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An Integer-Programming Model for Assigning Projects to Project Managers

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Abstract- This study proposes an integer-programming model as a systematic methodology for assigning projects to project managers (project manager assignments). This model is a valuable extension of the existing methodologies in the literature since it considers the strategic elements of an organization and organizational/personal limitations in project manager assignments in addition to project requirements and competencies of project managers as being considered in the existing methodologies. By using this proposed model, management can assign projects to project managers in a way that contributes to the project and organizational performance.

I. INTRODUCTION

Project manager assignment is a process of assigning projects to project managers. It is considered as one of the important decision in project management [1, 2]. In practice, a project manager assignment is a challenging decision and must be done properly since an inappropriate assignment often decreases project success rate, [3] which in turn negatively impacts the organizational performance [4, 5].

In the literature, several researchers propose the methodologies for project manager assignments. These methodologies are based solely on two sets of criteria, project requirements and project managers' skills [6-8]. We believe that considering only two sets of criteria is insufficient. The other sets of criteria should be considered e.g. the strategic importance of projects to the organization or the organizational limitations such as the resource capacity of a project manager. This consideration is especially important in the current project management environments where having a project manager lead multiple, simultaneous projects (a multiple-project manager) is fairly common [9-11]. Because they use the two set of criteria— project requirements and project managers' skills— as a foundation, we suspect that, perhaps the proposed methodologies are not applicable in the current project management environments.

With the above concerns, we conducted our study with the main purpose of developing a methodology as a decision-aid tool for project manager assignments. Importantly, our proposed methodology should be applicable to the current project management environments. In order to so do, applying the case study research methodology, our study started with exploring the current processes and criteria for project manager assignments. Based on the emerging processes and criteria, we developed a methodology for project manager assignments, an integer-programming model.

II. LITERATURE REVIEW

In this section the literature on the current methodologies for project manager assignments is reviewed. Also, the discussion on the researchers' observations of the current methodologies is presented.

A. Current methodologies for project manager assignments

Despite the importance of project manager assignments, in the literature, only few researchers proposed the methodologies for assigning a project to a project manager. These methodologies base project assignments on project requirements and the project manager's skills.

Adams, *et al.* [6] propose a contingency approach based on attribute matching. They suggest that management should (1) identify the demands of the project according to factors regarding economic, organizational, technological, and behavioral characteristics of a project. (2) Then, factors are prioritized according to their expected importance. (3) Project manager candidates are subjectively rated in terms of their abilities to cope with problems associated with the identified factors. (4) The final project manager selection is choosing a project manager who has capabilities matching the expected demands of the project.

Similar to the study of Adams, *et al.*, Hauschildt, *et al.* [7] propose a methodology for selecting a project manager. They suggests that (1) project managers should be classified into different types (the project star, the promising newcomer, the focused creative expert, and the uncreative decision maker) based upon their abilities (organizing under conflict, experience, decision-making, productive creativity, etc.). (2) Management should identify the types of projects that project managers in each type can successfully lead. (3) Project managers are assigned to lead only the type of projects that they lead successfully. However, Hauschildt, *et al.* state that their types of project managers may not have universal validity.

Mian and Dai [8] also propose a methodology for project assignments based on project requirements and a project manager's background. This methodology utilizes the concepts of the analytic hierarchy process (AHP) and assigns a project to a project manager based on the criteria— administrative and supervisory skills, technical knowledge, and personal abilities of project managers.

B. Researchers' Observations

As already mentioned, the current methodologies for project assignments are developed based on using project requirements and the project manager's skills as criteria. We believe that considering only these criteria is insufficient. The reasons are the following. In current business practices, some organizations, especially in high-technology industries, view projects as the engine of corporate success, survival, and renewal [12]. Usually, these projects are selected according to the strategic elements of an organization [11], with an eye to selecting those that will provide the highest

value to the company's strategy [13]. Assigning these projects to project managers without any consideration of the organization's strategic elements may eventually make the organization vulnerable. Also, in many organizations, several project managers (multiple-project managers) lead multiple, simultaneous projects [9-11, 14, 15]. Assigning projects to these project managers without any consideration of the resource (time) availability of project managers may overload project managers, which may eventually cause project failures [4, 14]. We believe that if organization's strategic elements and resource capacity of project managers are not part of a project assignment methodology, which seems to be the case with existing assignment methodologies, the methodology may not be applicable for project manager assignment in the current environments, especially to assign projects to multiple-project managers.

