Criteria for Project Assignments in Multiple-Project Environments

Peerasit Patanakul, Dragan Z. Milosevic, Timothy R. Anderson
Department of Engineering and Technology Management, Portland State University, Oregon, U.S.A
patanap@etm.pdx.edu, dragan@etm.pdx.edu, tima@etm.pdx.edu

Abstract

Project assignment, assigning a project to a project manager, is one of the organization’s most strategically important decisions since it is a determinant of the project performance and the organizational performance. Despite its importance, project assignment is not well studied in the literature and it is performed intuitively in practice. By using concepts of case study research, this study explores project assignment processes in their real-life contexts. Then, the project assignment criteria obtained from the case studies are validated by a panel of experts, following the concepts of the Delphi method. In this paper, some of the research results are presented. In particular, we propose an integrated set of project assignment criteria, including some already proposed in the literature, and others that are new. As part of the criteria, we place a special emphasis on an integrated set of project managers’ competencies that is applicable to the current multiple-project environments. In future research, we will use the criteria to build a model for project assignments. The conceptual outline of the model is presented.

1. Introduction

Research on project assignments, a process of assigning a project to a project manager, has developed several streams. One deals with the desired set of project managers’ competencies. The rationale is that competent project managers tend to have a higher rate of project success than those who are less competent [1-4], and therefore the competencies should be the major criterion for the assignment. Another stream that centers on methodologies for project assignments is also based on project managers’ competencies [5-7]. Both streams appear to assume that:

- The competencies are relevant in the current project management environments, and
- The competencies can serve as the project assignment criteria.

We believe that changes have occurred in project management that merits a review of the assumptions. If our belief is correct, this review may help identify opportunities for improvement of both the competencies and the assignment criteria.

Many experts describe current project management environments as multiple-project management environments in which some project managers lead one project, while others simultaneously lead several projects [8]. This is different from traditional single-project management environments – one project manager handles one project at a time. Because the nature of their management task is different, a project manager who leads multiple, simultaneous projects may need some competencies that a single-project manager may not. As a result, the competency sets of the single-project and multiple-project manager are different. This generally means that the competencies referred to in the above assumption, “the competencies are relevant in the current project management environments,” need to be updated to include both competencies of single-project and multiple-project managers.

The second assumption, “the competencies can serve as the project assignment criteria,” also needs an update. In this case, our belief is that the competencies can be used as project assignment criteria - but only along with other criteria. To explain our case, we will look at how project assignments influence the performance of projects and the performance of the organization (see figure 1) [4, 9, 10]. More specifically, when being assigned a project with requirements that match his competencies well, the project manager will likely perform better than if there was no match. The higher performance, then, contributes to the project success; in other words, to the project performance (see the left portion of Figure 1) [4, 10-12]. Additionally, project assignments have a direct influence on the organizational performance (see the right portion of Figure 1). This is possible to discern in the case of strategically important projects. Such projects are conceived to directly support some of the organizational goals whose accomplishment is the measure of the organizational performance.
Performance of projects

Performance of an organization

Project assignments

Influence

What this really means is that both project and organizational performance should be considered in project assignments. The existing methodologies, however, take into account only the influence of project assignments on the performance of projects but left out the consideration of the influence of project assignments on the performance of the organization. This is why the second assumption, “the competencies can serve as the project assignment criteria,” has to be updated to include, also, other criteria.

To address these issues, this research proposes two objectives: 1) to identify competencies that a project manager should possess in the current multiple-project management environments, and 2) to investigate the existing project assignment processes in order to identify project assignment criteria, which can be used later in the development of a methodology for project assignments. In pursuit of these objectives, in the next section we will review the literature in the areas of project managers’ competencies and project assignments.

2. Literature Review

2.1. Theoretical background

2.1.1. Competencies of project managers and project success. According to several researchers, having a competent project manager is a critical success factor in projects. For example, studies of Pinto and Slevin [1, 3] strongly indicate that project managers’ characteristics, including administrative, interpersonal, and technical competencies, relate significantly to the project success. Also, a project manager who has power, vision, and management skills is a driver of the process, product, and financial performance of a project [4].

