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Decision Making Method to Select Team Members Applying Personnel Behavior Based Lean Model

Jonnatan Avilés-González*, Neale R. Smith
School of Engineering and Sciences, Tecnológico de Monterrey, Monterrey, México

Rupy Sawhney
Industrial and Systems Engineering Department, University of Tennessee, Knoxville, United States

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ABSTRACT

Design of personnel teams has been studied from diverse perspectives; the most common are the people and systems requirements perspectives. All these point of view are linked, which is the reason why it is necessary to study them simultaneously. Considering this gap, a decision making model is developed based on factors, models, and requirements mentioned in the literature. The model is applied to a real case. The findings indicate that the Personnel Behavior Based Lean model (PBBL) can be converted into a decision making model for the selection of team members. The study is focused not only on the individual candidates' knowledge, skills, and aptitudes, but also on how the model considers the company requirements, conflicts, and the importance of each person to the project.

Keywords: Decision Making, Team Selection, Human Performance, Selection Model, and Team Optimization

* Corresponding Author, E-mail: jonnatan.aviles@gmail.com

1. INTRODUCTION

Working using teams is increasingly the norm in organizations (De Dreu and Weingart, 2003). In fact, some studies place the use of teams in industry at over 60 percent (Mannix and Neale, 2005). Barczak and Wilemon (2003) mention that teams are used in new product development between 70 and 75 percent of the time. Something similar is mentioned by Anderson (2005), who also explains the relevance of working in teams.

Teams are used in companies for a variety of applications like problem solving, product development, quality control, project management, decision-making, planning, and negotiation (D'Souza and Colarelli, 2010). Usually, organizations employ teams to increase project effectiveness and as an initiative for continuous improvement (Monden, 1993).

Unfortunately, several authors explain that teams are failing. For example, Forbes (1994) mentions that many organizations have wasted millions of dollars trying to empower workers and teams to increase overall quality. The author also explains that bad team management might result in additional costs for continuous improvement efforts and may hinder relationships in short term projects, which will affect profitability in the long term. In order to analyze why teams are failing, several authors have performed experiments, analyses, and studies (Katzenbach and Smith, 1996; Sharma *et al.*, 2009; Eichinger, 2007; Wall and Callister, 1995). Their results indicate that some factors must be taken into account during the team design, and those factors are often not considered because they cannot be controlled. Following this idea, various models to select team members have been proposed, the majority conceptual and some quantitative (Childs and Wolfe, 1972; Hackman, 1987; Bredereck *et al*., 2015). The Personnel Behavior Based Lean Model (PBBL) proposed by Sawhney and Chason (2005), is one of these models. This model was originally proposed as an assessment tool, but can be converted into a decision making model. Considering the flexibility of the PBBL model and its theoretical foundation, we present a method for the selection of team members applying the factors required for team design according to the literature.

Our paper is structured as follows. Section 2 presents a literature review focused on the factors needed to design a team, followed by a review of models and methods applied to team design. Section 3 details our decision making model based on PBBL. Section 4 documents an application of our model and conclusions are stated in the final section.

2. LITERATURE REVIEW

Our analysis starts by focusing on the criteria of different researchers who define why teams are failing. In fact, many authors have studied the factors required to avoid failures during team design. Some of them are based on experience and others on experimentation (Ross *et al*., 2008). For example, Katzenbach and Smith (2003) emphasize that team design has two main constraints: the team capacity and each member's time availability. Additionally, the authors mention that a team should have six basic elements: small number of members, adequate levels of complementary skills, truly meaningful purpose, specific goal or goals, clear working approach, and sense of mutual accountability. Several authors analyze teams considering number of members, duration of the projects, and type of projects (Honts *et al*., 2012; Abbott *et al*., 2006). Sharma *et al*. (2009) explain that teams usually fail for reasons such as conflicts, communication, individual behavior, and leadership. Something similar is exposed by Hackman (1987) who also discusses that teams not only have a beneficial side but also a shady side as they are typically designed and managed.

Some researchers explain that it is necessary to consider several main characteristics during team design, for example, effective communication, leadership, time availability, continuous improvement, knowledge, aptitudes, and skills (KAS's). These characteristics are the reasons why team design and modeling are complex fields of research (Childs and Wolfe 1972; Wall and Callister 1995; Ammeter and Dukerich 2002; Eichinger 2007; Stevens and Campion 2009). For our study, we consider as criteria the following characteristics: team size, time availability of each member, knowledge-aptitudes-skills (KAS's), relationship of people with company needs, system requirements, and direct conflicts among people. Criteria like empowerment, leadership, and communication are beyond the scope of our study.

