

## A Fuzzy Model for Evaluation of the Project Management According to the universal PMBOK Standards (Case Study of Mehr housing projects of Zanjan)

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### Abstract

The provision of housing is a major concern not only for individuals but also for the government. Mehr housing projects were a good idea of the government to give the opportunity to own a house. The purpose of this project was on the one hand for reduction of housing prices and on the other hand to create economic prosperity, an employment increase and production. In fact, Project Management is a method of successful implementation so that a project can be carried with good quality and less budget. Mehr housing projects are a good experience in industrialization of building construction in the country. In yearly National Ranking Zanjan Mehr Habitat Project has been the top five ranks in terms of physical development. In this study the researchers have examined the compatibility of different dimensions of project management of Zanjan Mehr habitat with universal standards of project management from the perspectives of building experts. The obtained results indicate a medium state of the project. This study also has identified weaknesses of the project management, ranked them and has proposed measures for necessary improvement of the different management fields.

**Keywords:** Project, Project Management, PMBOK and Mehr Housing

### 1. Introduction

Currently about 31% of the Mehr residential houses are constructed by the industrialized method. Industrialization means that the construction quality can be controlled industrially, has a higher life expectancy than existing buildings and they are more resistant to disasters. Meanwhile all national regulations of the building should be observed. Industrialization requires accessibility of standard [not sure what this means], high quality and resistant materials. To achieve this, piece production and construction units must be established according to new standards and existence of mentioned points as hardware are essential [this sentence is unclear]. In addition to the above mentioned issues, it is important to use common standards of project management developed and updated by the project management institute. The aim of building industrialization is to speed up construction, increase manufacturing, ease

implementation and change to installation and assembly. The result of which can be lightening, stabilization, saving materials, reducing energy consumption during construction, better utilization and reducing construction period, leading to lower construction cost and better utilization. (Construction Research Center) Scientific concept of project, (Review of literature) Since the term "project" must be defined precisely and professionally, let's refer to two standard definitions of "project": "Projects" are the unique temporary accepted duties [this phrase is problematic] to create a product or offer a service. Every temporary project must have a specific and clearly defined beginning and end. Unique means this product is different from other products in some aspects. (Standard PMBOK copies in 2004). Group activity standards with determined starting and ending point will be introduced and followed by a manager or organization with clear aims, time, and expenses.

Nowadays, one of the most important competitive advantages of organizations is efficiency in project management. To improve this advantage, competition is necessary so that all organizations can audit their projects, identify weaknesses and strengths and compensate their shortcomings with the implementation of quality initiatives as soon as possible (Najabat, 2007). This will lead to avoidance of material waste, resources and repetition of work. Finally, projects will be delivered according to timetable and with quality standards. Many professional researches have been carried out regarding the audit requirements in PMBOK standard for construction projects in research centers and project management development of petrochemical industries, one of which can be the improved model of petrochemical project management. Recently, other researches have been carried out by PMBOK, the ISO10006center, project centered

organizations, the National Road Research Center, Housing and Urban Development but none has introduced a specific clear model. Similar research in assessing management projects is carried out by a researcher (Farahmandian 1388) in gas projects.

## 2. Materials and Methods

### 2.1. Methodology Project life cycle

The Organization and managers of the project can divide projects into phases for better, easy management of projects and for suitable, reasonable and appropriate connections with other organizations. The collection of these phases and processes is called Project life cycle (Yazdanpanah and Keshtiban). One of the main reasons for dividing projects into different successive phases is to make assessment possible at the end so that the directors and officials can decide on continuation and other procedures of the project (Tabesh 2005).

Germination	Growth	Maturation	Death
Suggestion and Initialization	Designing and Assessing	Implementation and control	Finalization

### 2.2. Project Management, Body of Knowledge

The PMBOK standard is considered the descriptive and anatomical standard of the PMI Institute in the Project Management field (Nobakht, 2011). According to the original standard of project management, required knowledge for project management is divided into 9 classes and implementation procedures into 5 groups as follows: (PMI, 2004).