When it comes to the competencies, the early works emphasized the importance of technical knowledge, administrative skills, and leadership ability including communication, problem solving, conflict resolution, integration, and analysis [13, 14]. Similarly, a later study of Pettersen included competencies of problem solving, administration, supervision and team management, interpersonal relations, and some other personal qualities of project managers [15]. The works of Thamhain centered on leadership, technical, and administrative competencies as ideal attributes for project managers [16, 17]. On the other hand, Frame recognizes business-judgment competencies as essential to successful project management [18]. In the next section, we will discuss how these competencies are used in project assignments.

2.1.2. Competencies of project managers and project assignments. The literature on project assignment stresses that a successful assignment is one in which a project manager possesses competencies compatible with project requirements – type of project, its size, complexity, duration, etc. [4, 10, 19, 20]. This same concept can also be found in the literature on the assignment methodology. For example, in one of the strongest methodologies, Adams, et al. [5] propose a contingency approach for attribute matching (competencies vs. project requirements) by utilizing the concepts of the scoring model. The methodology of Hauschildt, et al. [6] focuses on the categorizations of projects and project managers and argues that project managers should be assigned to the types of projects that they are most likely to manage successfully. The methodology of Mian and Dai [7] relies on using the Analytic Hierarchy Process (AHP) to select a project manager based on technical, administrative, and interpersonal competencies.

2.2. Critical Observations and Implications

As was previously mentioned, the existing literature assumes that:

- The project manager competencies are relevant in the current project management environments, and
- The competencies can serve as the project assignment criteria.

In this section, we make critical observations about these two assumptions that are more specific than those described in the introduction section.

Observation 1: The project manager’s competencies in the literature do not account for a situation where one project manager leads multiple, simultaneous projects.

The current project management environments are considered to be multiple-project management environments where one can find a project manager leading multiple, simultaneous projects (in addition to single-project managers). This working condition requires project managers to use competencies such as the context switching ability [19, 21]. They should also have integrative...
competence that enables them to coordinate interproject processes [19]. Since they have to lead multiple project teams in a very limited time for each team, they should be competent in condensed team building [22]. As a result, we offer:

Implication 1: In addition to the project managers’ competencies proposed in the literature that relate to single-project managers, a project manager should possess some competencies specifically for multiple-project management environments where a project manager handles multiple, simultaneous projects.

Observation 2: The assignment criteria and methodologies in the current literature are incomplete and not applicable to multiple-project management environments.

In particular, while assigning projects per project-specific requirements and required competencies is necessary because of their influence on project performance [5-7], it is also necessary to include other criteria related to the performance of the organization (see the right portion of Figure 1). For example, several research studies suggest that performance of the projects affects the performance of the organization [9], specifically the accomplishment of the organizational goals and strategies (further referred to as organizational factors). Additionally, to assign a project, there are some personal and organizational limitations/concerns (referred to as organizational constraints) such as the resource capacity of project managers and their career path interests. Therefore, criteria related to the accomplishment of the organizational factors and the organizational constraints should be considered during a project assignment.

Because they use assignment criteria as the foundation, the current methodologies for project assignments are based on the dominant assignment criteria approach, one that matches project requirements and the project manager’s competencies. Therefore, when assigning projects these methodologies do not account for criteria related to the organizational factors and constraints. In addition, the methodologies are not practical when being used to assign a project to a project manager who leads multiple simultaneous projects. In summary, the implication of these arguments is as follows.

Implication 2: In addition to criteria related to project requirements and competencies, the project assignment criteria and methodologies should include criteria related to the organizational factors and constraints.

In that way, all criteria related to project and organizational performance would be accounted for. In addition, these criteria would eventually be used in a new methodology, which would be applicable to the multiple-project environments.

3. Research Design

To address the critical review observations and to respond to the implications, this study has two already mentioned research objectives: 1) to identify competencies that a project manager should possess in the current project management environments, and 2) to investigate the existing project assignment processes in order to identify project assignment criteria, which can be used later in the development of a methodology for project assignments. These research objectives are supported by the research questions as follows.

Research objective 1
Research question 1: What important competencies in the current project management environments should project managers possess?

Research objective 2
Research question 2: What criteria should be used in project assignments?

Research question 3: How should a methodology for project assignments be constructed so that the use of comprehensive project assignment criteria is assured?

In this study these research objectives and questions are focused on companies that pursue new product development (NPD) projects in a multiple-project environment in which some project managers lead one project at a time, while others lead multiple, simultaneous projects.