We now present a review of the models that use the criteria selected previously. Table 1 shows all the reviewed papers and organized according to the selected criteria. A summary of the techniques analyzed is shown below.

Childs and Wolfe (1972) propose a method to allocate personnel to research projects, studying the effectiveness of each given person in a given project. The authors focus on maximizing the global effectiveness using the transportation problem as a base for their research. Hackman (1987) evaluated a workgroup in a descriptive research. The results show that during the design, it is necessary to consider input factors such as the features of the group, tasks and work context, and group interaction levels. In addition, a conceptual and experimental method was proposed by Hinds *et al*. (2000) who explore group formation when permitting people to choose others with whom they want to work.

Quantitative methods for team selection have been proposed by several authors. For example, De Korvin *et al*. (2002) explain a method for selecting team members, studying the match between the skills possessed by each individual, the skills needed for each phase of the project, and budget considerations. Another approach is proposed by Sawhney and Chason (2005) based on human performance technologies. These authors present a model called the Personnel Behavior Based Lean model (PBBL). This model can be used to evaluate companies, linking the system and people requirements.

Lambert *et al*. (2010) propose using linear programing to select members for a sports team examining descriptive statistics and data collected over a period of time. El Asmar *et al*. (2010) mention how human evaluation creates error or biases during the selection process. Based on this idea, the authors propose applying a rigorous quantitative mathematical analysis for the selection process. Hayano *et al*. (2014) propose the use of multi-agent systems in task-oriented situations with no prior knowledge of the resources or abilities of other agents. Another quantitative approach is proposed by Bredereck *et al*. (2015) who mention a theoretical and mathematical approach using as constraints an attribute matrix, the cost to design each team, and team sizes.

Many authors have worked on methods to design teams, some considering only the project or systems requirements, others designing and focusing on the human point of view. The literature suggests that designing a team requires affronting managerial and organizational issues, and developing a mathematical model to solve the NP hard problem that usually arises in these kinds of situations.

It is possible to conclude that no model exists that considers all the criteria identified in the literature review. We initiate our study selecting the PBBL model as a base, because it uses the majority of the criteria required to design a team. In addition, it is easy to understand and apply and can be adjusted to our necessities. A brief overview of the model is presented below.

The Personnel Behavior Based Lean model (PBBL),

Table 1. Summary and analysis of literature review about models for team member selection

Year	Author	Short Title	Criteria							Model Overview
			Size	Time Available	KAS´s	Relating people and company needs	Leader	System Require.	Con-flicts	
1972	Childs, M. and Wolfe, H.	A decision and value approach to research personnel allocation	•		•			•		Transportation problem, constant sum technique method, and simplified ratio technique as evaluation methods
1987	Hackman, R.	The design of work teams	•		•			•	•	Considering individuals, group, and environment level factors. Interaction of members and performance outcomes.
2000	Hinds, P. *et al.*	Choosing Work Group Members Balancing	•		•			•	•	Exploring individual attributes, determining the work partners.
2002	De Korvin *et al.*	Utilizing fuzzy compatibility of skill sets for team selection	•		•			•		Fuzzy Algorithms
2005	Sawhney, R. and Chason, S.	Human Behavior Based Exploratory Model for Successful Implementation	•		•	•		•		Using Human Performance Technology, evaluates the performance of a company considering the people.
2010	Lambert *et al.*	Multi-criteria Selection of All-Star Pitching Staff for Fantasy Baseball	•		•		•	•		Linear integer programming based on statistical analysis
2010	El Asmar *et al.*	Quantitative Methods for Design-Build Team Selection	•		•	•		•		Score normalization and Monte Carlo statistical sampling model
2014	Hayano *et al.*	Role and member selection in team formation using resource estimation	•		•		•	•		Multi-Agent Systems
2015	Bredereck *et al.*	Using Patterns to Form Homogeneous Teams	•	•	•		•			Clustering members

proposed by Sawhney and Chason (2005), can baseline the current state of personnel and to develop a strategy for behavioral change to aid Lean implementations efforts. The PBBL model evaluates systems from two points of view, human behavior and management; each one is classified into six categories. The categories of human behavior represent the behavioral dimensions proposed by Gilbert (1996), whereas the categories of management are based on Lean implementation guidelines and represent the various implementation phases for Lean projects. The model uses a matrix with 36 cells, each of which represents information about how personnel address the organizational requirements in a specific project scheme. The rows refer to the human behavior dimensions: data, instruments, incentives, knowledge, capacity, and motivation. On the other hand, the columns show the different stages for Lean project implementation: Planning, Workplace, Flow, Support, Consistency, and Sustain. For more detailed information the reader can to refer to Gilberth (1996) and Sawhney and Chason (2005). Originally this model was designed to be used as an assessment tool to evaluate companies.