III. RESEARCH METHODOLOGY

In order to develop a methodology for project manager assignments that is applicable to the current project management environments, we started our study by exploring the process and criteria in the current environments. Then, we used the emerging processes and criteria to guide an effort of the development of a methodology for project manager assignments.

A. Exploring the processes and criteria for project manager assignments

Since there was not much empirically grounded research in this area and with our intention to develop a practical methodology, we deemed the case study research was an appropriate methodology. One benefit of this methodology is that the findings are drawn from their real-life context [16, 17].

To explore the assignment processes and criteria, we interviewed project managers and their superiors from four companies. These companies are from high-technology industries (in both hardware and software development), implement multiple projects simultaneously, and are leaders in their respective markets.

For analysis, each interview was transcribed and coded [18, 19]. Then, within-case and cross-case analyses were conducted. From case analysis, we developed not only our understanding of the processes but also we developed a set of criteria for project manager assignments. Our set of criteria was validated by a panel of experts before being used in the development of the methodology.

B. Developing a methodology for project manager assignments

Based on the emerging process and criteria from the case analysis we developed an assignment methodology, using the concepts of general assignment problems (GAP), an integer programming model [20]. We executed and validated our model with the information from a participating company.

IV. RESEARCH RESULTS

In our study, the step of exploring the process and criteria was done rigorously in order to understand the current process and develop an integrated list of criteria for project manager assignments. However, in this paper, we do not focus on the results from it but rather we concentrated on the results regarding the development of the methodology for project manager assignments.

A. Process and criteria for project manager assignments

In this study, we found that project prioritization, project/project manager matching, recognition of limitations are three main steps in the process of project manager assignments. We also found that the organizational strategic elements, project requirements, competencies of project managers, and organizational/personal limitations are four groups of criteria associating with the process.

The research evidence reveals that before being assigned, management should prioritize projects to understand their importance to the organization, i.e. the degree to which they contribute to the accomplishment of the organization's strategic elements. Therefore, the elements (also called organizational factors) such as organizational mission and goals should be used in project prioritization.

After identifying the importance level of a project, preferably, a strategically important project will be assigned to a competent project manager whose competencies are well matched to the project requirements. This leads to the next step in the assignment process: project/project manager matching. In this step, the project's requirements have to be identified. In addition, the competency levels of project managers have to be assessed to recognize those whose competencies correspond to the project's needs. We found that the project assignment criteria in a group of project requirements should include the criteria such as risk level, technology novelty, schedule criticality, task complexity, etc. In terms of the competencies of project managers, the criteria can be categorized into technical, administrative/process, intrapersonal, interpersonal, business/strategic competencies.

Besides considering strategic elements, project requirements, and competencies of project managers, the research evidence shows that organizational/personal limitations in project manager assignments have to be recognized. One example of limitations is the resource capacity of a project manager. A project should be assigned to a project manager if he is available to take on an additional project. Besides the resource capacity, the criteria such as the experience of project managers in managing multiple projects and their career path, the interdependencies among projects, etc. should be considered when assigning projects to project managers.

B. Methodology for project manager assignments

We developed a methodology for project manager assignments as an integer-programming model. This model incorporates the process and criteria found from our case study research.

a) The objective function

The objective function was developed from the evidence that strategically important projects that provide major contributions to the organizational mission should be assigned to competent project managers whose competencies meet the project requirements. In addition, we found from the case study that in some situations where competent project managers are not available for the new assignments, management may decide to release the competent project managers from their existing projects so that they will have resource availability to take on the new important projects. The drawback of this approach is that the existing projects that are assigned to other project managers may end up with some downsides, e.g. project delay, cost overrun, or quality problems. One cause of these downsides is the discontinuity in management because of changing the project manager [11]. With these downsides, the relative contribution of existing projects to the organizational mission may decrease in comparison to not changing project managers. To make proper assignment decisions, management has to consider what would be better for an organization between having competent project managers leads new projects (reassigning their existing projects to different project managers) and assigning strategically important projects to the less competent project managers who are available.