To accomplish the research objectives and for the simplicity of the research design (Figure 2), the study includes two main phases:

- Phase 1 - the development of project assignment criteria (parts of which are project managers’ competencies), which addresses research question 1 & 2, and
- Phase 2 - the development of a methodology for project assignments, which addresses research question 3.

Note that this paper reports the status of this study, which is currently at the end of Phase 1.
Phase 1: The Development of Project Assignment Criteria.

This phase consists of two research steps: 1) data gathering and 2) data analysis.

1. Data gathering: First, the literature review was conducted to identify the project assignment criteria. Additionally, four market-leader companies were studied by means of the case study method [23, 24] that included interviews with project managers and their superiors, and project document reviews. The purpose was to learn what project assignment criteria are in use in the companies. The selected companies are in high-technology industries and execute NPD projects in a multiple-project environment. Table 1 provides a description of the companies.

<table>
<thead>
<tr>
<th></th>
<th>Company A</th>
<th>Company B</th>
<th>Company C</th>
<th>Company D</th>
</tr>
</thead>
<tbody>
<tr>
<td>Department name</td>
<td>Program Management</td>
<td>Program Management</td>
<td>Project Management</td>
<td>Engineering Department</td>
</tr>
<tr>
<td>Department purpose</td>
<td>Department</td>
<td>Department</td>
<td>Department</td>
<td>Department</td>
</tr>
<tr>
<td>Number of department’s projects per year</td>
<td>40-50</td>
<td>16-20</td>
<td>&gt;50</td>
<td>&gt;100</td>
</tr>
<tr>
<td>Number of project managers of multiple projects in department</td>
<td>18</td>
<td>4</td>
<td>8</td>
<td>4</td>
</tr>
<tr>
<td>Average number of concurrent projects per project manager</td>
<td>3-4</td>
<td>2-4</td>
<td>4-8</td>
<td>10-12</td>
</tr>
<tr>
<td>Typical project duration (months)</td>
<td>Small projects: 9-15</td>
<td>Small projects: 3-6</td>
<td>Small projects: 1-2</td>
<td>3-18</td>
</tr>
<tr>
<td></td>
<td>Medium projects: 12-24</td>
<td>Large projects: 9-12</td>
<td>Medium projects: 3-4</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Large projects: 18-36</td>
<td></td>
<td>Large projects: 12-36</td>
<td></td>
</tr>
<tr>
<td>Typical project budget</td>
<td>Small: $1-2 M</td>
<td>Small projects: 5-12 M</td>
<td>Medium: 1000-3000 hrs</td>
<td>Small: &lt; 300 hrs</td>
</tr>
<tr>
<td></td>
<td>Medium: 2-5 M</td>
<td>Large: &gt; $5 M</td>
<td>Large: &gt; 3000 hrs</td>
<td>Medium: 300-1000 hrs</td>
</tr>
<tr>
<td></td>
<td>Large: &gt; $5 M</td>
<td></td>
<td>Large: &gt; 1000 hrs</td>
<td></td>
</tr>
<tr>
<td>Typical # of participants per project</td>
<td>20-60</td>
<td>Large projects: 25-35</td>
<td>Software Development</td>
<td>Hardware support for software development</td>
</tr>
<tr>
<td>Typical projects</td>
<td>New product development</td>
<td>New product development</td>
<td>Software Development</td>
<td>Hardware support for software development</td>
</tr>
</tbody>
</table>

Table 1. The description of the companies for case study research

2. Data analysis: The case analyses [24, 25] and literature comparisons were performed to identify a preliminary set of assignment criteria. Then, by utilizing the concept of the Delphi method [26], these criteria were presented to a panel of experts for several rounds of evaluation. Afterward, the panel recommended a set of assignment criteria (and ranked their importance) that can be subsequently employed to develop a methodology for project assignments. For the research results to be meaningful, the selection of panel members is vital. In this study, the panel consists of distinguished individuals (experts) who have knowledge and experience in project management, are well-recognized in the project management community, and are not biased toward the expected outcome of this study. In addition, to achieve a balanced mix of perspectives, the panel consists of six experts from different professions including researchers, consultants, and practitioners. This mix helps minimize the impact of prejudice of there is any [27].