3. DECISION MAKING PBBL MODEL (DM-PBBL) OVERVIEW

The PBBL model was selected as the base for our proposed method because it allows using the project requirements and aligning them with the people requirements in the system. Besides, the model can be adapted to other factors found in the literature review. We propose the Decision Making PBBL model (DM-PBBL) considering the criteria found in the original model as well as additional criteria such as time availability, leader selection, and conflicts (See Table 1). A mathematical representation of the model is developed. Table 2 shows the structure of DM-PBBL model; where: C_{1j} refers to the DATA required during implementation stage j, C_{2j} refers to the INSTRUMENTS required during the implementation stage j, C_{3j} represents the INCENTIVES available during the implementation stage j, C_{4j} represent the KNOWLEDGE in order to use the DATA in implementation stage j, C_{5j} represents the CAPACITY in order to use INSTRUMENTS in implementation stage j, C_{6j} refers to the MOTIVES evaluation considering INCENTIVES in implementation stage j, finally, $PBBL_{index}$ represents the global performance metric of the model.

The assumptions of the model are the following. First, the variables corresponding to the DATA and INSTRUMENTS rows in the environment section (see Table 2) are previously known. This means that the project is already defined and is following the company strategy. The INCENTIVES row refers to all financial and non-financial rewards that are available in the system.

We propose to analyze the KNOWLEDGE row considering the DATA required for a specific project. In other words, when a project is defined, the DATA required is established. Then, it is necessary to design a team that at least knows the minimum DATA established for the project. Something similar occurs with the INSTRUMENTS row. This row is analyzed considering the CAPACITY required to apply the tools and techniques required for a specific project. Regarding the MOTIVATION row, this is analyzed considering the INCENTIVES offered by the company. These relationships were established based on the studies done by Pershing (2006).

The scenario we intend to address is a company where staff and operators are working in an area under Lean management, and it is required to design a team to carry out a project. The information about people is obtained by studying the historical data regarding the skills, capacities, aptitudes, and previous training experiences of each possible candidate. All this information is usually provided by the human resources department.

3.1 The DM-PBBL Mathematical Model

The objective of our model is to increase the PBBL index value that represents the sum of all candidates' components. Eq. (1) represents the objective function for the DM-PBBL model; this is the general form. We propose how to compute each element of the objective function applying the relationships between DATA-KNOWLEDGE, INSTRUMENTS-CAPACITY, and INCENTIVE-MOTIVATION, as explained in the previous section. The following notation is used in the model:

Q	Set of people in the system
q	Index for a person $\in$ Q
x_q	$\begin{cases} 1 & \text{If of people in the system} \\ 0 & \text{Index for a person} \in Q \end{cases}$
i	Index for the human behavior dimension
j	Index for the implementation stage
C_{ijq}	Component of dimension i during implementation stage j for person q
C_{4j_q}	KNOWLEDGE required to use DATA in implementation stage j for person q
C_{5j_q}	CAPACITY required to use INSTRUMENTS in implementation stage j for person q

Table 2. DM-PBBL model

Human Behavior		Scheme for implementation of a project						Human Behavioral Analysis
		Plan.	Workpl.	Flow	Support	Consist	Sustain	
Environment	Data	C_{11}	C_{12}	C_{13}	C_{14}	C_{15}	C_{16}	These rows represent the data and instruments required for a specific project
	Instruments	C_{21}	C_{22}	C_{23}	C_{24}	C_{25}	C_{26}	
	Incentives	C_{31}	C_{32}	C_{33}	C_{34}	C_{35}	C_{36}	This row represents the incentives available in the System
People	Knowledge	C_{41}	C_{42}	C_{43}	C_{44}	C_{45}	C_{46}	$\sum_{j=1}^{6} C_{4j}$
	Capacity	C_{51}	C_{52}	C_{53}	C_{54}	C_{55}	C_{56}	$\sum_{j=1}^{6} C_{5j}$
	Motivation	C_{61}	C_{62}	C_{63}	C_{64}	C_{65}	C_{66}	$\sum_{j=1}^{6} C_{6j}$
Person Project Domain analysis		$\sum_{i=4}^{6} C_{i1}$	$\sum_{i=4}^{6} C_{i2}$	$\sum_{i=4}^{6} C_{i3}$	$\sum_{i=4}^{6} C_{i4}$	$\sum_{i=4}^{6} C_{i5}$	$\sum_{i=4}^{6} C_{i6}$	PBBL index (For each person) $\sum_{i=4}^{6}\sum_{j=1}^{6} C_{ij}$