With the above consideration, this research proposes the objective function of the optimization model for project assignments as follows.

$$Max \quad \sum_{i=1}^{n}\sum_{j=1}^{m}\left(V_j W_{ij} X_{ij} - U_j W_{ij}(1-O_{ij})X_{ij}\right) \qquad \textbf{(1)}$$

This function maximizes the objective value of project manager assignments considering the relative contribution of project j to the organization mission (V_j) and the correspondence level between project j and a project manager i (W_{ij}), representing by the term "$V_j W_{ij} X_{ij}$." The function also recognizes the fact that the relative contribution of any existing project j may decrease (U_j) if it is not re-assigned to its original project manager, represented by the term "$U_j W_{ij}$ (1- O_{ij})X_{ij}." X_{ij} is a binary decision variable.

Data definitions:

$V_j =$ Relative contribution of project j to the organizational mission

$W_{ij} =$ Correspondence level between project j and project manager i

$U_j =$ Decrease in the relative contribution of project j to the organizational mission when existing project j is re-assigned to a different project manager

$\quad U_j \quad = \quad V_j - R_j$ for the reassignment projects

$\quad\quad\quad = \quad 0$ for all projects that are not reassigned

$$\textbf{(1.1)}$$

$R_j =$ Relative contribution of existing project j to the organizational mission when it is re-assigned to a different project manager

$O_{ij} =$ Binary data

$\quad = 1;$ if project j was previously assigned to project manager i

$\quad = 0;$ if project j was not previously assigned to project manager i

i. The quantification of V_j

For every candidate project, the relative contribution of the project to the organizational mission (V_j) is evaluated by using the decision hierarchy. This is the project prioritization step in the assignment process. The hierarchy may be set with three hierarchical levels. The top level of the hierarchy is an organizational mission. The organizational goals are placed on the second level while the third level consists of projects to be assigned (see Figure 1 for example). To quantify a decision hierarchy, a constant-sum pairwise comparison method suggested by Kocaoglu [21] is recommended. The process starts with pairwise comparisons of organizational goals to identify their relative contribution to the organizational mission, resulting in a mission-goal matrix (MG $_{mission \times goal}$). The second step is pairwise comparisons of projects to identify their relative contribution to each organizational goal, producing a goal-project matrix (GP $_{mission \times proj}$). After performing the matrix multiplication, (MG X GP), as proposed by Kocaoglu [21], the relative contribution of each project to the organizational mission (V_j) is obtained.
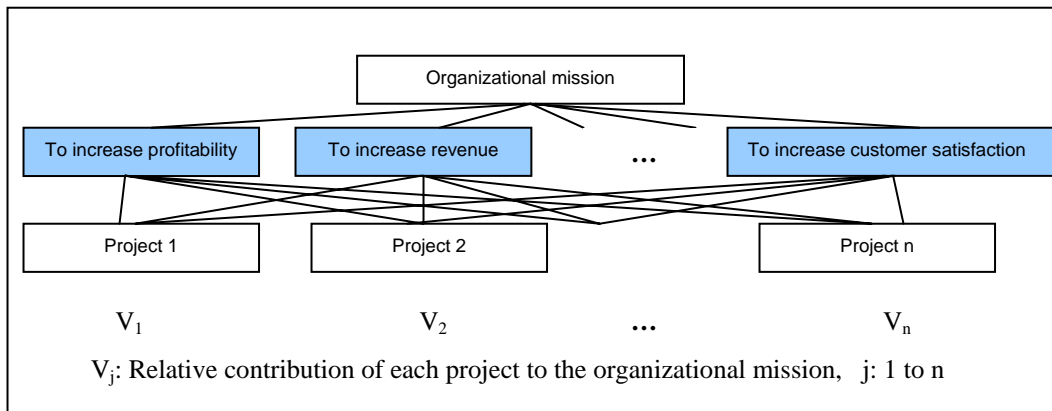