#### 1. Project Integration Management

A subset of project management that includes the processes required to ensure that the various elements of the project are properly coordinated. It consists of:

- Project plan development :taking the results of other planning processes and putting them into a consistent, coherent document.

- Project plan execution :carrying out the project plan by performing the active ities included therein.
- Overall change control :coordinating changes across.

#### 2. Project Scope Management

A subset of project management that includes the processes required to ensure that the project includes all the work required, and only the work required, to complete the project successfully. It consists of:

- Initiation: committing the organization to begin the next phase of the project.
- Scope planning: developing a written scope statement as the basis for future project decisions.
- Scope definition: subdividing the major project deliverables into smaller, more manageable components.

- Scope verification: formalizing acceptance of the project scope.
- Scope change control: controlling changes to project scope.

### 3. Project Time Management

A subset of project management that includes the processes required to ensure timely completion of the project. It consists of:

- Activity definition: identifying the specific activities that must be performed to produce the various project deliverables.
- Activity sequencing: identifying and documenting interactivity dependencies.
- Activity duration estimating: estimating the number of work periods which will be needed to complete individual activities.
- Schedule development: analysing activity sequences, activity durations, and resource requirements to create the project schedule.
- Schedule control: controlling changes to the project schedule.

### 4. Project Cost Management

A subset of project management that includes the processes required to ensure that the project is completed within the approved budget. It consists of:

- Resource planning: determining what resources (people, equipment, materials) and what quantities of each should be used to perform project activities.
- Cost estimating: developing an approximation (estimate) of the costs of the resources needed to complete project activities.
- Cost budgeting: allocating the overall cost estimate to individual work items.
- Cost control: controlling changes to the project budget.

### 5. Project Quality Management

A subset of project management that includes the processes required to ensure that the project will satisfy the needs for which it was undertaken. It consists of:

- Quality planning: identifying which quality standards are relevant to the project and determining how to satisfy them.
- Quality assurance: evaluating overall project performance on a regular basis to provide confidence that the project will satisfy the relevant quality standards.
- Quality control: monitoring specific project results to determine if they comply with relevant quality standards and identifying ways to eliminate causes of unsatisfactory performance.

### 6. Project Human Resource Management

A subset of project management that includes the processes required to make the most effective use of the people involved with the project. It consists of:

- Organizational planning: identifying, documenting, and assigning project roles, responsibilities, and reporting relationships.
- Staff acquisition: getting the human resources needed assigned to and working on the project.
- Team development: developing individual and group skills to enhance project performance.

### 7. Project Communications Management

A subset of project management that includes the processes required to ensure timely and appropriate generation, collection, dissemination, storage, and ultimate disposition of project information. It consists of:

- Communications planning: determining the information and communications needs of the stakeholders: who needs what information, when will they need it, and how will it be given to them.
- Information distribution: making needed information available to project stakeholders in a timely manner.
- Performance reporting: collecting and disseminating performance information. This includes status reporting, progress measurement, and forecasting.
- Administrative closure: generating, gathering, and disseminating information to formalize phase or project completion.

### 8. Project Risk Management

A subset of project management that includes the processes concerned with identifying, analysing, and responding to project risk. It consists of:

- Risk identification: determining which risks are likely to affect the project and documenting the characteristics of each.
- Risk quantification: evaluating risks and risk interactions to assess the range of possible project outcomes.
- Risk response development: defining enhancement steps for opportunities and responses to threats.
- Risk response control: responding to changes in risk over the course of the project.

### 9. Project Procurement Management

A subset of project management that includes the processes required to acquire goods and services from outside the performing organization. It consists of:

- Procurement planning: determining what to procure and when.
- Solicitation planning: documenting product requirements and identifying potential sources.
- Solicitation: obtaining quotations, bids, offers, or proposals as appropriate.
- Source selection: choosing from among potential sellers.
- Contract administration: managing the relationship with the seller.
- Contract close-out: completion and settlement of the contract, including resolution of any open items.

