills Commitment Professional skills

[a] Ranked skills in italic.

study. One possible explanation for this exclusion is that although the three skills surfaced in Napier et al.'s [6] study, almost no participants considered these to be among the "most important" skills.

We performed a similar comparison between our study results and those reported by Skulmoski and Hartman [7]. Again, we found a remarkable degree of consistency, with 34 skills identified as being common to both studies. Table C4 shows a comparison between the two skill sets by category. Table C5 presents the number of skills that are common or unique to each study. Among the ten categories, we found interesting differences between the two studies for the following: people skills, personal characteristics, and professionalism.

Under the people skills category, there were only three skills in common among the eight unique skills. There were two new skills that surfaced in our study that were not identified in Skulmoski and Hartman [7] (Table C4): relationship building and understanding the psychology of people. However, charisma, compromise, and political awareness, which were considered to be important skills in Skulmoski and Hartman [7], were not identified in our study.

For the personal characteristics category, as in the case of the previous comparison to Napier et al. [6], we see an emphasis on cooperation that was not evident in Skulmoski and Hartman's [7] findings. However, there were twelve personal characteristics identified in Skulmoski and Hartman's [7] findings that did not surface in our study. One possible reason for this difference is that our panelists might not have considered some of them to be skills per se.

The organizational skill category was new in our study and included two skills: organization skills and multi-tasking skills. The increased level of IT project complexity along with the fact that many of the IT PM's tasks must be addressed in parallel make both skills critical to current project environments. This importance was reflected by the results of our study, as our panelists considered both skills to be important enough to be ranked during the third phase.

Additionally, we observed a difference between the two studies under the professionalism skill category; Skulmoski and Hartman [7] reported five professionalism skills that did not surface in our study. One possible explanation for this difference would be that our panelists might have viewed the skills in the professionalism category as specific standards that IT PMs should value rather than as skills. However, the addition of professional skills to our study suggests that not only are these standards important but also that they need to be reflected through the IT PM's image in the team to increase credibility.

Overall, there were 14 skills that surfaced in our Delphi study that were not identified in the Skulmoski and Hartman [7] study (see Table C6). Note that development methodology skills surfaced in our study but were not reported by Skulmoski and Hartman [7].

Table C4
Comparison of the skills identified by Skulmoski and Hartman [7] and this study.[a]

Skill category	Skills	Skumoski and Hartman (2010)	This study
Team management	Ability to motivate team members	X	X
	Ability to empower future leaders	X	X
	Celebrating accomplishments	X	X
	Collaboration	X	X
	Ability to bridge diverse teams	X	X
	Virtual team skills	X	X
	Leadership		X
	Create an effective environment	X	
	Share-information and credit	X	
	Protect the team	X	
Business domain knowledge	Ability to understand the business domain	X	X
	Ability to identify stakeholders	X	X
	Business skills	X	X
	Knowledge of the end product		X
	Ability to document process		X
	Strategic thinking		X
	Vision-oriented/articulate the business problem	X	
Communication	Verbal communication	X	X
	Written communication	X	X
	Listening	X	X
	Ability to construct a persuasive arguments	X	X
	Effective questioning	X	
	Open communication	X	
	Presentation skills	X	
People skills	Conflict management	X	X
	Good people skills	X	X
	Negotiation	X	X
	Relationship building		X
	Understanding the psychology of people		X
	Charisma	X	
	Political awareness/agility/tact	X	
	Compromise	X	
Technical	Technical skills	X	X
	Development methodology skills		X
Project management	Scope management	X	X
	Project planning	X	X
	Time management	X	X
	Resource utilization	X	X
	Closing the project	X	X
	PM tool skills	X	X
	Project chartering	X	X
	Cost management	X	X
	Risk management	X	X
	Alignment	X	
Personal characteristics	Sense of humor	X	X
	Consensus seeking	X	X
	Attention to detail	X	X
	Patience		X
	Ability to handle stress		X
	Persistence		X
	Cooperation		X
	Decisiveness	X	
	Objectivity	X	
	Confident/realistic	X	
	High-level perspective	X	
	Flexibility/manage ambiguity	X	
	Judgment	X	
	80/20 perspective/Pareto principle	X	
	Mental capability	X	
	Ability to learn/self-evaluation	X	
	Self-organization/self-directed	X	
	Initiative/proactive	X	
	Empathy	X	
Organizational	Organization skills		X
	Multi-tasking		X
Problem solving	Analytical skills	X	X
	Research skills	X	X
	Creativity/innovation/resourcefulness	X	
	Scouting	X	

Table C4 (*Continued*)

Skill category	Skills	Skumoski and Hartman (2010)	This study
Professionalism	Credibility	X	X
	Commitment	X	X
	Focus on quality	X	X
	Professional skills		X
	Ownership of tasks	X	
	Not compromising on the facts	X	
	Participate and contribute fully	X	
	Results-oriented	X	
	Lifelong learning	X	

[a] "X" denotes that the skill was identified in the study.

Table C5
Difference in skill count by category between Skulmoski and Hartman [7] and this study.

Skill category	Total number of skills in category	Number of skills in common (% overlap)	Number of unique skills in Skulmoski and Hartman (2010)	Number of unique skills in this study
Team management	10	6 (60%)	3	1
Business domain knowledge	7	3 (43%)	1	3
Communication	7	4 (57%)	3	0
People skills	8	3 (38%)	3	2
Technical	2	1 (50%)	0	1
Project management	10	9 (90%)	1	0
Personal characteristics	19	3 (16%)	12	4
Organizational	2	0 (0%)	0	2
Problem solving	4	2 (50%)	2	0
Professionalism	9	3 (33%)	5	1

Table C6
New skills identified in this study compared with Skulmoski and Hartman [7].

Skill category	New skills[a]
Team management	*Leadership*
Business domain knowledge	Knowledge of the end product Ability to document process Strategic thinking
People skills	*Relationship building* Understanding the psychology of people
Technical	Development methodology skills
Personal characteristics	Patience Ability to handle stress Persistence Cooperation
Organizational	*Organization skills* *Multi-tasking*
Professionalism	Professional skills

[a] Ranked skills in italic.

Again, however, only four of the skills that surfaced in our study but were not identified by Skulmoski and Hartman [7] were judged by our panelists to be among the most important IT PM skills: leadership, organization skills, relationship building, and multi-tasking skills.

We should also note that Skulmoski and Hartman [7] reported 30 skills that did not surface in our study. Because the studies used very different approaches, it is perhaps not surprising that these differences exist. It is also difficult to perform a direct comparison between the studies because the level of granularity in the skills and how they were categorized appears to vary between the studies. For example, Skulmoski and Hartman [7] consider leadership to be a category of skills whereas our study treats leadership as a skill in itself. Additionally, as in the case of Napier et al. [6], many of the items identified by Skulmoski and Hartman [7] that did not surface in our study appear to be personal traits rather than skills per se (e.g., decisiveness, mental capability, and empathy).

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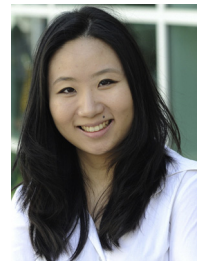
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