C_{6j_q}	MOTIVES evaluation considering INCENTIVES in implementation stage j for person q
V_j^1	Set of minimum DATA necessary in each stage j in a project
D	Element $\in V^1$ (DATA in the Cell C_{1j})
K_{D_q}	$\begin{cases} 1 & \text{If people q knows about DATA element D} \\ 0 & \text{Otherwise} \end{cases}$
V_j^2	Set of minimum INSTRUMENTS necessary in each stage j of the project
W_I	Importance of INSTRUMENTS I for the project
Exp_{Iq}	Experience level of person q with respect to element I
V_j^3	Set of INCENTIVES available for each stage j of the project
In	Element $\in V^3$ (INCENTIVES Cell C_{3j})
$MotIn_q$	$\begin{cases} 1 & \text{If person q is motivated by incentive In} \\ 0 & \text{Otherwise} \end{cases}$
TN	Number of team members
Imp_q	$\begin{cases} 1 & \text{If person q highly important for the team} \\ 0 & \text{Otherwise} \end{cases}$
Cfl_{mn} =	Conflict level between person m and person n

The objective function in a general form is explained below.

$$\text{Max PBBL index} = \sum_{q\in Q} x_q \sum_{i=4}^{6}\sum_{j=1}^{6} C_{ijq} \tag{1}$$

Thus, Eq. (1) can be expanded to obtain a more detailed form as follows:

$$\text{Max PBBL index} = \sum_{q\in Q} x_q \sum_{i=4}^{6}\left(C_{4jq} + C_{5jq} + C_{6jq}\right) \tag{2}$$

Expanding Eq. (2), considering the relationships previously mentioned and the requirements for each project, we obtain:

$$\text{Max } Z = \sum_{q\in Q} x_q \left(\sum_{D\in V_j^1} K_{D_q} + \sum_{I\in V_j^2} C_{I_q} \times (w_I + Exp_{Iq}) + \sum_{In\in V_j^2} Mot_{In\,q} \right)$$
$$\forall_j = 1,\cdots,6 \quad \forall q \in Q \tag{3}$$

Eq. (3) represents the detailed objective function. Each term of this equation will be explained below.

$$\sum_{D\in V_j^1} K_{D_q} \tag{4}$$

The term shown in (4) represents the KNOWLEDGE evaluation that a candidate has, considering the DATA required and available for a specific stage of the project.

$$\sum_{I\in V_j^2} C_{I_q} \times (w_I + Exp_{I\,q}) \tag{5}$$

This element (5) is the CAPACITY evaluation that a candidate has, using the INSTRUMENTS (tools or techniques) required for a project. Additionally, this element considers the experience of the candidate and the importance of the instrument to the project.

$$\sum_{In\in V_j^2} Mot_{In\,q} \tag{6}$$

Element (6) is the MOTIVES evaluation that a candidate has, considering the INCENTIVES available for the project.

Several criteria mentioned by some authors in the literature review section were considered as constraints in our model. For example, the importance of a certain person (leader) belonging to the team, the maximum number of members on the team, and the direct conflicts among possible candidates. The time availability constraint could be included in our set of constraints related to the importance of selecting a certain person. The constraints that will be used in our model are explained below.

$$TN = \sum_{q\in Q} x_q \tag{7}$$

Eq. (7) represents the number of members desired to be on the team

$$x_q \geq Imp_q \tag{8}$$

Eq. (8) evaluate the inclusion of a certain person in the team, for example a specific leader, due to the importance to the project. Also, this constraint refers to the selection of people who have time availability.

$$\sum_{m\in Q}\sum_{\substack{n\in Q\\ m\neq n}} Cfl_{mn} x_q \leq 3\sum_q x_q(\sum_q x_q - 1) \forall q \in \tag{9}$$

Eq. (9) imposes conditions to avoid direct conflicts. This constraint considers the following assumptions:

- If the number of candidates for the team is small, it is possible to use surveys to analyze direct conflicts among all the candidates. This will generate a matrix containing the level of empathy between each potential pair of candidates. The survey utilizes a Likert scale, where a value of 1 indicates that a candidate prefers to work with a specific person and a 5 indicates that they prefer not to work with that person.