Phase 2: The Development of a Methodology for Project Assignments

This phase, which has not started yet, is designed to provide the model development, execution, and validation. In particular, the project assignment criteria that are recommended by the experts will be employed to develop the assignment methodology by applying the concepts of the analytic hierarchy process (AHP) and integer programming (IP) (see Figure 2). Afterward, the model will be quantified by using the information from one participating company, which executes its NPD projects in a multi-project environment.
4. Results and Discussion

In this section, we will discuss the research results of Phase 1 that are based on the experts’ evaluation. The discussion will start with the competencies of project managers and will be followed by a set of project assignment criteria.

4.1. Competencies of project managers

Competencies are the knowledge, skills, and experience of a project manager that are necessary to lead a project. Based on the literature review and case studies, these competencies can be categorized into technical, administrative/process, interpersonal, intrapersonal, and business/strategic competencies. In addition, some other competencies such as interproject planning/scheduling, interproject resource allocation, and multitasking are especially needed for project managers who lead multiple, simultaneous projects. We call them multiple project management competencies.

In summary, the experts’ evaluations of these competencies (1 being not important and 7 being very important) indicate that it is very essential for a project manager to possess administrative/process (6.37) and interpersonal (6.33) competencies (see Table 2). Business/strategic, intrapersonal, and multiple-project management competencies are also important (5.77, 5.70, and 5.60 respectively). Even though its score is not high (4.09), a project manager of a NPD project should possess technical competencies as well. This finding confirms the influential study of Katz [28], which claims that as the level of administrative responsibility of managers grows higher, so does the importance of their human skills over their technical skills. Following are detailed discussions of the top five competencies of each category. Note that, without the level of importance, the findings of this study conform to several influential research studies, which will be cited along with the discussion.

<table>
<thead>
<tr>
<th>Competencies</th>
<th>Administrative/process</th>
<th>Interpersonal</th>
<th>Mean*</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Monitoring/control</td>
<td>6.37</td>
<td>- Leadership</td>
<td>6.33</td>
</tr>
<tr>
<td>- Risk management</td>
<td>6.50</td>
<td>- Communication</td>
<td>6.50</td>
</tr>
<tr>
<td>- Planning/scheduling</td>
<td>6.33</td>
<td>- Team management</td>
<td>6.33</td>
</tr>
<tr>
<td>- Resource management</td>
<td>6.33</td>
<td>- Conflict management</td>
<td>6.17</td>
</tr>
<tr>
<td>- Company’s project management process</td>
<td>6.00</td>
<td>- Problem solving</td>
<td>6.00</td>
</tr>
<tr>
<td>- Business sense</td>
<td>5.77</td>
<td>- Organized and disciplined</td>
<td>5.76</td>
</tr>
<tr>
<td>- Customer concern</td>
<td>6.00</td>
<td>- Responsible</td>
<td>6.00</td>
</tr>
<tr>
<td>- Integrative capability</td>
<td>6.00</td>
<td>- Proactive and ambitious</td>
<td>6.00</td>
</tr>
<tr>
<td>- Strategic thinking</td>
<td>5.33</td>
<td>- Negotiation</td>
<td>5.50</td>
</tr>
<tr>
<td>- Profit / cost consciousness</td>
<td>5.33</td>
<td>- Mature and self-control</td>
<td>5.50</td>
</tr>
<tr>
<td>- Experience</td>
<td>6.00</td>
<td>- Knowledge of product</td>
<td>4.67</td>
</tr>
<tr>
<td>- Interdependency management</td>
<td>5.83</td>
<td>- Knowledge of technology and trends</td>
<td>4.67</td>
</tr>
<tr>
<td>- Multitasking</td>
<td>5.67</td>
<td>- Knowledge of tech., tools and techniques</td>
<td>3.83</td>
</tr>
<tr>
<td>- Simultaneous teams management</td>
<td>5.33</td>
<td>- Knowledge of project products</td>
<td>3.60</td>
</tr>
<tr>
<td>- Interproject process</td>
<td>5.17</td>
<td>- Ability of solve technical problems</td>
<td>2.67</td>
</tr>
</tbody>
</table>

* Average score from experts (1: Not important, 7: Very important)

Table 2. The importance level of project managers’ competencies (top five of each category)

