

# Measuring Individual Job Performance of Project Managers using Fuzzy Extended Analytic Method

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**Abstract:** In addition to modern and advanced technology, the success of any project depends on the basic human philosophy of finding the right person, making the right delivery, and delivering at the right time. Therefore, project managers play a very important role in the success of a project. Moreover, project objectives are impacted by the ability of project managers to carry out personal tasks effectively, their ability to organize and run the project team, as well as in the application of their knowledge, experience and leadership. Therefore, this study explores key factors in measuring the performance of project managers. Data was collected through group interviews with experienced experts based on the fuzzyextended analytic method (FEAM).The results show that there are five important factors in measuring the performance of project managers: (1) Ability to learn and improve knowledge and skills; (2) Ability to build good relationships with project stakeholders; and (3) Ability to perform work in accordance with project procedures and accept overtime work; (4) Ability to lead, meet and make a decision with the consensus of a project team; and (5) Planning ability.

**Index Terms:** Fuzzyextended analytic method, Project manager, Project Management, Job performance.

## I. INTRODUCTION

A project consists of a sequence of tasks that are coordinated to achieve a particular goal under the constraints of a customer's needs and finances. In fact, there are many goals affecting the success of a project(Nguyen, Van

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Nguyen, To Nguyen, & Huynh, 2016). In particular, construction projects with significant investment capital need to be completed on time and must meet quality requirements within an allowed budget. In addition, a high-quality construction project requires proper equipment and advanced technology. Nevertheless, these are just the necessary conditions. In order to achieve the objectives of the project, the most important component is the human factor. Proper equipment or advanced technologies are also operated by people. Just like playing a piano, if the piano quality is good but the artist is lacking in talent, then sound quality cannot be improved.

In a project, the project manager is the key player that determines much of the success of the project(Quyen, Phong, & Vy, 2017).The position and role of project manager is similar to that of a commander in a campaign. Many famous campaigns were successful because they were led from victory to victory by capable commanders. In fact, a project manager needs to be capable of managing and is responsible for directing and coordinating all efforts to implement the project: from planning, organization, and leadership to project control. Thus, for a project to succeed, it is important to have a competent project manager that can assure implementation of project tasks in the most effective way. To support a determination about project manager competencies, the objectives of this study are to identify and classify key factors for measuring the performance of project managers. The results of the study will help project managers in evaluating their own performance and also for determining which areas can be improved for future projects.

## II. LITERATURE REVIEW

In the broad sense of a business, performance is a term used to describe the ability of a business to provide the best possible products or services while ensuring quality and output. In the narrow sense of an individual,performance is a concept that implies how people perform in their work. Individual work performance is defined as the behaviors of an employee that are related to the organization's goals rather than simply the result of such actions. This is an important research topic related to employment. Although there have been some studies on work performance in the literature, there is still no



consistency in the measurement of individual work performance, especially of project managers(Koopmans et al., 2014).

Individual work performance can be measured by the level of individual contribution to project goals(Johnson, 2003). Importantly, for a construction business, work performance means creating products of the best possible quality, while ensuring timely progress of the construction work under a contract. Performance can also include reducing material waste, machinery expenses, equipment and labor, maintaining stable working conditions, and avoiding labor safety errors and incidents.

Studies on the performance of work in construction industry are relatively limited. There is currently no standardized way to measure productivity or evaluate human performance because of the complexity of activities and connections at construction sites. Enshassi and Liska (1999)studied the relationship between the effectiveness of management style and the productivity of the labor force in Palestine and the United States. The results of their study show that there is a positive relationship between the efficiency of construction management and the level of labor productivity. In Taiwan, Huang and Lu (2011)analyzed the level of work performance of subcontractors' workers to improve their productivity. In another study work by Abdullah, Bilau, Enegbuma, Ajagbe, and Ali (2011),the level of job satisfaction and job performance of employees in small and medium construction companies in Nigeria was identified based on their behaviors and attitudes.