Given that the questionnaire is a research instrument, the methodology of this study is descriptive - survey. In this study the relationship and effect between two environments are observed. The research prepares questions according to the project management standards in the form of check lists and distributes them among all custodians of the Mehr housing project. The researcher also observes several projects through site investigation to see if they match the principles formulated in the context of project management. The sample consisted of 90 people (designers, consultants, officers and supervisors involved in public and private housing Mehr projects of Zanjan). According to the Cochran formula the easiest way to determine a sample size for definite and indefinite populations  $n = 73$  was calculated.

$$n = \frac{N.z^2.a/2.p.q}{e^2.(N-1)+(z^2.a/2).(p.q)}$$

n: Sample

N: Population size

t or z: percent error of acceptable safety factor

p: proportion of the population lacking certain traits

q = 1-p: proportion of the population lacking certain features

e: degree of certainty or potential efficiency

It should be mentioned that because of different experts involvement samples were determined by stratified random sampling method: (Housing and Urban Organization 18, Engineering Disciplinary Organization 37, contractors 10 and consultants 8).

Mehr Housing Projects: The Mehr Housing idea was the important program ninth and tenth presidential government. Created for mass house production in the suburbs of big cities to reduce housing prices and establish economic prosperity, It has achieved relatively acceptable results by industrialized building houses on a large scale. Mass production of housing has already been experienced in many of the developed countries of the world like European countries, especially Britain, and in the recent decade in South East Asia, such as Malaysia. This on the one hand achieves a decrease in the price of housing and an increase in public welfare especially in deprived classes of society and leads on the other hand to economic prosperity, employment, production and a healthy economic cycle, considering that the Mehr Housing construction project has been a successful experience and a peak of industrialization of building in the country. ( Based on the National Building Research Center), in this research project management of the Mehr housing of Zanjan is evaluated with the use of a Check List from the viewpoints of different experts. After collecting questionnaires and analysing the data, the gap between the existing situation and an ideal one in each section will be clarified. Finally

to determine priorities for the change in different aspects, the weight coefficient of different dimensions in project management will be multiplied with the amount of deviation in each part. The higher results will show the priority for the change Check List for Project Assessment: The goal of the instructions is to identify the use of international standards as guidelines in a quality management project. Questions in the instruction indicate to the usefulness of the project management process. Stated questions have been based on PMBOK, ISO 10006: 1997 (E) standards, resulted from including all kinds of projects regardless of the products of the project.

In order to achieve reliable information, more meticulous observation, promotion of units of

planning, project control and project management systems will be necessary to implement project audit management. The audit will be carried out according to the following check list. Rating in the Check List is as follows:

0= not existing 1= weak 2 average

3= good 4 = very good

After auditing and issuing scores, obtained data will be divided by the maximum scores and the percentage points will be obtained, and will be put in the following table under the relevant column. At the end percentages will be multiplied by the relevant weight and a final record will be obtained. Finally the report of accepted analysis will be presented.

description	Weight
Project scope management	10
Project time management	20
Project cost management	15
Project human resources management	5
Project relations management	5
Project procurement management	10
Risk management	10
Quality management	5
Integration management	5
A timely report	5
The average project delay	10
Sum	

Based classification is as follows:

Score	Level	Grade
81-100	Excellent	A
61-80	Good	B
41-60	Average	C
21-40	Poor	D
1-20	Awful	E

To determine the reliability of the questionnaire Cronbach's alpha coefficient method is applied.

$$\alpha = \frac{K}{K-1} \left( 1 - \frac{\sum_{i=1}^K \sigma_{Y_i}^2}{\sigma_X^2} \right)$$

where  $\sigma_X^2$  the variance of the observed total test scores,

and  $\sigma_{Y_i}^2$  the variance of component i for the current sample of persons.