Administrative/process competencies. Administrative / process competencies include the knowledge, skills, and experience of a project manager in planning, organizing, and controlling projects. Our results show that for a project manager to lead an NPD project in high-technology industries, he should be an expert in monitoring/control (6.67) and risk management (6.50) [13-15, 29]. To do so, the project manager should set project goals and monitor/control project activities toward accomplishing the goals [30]. In order to manage risks in these generally uncertain projects, the project manager should first be competent in risk identification and evaluation, and, then, in preparing and implementing risk response plans [31, 32]. Also of high importance to project managers is the competence of planning and scheduling project activities (6.33) [13-15, 29]. Further, the experts placed a high importance on resource management including project managers’ ability to negotiate, allocate, and direct resources (6.33) [16]. Finally, the fifth most important competency in this group is understanding the company's project management process (6.00), which details policies, procedures, and tools that a company wants to be deployed in managing its projects [16]. That understanding enables project managers to properly employ their competencies discussed in this and forthcoming sections.

Interpersonal competencies. Interpersonal competencies include the knowledge, skills, and experience of a project manager in interacting with other project stakeholders. These competencies are essential to project managers because they often have to exert their influence on project team members without having a direct authority over them [33]. According to our results, the project managers should be proficient in leadership (6.67) in order to set a direction, delegate authority, and influence a project team with fairness [13, 15, 17, 30]. As a quote from the interview, “they (project managers) should have political skill and be able to set priority of project activities to be in line with management and goals of the company.” Also, they should have the ability to know when to involve management in
Intrapersonal competencies. In terms of communication skills (6.50), a project manager should be capable of listening, asking, communicating (oral and written), articulating, and handling the information whether it is technical, legal, administrative, or interpersonal in nature [13-15, 29, 34]. The third most important competence in this group is team management (6.33), whose purpose is to help put together a team that is committed and mutually accountable [15, 16]. This is especially important in multidisciplinary and distributed teams. Another competence that matters in project managers’ work is conflict management (6.17) [15, 17], defined as the ability to understand and resolve conflicts. Experts also highly ranked the problem solving competence (6.00), expecting the project manager to be able to resolve problems when they arise [15, 17, 18]. This competency includes skills in analyzing and identifying problems, facilitating emergence of solutions and tradeoffs, and making decisions or facilitating team decision making [14, 16, 34].

Business / strategic competencies. Business / strategic competencies include the knowledge, skills, and experience of a project manager in addressing the business/strategic aspects of projects. As the acceptance of projects as basic business vehicles has grown in the business community, it appears that the importance of the business/strategic competencies in managing projects has increased as well [18]. It is, therefore, necessary for project managers to possess these competencies. According to our expert panel, project managers should have business sense (6.17) so that they can formulate any project issues in a business context, discern fine variations among schedule / budget / performance needs, and make benefit-cost tradeoffs [13, 18]. Also highly important to project managers is to competently understand and respond to customer concerns (6.00) [18] and have an integrative capability that helps them make decisions in the systems context (6.00) [35]. The final two of the top five competencies in this group are strategic thinking (5.33) and profit/cost consciousness (5.33). The former relates to the competence of project managers to understand and adapt to the strategic direction of an organization, recognizing the industry’s and organization’s competitive components (5.33) [15, 35]. The latter deals with project managers being profit- and cost-conscious in making project decisions [18].

Intrapersonal competencies. Being qualities internal to a project manager’s character, intrapersonal competencies are the important foundation for the development of the other competencies. The experts in this study gave “organized and disciplined” the highest ranking among the intrapersonal competencies (6.00). These qualities will help project managers perform better in an unstructured work environment [14]. Being responsible earned the second highest ranking (6.00), meaning that project managers demonstrate the ability to lead a project without guidance or superior authority [34]. Project managers, according to the experts, should also be proactive and ambitious (6.00), including having action-oriented and self-motivated competencies to anticipate issues and develop a plan to account for them [5, 14]. They should also be able to negotiate for resources with an understanding of the overall benefits to an organization (5.50) [14, 15]. Lastly, the fifth most important intrapersonal competence for project managers is to be mature and self-controlled (5.50). Equipped with this competence, project managers will have emotional stability, patience, poise, and tolerance toward ambiguity [14, 15, 34]. Although we do not discuss it here, it is interesting that more competencies were identified in this research as well as in the literature; the experts also suggested that a project manager should be flexible and adaptive to change (5.17), entrepreneurial (4.83), creative (4.83), visionary (4.67), and competitive (4.33).