- If the number of candidates is large and it is not possible to use surveys in a conventional way, it is possible to ask the candidates to identify only those people with whom they prefer to work and those with whom they do not.
- Constraints (9) include a value of 3 on the right hand side. This value is the mean between the maximum and minimum values of a Likert scale. These constraints ensure that the team will be designed so as to decrease the possibility of direct conflicts among members.

4. APPLICATION

In this section, we present an example of team member selection for a project, applying our methodology to a real case in the Department of Industrial and Systems Engineering at the University of Tennessee Knoxville.

A brief overview of this case is explained next. A local factory was looking for assistance in the creation and maintenance of a better work environment focusing on company safety records and Lean manufacturing. Following departmental policies, two people were selected to evaluate this project. Later, these people were also to become part of the working team. Currently, the Department of Industrial and Systems Engineering at the University of Tennessee Knoxville has 20 people available to participate in the project. Information about previous projects indicates that a team of at least 6 members is required: a principal investigator (PI), a technical mentor, and four consultants.

The PI and technical mentor developed a methodology to achieve the objectives of the company. Table 3 shows a summary of the main techniques required for the project, classified according to our methodology.

The company provided all the information or DATA required to apply the proposed techniques (INSTRUMENTS). In addition, the Department of Industrial and Systems Engineering proposed non-financial INCENTIVES for the people who were to work on this project, for example, public recognition, internal awards, and external training. In order to apply our method, a survey, applied to each candidate, was conducted. The survey considered knowledge-aptitudes-skills (KAS), incentives, and conflict, measuring the responses using a Likert scale. The complete survey can be obtained from the authors. The conflicts were analyzed by applying direct surveys to each possible candidate. The information was obtained and organized according to our methodology.

Summarizing, we analyzed a situation in which a team of 6 people is required but 2 members are already selected. The selection is from among 20 people, on whom information is available. This problem was modeled using AMPL and solved with CPLEX. The data for the analyzed scenario is shown in the tables that follow. Table 4 shows the importance matrix of each instrument. These results were proposed by the PI and the technical mentor considering the techniques that are critical for the project. The evaluator used the Likert scale, where 1 means not critical and 5 most critical.

Table 5 shows the evaluation of one candidate. The candidate was asked about his level of knowledge re-

Table 3. Required techniques

Project Stage	Techniques	Code	Project Stage	Techniques	Code
Consistency	ROOT CAUSE ANALYSIS	C1	Flow	MATERIAL LOGISTIC ANALYSIS	F3
Consistency	FISHBONE DIAGRAM	C2	Planning	INDICATORS DEVELOPMENT	P1
Consistency	PARETO ANALYSIS	C3	Planning	MODELING/SIMULATION	P2
Consistency	FAULT TREE ANALYSIS	C4	Planning	FMEA ANALYSIS	P3
Consistency	STATISTICAL CONTROL	C5	Planning	VALUE STREAM MAPPING	P4
Consistency	SURVEY METHODS	C6	Workplace	LAYOUT ANALYSIS	W1
Consistency	PROBABILITY ANALYSIS	C7	Workplace	IDENTIFY RISKY EVENTS	W2
Consistency	HYPOTHESIS TEST	C8	Workplace	WORKPLACE SAFETY ANALYSIS	W3
Consistency	REGRESSION MODELS	C9	Workplace	RISK SAFETY ASSESSMENT	W4
Flow	PROCESS FLOW ANALYSIS	F2			

Table 4. Importance of data and instruments

	C1	C2	C3	C4	C5	C6	C7	C8	C9	F1	F2
DATA	1	1	1	1	1	1	1	1	1	1	1
INST	3	2	2	4	2	2	2	2	3	3	3
	F3	**P1**	**P2**	**P3**	**P4**	**W1**	**W2**	**W3**	**W4**	**SUS1**	
DATA	1	1	1	1	1	1	1	1	1	0	
INST	5	5	5	5	2	2	4	3	3	3	

Table 5. Evaluation of one candidate

	C1	C2	C3	C4	C5	C6	C7	C8	C9	F1	F2
DATA	1	1	1	1	1	1	1	1	1	1	1
INST	1	1	1	0	1	0	0	1	0	1	1
	F3	**P1**	**P2**	**P3**	**P4**	**W1**	**W2**	**W3**	**W4**	**SUS1**	
DATA	1	1	1	1	1	1	1	1	1	1	
INST	1	1	1	1	1	1	0	0	0	1	

garding the use of a specific technique and how to collect the data required to apply it in the project. Values of 1 represent excellent or very good knowledge according to the responses. Other responses were considered as 0. The training and experience evaluation was obtained by reviewing information from a historical data base and was measured in percentages.

