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The effectiveness in managing a group of multiple projects: Factors of influence and measurement criteria

Peerasit Patanakul [a,*], Dragan Milosevic [b]

[a] Howe School of Technology Management, Stevens Institute of Technology, Castle Point on Hudson, Hoboken, NJ 07030, USA
[b] The Department of Engineering and Technology Management, Portland State University, Portland, ME, USA

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Abstract

To improve management and efficiency, many organizations nowadays employ multiple project management (MPM) practices. A common way to do so is having one project manager lead multiple concurrent projects, which we term – the management of a group of multiple projects (MGMP). Despite the high rate of utilization in the industries, MGMP research is still limited. In responding to the demand in this relevant research area, we examined the issues leading to effectiveness in MGMP from six leading high-tech organizations. We found the organizational-level and operational-level factors influencing the effectiveness in MGMP and the criteria for measuring the MGMP effectiveness. This finding was organized as a framework underlying the effectiveness in MGMP, providing important managerial implications and suggesting potential future research.

Keywords: Multiple project management; Multiple-project manager; Management of a group of multiple projects; Effectiveness; Influencing factors; Measurement criteria

1. Introduction

Multiple project management (MPM) has taken hold in organizations as they seek to improve management and efficiency [1,2], coordinate interrelated projects to cut cycle time [3], and transfer technology between projects to outperform the competition [4]. MPM can take different forms. Several researchers perceive MPM as portfolio management [5], while others recognize MPM as the management of multiple projects in a functional level, *a.k.a.* managing resources across multiple projects [6].

On an operational-level, the focus of our study, MPM can be perceived as the management of *groups of several concurrent projects*. Each group of projects managed by a project manager typically termed *a multiple-project manager*. These managers are tasked with making decisions lower in an organization hierarchy and have interrelationships with multiple functional units from which they draw resources [7]. Essentially, this form of MPM is designed as an overlay to an existing functional organization [7] and is of strong interest to many organizations in various industries [8–10].

Multiple-project managers share many characteristics with single-project managers (project managers who run one project at a time), but also differ in many ways. A few examples can help illustrate the differences. First, a major piece of multiple-project managers' role – linking multiple concurrent projects – does not exist in single-project management. Second, in dealing with multiple projects at a time, a multiple-project manager leads multiple teams for the projects of different objectives, while a single-project manager leads only one team. Third, multiple-project managers face the challenge of switchover from project to project, at times several times a day [9] while the switchover among projects does not exist in a single project. Therefore, in a project manager level, the assumption that managing a

* Corresponding author. Tel.: +1 201 216 8156; fax: +1 201 216 5385.
E-mail addresses: Peerasit.Patanakul@stevens.edu (P. Patanakul), dragan@etm.pdx.edu (D. Milosevic).

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group of several concurrent projects is no more than the sum of managing individual projects may appear to be incorrect [8].

In the research domain, most literature in project management focuses on single-project management, program management, or MPM in management level. Empirical research on the management of multiple projects, especially in the project manager level is rare and well behind its rate of utilization in the industry [9,10]. More research is needed to answer the question, posted by practitioners: "*what is an effective way to lead multiple projects [in a project manager level]?*" While existing literature on single-project management, program management, and MPM is a beneficial point of departure, it has also left some important questions unanswered. In this paper, we seek to develop a framework for understanding the effectiveness in multiple project management in a project manager level. To eliminate the confusion with regard to the terminology, we use a term management of a group of multiple concurrent projects (MGMP) to represent this form of project management. We collected and analyzed qualitative data from six organizations. Thus, the primary contribution of this research is to investigate MGMP – an MPM form – and to develop a framework that can be used in both studying and effectively implementing MGMP.

2. Background

2.1. Definitions

Several different definitions of management of multiple projects are in use today. To avoid possible confusion related to definitions, we will choose our definitions and use them consistently in this paper. We define *multiple project management (MPM)* – also referred to as multiproject management – as an organizational-level environment in which multiple projects are managed concurrently (see Fig. 1). Some experts employ the term *portfolio management* for such environments [3,5]. In it, projects are grouped together to facilitate effective management to meet strategic business objectives. They are diverse in size and importance, may be at any point in their life cycle, and may not necessarily be interdependent or directly related [3].

Some of the projects in MPM environment are sufficiently large and strategic in nature to have a full-time project manager. We term such an approach *single-project management (SPM)* – the project manager leads a single project at a time. Often, these projects are undertaken to create a competitive advantage for the company. An example is a product platform development project.

Other projects in the multiproject environment that are of smaller size and more tactical nature tend to be grouped such that one project manager (called multiple-project manager) handles several concurrent projects at a time. For this approach, we use the term *management of a group of multiple projects (MGMP)*. Typically, projects in the group are not mutually dependent in terms of objectives and goals but rather grouped for the sake of efficiency and better management in a project manager level, leading to interdependencies among these projects as they are managed by the same project manager [1,2]. An example is the assignment of a product improvement project, an internal process improvement project, and a small IT upgrading project to one project manager. This form of project management is to the interest of the industries (some refer to it as multiple project management). This paper focuses on MGMP as a unit of analysis.

Another case of MPM is *program management*, where the projects in the group are mutually dependent, share a

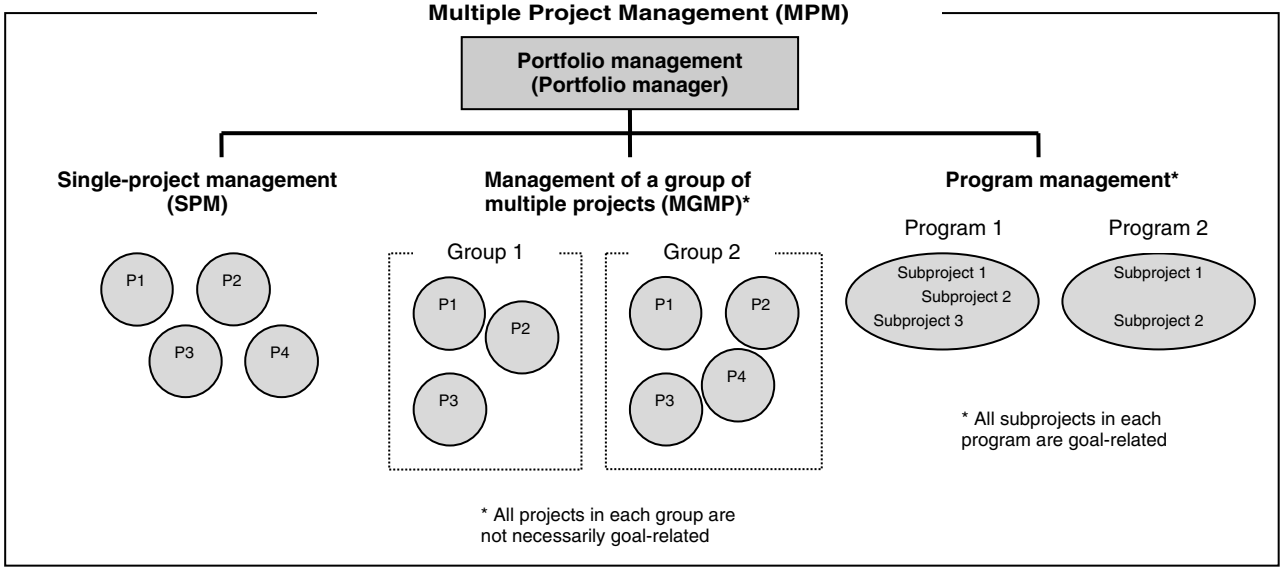

Fig. 1. A possible multiple-project management setting in one organization.

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common goal, and lead to a single deliverable product or service. In contrast with MGMP, program management is the centralized coordinated management of a group of goal-related projects to achieve the program's strategic objectives and benefits [3]. Although a certain number of our findings are applicable to it, program management is beyond scope of this paper.

2.2. Literature review

The little literature that exists on MPM offers two related streams of research that we used as a framework for developing the guiding propositions of our research. The first is the literature on the management of multiple projects and their organizational inputs. The focuses of the second stream are on the internal process and the expected outputs.