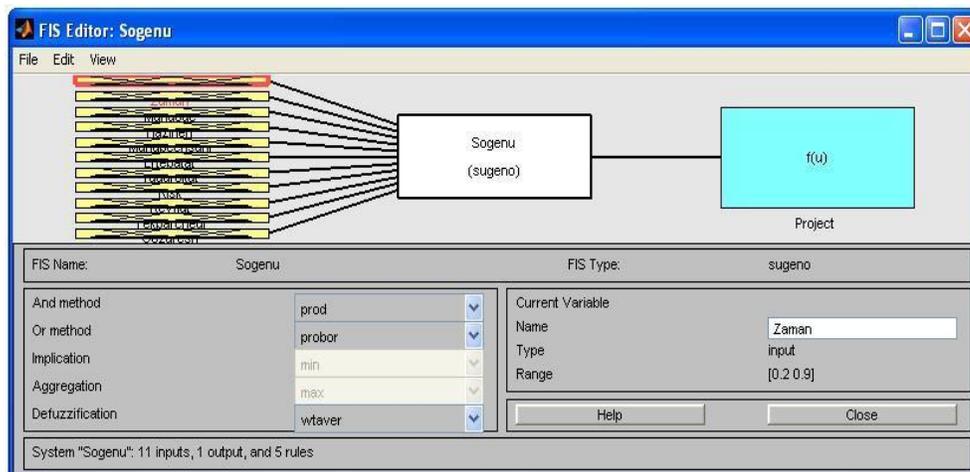
K= The number of questions

With the use of the Cronbach's alpha coefficient definition it can be concluded: (1) the higher the positive correlation, the higher the alpha will be and vice versa, (2) the higher the average variation of the questions, the lower alpha we will have, (3) increasing the number of questions will have positive or negative effects on alpha, and (4) increase in sample size will decrease the average variation. As a result it will lead to an increase in alpha.

It is obvious that if alpha is close to 1, then internal correlation between the questions will be higher and questions will be more homogeneous. .45 will be lower, .75 will be average and .95 will be high. (Chronbach 1951). If we obtain lower alpha we should check the questions and eliminate weak ones to increase alpha.

The coefficient is calculated individually for each standard of project management, and the results are: 0/74, 0/79, 0/84, 0/73, 0/79, 0/82, 0/75, 0/71, 0/83, and 0/87 for the whole questionnaire. Since all obtained numbers are above 70%, it indicates that the questionnaire has high reliability. Based on a designed model for the matching audit requirement, each section of the PMBPK project management standard will be done based on visiting the project site and collecting the opinions of involved staff and experts in the Mehr housing projects of Zanjan.

Each of the factors influencing project management is considered as an input, in this paper the ANFIS model is used.