Table 6 shows a sample of the responses of each candidate to the question regarding if the incentives motivateor do not motivate participation in the project.

Table 6. Sample of an evaluation of incentives according to each candidate

Candidates	Incentive 1	Incentive 2	Incentive 3
1	1	1	1
2	0	0	0
3	0	1	0
4	0	1	0
5	1	1	0
6	0	1	0

Table 7. Sample matrix of direct conflicts or preference among candidates

		PEOPLE									
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
PEOPLE	**1**	0	3	3	3	1	3	1	3	3	3
	2	3	0	3	3	3	3	3	3	3	3
	3	3	3	0	3	3	3	3	3	3	3
	4	3	5	3	0	3	3	1	1	3	3
	5	3	3	1	5	0	3	3	3	3	3
	6	3	3	3	3	1	0	3	3	3	3
	7	3	1	3	3	3	3	0	3	1	1

Table 8. Team selection solutions

Candidates Selected by the PI (without specific method)	Candidates Selected using DM-PBBL method	Candidates Selected using alternative method
7	5	3
11	7	5
12	9	7
18	15	13

Finally, Table 7 shows a sample of the direct conflicts analysis, where a value of 1 indicates that the candidate prefers to work with a specific person, and a value of 5 indicates that the candidate prefers not to work with that person. In our case, we have 20 people and it is necessary to choose four to create the team. The leader was selected based on departmental policies.

In order to create a comparison situation, we applied an alternative model to contrast the results. The model selected is proposed by Hinds *et al*. (2000) who developed an experiment in which the candidates are allowed to choose the members for the team. Using surveys, a similar experiment was conducted. The results of our method, the alternative method, and a team selected by the PI without a specific method, are shown in Table 8.

According to our methodology, the candidates who should work with the PI and the technical mentor are candidates 5, 7, 9, and 15. The alternative method selected candidates 3, 5, 7, and 13, whereas the PI chose candidates 7, 11, 12, and 18.The results show that all three solutions have candidate 7 in common. Candidate 7 is the most experienced person in the group. He usually teaches the others, which is the reason why the majority of the other candidates have a great affinity with him. The team selected by the PI was based on experience. A problem with this team is the affinity among candidates, and this might result in problems during the project execution. Likewise, the team selected using the affinity experiment has some issues. For example candidate 13 does not have time availability, and candidate 3 has similar experience and knowledge as other selected candidates. Furthermore, this selection does not cover all the KAS's required. Our method selected candidate number 5 due to the affinity with the majority of the group and his level of knowledge in the use of some techniques that are important for the project. Candidates 9 and 15 complement each other to cover the majority of knowledge, aptitudes, and skills required for the project. In addition, all the members chosen by our method selected at least two incentives offered by the Department of Industrial Engineering.

5. CONCLUSIONS AND FUTURE RESEARCH

Our proposed model can be used to better select team members for Lean projects. The main objective of this approach is to link the needs of the system with the characteristics of the possible candidates, considering direct conflicts, time availability, and the individual's knowledge, aptitudes, and skills (KAS's). This point of view creates a work environment based on real needs and existing resources. Applying the DM-PBBL model requires close collaboration with the human resources department (HR) and access to the information that HR collects with respect to each employee. The proposed mathematical model provides a starting point to further develop optimization solutions for team design. For example, it may be possible to add more constraints and a greater number of variables to model a situation more accurately. For future research, we suggest exploring how to use our method for multi-team selection, considering other metrics like group performance or productivity. It is possible to analyze other kinds of possible conflicts, as well as the impact of a specific leader on a team. The DM-PBBL can be applied in other situations by adapting the columns of the matrix to other projects, for example, product development, sports, and financial projects. Finally, the mathematical model could be improved by adding more constraints related to leader definition, minimum knowledge required, group conflicts, and individual time constraints.

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