

Evaluation of Urban Projects Management Using the Standard Project Management Body of Knowledge (PMBOK) Based on Network Analysis

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ABSTRACT

Considering the execution of numerous urban projects by municipalities, they are considered as project-oriented organizations, and for organizational success and excellence along with the technical and engineering standards, they have to pay serious attention to the existing standards regarding project management and evaluation models. While investigating the requirements in the area of project management called PMBOK (a work of Project Management Institute –PMI– in the US and accepted worldwide), this paper provides an applied model for self-evaluation by municipalities in compliance with the requirements of the project management standards in urban projects. This model is used case-wise in urban projects of Tehran Municipality, Zone 1. Hence, first, using Analytic Network Project (ANP), weights of the evaluation model's indices are evaluated. Eventually, using a questionnaire, the indices are evaluated by managers of the urban projects in Zone 1 of Tehran municipality, and then by applying the weights, performance index of project management in Zone 1 of the Municipality is determined.

KEYWORDS: Analytic Network Process, Performance Evaluation, PMBOK, Urban Project Management.

INTRODUCTION

Each organization for success and excellence should be in possession of tools and standards specific to the type of its operation. Given that the number of project-oriented organizations is significantly increasing, these organizations need to pay attention to the existing models in the area of project management in order to achieve success and organization maturity. On the other hand, given the huge volume of published statistics on high rate of projects failure and the heavy costs associated to it, most companies and organizations are increasingly resorting to approaches which lead to improvement in their way of project management. These organizations as part of their competitive strategies have resorted to project management. Municipalities, including Zone 1 of Tehran Municipality, are among the project-oriented organizations which operate in urban projects. An interview with managers of the municipality (zone 1) indicated that this organization needs improvement in management system of its projects. However, in the first step, implementation of such program requires the municipality to know at what stage it is in terms of urban projects management. And after evaluation and understanding of the status quo in terms of project management, it should begin with identification and implementation of improvable aspects for promotion of its project management maturity and capabilities, because otherwise by sudden start of improvement in management system of urban projects in its organization without knowledge of its strengths and weaknesses in the status quo leads to going astray, redundancy, and loss of plenty of resources, and it will not realize its ultimate goal in execution of organizational projects. Now, the question is that how the organization can promote the improvement in organizational project management?

1. The organization needs to know what knowledge, skills, tools and techniques the usefulness of which has been proved are required.
2. The organization needs a method for evaluation (assessment) of its existing situation regarding the above mentioned purposes.
3. If the organization decides to implement improvement program in some areas, it needs to know how to create these improvements inside it.

PMBOK (Project Management Body of Knowledge) is a standard in the area of project management which examines the above mentioned aspects. This standard has been prepared under supervision of Project Management Institute in the United States the purpose of which is provision of a ground for organizations in order to acquaint them with project management and to evaluate their project management processes based on this standard and to bring the necessary improvements for coordination of project management processes with the standard. PMBOK will not only provide a launch pad for further progress in this area, but also by allowing firms to learn, evaluate and eventually to improve their capabilities in order to achieve organizational success using management project it will be quickly effective. However, the point which always has been a major

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challenge for organizations, given the specific limitations and conditions of each organization, is prioritization of improvement areas considered as a weakness for the organization and how and based on what criteria to select a number of them for establishment in the organization in order to avoid loss of resources and lag in the path of maturity. In this research, using PMBOK standard which in 2008 was published by PMI of the US, it is tried to measure the state of affairs of project management in the urban projects of Tehran Municipality in Zone 1, and after extraction of strengths and weaknesses and definition of improvement grounds given the limitations of Tehran Municipality zone 1, improvement priorities in project management were recommended.

2. RESEARCH LITERATURE

2.1. Project Management Body of Knowledge

The Project Management Institute (PMI) of the US was founded in 1969. This institute in 1976 decided to document opinions of project managers the result of which in 1987 was published under title of Project Management Body of Knowledge. In 1996, the first official script of PMBOK standard was published and in 1999 was approved by ANSI. In the end of 2004, more than one million copies of the guide book PMBOK was sold and about 75000 individuals received PMP certificate.