Figure 1: The decision hierarchy for project prioritization.

ii. The quantification of U_j

The value of U_j represents the decrease in the relative contribution of existing project j to the organizational mission in the case of reassigning it to a different project manager. In calculation, U_j is the difference between the relative contribution of that project (V_j) and its relative contribution if there are downsides, e.g. delay, cost overrun, quality problems, because of discontinuity in management, etc. from changing project manager— (R_j) or "$U_j = V_j - R_j$."

For any existing "Project j" that is a candidate for reassignment, R_j is quantified after the quantification of V_j or after obtaining the matrix GP $_{goal \times proj}$ and the matrix MG $_{mission \times goal}$. The following is the quantification procedure of R_j.

➤ For "Goal i", a decision maker has to estimate the percent decrease in the contribution of "Project j" in its downside condition (because of changing the project manager) with respect to when "Project j" is assigned to its original project manager (referred to as a current condition of "Project j"). For example, while "Project j" contributes 20% to "Goal i" in its current condition, the contribution decreases by 10% in its downside condition.

➤ The percent decrease from the previous step is used to calculate the contribution of "Project j" to "Goal i" in its downside condition. From the previous example, the contribution of "Project j" to "Goal i" in its downside condition is 18% ($0.20 - 0.10 \times 0.20 = 0.18$).

➤ This procedure is repeated for every goal and every existing project.

➤ After obtaining the contributions of "Project j" (in its downside condition) to every goal, the relative contribution of existing "Project j" to the organizational mission when it is re-assigned to a different project manager (R_j) is calculated from the matrix multiplication of the matrix of the contribution of "Project j" (in its downside condition) to the goals and the matrix of the contribution of the goals to the organizational mission (MG $_{mission \times goal}$), similar to the computational procedure of V_j.

iii. The quantification of W_{ij}

The correspondence levels between projects and project managers (W_{ij}) are the project/project manager matching score based on project requirements and competencies of project managers. This is the project/project manager matching step in the assignment process. W_{ij} is quantified by using the matrix of required competencies and the matrix of available competencies (see Table 1 and 2 for examples).

The matrix of required competencies is used to identify the level of competencies of project managers that were required for managing projects. It represents the use of criteria in the group of project requirements in project assignments. However, those project requirements are not directly presented in this matrix but rather are in the form of the competencies that projects require from project managers. In this matrix, each row represents each project managers' competency that projects require and each column represents each candidate project to be assigned (Table 1). The matrix of available competencies is used to evaluate the level of competencies that candidate project managers possess. Those competencies are in the rows of the matrix while the names of candidate project managers are in the column (Table 2). In project assignments, these matrices are used to find proper matches between projects and project managers. The quantification procedure is as follow.

TABLE 1: THE MATRIX OF REQUIRED COMPETENCIES.

Competencies		P 1	P 2	...	P j
Technical	Knowledge of prod. app.				
	Knowledge of tech. & trends				
	...				
Admin./ process	Monitoring and control				
	Risk management				
	...				
Intra-personal	Organized and disciplined				
	Responsible				
	...				
Inter-personal	Credibility				
	Leadership				
	...				
Business/ strategic	Business sense				
	Customer concern				
	...				

P = Project

TABLE 2: THE MATRIX OF AVAILABLE COMPETENCIES.

Competencies		PM 1	PM 2	...	PM i
Technical	Knowledge of prod. app.				
	Knowledge of tech. & trends				
	...				
Admin./ process	Monitoring and control				
	Risk management				
	...				
Intra-personal	Organized and disciplined				
	Responsible				
	...				
Inter-personal	Credibility				
	Leadership				
	...				
Business/ strategic	Business sense				
	Customer concern				
	...				