2.2.1. The organizational inputs

In the literature, several authors have discussed issues related to the organizational context of MPM. Essentially, the issues look at interactions between the groups of multiple projects and their organizational environment as being important for effectively managing multiple projects. Such issues focus on the need for realistic portfolio management, typically in conjunction with formal project selection, prioritization, and resource allocation. To be effective in highly competitive business environments, it is important that an organization carrying out multiple projects has the ability to provide sufficient and appropriate resources. To do so, the organization should employ a rigorous, clear, and formal project selection method [9,11]. Projects should be selected based on their relevance to the organization's business objectives, the appropriateness of the project size, the schedule and technical feasibility, the financial viability, etc. Along the same line as Payne [11], Adler et al. [12] emphasized that it is very ineffective when an organization implements too many projects to be handled by its available resources.

After the selection process, another challenging task of managers in MPM environments lies on the assignment of projects to multiproject managers. Kuprenas et al. [13] proposed that the effectiveness in MGMP depends on the number of projects a multiple-project manager runs at a time. In manufacturing support environments, a study found that assigning two to three "major" projects to an engineering project manager is an effective maximization of his/her productivity [9]. With regard to the assignment process, Patanakul et al. [14,15] asserted that an effective assignment process should consist of the steps toward the understanding of project priority, the matching between competencies of multiproject managers and project requirements, and the recognizing of the organizational/personal limitations.

Besides project manager assignment, the allocation of resources also posts another challenge to management [9]. Several studies proposed tools and techniques for scarce resource allocation, which include integer programming, heuristic methods, queuing theory, etc. [8,16–18]. However, these techniques were proposed for a use in the functional level – the allocation of functional resources across multiple projects. Since they were not proposed for the MGMP settings, these techniques may not be applicable to an operational-level for a multiple-project manager to allocate resources across projects in his/her group.

In terms of multiple-project success factors, Fricke and Shenhar [9] found that management support is one of the key success factors. This support can be seen in terms of implementing the reasonable amount of projects, allocating resources appropriately, setting clear goals and project priority, and assigning project manager properly. In addition, multiproject organizations should have strong organizational culture. This includes project ownership and communication [9]. However, the organizational culture of MGMP has not attracted much attention of researchers, although it is reasonable to posit that the culture influences MGMP.

2.2.2. The process and outputs

When multiple projects are presented, the interproject interaction becomes an issue [11,19]. As a result, multiple-project managers need to focus on interdependence among projects in order to maximize the objective of group success as opposed to individual project success. With the lack of management attention to project interdependence, local suboptimum reigns. Research suggested that the concept of portfolio management should be applied to an operational-level so that functional managers, multiple-project managers, and team members can couple the planning and control cycles for single projects and the portfolio of projects. This will help identify the balanced trade-off among the interests of multiple-project managers and functional managers in a team effort [5,20]. The idea is to manage all projects as a collection, by adjusting and linking their schedules to match available resources, and removing unnecessary variation in workloads of multiproject managers [12]. Some see multiproject scheduling as an efficient way to link projects [2].

To lead a group of multiple projects, studies show that multiple-project managers should possess certain competencies in order to be effective. Tullett's study [21] suggests that a typical manager of multiple projects has an innovative thinking style. She/he is likely to be less concerned with the attention to detail and the structured, systematic approach required to plan and manage such project successfully. Multiproject managers should be capable of multitasking, minimizing the switchover time cost [22] when shifting attention from project to project. Also, handling multiple projects is likely to increase pressures on multiple-project managers as they lead and build multiple teams at the same time. They should be effective in simultaneously leading multiple project teams [9,23]. In addition, because of the unstable relationships, e.g. change in priority, unsustainable resources, that occur in a multiple

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Table 1
Summary of the literature related to MGMP

Relationship with MG/MP	Theme of literature and samples of citations	Remark
Inputs	Organization capacity: [11,12] Project manager assignments: [13–15] Resource allocation: [8,16–18] Success factors: [9]	The majority of the literature investigate MPM on a functional level, MGMP is not a unit of analysis
Process	Management of project interdependency: [11,19] Competencies of multiple-project managers: [9,21,23]	Literature provides limited investigation, more research is needed
Outputs	Resource utilization: [2,9] Multiple-project managers' expectation: [9,13]	Not much research is done in the output domain of MGMP

project environments, multiple-project managers must know how to deal with conflicts when they arise [11].

Typically, a key reason that an organization implements MGMP is to achieve better efficiency and management of projects. The expected output from multiple-project managers, besides meeting time, cost, performance, and satisfying customers, is the effective use of organizational resources [2,9]. However, research on the multiple-project managers' expectation from MGMP is limited. Those outputs may be seen in terms of bonus, job satisfaction, and career growth [9,13].

2.3. Linking literature to research

In summary, the literature's two streams appear to cover three major domains – inputs, process, and outputs of MGMP. As our literature review indicates, project management research have been done to investigate such critical issues in MPM as success factors, resource allocation, priority setting, management support, communication, competencies, etc. Even so, the literature is still limited. Even more lacking is research in MGMP, our unit of analysis, see Table 1. Specifically, no research addresses the question that our exploratory study asks: "*What are important issues leading to the effectiveness in MGMP?*"

3. Research description

3.1. Research objectives and guiding propositions

Our research objective was to identify the important issues leading to the effectiveness in managing a group of multiple projects. To accomplish this objective, we developed guiding propositions to guide our research based on what we have learned from the literature.

To ensure effectiveness in MGMP, an organization may have to provide its multiple-project managers with an appropriate project management setting (organizational inputs). One example of such a setting is a proper project assignment [9,13–15]. To do so, a process of project assignment should be in place. This process may be linked to project selection process and project portfolio management. With this, we stated:

Guiding proposition 1. *The organizational factors such as project assignment may influence the effectiveness in MGMP.*

Having only an appropriate project management setting may not be sufficient to ensure the effectiveness in MGMP. Literature suggested that multiple-project managers should be experts in project management process (possessing hard skills). In addition, multiple-project managers should possess soft skills to be able to simultaneously lead multiple project teams [9,21,23]. Thus, we conceptually stated:

Guiding proposition 2. *Multiple-project managers' competencies influence their effectiveness in MGMP.*

Even though these two guiding propositions are rather evident, in the literature, there is no empirical research that confirms the factors influencing the effectiveness in MGMP. The findings based on these guiding propositions would, therefore, help expand the concepts of project management that would in turn lead to a more effective MGMP in practice.

3.2. Design and sampling

With the limited knowledge and perspective in MGMP, case study research was used in this study. In particular, we used multiple cases design, which allowed a replication of logic. In other words, cases were treated like experiments so that each case was served to confirm or disconfirm the conclusion drawn from others [24]. To enrich the findings from case study, we reviewed the existing literature to identify the similarities/dissimilarities to the findings.

In this study, our focus was on the management of development projects of market leaders in high-technology industries. Following the principles of theoretical sampling, choosing the cases that are likely to replicate the previous cases, extend emergent concept, and fill theoretical category [24,25], we studied MGMP of six companies. They were: an LCD projector manufacturer (LCD), a testing measurement equipment manufacturer (EI), two computer component manufactures (ITC and MG), a construction management software developer (CSD), and a dealership software developer (DS) (see Table 2). All of them were in high-technology industries and held a top position in their respective market. While revenues of four manufacturers were around $1B and more, those of two software developers were between $50M and $100M. Each company is considered a case, meaning we had six cases. The reason that we stopped our research after studying six cases was because the saturation of information had been reached [25]. Studying six cases is in line with this type of research – four to ten cases [25].

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Table 2
Descriptions of the companies participating in this study

	LCD	EI	ITC	MG	CSD	DS
Company's market standing (ranking)	1	2	1	2	1	1
Department name	Project management group	Project management group	Project management group	Corporate engineering	Project management department	Engineering management department
Department purpose	Product development management	Product development management	Product development management	Product development management	Software development management	Support software development
Number of projects per year	30–40	40–50	10–15	10–12	>50	>100
Number of project managers	12	18	4	4	8	4
Average number of projects per project manager	2–4	2–4	2–4	2–3	4–8	10–12
Typical project duration (months)	Small: 4–8 Med: 10–14 Large: 18–24	Small: 9–15 Med: 12–24 Large: 18–36	12–30	6–12	Small: 1–2 Med: 3–4 Large: 12–36	3–18
Typical project budget (M: million, h: person-hours)	Small: $0.5–3 M Large: $6–9 M	Small: $1–2 M Med: $2–5 M Large: >$5 M	No project categories: 2000–36,000 h	No project categories, 1000–3000 h	Small: 300–400 h Med: 1000–3000 h Large: >3000 h	Small: <300 h Med: 300–1000 h Large: >1000 h
Typical # of participants per project	Small: 20 Large: 25–35	20–60	5–20	2–4	8–25	20–56
Typical projects	New product development	New product development	New product development	Product/ Software development	Software development	Hardware support for software development

4. Data collection

In each company, we interviewed a multiple-project manager (responsible for MGMP) and his/her manager. These respondents were located in program management for the new product development department (LCD, EI, ITC and MG), the project management department (CSD), and an engineering management group (DS). The purpose of having respondents from different organizational-levels was to get a triangulated view of important MGMP issues from two different analyses.