2.1.1. PMBOK processes

PMBOK standard divides project executions stages into 5 processes:

1. Initiating Process Group: The necessary activities to obtain official permits and authorities for start of a project are termed as Initiating Process Group. The summary of these activities includes the two following main stages:

1.1. Project chart preparation: includes obtaining project permits, initial actions, identification of financial sponsors, beneficiaries (stakeholders), and key people, documentation of requirements, formation of project's initial team and its managers, programs and plans, negotiation meetings, initial control procedures, and project declaration (manifest).

1.2. Preparation of (initial) declaration of project's scope: this document includes documentations of the main deliverables requirements, principal scopes or project's boundaries, high level approval and control methods.

2. Planning Process Group: These activities include all knowledge areas of project management.

3. Executing Process Group: Includes all the necessary actions and co-ordinations for execution of programs and producible according to the required quality and specifications.

4. Controlling Process Group: it concerns such activities as control and measurement of performances and results, comparison of performances' results through predictions (estimations), identification of causes of deviations and selection of a fitting strategy.

5. Closing Process Group: it concerns required processes for official completion of project. These activities include delivery of deliverables or termination of a dissolved project.

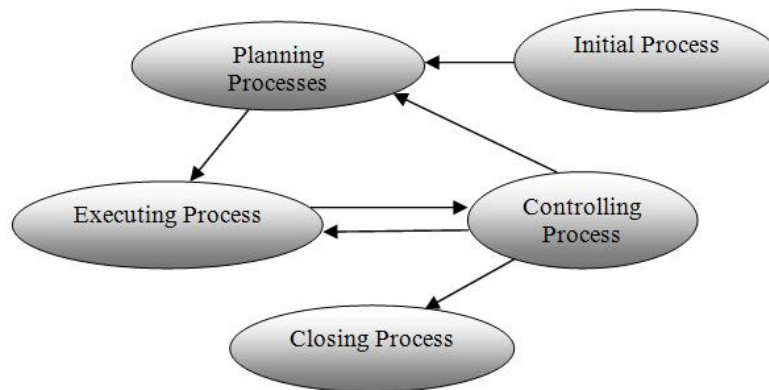


Figure 1: Project management processes

2.1.2. The nine-fold project management knowledge on PMBOK

Level of Basic Knowledge: knowledge of boundary (scope) management, cost and quality management is called Basic Knowledge. Level of Facilitating Knowledge: it refers to human resource management, communications, risk and procurements, since they are as siding tools for achievement of deliverables and goals. Level of Linking Knowledge: the knowledge level of project integration management has the task to coordinate the above eight levels and leads to their standardization. Therefore, it affects other levels of

knowledge and in turn is influenced by them. In each of the knowledge levels, some works have to be done. Position of these tasks is determined according to process stage or group. In PMBOK standard, the number of these activities which in fact are the tasks of project management is 44 tasks or processes the most important items of which are presented in table 1.

Table 1: Relationship between processes and areas of project management knowledge in PMBOK

Knowledge areas processes	Project management process groups				
	Initial	Planning	Execution	Supervision & control	Completion
4. project integrity management	4.1. creation of project charter 4.2. project initial declaration	4.3. preparation of project management program	4.4. project direction and management	4.5. works supervision and control 4.6. changes integral control	4.7. project termination
5. project scope and content management		5.1. Scope and content planning 5.2. scope and content determination 5.3. creation of work break-down		5.4. Scope and content approval 5.5. scope and content control	
6. project time management		6.1. activities determination 6.2. activities succession order 6.3. activities resources determination 6.4. activities time specification 6.5. creation of scheduling network		6.6. scheduling network controlling	
7. project cost management		7.1. costs estimation 7.2. costs budgeting		7.3. costs control	
8. project quality management		8.1. quality planning	8.2. quality guarantee execution	8.3. quality control execution	
9. project human resource management		9.1. work force planning	9.2. project team provision 9.3. project team training	9.4. project team management	
10. project communication management		10.1. communication planning	10.2. information distribution	10.3. performance report 10.4. stakeholders management	
11. project risk management		11.1. risk management planning 11.2. risk specification 11.3. risk qualitative analysis 11.4. risks qualitative analysis 11.5. planning of response to risks		11.6. risks supervision and control	
12. project procurement management		12.1. goods purchase and procurement planning 12.2. contracts planning	12.3. asking suppliers recommendation 12.4. contracts planning	12.5. contracts execution	12.6. contracts termination