PM = Project Manager

➤ Both the matrix of required competencies and the matrix of available competencies can be quantified by using 1-5 Anchor scales to identify, for each competency, the level each project needs and the level that each project manager can provide (1: very low, 5:very high).

➤ For project j, comparing the level of each competency that project manager i can provide with the level that the project needs. If the difference is zero or a positive value, we consider it as a *good match* competency. If the difference is a negative value, we considered it as a *no match* competency. Then, for a good match competency, we code it as "1" and for a no match competency, we code it as "0." However, if it is acceptable in some organizations that a project manager has one level of competency less than that the project requires (the difference is "-1"), we propose a coding of "0.5" or a

somewhat match competency. This procedure repeats for every project manager. For project j, the results from the coding create the coding matrix.

➢ In the coding matrix, for each competency, the coding score of project manager i is multiplied with the level of importance of that competency to the project. (The level of importance of each competency can be calculated from the pairwise comparisons among the competencies.) The project/project manager matching score or the correspondence level (W_{ij}) of project manager i to project j is the summation of his scores from all competencies. The higher the value, the better is the match between project j and project manager i.

➢ This calculation is repeated for every project.

b) The mathematical constraints

The mathematical constraints were formulated from the criteria regarding organizational/personal limitations. This represents the recognition of limitations step in the assignment process. The followings are the discussion of each of the constraints.

i. Resource Availability Constraints

$$\sum_{j=1}^{m} D_{ij} X_{ij} + S_i \le A_i \quad \forall i \tag{2}$$

This important group of constraints was developed to ensure that project j is assigned to project manager i only if the project time demand (D_{ij}) and the demand according to multitasking (switchover-time loss) among projects (S_i) do not exceed a project manager's time availability (A_i). In this set of constraints, the parameters D_{ij}, A_i, and S_i are estimated per time period or planning horizon e.g. three months. In other words, these parameters are the predicted future values.

➢ D_{ij} represents the time demand of project j for project manager i (person-hours per time period). Since project managers spend different amount of time on managing projects depending on their level of experience, the time demand has to be estimated for each project manager.

➢ A_i represents the resource availability of project manager i (person-hours per time period).

$$A_i = E_i - L_i \tag{2.1}$$

➢ E_i is the effective capacity of project manager i (person-hours per time period). This capacity indicates the total time of a project manager spending on projects after taking out non-project work or overhead time e.g. administrative and vacation [22]. In the case of a 40-hour work week, the effective capacity of a project manager may be estimated as 32 hours with an assumption of 8 hours (20%) of non-project work or overhead time.

➢ L_i is the existing workload of project manager i (person-hours per time period). This parameter indicates a future workload of a project manager from the existing projects that the project manager currently leads.

➢ S_i represents the switchover-time loss of project i (person-hours per time period). It is the loss in project managers' capacity when switching from the issues of one project to the next project (multitasking). In this study, S_i was estimated based on the total number of projects that a project manager leads. Based on the information from Kapur International [23], we estimated that by having 2 projects, a project manager will lose 6 hours per week in multitasking and by having 4 projects, he will lose about 9 hours per week. The mathematical equations representing this estimation is:

$$S_i = 1.5Y_i + 4.5Z_i \quad \forall i \tag{2.2}$$

$$Y_i = N_i - 1 \tag{2.3}$$

$$N_i = \sum_{j=1}^{n} X_{ij} + n_i \quad \forall i \tag{2.4}$$

n_i = Total number of existing projects under the responsibility of project manager i,
Z_i = Binary decision variable, and

$$4Z_i - Y_i \ge 0 \tag{2.5}$$

$$Z_i - Y_i \le 0 \tag{2.6}$$

Note that Equations 2.2 to 2.6 can be used only when a project manager has at least one project to lead. In the case that a project manager will not have any assignment, these equations have to be modified.