We recognized that in each company we conducted our study based on two case informants. Conducting interviews with more than two informants may enrich the data collection. However, it was in our research design that those informants were selected based on their high level of project management expertise and experiences. In other words, our case informants were the top managers and project managers of these six market leading organizations. All of them had multiple years of experience in managing or supervising groups of multiple projects for their organization, spanning from two to 20 years. In addition, some of them had multiple years of MGMP experience from their previous employment. All of them are certified project managers by Project Management Institute.

We collected data through the interviews ranging from 100 to 120 min. The basis for interviews was a semi-structured questionnaire seeking to get information about the characteristics of the company, department, the group of multiple projects, important issues in MGMP, or other significant issues indicated by the respondents. To gain different perspective, the way the questions were asked depended on the level of the respondents (managers or project managers). For example, the following questions were addressed to the managers: "*How do you assign projects to multiple project managers? What are the criteria do you use?*" On the same issue, the following questions were addressed to the multiple-project managers: "*How the projects are assigned to you? What criteria are used?*" As already mentioned, this helped us gain the richness of the information that was addressed from different perspectives.

In general, we asked the questions such as: "*Please explain the project management process in your company, what is effective, and what is ineffective? How much different you see between MGMP and SPM? What make MGMP effective? What MGMP outcomes do you measure?*" Based on what we learned during the course of data gathering and analysis, we also asked more specific questions such as: "*How the projects are assigned to multiple- project managers? What are the criteria for the assignments? How many projects a multiple- project manager can effectively lead at one time? Please explain resource allocation process? Is there any specific organizational culture that supports MGMP? Please explain the process you used in managing multiple*

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projects? What tools and techniques are available to multiple-project managers? What are the important competencies that multiple- project managers should possess? How do you measure success?" We always asked them to contrast between effective and ineffective practices. Note that these questions were used as guidelines. Depending on the dynamics of the interview and the emerging information, questions could be rearranged or eliminated. New questions could be added.

To ensure the research validity, all interviews were conducted in the respondents' departments using at least two researchers (one was taking notes only). Since the respondents also have had experience as a single-project manager, it was repeatedly made clear that all questions were related to MGMP, not SPM. When appropriate, we explicitly asked them to contrast the issues of MGMP and SPM.

5. Data analysis

We tape-recorded during each interview. Each interview was then transcribed, yielding 15–29 pages transcripts. The transcripts were coded and the chains of evidence were developed. Within-case analysis was conducted to gain an understanding on the effectiveness in MGMP. The document we received from the respondents (e.g. progress reports, resource allocation documents) was also reviewed. With the parallel process between data gathering and analysis, the case analysis results were used to sharpen the next interviews.

Cross-case analyses were also conducted to analyze the consistency and inconsistency of the data across cases and to ensure the construct and internal validity of the findings [24–26]. After these analyses, the findings were compared with the literature to identify the similarity/dissimilarity and for the external validation. All of these resulted in tabulation of qualitative data that led to the identification of important issues in MGMP, discussed in the next section.

To develop a research proposition, once the preliminary analyses had been developed from the cases, we combined the analysis and developed propositions, as suggested by [25]. After the development of these tentative propositions, each case was revisited to investigate whether the case data confirmed the proposed relationship. The case data was also used to improve the understanding of the underlying dynamics.

6. Findings and discussion

The findings of this research reveal factors leading to the effectiveness in MGMP. Based on our analysis we organized them into the organizational-level factors and the operational-level factors. We also found the criteria that can be used in a metric measuring the effectiveness in MGMP. In the following sections, we present and discuss the research evidence – the factors or criteria in each group and quotes from the case study research. Associated with each group or factors and criteria, we also suggest propositions that can be the basis for future research. Then, we introduce a framework underlying the effectiveness in MGMP, summarized from the research findings.

6.1. The influencing factors in the organizational-level

Based on our research evidence, we found three major organizational-level factors influencing the effectiveness in MGMP. These factors are project assignment, resource allocation, and organizational culture, (see an example of case data in Table 3).

6.1.1. Project assignment

The evidence from all six cases indicates that the realistic project assignment is one of the most important factors leading to the effectiveness in MGMP. With realistic assignment, a multiple-project manager would have skills and time availability to effectively lead each project. With sufficient attention from a multiple-project manager, a project tends to be more successful.

Since realistic project assignment influence the effectiveness in MGMP, we went beyond this finding and asked our informants what constitutes such assignments. We learned that to properly assign projects to multiple-project managers, management should find a good match between skill sets of multiple-project managers and the project requirements by considering also the project priority and some other limitations. A manager of project managers of Company DS stated, "*What I did was I went and ranked my multiple- project managers based on their skill set and their abilities. And then, when I get projects in, I classify them in terms of difficulty of managing them and I assign them accordingly... A lot of time, risk is a big issue. And if I know I have a project manager who is really strong on risk management; even though they might not have a technical expertise they need, I say, ok, the team is going to be staffed with technical people*".

Our case informants also reveal that proper assignment also means having an appropriate number of projects per a multiple-project managers and having a balanced mix of projects in terms of project types and phases. Being assigned too many projects, our evidence shows that a multiple-project manager would lose a tremendous amount of time catching up with all the issues in the projects instead of focusing on leading projects. A manager of Company EI put it: "*You do not want to load them (multiple-project managers) up to the point that they cannot be effective... Four projects for one multiple-project manager, I think they are going to lose a lot of effectiveness and a lot of efficiency because they are changing gear too much. And I think it is really inefficient.*" We also found that there is no universal rule of thumb on how many project should be assigned to a multiple-project manager. The appropriate number projects being assigned to a multiple-project manager varies from company to company. It also depends on the complexity of projects and their phase. "*Four to five is probably as good as you can get from somebody effectively. I have to*

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Table 3
Example of case data, summarized as the influencing factors in the organizational-level

Issues	Case data
Project assignments	"You do not want to load them (multiple-project managers) up to the point that they cannot be effective... Four projects for one multiple-project manager, I think they are going to lose a lot of effectiveness and a lot of efficiency because they are changing gear too much. And I think it is really inefficient." – EI "What I did was I went and ranked my multiple- project managers based on their skill set and their abilities. And then, when I get projects in, I classify them in terms of difficulty of managing them and I assign them accordingly ... A lot of time, risk is a big issue. And if I know I have a project manager who is really strong on risk management; even though they might not have a technical expertise they need, I say, ok, the team is going to be staffed with technical people" – DS "I think the ideal criteria are to find what skill set is and what is needed for that project." – CSD "We always have that discussion in terms of what the person skill level is, how they are doing? What they are doing? And also in terms of what skill we want them to develop. To assign them a project, is it going to be something that is going to get them to the next level of whatever their career goals are. We look at all that but again you know, that is not optimum, we may compromise. But we also look at people preferences." – LCD "Four to five is probably as good as you can get from somebody effectively. I have to balance that ... I think the whole key to success is you make sure that you do not have all projects in the same phase at the same time." – DS "What you really like to do for a project manager, have somebody who has either some related experience to that project what ever the goal of that project is or, in-depth knowledge about the technology." – MG
Resource allocation	"When the project is put on the list and assigned to me, I do not have resource, I beg... I was allocated resources three months ago for a project, project has been going on and on, it does not mean that these resources will stay with me throughout the entire project. If the company changes its direction, or major project is coming out, a manager may say that your priority has been changed and this project becomes more priority... Probably the worst risk is someone is stealing my resource." – DS "What we do in our organization is that a multiple-project manager gives the resource requirements to the functional manager. Here is what I need of this type of resources during this time frame. Then, the functional manager would muster the resources for that particular function and figure out how we are going to resource load all those projects." – EI "I think that at a time when you need negotiation you went out looking with the function managers who own the resources above the different people that you like to have on the multiple projects and you try to work with them centrally instead of working with each individual level. " – LCD
Organizational culture	'We have a "disagree and commit" practice. This means that you can give your opinions as much as you want but when the decision is made, you have to commit to it." – ITC "I think our culture encourages being really crisp and clear on the objective, building a sense of teamwork, building the idea of it is not okay to miss your commitment, having consequences for missing commitment, having reward for making commitment. It also has to be fun, be enjoyable." – EI "Commitment absolutely... I think it has to come from the top and has to be supported by every level of the organization." – CSD "We have a culture of reward for performance... We have a pretty direct communication style." – LCD "The culture of this company is everyone is very nice. Everybody treats everybody with respect. Very open atmosphere. Pretty much everyone has open door policy." – CSD

balance that... I think the whole key to success is you make sure that you do not have all projects in the same phase at the same time," stated a multiple-project manager from Company DS.