The work of Shehata and El-Gohary (2011)shows that the five most important factors that affect labor productivity and performance in construction projects in Egypt are, in descending order, as follows: (1) skills and experience of workers; (2) incentive programs; (3) timely provisions of available materials; (4) leadership skills and capacity of leaders; and (5) capacity for direct labor supervision. Meanwhile, a similar study conducted in Sudan shows that the higher the level of job satisfaction, the greater the level of individual work performance and dedication (Ahmaidi, 2011).In addition, it indicates that good work performance with reasonable rewards will significantly increase job satisfaction. Leung, Shan Isabelle Chan, and Dongyu (2011)points out that the performance of mandatory work has a negative impact on project managers because of the level of stress.

According to Koopmans et al. (2011),individual work performancecan be determined on basis of the following four categories of factors: task performance, contextual performance, adaptive performance, and counterproductive work behavior. Of these, task performance is relevant to proficiency in performing primary tasks at work (Borman & Motowidlo, 1993).Contextual performance involves behavioral support in the organization, such as in a co-worker relationship, and in the work environment while performing their primary tasks. Adaptive performance is related to the ability to adapt well to the changing environment and the task of the job(Griffin, Neal, & Parker, 2007).Counterproductive work behavior is related to behavior that is harmful to the organization or company in which the individual works(Rotundo & Sackett, 2002). In addition, the results of a study conducted at construction

companies in Central Java in Indonesia show that job characteristics have a relationship with the performance of project managers in which the intermediary variable is loyalty to the company (Djastuti, 2015).

### III. METHODOLOGY

The main contribution of the fuzzy set theory is the ability to express ambiguous data. The fuzzy theory also allows mathematical operators and programmers to apply to fuzzy domain (Ma, Chang, & Hung, 2013). Fuzzy set theory consists of a special set of mathematical tools that are particularly suited to handle incomplete information or the ambiguity of object classes or situations in the most flexible way(Phong & Quyen, 2017). The steps of the fuzzy extended analytic method (FEAM) are as follows (Bozbura, Beskese, & Kahraman, 2007; Mateo, 2012; Thipparat, Chovichien, & Lorterapong, 2009):

Let  $X = \{x_1, x_2, \dots, x_n\}$  be an object set, and  $U = \{u_1, u_2, \dots, u_m\}$  be a goal (objective) set.

Each object is taken, and extent investigation for each goal ( $g_i$ ) is conducted, respectively. Then, the  $m$  extent analysis values for each  $i^{\text{th}}$  object for  $m$  goals are obtained and shown as follows (Ertuğrul & Karakaşoğlu, 2008; Moghadam, Jahromi, & Nooramin, 2011):

$$\tilde{M}_{g_i}^j \text{ where } i = 1, 2, \dots, n; j = 1, 2, \dots, m$$

All the  $\tilde{M}_{g_i}^j$  are triangular fuzzy numbers (TFNs).

#### Step 1: Obtain priority weights

The value of fuzzy synthetic extent on the  $i^{\text{th}}$  object is represented as (Duru, Huang, Bulut, & Yoshida, 2013; Mateo, 2012):

$$S_i = \left( \sum_{i=1}^m l_i, \sum_{i=1}^m m_i, \sum_{i=1}^m u_i \right) \otimes \left( \frac{1}{\sum_{i=1}^n u_i}, \frac{1}{\sum_{i=1}^n m_i}, \frac{1}{\sum_{i=1}^n l_i} \right)$$

#### Step 2: Comparing degrees of possibility

The degree of possibility of  $M_2 = (l_2, m_2, u_2) \geq M_1 = (l_1, m_1, u_1)$  is defined as  $V(M_2 \geq M_1)$  and can be equivalently expressed as follows (Cebeci & Ruan, 2007):

$$V(M_2 \geq M_1) = \text{hgt}(M_1 \cap M_2) = \mu_{M_2}(d)$$

$$= \begin{cases} 1 & \text{if } m_2 \geq m_1 \\ 0 & \text{if } l_1 \geq u_2 \\ \frac{l_1 - u_2}{(m_2 - u_2) - (m_1 - l_1)} & \text{otherwise} \end{cases}$$

where  $d$  is the ordinate of the highest intersection point  $D$  between  $\mu_{M_1}$  and  $\mu_{M_2}$ .