2.2. Fuzzy Analytic Network Process

One of the early techniques in multi-criterion decision making methods is Analytic Hierarchy Process (AHP) which is suitable for solution of most complex problems, and this method since 1980 has been used as a technique to solve decision making issues. AHP has provided a broad context in order through this way to solve all problems of intuitive, rational and irrational properties despite their multi-purpose, multi-criterion and multi-decision maker nature in certain and uncertain conditions in presence of various options. AHP assumes operational independence of the upper part in hierarchical structure from the lower part and from criteria of each level or class. However, plenty of decision making issues cannot be placed in a hierarchical structure and this is due to interactions between various factors which occasionally are the factors of a particular level of interdependencies. Structuring of a problem or operational interdependencies allow us to receive a feedback between identified clusters in network system. Saati proposes AHP for solution of the problems in which independence of criteria or options is preserved, and he also proposes ANP for solution of problems assuming interdependence between options and criteria. ANP is a more general state for AHP. While AHP provides a one-way hierarchical relationship, ANP considers relationship and dependence between decision levels and characteristics. ANP feedback method replaces hierarchical structure by networks so as relationship between levels is defined as higher and lower, dominant and non-dominant, direct and indirect (Mohammadi Lord, 1388, p.98)

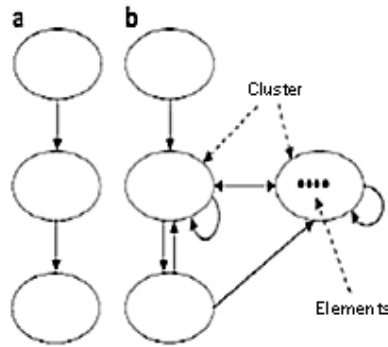


Figure 2: Difference between hierarchy structure and network: (a) Hierarchy and (b) Network

2.3. Literature Review

In an article by Najafi (2009) titled “Application of Analytic Network Process in Analysis of Structural Challenges and Organization Executing Environment in Project Management” using ANP measures interdependencies between strategic factors and presents the key effective strategy in project management. This method has been tested in Alop Company and using Structural Credit Rating Approach its validity has been confirmed.

In a research titled “Organizational Maturity in Project Management: Field Study in the Association of Engineering and Construction Firms”, Saremi et al (2009) by carrying out a field study investigated the extent of theoretical evolution in 9 large project-oriented organizations in oil, gas, and petrochemicals industries of the country. Their studies indicated that the necessity for correct application of decision making criteria and problem solving by reliance on appropriate performance reports as the two critical indices in managers’ skills have been sufficiently understood, but the structural complications and conflict of power and authority are among the serious issues in dimension of authority relations in organization. In sum, theoretically, organizations general situation was evaluated as the transition state from renaissance to modernism.

In a research, titled “Presentation of a Model for Evaluation of Project Management in Manufacturing Vehicle Parts and Study of the Obtained results from its Application”, in addition to consideration of the time, cost and quality triangle, by preparing a questionnaire based on evaluation indices proposed from customers’ viewpoint in management of this type of projects, Salehi et al (2009) have determined significance of these indices from their point of view as the main source of the research data. In addition, they have profited from factorial analysis to summarize the initial indices and to specify their constituting infrastructural components for creation of an evaluation model. Next, using the presented model, projects management performance in manufacture of cars has been evaluated. The obtained results indicated that the existing weakness in knowledge and application of risk in management process of these projects is considered as one of the negative determinants in their success.