Multiple project management competencies. These competencies include the knowledge, skills, and experience of a project manager in managing multiple, simultaneous projects. Although we may intuitively presume that managing multiple projects is no more than a sum of managing individual projects, that is not the case. Shifting from managing a single project at a time to managing multiple, simultaneous projects is challenging because the nature of project management changes under those circumstances [36, 37]. The reason is that managing multiple projects requires two sets of competencies: those for managing individual projects and those for coordinating the projects [38]. The former includes administrative/process, interpersonal, business/strategic, intrapersonal and technical competencies that we discuss earlier in this paper. The latter is the focus of this section.

Despite the fact that multiple project management has been around for a long time [14], there has been very little empirical research about it, especially research on the competencies. In this study the experts ranked experience in managing multiple projects as the most important competence (6.00) [10]. Immediately following is the competence of interdependency management (5.83). Its purpose is to manage interdependencies and interactions among projects related to shared milestones, goals, and technology [36, 39, 40]. Also important is multitasking (5.67), in which project managers estimate their own resource capacity in order to set priorities and switch contexts to multitask among different projects [19, 21, 22]. This poses a significant challenge because often each project has its unique characteristics. In addition, project managers need the competence of simultaneously leading several project teams (5.33) [19]. To do so, they need to select and use different management styles specifically for each team. Further, they need to proceed with what we called “a condensed team building” since the time they
have for this task is very limited for each team [22]. The fifth most important competence in the experts’ ranking is managing the interproject process (5.17). This competence integrates planning/scheduling, monitoring/control, and resource management among projects [19, 22], helping the project manager optimize his resource capacity.

Technical competencies. These competencies include the knowledge, skills, and experience of a project manager related to the technical facets of the project product. Experts in this study believe that the single most important competence is the knowledge of product applications (5.67), which provides project managers with an understanding of the general technological concepts of products and their applications [17]. The second most important competence is the knowledge of technology and trends (4.67), including expertise in the technology of the company’s products and the trends of this technology [16, 35]. Significantly lower are the ratings of the next three competencies. The first is the knowledge of technical tools and techniques related to product development (3.83), followed by the specific knowledge of product technology (3.60). The fifth most important competence is the ability to solve technical problems with a low score of 2.67 [13, 29, 34, 35]. The low ratings of the last three technical competencies seem to be in tune with some arguments in the literature indicating that when it comes to project products and technology, project managers need no more than a “working” level of their knowledge. This also found from our case interviews that it is rather difficult for multi-project managers to possess all technical knowledge that every project requires. The expectation is that the project team is equipped with technical persons who have responsibility for the technical aspects of projects, as a quote from our management-level interviewee suggests: “Even though they (multi-project managers) might not have the technical expertise they need, I say, okay. The team is going to be staffed with technical people.”

4.2. A set of project assignment criteria

To assign a project to a project manager, management can use two sets of criteria. The first set includes criteria related to project requirements and competencies of project managers. Because the criteria are project-specific, we describe them as directly influencing project performance. The second set comprises criteria related to organizational factors and organizational constraints. Considering that they are organization-specific (mostly external to projects), we view them as directly influencing organizational performance. Together the two sets of criteria influence the performance of projects and the performance of the organization (see Figure 3). Following are the detailed discussions of the results after experts’ evaluations.

![Figure 3. Project assignment criteria](image-url)

**Project requirements.** Project requirements are criteria based on the project characteristics such as the complexity of projects. These requirements are used to identify the project profile and which competencies a project manager needs to manage a project.

In evaluating the importance of the requirements in project assignments (see Table 3), the experts in this study ranked level of risk (5.67) - the degree of technical and commercial risk of projects - as the most important. Closely following is the schedule criticality (5.60), describing the degree to which a project has a time-to-market driven schedule [5, 41]. Also important are the organizational complexity (5.17) in terms of the degree of organizational interfaces and interdependencies; task complexity (5.00), which expresses the degree of task interdependency and scope of work [5, 41]; and technology novelty (5.00), the degree of using new versus mature technology [5, 41, 42].