To compare  $M_1$  and  $M_2$ , we need both values of  $V(M_1 \geq M_2)$  and  $V(M_2 \geq M_1)$ .

#### Step 3: Obtaining the weight vector

The degree possibility for a convex fuzzy number to be greater than  $k$  convex fuzzy numbers  $M_i$  ( $i = 1, 2, \dots, k$ ) can be defined by (Duru et al., 2013):

$$V(M \geq M_1, M_2, \dots, M_k) = V[(M \geq M_1) \text{ and } (M \geq M_2) \text{ and } \dots \text{ and } (M \geq M_k)] = \min_i V(M \geq M_i), i = 1, 2, \dots, k.$$

Assume that

$$d'(A_i) = \min_i V(S_i \geq S_k)$$

for  $k = 1, 2, \dots, n; k \neq i$ .

Then, the weight vector is



given by:

$$W' = (d'(A_1), d'(A_2), \dots, d'(A_n))^T$$

where  $A_i$  ( $i = 1, 2, \dots, n$ ) are  $n$  elements.

*Step 4: Calculate the normalized weight vector*

Via normalization, the normalized weight vectors are:

$$W = (d(A_1), d(A_2), \dots, d(A_n))^T$$

where  $W$  is a nonfuzzy number.

*Step 5. Ranking of the factors*

After getting the weights of the factors, the ranking of all factors is determined.

#### **IV. RESULTS AND FINDINGS**

Group interviews with construction experts identified nine factors that determine the performance of project managers:

- (1) Ability to learn and improve knowledge and skills;
- (2) Ability to build good relationships with stakeholders, as well as mutual support at work among team members;
- (3) Ability to perform work in accordance with project procedures and company regulations and accept overtime work;
- (4) Ability to lead, meet and make a decision with the consensus of a project team;
- (5) Planning ability;
- (6) Ability to use project management and other specialized software;
- (7) Ability to stay with the company;
- (8) Ability to innovate and develop unique ideas to improve work performance; and
- (9) Ability to communicate, exchange and persuade.

*Ability to learn and improve knowledge and skills* was the highest-ranking factor in measuring the performance of project managers. This factor was considered as a hard skill that demonstrates an active and proactive approach in the job. Usually, the skills and experiences of project managers are developed through the accumulation of knowledge gained from similar projects. Experienced project managers will do the job as quickly as possible and contribute to improving the effectiveness of the project.

This result is quite similar to the study work of Shehata and El-Gohary (2011). In fact, the experience and skills of PMU staff play an important role in improving work performance and contributing to the success of the project. In contrast, inexperienced PMU staff will affect labor productivity. In the process of performing the work, employees must use their existing skills and experience to influence others and utilize tools to create the product. For experienced workers, the time required to create a product is faster. In addition, the more skills and experience that employees have, the easier it is to avoid problems that lead to rework or wasteful time, materials, or equipment and additional costs to the project.

In addition, the construction environment always needs attention and regular supervision from project managers. Each construction site has its own conditions such as different designs, construction sites, construction methods, characteristics of the involved parties, etc. Such differences form the requirements of a dynamic and changing job.

Therefore, an ability to quickly improve knowledge and skills will increase the abilities of project managers. Such adaptability facilitates more timely and accurate decisions to deal with daily affairs as well as when the project is experiencing incidents. Therefore, companies should focus on training, skill development and development of PMU staff so that they can do their best in the best possible evidence-based and research-supported approach. Project staff that are fully equipped with knowledge and skills can maximize their productivity and achieve the highest work performance.

*Ability to build good relationships with stakeholders, as well as mutual support at work among team members* is ranked as the second most important factor. For the project team, this factor demonstrates the ability to support the spirit, create a collaborative working environment, and increase the work performance of the whole team. Project managers must understand the nature, characteristics, motivations and purposes of each project member. This helps to orient and focus contributions, efforts, and energy of project members towards the common goal of the project. If there is a personal conflict within the project team, individual decisions and actions often will not take place the ultimate goals of the project as a priority. Therefore, a PMU should promote a sense of responsibility and cooperation among project participants. This will provide an effective communication channel, increasing their trust and responsibility for the common goals of the project. As a result, issues within the group will be limited, and handling and solving issues related to project management work will be easier.