In sum, we found the evidence that project assignment influences the effectiveness in MGMP. Such an assignment is based on a good match between the skill levels of multiple-project managers and project requirements, project priority, some limitation e.g. the multiple project managers' time availability. In an attempt to corroborate with the literature, we found that this finding supports preview research [13,14]. Having projects that match with their expertise and with an appropriate workload, multiple-project managers would be more effective in leading projects to their success. In fact, the project assignment process should be linked to project portfolio management. Based on the balanced portfolio, some projects will be strategic projects and others will be operation projects [5,27]. The appropriate assignments of these projects should lead to the effective management of projects and organization success. Based on the finding and analysis, we propose:

Proposition 1. *The greater the consideration of project strategic importance, the good match between project requirements and competencies of multiple-project managers, and the organizational/personal limitations during project assignments, the greater the effectiveness in MGMP.*

6.1.2. Resource allocation

Based on the study of all six organizations, we found the evidence that having resources when needed is another critical factor and is a prerequisite for effective MGMP. However, all cases informants agreed that having sufficient resources is rare for most multiple-project managers. They also admitted that with the nature of MGMP, e.g. the smaller project size and tactical nature of projects, a multiple-project manager always faces a challenge with insufficient resources. In addition, smaller projects are always on the back burner resource. Often time, they have to deal with resource sharing and live with the risk of unsustainable resources as stated by a multiple-project manager of Company DS, "*When the project is put on the list and assigned to me, I do not have resource, I beg... I was*

allocated resources three months ago for a project, project has been going on and on, it does not mean that these resources will stay with me throughout the entire project. If the company changes its direction, or major project is coming out, a manager may say that your priority has been changed and this project becomes more priority... Probably the worst risk is someone is stealing my resource."

When asked about a process of resource allocation, multiple-project managers in our study commented that as in a typical matrix organization they worked in, resources are owned by the functional managers. Multiple-project managers have to negotiate for resources. A multiple-project manager from Company EI stated that "*What we do in our organization is that a multiple-project manager gives the resource requirements to the functional manager. Here, is what I need of this type of resources during this time frame. Then, the functional manager would muster the resources for that particular function and figure out how we are going to resource load all those projects.*"Even with such a systematic resource allocation process, there is no guaranteeing that multiple-project managers will end up with resources they need.

In conclusion, even though all case informants agreed that having sufficient and sustainable resource leads to the effectiveness in MGMP, they admitted that resource sufficiency and sustainability are uncommon. From our analysis and the corroboration with the literature, this finding is typical to project management. It is not only the nature of project management (MGMP) but it is also the nature of the competitive environments these companies are in that leads to the insufficient resource allocation. There are a lot of new opportunities for a company to pursue. Without a good resource management system, the company will always be resource-strapped [12]. This discussion leads us also to the concept of project portfolio management. By having a balanced portfolio, first, a company would not implement too many projects such that the resource bottleneck is created [12]. Second, the project priority would be set such that resources can be allocated to the projects accordingly [28]. The use of project management office can also help balance the resource usage [29,30]. These seemed to be the case of the companies we studied. However, it is always in project managers' hope that they will have sufficient resources and by having so, it will lead to management effectiveness. From the finding and analysis, we state:

Proposition 2. *The greater the resource sufficiency and sustainability, the greater the effectiveness in MGMP.*

6.1.3. Organizational culture

Our research evidence, developed through within- and cross- case analyses, reveals that to be effective in MGMP, an organization should establish the culture that supports such a management form. Since multiple projects are implemented concurrently – functional managers manage resources across multiple projects, the multiple-project managers juggle issues among projects, and the project teams work on tasks of multiple projects – commitment, communication, strong working relationship, and reward for performance are needed for the effective MGMP.

In terms of commitment, our case informants agreed that the project commitment has to come from top management and has to be supported by every level of the organization. In a project level, commitment of the project team is also important. A multiple-project manager of Company ITC stated, "*We have a "disagree and commit" practice. This means that you can give your opinions as much as you want but when the decision is made, you have to commit to it.*" With multiple projects to work on simultaneously, having the culture that supports communication is also significant. With clear communication channels, the project teams can share knowledge and experience across projects. In addition, multiple-project managers can use these channels to communicate project objectives to the teams in order to engage them in project activities. In addition, the case informants also emphasized that the organization should have the culture that helps build a strong working relationship and supports reward for performance, as stated by multiple-project managers of Company EI, "*I think our culture encourages being really crisp and clear on the objective, building a sense of teamwork, building the idea of it is not okay to miss your commitment, having consequences for missing commitment, having reward for making commitment. It also has to be fun, be enjoyable.*"

Our finding suggests significant ingredients of the organizational culture influencing the effectiveness in MGMP. With the extensive literature on team, this finding may not be unique to reveal that commitment, communication, teamwork, and reward for performance have some impacts on team effectiveness [31–37]. However, based on our analysis, we found the evidence that MGMP requires high intensity of such elements. With multiple projects to simultaneously lead and with multiple projects for a project team to work on, without the strong emphasis (culture) on commitment, communication, teamwork, and reward, works may not get done and ineffectiveness may reign. From the finding and analysis, we state:

Proposition 3. *The greater the organizational culture cultivates commitment, communication, teamwork, and rewards for performance, the greater the effectiveness in MGMP will be.*

6.2. The influencing factors in the operational-level

We found from the cases that to be effective in MGMP, there is a need for a strong process to manage concurrent projects. This, in fact, is related to a way the multiple-project managers tactically execute concurrent projects and their competencies. We refer to these as the influencing factors in the operational-level; see case data in Table 4. We also found that with a limited support from the organization (somewhat lack of the influencing factors in the

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Table 4
Example of case data, summarized as the influencing factors in the operational-level

Issues	Case data
Project management process	"We have phases we go through. It is a standard model but we as a team can choose to modify it." – CSD "It is an ISO process. We also have, in our process, the flexibility to go ahead and waive certain milestones depending on the complexity of the product." – LCD "We do not have a formal document or process on how we combine projects. It is an informal process, but we are very aware of it...I might link my MS project if I have schedules that are separated. A lot of time, I enter them in the same schedule. So I am just moving those deliverables to the milestones." – LCD 'We kind of have our own website that we post all kind of stuffs to. We come up with template and plan and schedule that we all agree upon. And that what we try to go by." – CSD "It may be two enhancements in one platform going on at the same time. We always, the discussion we have here is, how can we combine them to make it efficient. Can we have basically one team working on two projects, not only project manager but also the engineering team underneath?" – LCD "We need to be able to move out of that mindset that the project manager needs to know the task level. We need to move up to managing the deliverable level across the board for all disciplines. We are not there yet." – LCD
Competencies of multiple-project manager	"I think our skill set, is to manage, communicate, and make sure it gets done. It is not us substantial hold up the project. In fact, it never had been us. It is the resources that we have." – CSD "So, it is really forward problem solving thinking skill, being organized, and understanding time management. And I think you have to have a lot of patient." – LCD "I am kind of responsible to get people motivated. If I cannot get motivated on the project, my team will not get motivated." – DS "We look at the leadership skills would they control of their team. We look at problem solving skills would they are able to put the effective strategies together when unforeseen things happen on their programs, which happen on every program." – LCD "In my organization, it is a matrix organization. So, I would focus on project manager who has expertise on project management skills. He has to have expertise on career building and all those other kinds. Certainly, they need a basic of project management. They need to drive to deliver which is very different than functional managers. Typically, I try to build skills around identification of risk and risk management." – MG "I think the skill set for multi projects manager is some one who able to multitask and switches context. And yet able to focus when necessary." – MG "If I am sitting here working on one project and the phone rings and there is somebody talking about totally different project, switchover time is like "can you explain to me a little bit more" and that will give my brain a time to say, o.k. What did we talk about in the last meeting? So, switchover time can take about a couple minutes for every single change. We have to get refocused on what we are doing. So I would say, within one day time period, you are looking probably at a quarter of your day is switchover time...I really believe that we spend probably 15–20% of our time in this kind of activities because we are less than optimum in our focus." – DS "I have to say the most important thing is that you [multiple-project managers] have to find a method that works for you to keep you the most focused at any given time. For me, I try to keep project B, C, and D in my drawer while I am working on project A." – EI "We have to learn how to think out of the box or be able to, like I said before draw the big picture, learning how what affect on the different areas." – LCD "They (multiple project teams) probably involve you in a lot more things than you are normally exposed to because you get different personality, different dynamics on each one of the team." – EI You have to have a style that allows you to work with a whole bunch of different kinds of people. You have to know and adapt your style to different situations in order to be effective." – DS

organizational-level); there is a possibility to achieve MGMP effectiveness if the following influencing factors do exist:

6.2.1. Project management processes

When we studied the first case, we found that having shared project management processes helps multiple-project managers to be effective in MGMP. And this finding, in fact, repeated in every case. When studied in detail about shared project management processes, we found that our case informants referred to shared processes in two folds. One is the typical project management process for individual project as suggested in e.g. PMBOK [3]. In addition, they also referred to interproject processes, which include sequence of steps to *concurrently lead* and complete multiple projects, while delivering results.

The case respondents asserted that for the effectiveness in MGMP, it is necessary that an organization should have standard project management processes and multiple-project managers should have a solid foundation of those processes. For each individual project, the process would lead a way for multiple-project manager to plan, schedule, monitor, and control project activities, allocate resources, manage risks, etc. A multiple-project manager of Company CSD stated, "*We have phases we go through. It is a standard model but we as a team can choose to modify it.*" A similar comment was found from company LCD, "*It is an ISO process. We also have, in our process, the flexibility to go ahead and waive certain milestones depending on the complexity of the product.*"

In addition to a standard process to lead each project individually, all case informants agreed that, to be effective

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in MGMP, multiple-project managers should be proficient in the interproject process and the management of interdependencies among projects. They asserted that even though knowing and executing the interproject process is a must because it is the hard core of MGMP, their companies still do not have a formal or shared interproject process. We found that, to be effective, multiple-project managers use various methods to manage interproject process e.g. consolidating projects' deliverables or milestones of projects and managing them together. This will help multiple-project managers optimize their own resource capacity and also reduce the magnitude of multitasking. A multiple-project manager from Company LCD mentioned, "*We do not have a formal document or process on how we combine projects. It is an informal process, but we are very aware of it... I might link my MS project if I have schedules that are separated. A lot of time, I enter them in the same schedule. So I am just moving those deliverables to the milestones.*" We also found the evidence that having interproject process also help multiple-project managers manage interdependencies and interactions among projects related to shared milestones, resources, and technology. In other words, this process helps multiple-project managers manage the impact of one project on the others. A multiple-project manager elaborated to us that, for example, he manages four projects simultaneously, and resources are assigned to these projects, some resources are shared. His responsibility is to manage resources across these four projects. He must find a way to know the impact on the other three projects when he decides to have his shared resources concentrate on one project. He asserted that having the interproject process helps. A multiple-project manager of Company LCD mentioned that her tactic is seeing a big picture, "*We need to be able to move out of that mindset that the project manager needs to know the task level. We need to move up to managing the deliverable level across the board for all disciplines. We are not there yet.*"

In sum, the research evidence suggests that having a process for leading individual project and an interproject process to manage the interdependencies among projects impacts the MGMP effectiveness. The finding also suggests that even though the processes are standardized, multiple-project managers should have some flexibility to adapt them so that they are contingent to the types of projects. This finding is rather unique. Even though, our finding in terms of the impact of a standard process on the effectiveness in project management is not new [38], the literature looks at such impact in the context of the standard process for managing individual project rather than the interproject process as our research evidence also suggested. As already mentioned, interproject process is important to the effectiveness in MGMP since it helps a multiple-project manager manages the interdependencies and interactions among projects, leading to the overall benefit of all projects. While several multiproject scheduling algorithms have been proposed in the literature [17,39–43], they are proposed for the use in the functional level and may be too rigid to be used in MGMP setting. When the finding is corroborated with the project management office (PMO) literature, we found a research suggesting that a feature of the PMO in promoting project management standards and methods is highly correlated with project performance [44]. Our finding may suggest a new agenda to PMOs to also promote the standards and methods of interproject process in addition to typical project management processes as suggested in PMBOK [3]. From this finding and analysis, we propose:

Proposition 4. *The greater the systematic management of individual project process, interproject process, and project interdependency, the greater the effectiveness in MGMP.*

6.2.2. Competencies of multiple-project managers

The literature in project management has always suggested that the project manager is a key success factor of a project [45]. Our finding goes along the same line. However, what we found in this research is not only a confirmation that multiple-project managers influence project success, but it is also what the competencies of effective multiple-project managers are. We found that to be effective in MGMP, multiple-project managers should possess a combination of competencies that help them lead each individual project and coordinate among projects.

Our evidence suggests that, to be effective in MGMP, multiple-project managers should have *experience* in managing multiple-project for the organization for some time. We learned from Company DS that having two years of experience with the company is sufficient. Multiple-project managers should have *administrative competencies* – planning, scheduling, monitoring and control, and the management of cost, resource, and risk. They should also have a solid foundation of project management processes both individual project and interproject processes, as discussed earlier. In addition, multiple-project managers should possess the ability in *interdependency management.* Evidence from all six cases also shows that multiple-project managers should possess the *business competencies*, which includes having business sense, understanding customers, having integrative capability, having strategic thinking, and being profit/cost conscious. They asserted that having business competencies helps them to solve interdependency problems to benefit all projects they lead as much as possible.

All the case informants agreed that the *ability to multitask* is very important for effectiveness in MGMP. They accepted the fact that they must be able to estimate their own resource capacity in order to set priorities and switch contexts to multitask among different projects. Multitasking poses a significant challenge when managing more than one project because often, each project has its unique characteristics. During switchover from one task to another, it is not only that multiple-project managers have to recognize the difference between tasks, but they also have to realize different project objectives associated with those tasks.

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As a result, they often lose some time while refocusing (Rubinstein et al. [22] call this lost time "switchover time cost"). A multiple-project manager of Company DS mentioned, "*If I am sitting here working on one project and the phone rings and there is somebody talking about totally different project, switchover time is like "can you explain to me a little bit more" and that will give my brain a time to say, o.k. What did we talk about in the last meeting? So, switchover time can take about a couple minutes for every single change. We have to get refocused on what we are doing. So I would say, within one day time period, you are looking probably at a quarter of your day is switchover time... I really believe that we spend probably 15–20% of our time in this kind of activities because we are less than optimum in our focus.*" We learned from the cases that to be considered as being competent in multitasking, multiple-project managers must possess the ability to minimize the switchover time cost. Our evidence shows that they usually are intensely organized, methodical, and focused. Sometimes, it is more effective to trust the project team and delegate some project activities. A multiple-project manager from Company EI pointed out, *"I have to say the most important thing is that you [multiple-project managers] have to find a method that works for you to keep you the most focused at any given time. For me, I try to keep project B, C, and D in my drawer while I am working on project A.*"

Another group of competencies we found is *internal traits*, which includes being organized and disciplined, being proactive, being mature and self-controlled, being self-motivated, and being flexible. Last but not least is *Leadership/Simultaneous team management*. The information from the cases reveals that multiple-project managers must be competent in simultaneously leading several project teams, literally at the same time. To do so, we found that they had knowledge, skills, and experience in interacting with numerous project stakeholders in a very short time, a.k.a. interpersonal competencies. Multiple-project managers must be proficient in putting together a team that is committed and mutually accountable, setting direction, delegating authority, and influencing a project team with fairness, all in a speedy manner and in a limited time. Importantly, they must have ability to select and use different leadership styles specifically for each team as stated by our case informants, "*They (multiple project teams) probably involve you in a lot more things than you are normally exposed to because you get different personality, different dynamics on each one of the team (EI)... You have to have a style that allows you to work with a whole bunch of different kinds of people. You have to know and adapt your style to different situations in order to be effective (DS).*" This is especially important in multidisciplinary and distributed teams, a frequent organizational design in our sample. In addition, to be effective, we found that multiple-project managers should be a good communicator – being capable of listening, asking questions, communicating (verbally and in writing), and articulating and handling the information whether it is technical, legal, administrative, or interpersonal in nature. Problem solving competence is also significant in MGMP.