ii. Project-type Mix Constraints

$$\sum_{j=1}^{m} PP_j X_{ij} + CPP_i \le MPP_i \quad \forall i \tag{3}$$

The group of constraints was developed as an extension of the resource availability constraints to represent the limitations regarding the types of projects that a project manager can simultaneously lead. For project manager i, the total number of projects of a certain type (platform project is used in this illustration) from both the new assignments ($PP_j X_{ij}$) and the existing assignments (CPP_i) cannot exceed the maximum number of platform projects per project manager i (MPP_i). PP_j is a binary data (PP_j = 1; if project j is a platform project or PP_j = 0; if project j is not a platform project). Since the constraints in this group measure resource availability by the unit of the number of projects at the time of assignments, they are more static but they are easier to quantify.

iii. Project–phase Mix Constraints

$$\sum_{j=1}^{m} CP_j X_{ij} + CCP_i \le MCP_i \quad \forall i \tag{4}$$

This group of constraints represents the limitations regarding the number of projects in certain phases that a

project manager can simultaneously lead. For project manager i, the total number of projects in conceptual and development phases, for example, both from the new assignments (CP_jX_{ij}) and the existing assignments (CCP_i), cannot exceed the maximum number of projects in conceptual and development phases per project manager i (MPP_i). CP_j is a binary data ($CP_j = 1$; if project j is in conceptual and development phase or $CP_j = 0$; if project j is not is in conceptual and development phase). Also, this group of constraints also measures resource availability of project managers by the unit of the number of projects at the time of assignments.

iv. Maximum Number of Project Constraints

$$\sum_{j=1}^{m} X_{ij} + C_i \le M_i \quad \forall i \tag{5}$$

This is another group of resource capacity constraints representing the limitations regarding the total number of projects that a project manager can simultaneously lead. These constraints also measure resource availability by the unit of the number of projects at the time of assignments. For project manager i, the total number of projects from both the new assignments and the existing assignments (C_i) cannot exceed the maximum number of projects per project manager (M_i).

v. Special Requirement Constraints

$$\sum_{i=1}^{n} SC_{ij} X_{ij} = 1 \ \forall j \in \{\text{Projects with special requirements}\} \tag{6}$$

This group of constraints was developed to accommodate situations where special project j has to be assigned to project manager i who possess specific competencies to lead project j to its success. SC_{ij} is a binary data ($SC_{ij} = 1$; if project manager i has special competencies to respond to special project j or $SC_{ij} = 0$; project manager i does not have special competencies to respond to special project j).

vi. Fixed Assignment Constraints

$$X_{ij} = 1 \quad \forall i, j \in \{\text{Fixed project assignments}\} \tag{7}$$

This group of constraints represents some special situations where project manager i requests to lead project j according to his personal preference or management would like to assign a project to him for skills or knowledge development.

Along the same line as the above constraints, in some situations, project manager i are not allowed to lead project j. For example, a customer does not want project manager i to lead project j. The mathematical expression of these constraints is as follows.

$$X_{ij} = 0 \quad \forall i, j \in \{\text{Unallowable project assignments}\} \tag{8}$$

vii. Interdependency Constraints

$$X_{ij} = X_{ik} \quad \forall i, (j,k) \in \{ \text{ A set of projects } j \text{ and } k \text{ such}$$
$$\text{that projects } j \text{ and } k \text{ must be}$$
$$\text{assigned to the same project}$$
$$\text{manager } i \} \tag{9}$$

This group of constraints was developed to accommodate the fact that some projects (j and k) must be assigned to project manager i because of the interdependencies and interactions between projects. Assigning these projects to the same project manager leads to better project management and project success.

viii. Technical Constraints

$$\sum_{i=1}^{n} X_{ij} = 1 \quad \forall j \tag{10}$$

Each project must be assigned, and it can be assigned to only one project manager. In the case that some projects do not have to be assigned at this time of assignments, the constraints in Equation 10 should be changed to

$$\text{``}\sum_{i=1}^{n} X_{ij} \le 1 \quad \forall j \text{.''}$$

$X_{ij} = 0, 1$ binary variables $\tag{11}$
$Z_i = 0, 1$ binary variables $\tag{12}$