In addition, a construction project has many stakeholders such as investors, contractors, consultants, subcontractors, suppliers, etc. They may or may not have pre-existing relationships. Each party has different goals and interests in the project, and as a result, there are often conflicts and disputes when working together on a project. Such conflicts can arise for various reasons: personal issues, economic interests, stressful working environment, and disputes over material and equipment resources, etc. Conflicts and noncooperation during a project can affect the overall objectives and timeline of a project. This may result in limited communication and exchange within the project, and interruption or disturbance of work performance. Therefore, project managers need to be able to build good relationships with various parties to ensure project success.

As there are often conflicts among individuals, project teams, or between the owner and contractors, contractors and consultants, contractors and subcontractors, and among subcontractors, or between the project and local government, etc., project managers need to pay attention to coordination between the parties. Any major disruptions to the timeline of the project can result in failure or costly delays. Non-cooperation is one factor that can slow progress, create cost overruns, result in poor and unsafe quality, and thus affect overall work performance. This is especially the true for the relationship with material suppliers as any lack of supplies and equipment can



disrupt the project. Inadequate materials and equipment will impact employee performance and can be demoralizing. In addition, excessive or unexpected delays for material supply may lead to wasted labor resources and slow progress, thereby affecting work performance.

Therefore, project managers should promote a spirit of cooperation, frankly communicate with concerned parties regarding obstacles, promptly resolve disputes in thru various agreements, legal, diplomatic, etc., to deal with conflicts and achieve the best possible work coordination. Having the trust and cooperation of the stakeholders will help remove barriers to work and unnecessary misunderstandings. Focusing on these relationships is an important factor that impacts the performance of project managers.

*Ability to perform work in accordance with project procedures and company regulations and accept overtime* is ranked as the third most important factor. This factor demonstrates the project managers' ability to master the work. In addition to good cooperation and relationship mentioned above, project managers should properly implement the principles of management according to the process announced and agreed to with project participants. Maintaining the principles of management facilitates proper control and understanding of project status. In addition, such processes help project managers create a clear, concrete and professional working environment to coordinate work among the parties. In addition, adherence to project processes mitigate unforeseen and unknown risks as procedures and regulations are introduced and developed to limit possible expected risks.

On the contrary, if consciousness and commitment are poor, it is likely that the project product will be inadequate or low quality. Critically, a failure to comply with project processes or company regulations can lead to labor accidents in construction projects, especially when PMU staff work on high-rise projects. This can result in property damages and injury to people, which also seriously affects the progress of the project as well as reputation of the company.

Completing work based on an established schedule is vital for construction projects, and results in a key pressure upon project managers. Therefore, the most necessary and frequently used method to shorten implementation time is to add overtime shifts at night. However, continuous and frequent overtime will affect the health of PMU staff. Being forced by the owner or client tp increase the duration of overtime in the project, is likely to lead to an increase in the stress level of PMU staff due a lack of adequate rest. This can lead to fatigue, poor health, and insufficient alertness during work, resulting in poor performance and possible labor accidents.

## V. CONCLUSION

This study identified key factors for measuring the performance of project managers. The study also applied a FEAM quantitative method to rank these factors. The results show that there are five key factors that affect the work performance of project managers: (1) the ability to learn and improve upon knowledge and skills, (2) ability to build good relationships with stakeholders, as well as mutual support at work among team members, (3) ability to perform work in

accordance with project procedures and company regulations and accept overtime work overtime, (4) ability to lead, meet and make a decision with the consensus of a project team, and (5) planning ability. These results are helpful to construction companies that want to evaluate the performance of their project managers based on key skills and as indicators in recruitment of the most qualified candidates project managers. In addition, the results also help individual project managers to identify the most important skills necessary to perform the most effectively. This research provides information from which they can learn, foster and improve necessary skills to improve their productivity.

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