To conclude, we found the evidence that multiple-project managers should possess a combination of hard and soft competencies to be effective in managing a group of multiple projects. These competencies help them to manage each individual project and coordinate among projects. The uniqueness of this finding is not on the evidence showing that the ability of project managers influences the effectiveness in project management, since it has been extensively researched [45,46]. This finding, on the other hand, suggests a list of competencies of effective multiple-project managers, which is under researched. Most of the project managers' skills proposed in the literature are the skills of a single-project manager who leads one project at a time [46–49]. Even though our list of competencies is rather similar to the list of a single-project manager, there are some elements that are different since a multiple-project manager has to also coordinate among projects. Such elements are, e.g., the ability to manage interproject process and project interdependencies and interactions, the ability to multitask, and the ability to simultaneously lead multiple project teams. We agreed with the finding that these competencies are needed when it comes to MGMP. They are the competencies that differentiate a multiple-project manager from a single-project manager. This explains why one of our case informants stated, "*I had a project manager who was great in leading a single project. However, when I assigned him three projects to lead simultaneously, he came back to me later and told me that he could not do it. I then realized that some project managers can lead multiple projects but some of them cannot. I think it is a combination of their experience, their expertise level, and their interpersonal skills.*" From the finding and analysis, we broadly state:

Proposition 5. *The greater the multiple-project managers' ability to lead each individual project and to coordinate among projects, the greater the effectiveness in MGMP.*

6.3. The measurement criteria

From case analysis, certain issues can be categorized as the criteria for measuring the effectiveness in MGMP. Typically, they are the criteria from organizational, project, and personal perspectives. Those criteria are resource productivity, organizational learning, project success, and personal growth/satisfaction. The use of these criteria to measure the effectiveness in MGMP implies that they are also the expected outcome of MGMP (see Table 5).

6.3.1. Criteria from organizational perspective

We found from four companies that *resource productivity* is one of the criteria the organizations use to judge the effectiveness in MGMP. The expectation is that, as the nature of MGMP, the assignment of more than one project to

Table 5
Example of case data, summarized as the measurement criteria

Issues	Case data
Resource productivity	"If people are assigned to two projects and they are working about half time on two projects that can be, sometimes that can be pretty efficient because, depending on where in the project, they can, if they have slack time on one, they can work on the other." – EI "We discussed how we are going to manage projects and how we are going to utilize resources effectively. And we actually laid out the whole team, the engineering team and said this person has this expertise can they handle. Can we have one electrical engineer do both boards because they are so similar than having two electrical engineers? How can we free up resources to go do something else? We have those discussions." – LCD "That what I am saying where this process here is not always the linear because if I have a resource problem and if I can swamp this activity up ahead, I will do it to get the project done." – DS
Organizational learning	"So, I guess that if I can say that again, the big project [SPM] gets the depth and the focus. The multiple small projects [MGMP] get the breadth and the diversity of experiences." – EI "It was not only a product development project but it was also a project to bring some formal education into the company." – EI "There are some projects that we are doing mainly to gain experience in those areas."-LCD
Time-to-market	"In our planning process, even in our core projector product, we are always looking at how we can shorten cycle time, shorter, shorter, and shorter." – LCD "Every individual product development project has objective or metric set up around time-to-market, around market share, around market forecasting as far as revenue and units, and of course, the normal project metric around cost, performance, and schedule of delivery of the project." – EI "Typically, we have something we call a bounder box, which basically is an outline of what our deliverables is, one of those areas is the schedule. So we need to have a product on a certain date, time to market is very important." – LCD "We do what we can to meet the time schedule." – DS "Time to market, so, part of our process is pretty enforce business plan to say, you know, we are going to bring out this product in this time frame for this amount of money." – EI
Customer satisfaction	"We have also a template in a process of putting some new concepts that came out of the IPD or Integrated Product Development study that we did. Which integrate some voice of the customers and more closely tie interaction with the customer as well as some bounding box concepts, which is the way of controlling the team and empowering the team as they move through the development cycle...Bring the product to the market at the right time with the right feature set to satisfied customer needs." – EI "In our case, we are developing technology for other product groups. The other product groups, we have to accept the deliverables. So, unless they were satisfied with what we gave them, we were not done." – MG
Personal growth and satisfaction	"We always have that discussion in terms of what the person skill level is, how they are doing? What they are doing? And also in terms of what skill we want them to develop. To assign them a project, is it going to be something that is going to get them to the next level of whatever their career goals are." – LCD "It is something that in every year, we sit down and we decided ok, what do I want to change? What do I want to do differently? What do I want to learn? Do I want to become more technical? Do I want to become more cost effective?" – DS "So, I guess that if I can say that again, the big program gets the depth and the focus. The multiple small programs get the breadth and the diversity of experiences." – EI

a project manager will lead to the effective use of project manager's resource and the better management of projects. In addition, the resources in the project team level are also shared to increase resource productivity. The manager of multiple-project managers from Company EI mentioned "*If people are assigned to two projects and they are working about half time on two projects, that can be, sometimes that can be pretty efficient because, depending on where in the project, they can, if they have slack time on one, they can work on the other.*"

We also learned from the cases that *organizational learning* is also an important criterion used to measure the effectiveness in MGMP. The case informants explained to us that it is the nature of MGMP that one project manager leads several projects simultaneously. With this type of management setting, knowledge gained from one project can be disseminated to the other projects. In other words, the organizational learning can be achieved by the use of shared resources (both at the project manager level and the team level). A multiple-project manager from company EI stated the comparison between organizational learning of SPM and MGMP that, "*So, I guess that if I can say that again, the big project [SPM] gets the depth and the focus. The multiple small projects [MGMP] get the breadth and the diversity of experiences.*" We also found that, sometimes, the companies implement projects for the sake of learning new knowledge and technologies. In that case, financial benefits are not high in priority but the knowledge gained for future endeavor is, as the case informant stated: "*It was not only a product development project but it was also a project to bring some formal education into the company (EI)... There are some projects that we are doing mainly to gain experience in those areas (LCD)*".

To summarize, we found that resource productivity and organizational learning are the criteria from the organizational perspective used to measure the effectiveness in MGMP. This implies that resource productivity and organization learning are among the expected outcome of

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MGMP. This finding is convincing since using resource productivity as a criterion helps promote the efficiency in management, a main reason for implementing the MGMP setting. Organizational learning is also a product from the use of shared resources that should be measured. In corroborating this finding with the literature, we found that our finding support the literature on balanced scorecard [50–52]. Organizational learning fits the category of training and innovation perspective of a balanced scorecard. Resource productivity fits to the financial perspective since it will eventually benefit a cost saving initiative. The reason that we did not find the criteria such as return on investment or shareholder expectation, the typical criteria to the financial perspective category of the Balanced Scorecard, may be because our focus was on the operational-level of MGMP. Such criteria may be realized in the portfolio management level. From this finding and analysis, we state:

Proposition 6. *The greater the effectiveness in MGMP, the greater the resource productivity and organizational learning.*

6.3.2. Criteria from project perspective

The evidence from our study shows that *project success* in terms of *time-to-market* is used as a criterion to assess the effectiveness in MGMP from project or customer perspective. We found from all six cases that multiple-project managers have to pay a lot of attention to the project schedules and give the priority to it over the other elements of project management. Our case informants from company LCD stated, "*In our planning process, even in our core projector product, we are always looking at how we can shorten cycle time, shorter, shorter, and shorter.*" However, even though time-to-market is important, it does not mean that other success measures were ignored. The multiple-project manager of company EI mentioned, "*Every individual product development project has objective or metric set up around time-to-market, around market share, around market forecasting as far as revenue and units, and of course, the normal project metric around cost, performance, and schedule of delivery of the project.*"

Customer satisfaction, another project success measure, is also an important criterion for assessing the effectiveness in MGMP. To maintain high level of customer satisfaction, the evidence from four cases shows that the project teams have to focus on the needs or the requirements of the customers. They have to employ a mechanism to involve customers in the development process and keep the customers informed. The information from the cases reveals that the tradeoffs among project schedule, cost, and product performance depend on what customers see as priorities, which can be changed over the course of the project. The case informants from the company EI stated, "*We have also a template in a process of putting some new concepts that came out of the IPD or Integrated Product Development study that we did. Which integrate some voice of the customers and more closely tie interaction with the customer as well as some bounding box concepts, which is the way of controlling the team and empowering the team as they move through the development cycle... Bring the product to the market at the right time with the right feature set to satisfied customer needs.*"