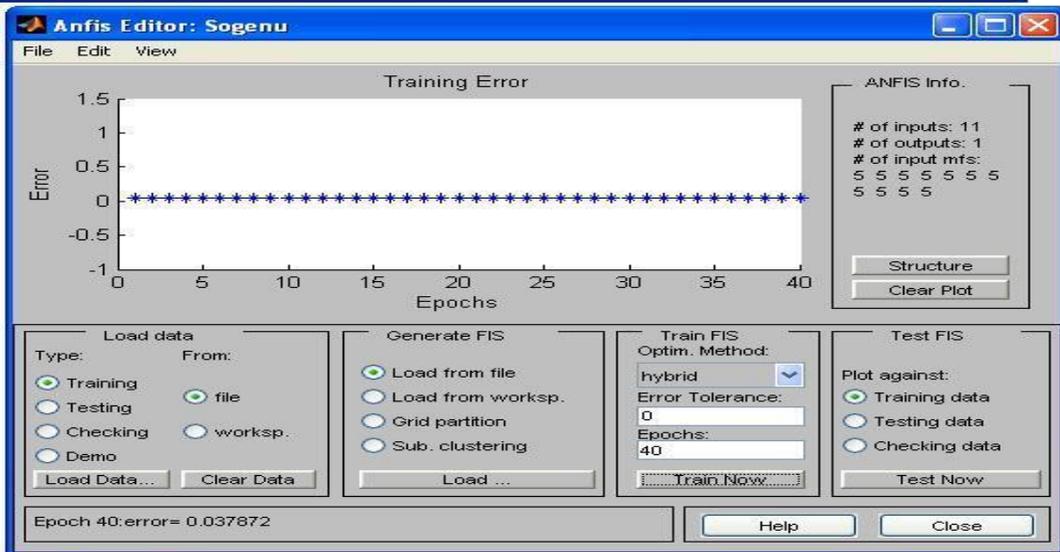
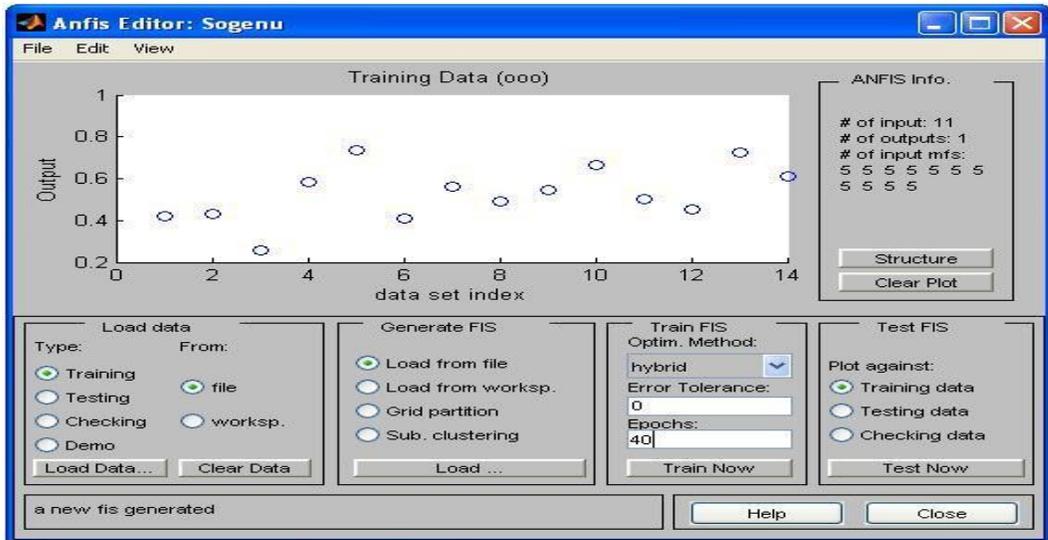


**Table2.**The results of running the model

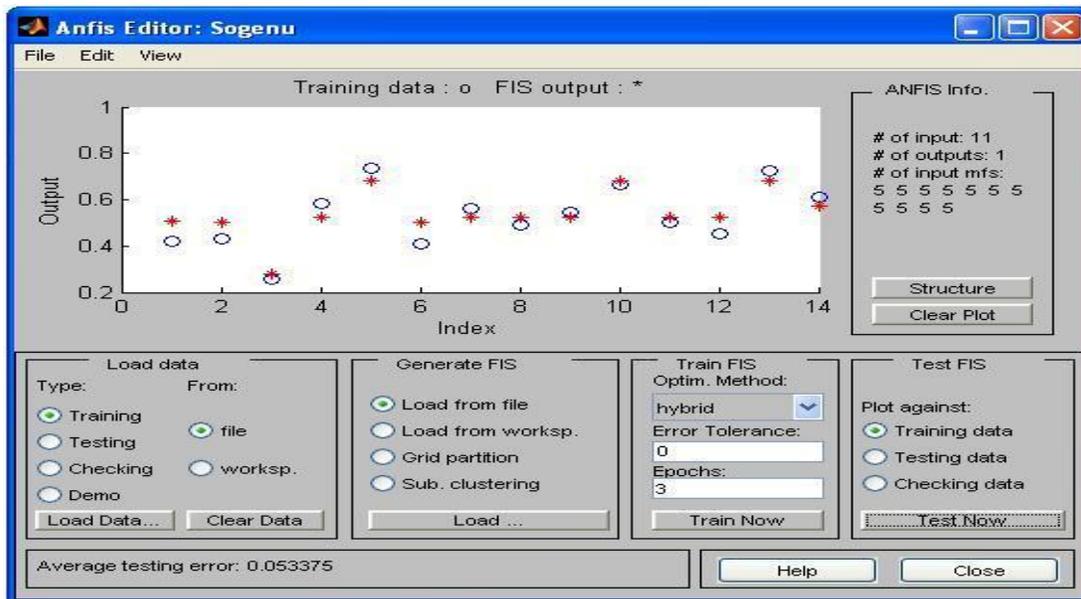
Ranking improvement opportunities	The relative deviation	Deviation from the ideal situation	The final score	Weighting factor	Percentage of quarter points	description
Nine priority	0.37	3.7	6.3	10	0.63	Project scope management
Second priority	0.55	11	9	20	0.45	Project time management
Fourth priority	0.48	7.2	7.8	15	0.52	Project cost management
Third priority	0.5	2.5	2.5	5	0.50	Project human resources management
Seventh priority	0.46	2.3	2.7	5	0.54	Project relations management
Eighth priority	0.46	4.6	5.4	10	0.54	Project procurement management
First priority	0.58	5.8	4.2	10	0.42	Risk management
Fifth priority	0.48	2.4	2.6	5	0.52	Quality management
Sixth priority	0.47	2.35	2.65	5	0.53	Integration management
		0	0	5	Lack of information	A timely report
		0	0	10	Lack of information	The average project delay
GRAD ---C			43.15	100	-	total