<table>
<thead>
<tr>
<th>Project requirements</th>
<th>Mean*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level of risk</td>
<td>5.67</td>
</tr>
<tr>
<td>Schedule criticality</td>
<td>5.60</td>
</tr>
<tr>
<td>Organizational complexity</td>
<td>5.17</td>
</tr>
<tr>
<td>Task complexity</td>
<td>5.00</td>
</tr>
<tr>
<td>Technology novelty</td>
<td>5.00</td>
</tr>
</tbody>
</table>

* Average score from experts (1: Not important, 7: Very important)

Table 3: The importance level of project requirements

**Competencies of project managers.** Competencies of project managers are the important criteria for project assignments. As discussed in the earlier section, competencies can be categorized into technical, administrative/process, interpersonal, intrapersonal, business/strategic, and multiple project management
For project assignments, project requirements should be studied and translated into the required competencies (the level of competencies that each project needs). These required competencies should be compared with the level of competencies of each project manager (available competencies). The level of matching between required and available competencies indicates the level of compatibility between a project and a project manager, and has a vital role in project assignments.

**Organizational factors.** Organizational factors are a group of criteria based on the strategic elements of the organization such as the organizational goals. The experts in this study suggest that the single most important organizational factor (see Table 4) is the business-related goal to increase profitability (6.17), followed by the business-related goal to increase revenue (6.00) [43, 44]. Slightly behind are ranked the operation-related goal to accelerate time-to-market speed (5.33) [45, 46]; the business-related goal to improve customer satisfaction (5.33) [47, 48]; and the technology-related goal to strengthen and leverage technological competence [47, 49, 50].

<table>
<thead>
<tr>
<th>Organizational factors</th>
<th>Mean*</th>
<th>Organizational constraints</th>
<th>Mean*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Goal: To increase profitability</td>
<td>6.17</td>
<td>Credibility of a project manager</td>
<td>5.83</td>
</tr>
<tr>
<td>Goal: To increase revenue</td>
<td>6.00</td>
<td>Strength of project team</td>
<td>5.50</td>
</tr>
<tr>
<td>Goal: To accelerate time-to-market</td>
<td>5.33</td>
<td>Resource capacity of a project manager</td>
<td>5.00</td>
</tr>
<tr>
<td>Goal: To improve customer satisfaction</td>
<td>5.33</td>
<td>Project interdependencies and interactions</td>
<td>4.80</td>
</tr>
<tr>
<td>Goal: To strengthen/leverage technological competence</td>
<td>5.33</td>
<td>Ability of support resource</td>
<td>4.50</td>
</tr>
</tbody>
</table>

* Average score from experts (1: Not important, 7: Very important)

Table 4: The importance level of organizational factors and constraints

For project assignments, these organizational factors should be used to evaluate the degree to which projects contribute to their accomplishment, thus ranking the importance of each project to an organization. Then, each project would be specifically assigned to the most competent project manager.

**Organizational constraints.** Organizational constraints are criteria representing some personal and organizational limitations/concerns regarding project assignments. According to the experts in this study (see Table 5), the credibility of a project manager (5.83) is the single most important constraint. This constraint states that a project assignment should depend on the degree of trust that stakeholders have in the success of a project manager [34]. The strength of the project team came in second (5.50). In particular, if a project manager is assigned to a strong project team, he may be free from managing details. The experts also selected the resource capacity of the project manager as the third most important constraint (5.00). This often-ignored constraint includes the effective capacity, the current workload, and the availability measures (expressed in person-hours per time period) [51]. Essentially, this constraint prevents a project manager from taking on more project assignments than his resource hours can support. Another constraint rated as being important (4.80) is the project interdependencies and interactions [36, 40, 52]. The point here is that when several projects have strong interdependencies and interactions, they should be, if possible, assigned to the same project manager. The last constraint is the ability of the support staff (4.50), whose higher skills can enable a project manager to spend more time on value-added activities.

In this section, the competencies of project managers and project assignment criteria were presented. These criteria will be used in the development of a project assignment model in Phase 2 of this research (Figure 2), which has not started yet. In the next section, the implications of the competencies and assignment criteria will be discussed. Additionally, the basic concepts of the project assignment model will be discussed in the Future Research section.

## 5. Managerial Implications

The current results of this study reveal several important implications that we summarize in this section.