In conclusion, our evidence shows that in the project or customer level, the effectiveness in MGMP is judged based on the success of projects, especially in time-to-market and customer satisfaction dimensions. This finding also support the literature on project success [53]. The reason that our evidence reveals time-to-market as one of the important criteria may be because of the nature of high-technology industries. In such a volatile and competitive environment, the company will usually gain high profitability from early markets. In addition to time-to-market, since the projects we studied are product and software development projects, satisfying their customers is also important. The project success is therefore, judged on the level of customer satisfaction on the product. This finding supports the literature on Balanced Scorecard. It fits into the internal business perspective and customer perspective categories [51,52]. From this finding and analysis, we suggest:

Proposition 7. *The greater the effectiveness in MGMP, the greater the achievement of time-to-market and customer satisfaction.*

6.3.3. Criteria from personal perspective

The evidence from four cases shows that *personal growth and satisfaction* are also the criteria determining the effectiveness in MGMP. We found that such growth and satisfaction came from the learning of new knowledge and skills both in project manager and project team levels from working on project simultaneously. A manager of multiple-project managers from company LCD stated, "*We always have that discussion in terms of what the person skill level is, how they are doing? What they are doing? And also in terms of what skill we want them to develop. To assign them a project, is it going to be something that is going to get them to the next level of whatever their career goals are.*" In addition, we found the evidence that the personal growth and satisfaction also includes future promotions, financial benefits such as bonus and reward, and pride.

In corroborating with the literature, we found that this finding fits into the project/internal business perspective category of project balanced scorecard [52]. This finding also supports the literature on team effectiveness which include growth and satisfaction among the measures of the team outcomes [34]. Even though the finding is not unique, it highlights the important issue discussed in the literature. From this finding and analysis, we propose:

Proposition 8. *The greater the effectiveness in MGMP, the greater the personal growth and satisfaction.*

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7. Toward a framework underlying the effectiveness in MGMP

Based on the research evidence, we propose a framework underlying the effectiveness in MGMP, organized around the influencing factors and measurement criteria (see Fig. 2).

To achieve the effectiveness in the management of a group of multiple projects, all multiple-project managers and their managers in our study agreed that the support from their organization has a significant influence. This support can be found in terms of project assignment, resource allocation, and organizational culture. First, the effectiveness in MGMP lies upon the realistic project assignment (Proposition 1). Such an assignment should consider the project strategic importance, the good match between project requirements and competencies of a multiple-project manager, and some limitations such as time availability. As a result, an important project will be assigned to a project manager who has skills and time to successfully lead it. Second, it is important that the resources should be allocated appropriately (Proposition 2). Such an allocation yields the sufficiency and sustainability of resources, resulting in the continuity of the project work. Third, the effective MGMP needs the organizational culture that promotes commitment, communication, team-

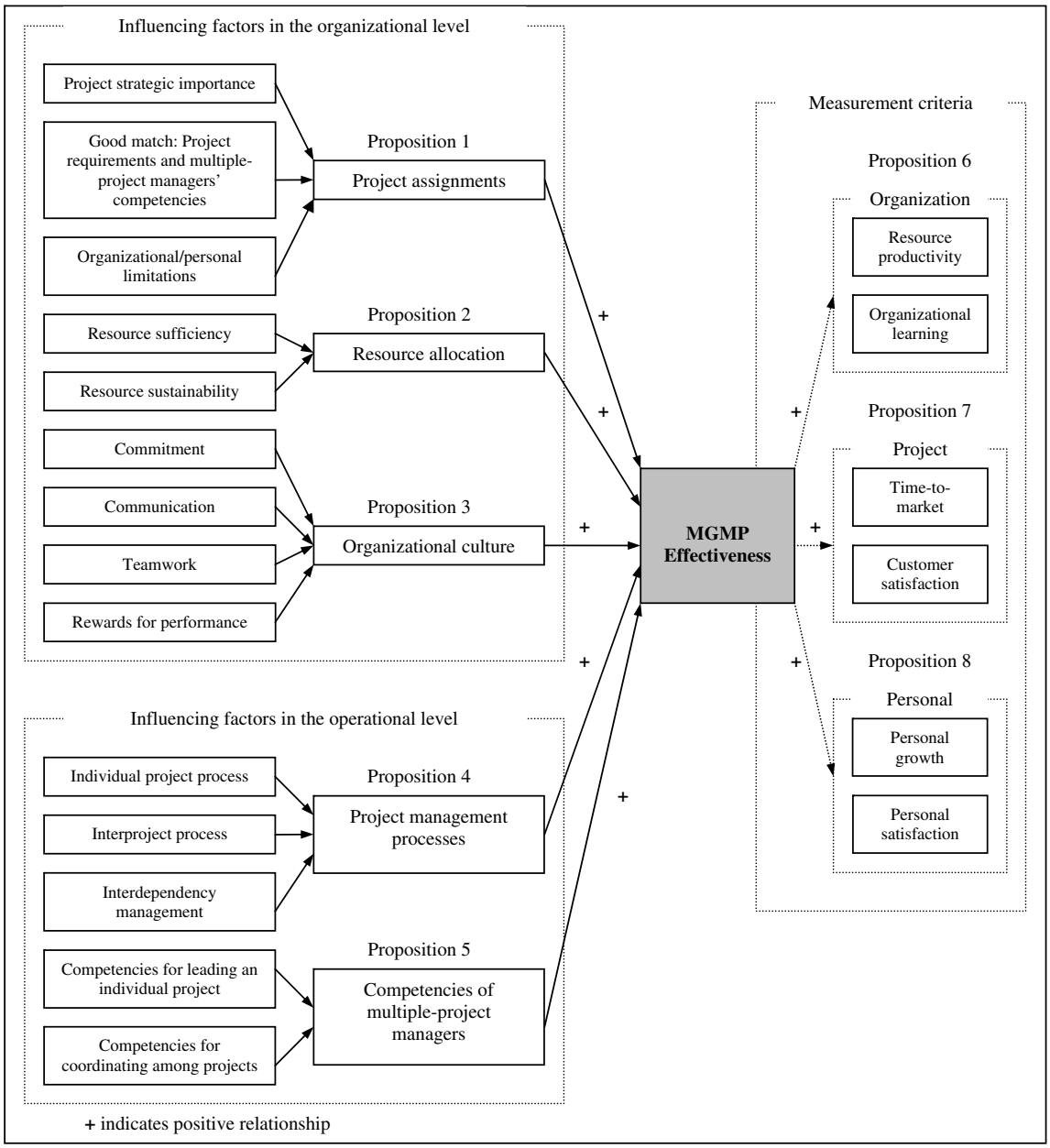

Fig. 2. A framework underlying the effectiveness in the management of a group of multiple projects.

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work, and rewards for performance. Such a culture provides ground rules for the project team, leading them to be more effective (Proposition 3).

It is not only the organizational support that promotes MGMP effectiveness, in the operational-level, all case evidence led to the conclusion that understanding the processes with respect to MGMP and having competent multiple-project managers are also the factors influencing the effectiveness in MGMP. In terms of the project management processes, besides managing each individual project process as in typical project management, MGMP needs a systematic way of managing interproject process and project interdependency (Proposition 4). Having multiple-project managers who have the competencies for leading each individual project and coordinating among projects are also important for MGMP effectiveness (Proposition 5). Such managers should have competencies such as administrative competencies, business competencies, interdependency management, multitasking, and leadership/simultaneous team management.

When asked about the criteria in use for measuring the MGMP effectiveness, case informants suggested that in the organizational level, the overall effectiveness of MGMP should be measured with respect to resource productivity and organizational learning (Proposition 6). In terms of project success measures, time-to-market and customer satisfaction should be emphasized (Proposition 7). Personal growth and satisfaction is also used to measure the effectiveness in MGMP in a personal *a.k.a.* project team level (Proposition 8).

At this state, we intended to propose a framework to provide a big picture of the issues underlying the effectiveness in MGMP. These issues can be further researched in the future studies, discussed in the next section.

8. Contributions and proposed future research

Despite its exploratory characteristic, this study highlights the unique nature of MGMP and proposes the factors influencing its effectiveness, including the measurement criteria. To practitioners, understanding these may help organizations design and deploy MGMP in a way that would enhance its quality and effectiveness. In the research domain, since MGMP has not been much researched, the finding of this study contributes to the existing literature and could be considered as a foundation for future research.