### 3. Results and Discussion

With regard to the application of the model outputs the following results have been observed. It should be noted that the input data set is randomly generated.



The following figure illustrates the output of predictive models:



According to the above table as a whole, the Mehr Housing Project GRAD -C category is equivalent to the intermediate level.

According to the above table, the overall condition of the Mehr housing project Zanzan is evaluated in GRAD-C (equal to the average level). The numbers in the above table are indicators of the current status of Mehr housing projects in each of the project management standards and deviation from the ideal situation. Considering that the weight factor for each aspect is not the same, the relative standard deviation was calculated for each one. Then according to the relative standard deviations, appropriate priorities are determined for changing the situation to get closer to the ideal situation. Finally, on these bases, implementation suggestions are determined for each management aspect, as follows:

#### *First priority- project risk management*

1. Separate project management team Formation for each project to identify the different kinds of risks and analysing them qualitatively and quantitatively.
2. Prioritizing identified risks based on their RPN value.

3. Determining the necessary practical revision measures to overcome the critical risks in the projects.

#### *Second priority- project time management:*

1. Holding orientation courses for structural failure of the WBS project for project team members to provide a comprehensive plan (including: obtaining permit, scheduling procurement and design, implementation and monitoring).
2. Warnings to contractors about the proposed project implementation schedule based on the project control charts and determining the control measures to carry out activities based on offered programs.
3. Continually determining the project's time delays and analysing their causes.

#### *Third priority- project human resource management:*

1. Supervising staff employment and conceding activities to people by contractors based on education, experience and their individual and group abilities. Then, defining responsibilities for key roles.
2. Needs analysis, holding training courses for those involved in the project.

*Fourth priority- project cost management:*

1. Introducing budgeting issues and cost estimation techniques for project team members.
2. Updating rules and regulations of price in the building industry.
3. Preparing and presenting budget reports monthly and analysing in the project management team and taking necessary measures to correct budget deviations during the year accordance with the project progress.

*Fifth priority- quality project management:*

1. Formulating quality policy of projects and notifying the contractors
2. Measuring the achievement of the formulated quality objectives in the project implementation.
3. Holding necessary training courses to improve the quality of projects.

*Sixth priority- project integration management:*

1. Emphasize holding regular meetings of the project management team and presenting it to the relevant authorities.
2. Preparing the comprehensive management software and controlling the project in order to harmonize and exchange information between people and relevant organizations.

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*Seventh and eighth priority- project communications and logistics management:*

1. Correcting collecting and distributing of project development information methods (this can be done online, if comprehensive management software and project control are used)
2. Defining work scope and duties of each organization and individual in projects according to unified command.
3. Revising the methods for estimation of needed resource materials for the projects.
4. Creating a database of project goods suppliers and revising criteria for supplier evaluation.

*Ninth priority- project scope management:*

1. Defining goals, work scope, operation size and time limits for within the project performance.
2. Defining rational and proper study methods for project feasibility and reasonably.

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