The constraint specifies X_{ij} and Z_i as zero and one binary variables (decision variables)

c) The Assumptions of the Model
The model has three major assumptions as follows:
- **Competencies of project managers:** For project/project manager matching, the model assumes that the project management competencies of project managers who have the level of competencies to match project requirements is comparable.
- **Function of time:** The model assigns projects to project manager by using the total time demand of a project and the total time availability of a project manager in a certain time period. It assumes that after assignments, project managers have their opportunity to prioritize and organize their tasks to balance their workload in that time period. Therefore, the project demands and resource availability of project managers are not formulated as functions of time.
- **Switchover-time loss equations:** The switchover-time loss is incorporated in the model as a function of the number of projects at the time of assignments. This assumes that a project manager continuously has the same amount of projects to lead within that

planning horizon. The model also assumes a linear relationship between the number of projects and the switchover-time loss when the numbers of project is greater than one; also, it assumes that the complexity of projects and the experience level of project managers do not have any influence on the switchover-time loss. In addition, to use these equations, a project manager has to be assigned at least one project.

d) Model Execution and Validation

In our study, we executed and validated the model with the information from a participating company. However, we cannot show the numerical information here since it is the company's the confidentiality issues. The model that we built for the company was used to assign 6 projects (1 new and 5 existing projects) to 6 project managers. The projects had different levels of importance to the organization, had different levels of requirements, were in different types (1 breakthrough and 5 platform development projects), and were in different phases of the implementation. In addition, the project managers have different level of competencies and experiences ranging from junior to senior project managers. After model execution, we found that the model can assign projects to project managers and the director of project management group of the company found the assignment decisions from the model reasonable.

V. CONTRIBUTIONS & MANAGERIAL IMPLICATIONS

The original contribution of this study is a systematic methodology for project manager assignments, a project assignment model. The model facilitates the assignments with the consideration of the performance of projects, project managers, and an organization, which seems to be applicable to the current project management environments of high-technology industries. In spite of its strength, the limitations of the model center around its assumptions and its current focus on the assignments of product development projects.

In terms of the implications, the project assignment model can be used in several situations. It can be used to assign new projects including re-assign existing projects to project managers. It can be used to assign one project or several projects when having several candidate project managers. However, when using it in different situations, the model has to be modified.

When implementing a model, an organization has to start with the development of the criteria for project manager assignments. This study proposed four groups of criteria namely the strategic elements of an organization, project requirements, competencies of project managers, and organizational/personal limitations. However, the organization should develop the criteria in each group by considering the organization's strategy, culture, and project management characteristics. These criteria are used in the project assignment model. In fact, we propose the list of the

mathematical constraints developed from some of the organizational/personal limitations. In the project assignment model, it is not necessary to use all of these constraints at once.

Note that, the project assignment model developed in this research demonstrates its application in the environment of product development projects. In order to apply the model to different environments, the structure and concepts of the model, including the process of model development, may be utilized. However, some elements in the list of criteria should be revised.

VI. CONCLUSION AND FUTURE RESEARCH

In this paper, we present an integer-programming model, a systematic methodology for project manager assignments. While the current methodologies deal with the project performance during the assignments, the model extends them by facilitating the consideration of both project and organizational performances. The reason is that it includes strategic elements of an organization, project requirements, competencies of project managers, and organizational / personal limitations as the assignment criteria. In addition the model is applicable in the current project management environments, especially to assign projects to project managers who lead multiple simultaneous projects. Also, the model provides an opportunity for management to assign several projects to project managers at the same time.

In the future research, some assumptions of the model should be relaxed. Also, it may be possible to formulate the objective function and the mathematical constraints of the model as a function of time so that the assignments can be done with the consideration of the balanced workload of project manager over time. Even though the model was executed and validated by using the information from one company, to ensure its applicability, it should be executed and validated with the information from the other companies. Since its current focus is on the assignments of the product development projects of high-technology industries, in the future, the model can be modified to assign different type of projects or to be used in project manager assignments in different industries.

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