As part of the research outcomes, we proposed several propositions, organized as a framework underlying the MGMP effectiveness. These propositions may be straightforward. However, they are unique as they suggest the future research possibility in MGMP setting. All propositions are testable and can be deployed to research hypotheses for the future empirical research. The results from hypothesis testing based on a large sample study will provide a better understanding on the impact/relationship between the proposed factors and criteria and the effectiveness in MGMP. In addition to the future large sample studies, these propositions shed some light on some future prescriptive studies. The following are some examples.

Proposition 1 suggests the significance of project assignment on MGMP effectiveness. This proposition implies the need of more research on project assignment, especially assignment tools and techniques. In project assignment literature, limited tools and techniques have been proposed. While Patanakul et al. [14,15] proposed a project assignment process, including tool and technique, future research can be done to adapt such a technique or develop new techniques for the assignments in MGMP setting. In addition, as already mentioned, future study can be conducted to propose a framework that includes project assignment as a part of project portfolio management.

Proposition 2 suggests the impact of sufficient and sustainable resources on the effectiveness on MGMP. This proposition raises a concern about the utilization of limited resources. While several resource management tools and techniques have been proposed in the literature [18,39,54], Huemann et al. [55] concluded that more resource management research is needed in project-oriented organizations. One may also argue that the implementation of enterprise resource planning (ERP) system should help alleviate the resource allocation issue. However, research found that ERP implementation is a complex and expensive process [28,56]. Even though ERP promises to computerize an entire business, its focus is on promoting the integration between all functional areas within a firm's supply chain, especially related to manufacturing. What we found from our cases was that even though ERP was used in other parts of the organization, it is not commonly used when it comes to project management, especially for managing project resources. This leads to a future opportunity to develop tools and techniques that can be applied to resource allocation in project management, especially for MGMP.

Proposition 3 suggests that the organizational culture should emphasize commitment, communication, teamwork, and reward for performance for the effective MGMP. While this finding is not new, project management practice still seeks a better way to establish such culture. This issue is even more demanding in an MGMP setting where project managers lead multiple, simultaneous projects and the team members typically work on more than one project at a time. Future research that emphasis such issues in the MGMP setting is needed.

Proposition 4 suggests the importance of project management processes. While several studies have been done and some standards were proposed on the individual project process [3], no research has been conducted on the interproject process and project interdependency. This provides the opportunities for future research and the development of tools and techniques for the management of interproject process and project interdependency, especially for multiple-project managers to use. Practitioners will have direct benefits from the development of such tools and techniques.

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Proposition 5 addresses the competencies of multiple-project managers. It implies that such managers need both sets of competencies, one set for leading an individual project and another set for coordinating among projects. The existing literature on skills and competencies of project managers such as [1,47–49,57,58] only address the competencies for leading individual projects. Limited studies were done on the competencies necessary for coordinating among projects, e.g. multitasking, simultaneous team management, and management of interdependencies and interactions. More research is needed to study these competencies. In addition, there is a possibility for the future study to propose a competency metric of multiple-project managers that can be used for hiring, performance appraisal, and competency development purposes.

Propositions 6–8 discuss the measurement criteria, which can be considered as the expected outcomes of MGMP. Besides being the basis of the empirical studies, these propositions also imply the need of the methodology that can be used to quantify such criteria. With the focus on MGMP, future research can be done on the development of a model to quantify e.g. resource productivity, the level of organizational learning, customer satisfaction, personal growth and satisfaction.

9. Managerial implications

The finding of this study also suggests some managerial implications. To achieve the effectiveness in MGMP, management should recognize the uniqueness of MGMP as a form of project management that multiple projects are simultaneously led by one project manager (a multiple-project manager). Its purpose is to achieve the efficient use of resources and better management. These projects are mostly tactical in nature and are not goal-related. However, the projects are interdependent and have some interactions due to shared resources. With this uniqueness of MGMP, project assignment and resource allocation should be done with caution. Since a multiple-project manager handles multiple projects at a time, a new project should be assigned to him or her only when he/she has skills and time availability matched with the requirements of the project. Some reassignments may have to be arranged so that a good fit can be reached. It is important that management should not overload their multiple-project managers since it will lead to the ineffectiveness in project management. Once the project is assigned, resources should be allocated to the project accordingly. Because of the tactical nature of the projects in MGMP, resources may not be sufficiently assigned to these projects or reallocated from them to the more strategic important projects. This practice seems to be acceptable if it is done for the benefit of the organization overall. However, resource management system should be implemented to facilitate effective resource sharing. The implementation of portfolio management or project management office may help. In addition, with the uniqueness of MGMP, organization should have the culture that facilitates commitment, communication, teamwork, and reward for performance. With multiple projects to work on at a time, such culture would alleviate "out of sight, out of mind" situation both on project manager and project team levels.

The interdependencies and interactions among projects in MGMP require unique project management processes and competencies of multiple-project managers. Even though the execution of the process for the management of individual projects has proven to be critical, connecting such process with an interproject process is also of vital importance. While multiproject scheduling algorithms may be useful, their impact is of limited value in MGMP. The reason may be that the development projects in our study unfold in such a fast environment that they cannot tolerate the rigidity of multiproject scheduling. For interproject process, multiple-project managers may start by connecting multiple projects via points of shared functional resources, milestones, technologies, and multiple-project manager's time. Then, organize work and schedules around these points, using face-to-face adjustments with functional managers and their resources. Note that the realistic project assignment will reduce the number of connecting points and switchovers while increasing the simplicity of the interproject process. In terms of the competencies, besides typical competencies of project managers, management should make sure that multiple-project managers possess competencies for coordinating among projects. Those competencies are multitasking, the management of interdependencies and interactions, and leadership/simultaneous team management. It has been suggested in the literature that an organization should have a standard set of project managers' competencies. In addition to having a set of standard for single-project managers, our finding implies that the organization should have a standard set of multiple-project managers' competencies as well. This suggests a new agenda for PMO in implementing both processes and competencies that influence the effectiveness in MGMP.

To measure the effectiveness in MGMP, the criteria in use should reflect its nature, the goals of the organization, and the team. Since a main purpose of implementing MGMP setting is to achieve resource efficiency, the metric to measure the effectiveness in MGMP should include resource productivity as one of the criteria. With the MGMP's nature of shared resources, the organization should expect to have a certain level of knowledge sharing a.k.a. organization learning and it should be measured. This nature of MGMP also contributes to the personal growth, career path, and the satisfaction of the multiple-project managers and the team members. As in a typical metric, the outcome in terms of project success should also be assessed. If we perceived the influencing factors as parts of the inputs of MGMP, these criteria could be perceived as parts of the expected outputs. We, then, suggest that first, upper management has to set the expected output levels in the form of clear project objectives that are handed

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down to multiproject managers via the inputs. Second, these outputs have to be prioritized – e.g. the first priority is project success in terms of time-to-market. Third, these priorities need to be grounded in realistic inputs – e.g. an extremely fast time-to-market would not be realistic if insufficient resources are provided. Fourth, making educated output tradeoffs is a must – e.g. the fast development may lead to more rework, lower resource productivity, and lower team satisfaction. This implies that to be effective, management should understand the interconnection among the elements within an MGMP setting.

10. Conclusion

This exploratory study has examined a management of a group of multiple projects, a widespread management phenomenon, and developed a framework underlying the effectiveness in MGMP. This framework suggests some new knowledge and propositions that can be used in both practice and future research. It suggests that the effectiveness in MGMP depends on the influencing factors with respect to project assignment, resource allocation, organizational culture, project management processes, and competencies of multiple project managers. It also suggests that the effectiveness in MGMP should be assessed in terms of resource productivity, organization learning, project success, personal growth and satisfaction. The strengths of this study are in its focus on a little-researched project management approach, richness of the research process, and the application to a wide variety of development projects in high-technology business.

Potential limitations of the study are related to the fact that data were collected using twelve participants in the total of six organizations. Even though these participants have the high level of expertise and experience in MGMP, further validation of the framework would benefit from gathering data in many more organizations or a large sample study. An emphasis on product and software development projects is a limitation as much as it is the strength. The strength comes from these projects being among the most demanding types of projects. Also such projects are the major element of the project management research agenda. As for the limitation, our findings may not be applicable to MGMP in other types of projects without additional research. This provides a future opportunity to extend the research on this subject across the borders of the project management domain.

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