### 5.1 Developing a set of competencies

This research identifies the most important competencies that a project manager should possess in order to lead a new product development project in a multiple-project environment. Most importantly, it proposes a new set of competencies for multiple project management that are specifically important for a project manager who leads multiple, simultaneous projects.

In fact, it may be difficult to find a project manager who possesses every competency identified in this study. However, it is possible for project managers to develop or improve their set of competencies. To do so, project managers should start with the more important competencies and move toward less important ones. Based on the results of this study, project managers should start by developing their administrative/process and interpersonal competencies. Also, in terms of administrative/process competencies, project managers should put more emphasis on developing the competencies regarding monitoring/control and risk management.
5.2. Using project assignment criteria

This study also proposes project assignment criteria, which help improve the criteria proposed in the literature. While the proposed criteria in the literature basically consider those related to impact of project assignments on the project performance, the criteria proposed in this study consider both the performance of a project and the performance of an organization. In addition, this new set of project assignment criteria is applicable when assigning a project to a project manager who leads multiple, simultaneous projects (especially NPD projects), an area unaddressed in the existing literature.

In general, a concern in project assignments is that a strategically important project should be assigned to the most competent project manager who has sufficient resource capacity to lead it. To do so, each project first has to be evaluated in terms of how it contributes to the organizational goals (herein referred to as organizational factors) in order to identify its strategic importance to the organization. Secondly, project requirements have to be studied and translated into the level of competencies that a project needs from a project manager (required competencies). Also, the level of competencies of each project manager has to be identified so that the level of compatibility between a project and a project manager is established. Finally, management has to check the personal or organizational limitations/concerns (organizational constraints) to make sure that the violation of these constraints does not occur when project assignments are made.

5.3. Taking the contingency approach

Even though this study was developed from a real-life context based on case study research and was validated with the literature and the panel of experts (following the Delphi method), we recognize several of its limitations. The study was based on an in-depth analysis of project assignment processes of four market-leader companies involved in NPD in high-technology industries. Although, the sample size was small, it was based on the theoretical sampling of the case study research, and was therefore adequate [24]. Also, we specifically studied the environments of NPD projects since an effective system of managing NPD projects is considered to be a driver of the technology driven organizations. Also, such a system is of strong interest to groups of researchers and will increase in demand in the future research agenda. In addition, to ensure the external validity of our findings, the literature comparisons and the evaluation of expert panels are implemented. The experts were rigorously selected based on the established selection criteria, and their evaluations were done systematically by following the Delphi method.

With the above concerns, while the study proposes an integrated list of project manager’s competencies and a set of project assignment criteria, these lists are no more than guidelines. In certain organizations, project managers may not need to possess every competency on the list. However, they have to make sure that they possess the competencies that meet the needs of the typical projects in their organization. This is also applied to the set of project assignment criteria. For project assignments, management may not use every criterion proposed in this study or they may start from these criteria and tailor them to strategies and organizational conditions. Also, we do not suggest that this list should be generalized across the industries. For example, in an IT environment, the set of project manager competencies and project assignment criteria may be somewhat different.

6. Conclusion and Future Research

The results of this study centered on the integrated list of project managers’ competencies and a set of project assignment criteria in NPD environments. With the list of competencies, project managers can recognize what competencies they need to improve or develop. In many ways, our list of competencies seem to be approaching the studies on competencies of managers in general [28, 35]. However, the real differences is in the multiple project management competencies, which have not been proposed in the literature. In addition to the list of competencies, a set of project assignment criteria provides a better understanding of what should be considered during project assignments. Management can use these competencies and criteria as guidelines to develop the ones that are applicable to their organizational condition.

The research in the next step is to deploy the project assignment criteria to the development of a systemic methodology for project assignments (project assignment model). As already mentioned, firstly, when assigning projects, management needs to evaluate and rank each project by the degree of its strategic importance to the organization. The concepts of the analytic hierarchy process make it possible to perform this evaluation. Secondly, management needs to ensure that the competencies of a project manager correspond to the project requirements. To do so, the concept of attribute matching based on the competency matrices can be used. Thirdly, the project assignments should conform to some personal or organizational limitations/concerns. These limitations can be formulated into the mathematical constraints of the optimization model. Finally, with the concepts of the integer programming model, a project assignment model can be built. Upon its completion, a project assignment model will be executed and validated with the information from a participating company.
References