In a research titled “Evaluation of Gas Supply Projects Management using PMBOK: Case Study of Zanjan Province Gas Company”, Farahmandian et al (2009) while studying the requirements of PMBOK titled as PMBOK@Guide: 2004 prepared by PMI in the US and accepted worldwide, provide an applied model for self-evaluation of organization’s movement in compliance with requirements of the project management standard. This model has been used case-wise for the projects of Zanjan Province Gas Company which is one the companies operating if gas supply to urban and rural areas.

In as study titled “Risk Management in Projects based on PMBOK standard”, Salemnia (1983) analyzes project environment and adopts a systematic view to determinants of project organization which leads to a structured method for identification and ranking of risks. By means of an intensity – probability matrix (risk management matrix) he achieves a decision making about treatment of a project. The risk qualitative analysis methodology includes specification of relative weight for the determinant and the corresponding probability to it and eventually preparation of the table of probability – intensity matrix and provision of its exigent program from results of this research.

Wu and Yun (2011) in a research titled “Critical Success Factors for Urban Renovation Projects in Korea” investigate and prioritize the key success factors in renovation projects of urban worn-out textures. For this purpose, through a brain-storm process by 29 experts, the key success factors for urban renovation projects in Korea were examined and eventually 10 key success factors were identified. Next, using a polling from 120 experts and statistical and t-test, ranking means were compared and the priorities for the selected key factors were specified, and the recommended model was presented by the researchers. These factors included minimization of conflict between stakeholders, optimization of legal – administrative services, standardization of decision making process, appropriate communications and information sharing, rationality of macroeconomic and executing plans, consistency of project management system, establishment of a suitable organizational

structure, cooperation between stakeholders of project, performance management in each phase, balanced tuning (regulation) of general and particular factors.

In a research titled "Project Management Performance analysis based on Multi-Criterion Decision Making Method" inspired by PMBOK, Marco et al (2010) measures performance of projects in areas of cost, quality, human resource, communication, risk and procurement using multi-criterion decision making methods. They provide an innovative model based on experts decision making and investigate internal relationships between decision makers' preferences by examining sensitivity analysis in a particular sample and prioritize the state of the introduced criteria in the sample project.

In a study titled "Identification of Success Grounds in Landscaping Projects: Requirements for Evaluation of Landscaping Projects Success", given the purposes as inputs, Dwik et al (2009) investigate processes, output and results using General Organizational Logic Framework Model in landscaping projects in the Great Britain. In this research, by gathering the data regarding the landscaping projects from 1996 through to 2000 in the GB and using variance analysis and population mean, they considered productivity and effectiveness management, information supply in financial aids and stakeholders support, documentation and use of knowledge management and the learned lessons, formulation of the best learned lessons and providing opportunities for interaction with the society as the success factors (grounds).

In a study titled "Project Management Performance Evaluation", Ghoreishi et al (2009) suggested 6 criteria for evaluation of project management performance based on EFQM (European Foundation for Quality Management). In this research, effect level of project management leadership criteria, projects employees, policy and strategy, partners, and life-cycle process of project management and its key performance indices in the course of its execution have been investigated. To test their model, they used a series of the listed organizations in Pakistan operating in various areas. Eventually, by proposition of some assumptions using correlation test, they have proved that project management leadership has positive and significant effect on project performance improvement. It should be noted that the evaluation tool in this research was the prepared questionnaire based on Lickert Scale.

In another research titled "Study and Revision of Projects for Identification of Project Management Competences", using the stored databases and knowledge from life cycle of executed projects, evaluated and identified project management competences. Inspired by PMBOK standard considering initial, planning, controlling, execution and termination of project using the learned lessons in the performed projects and experts in the mentioned projects using AHP, Frank et al (2008) investigated and prioritized project's main components.

3. RESEARCH METHODOLOGY AND MODEL

This research is of applied type and belongs to the group of evaluation researches. It belongs to applied researches because it makes use of the proved theories, principles and techniques in such developmental researches as project management and ANP in order to provide a method for evaluation of urban projects management. In addition, since in this research, data are gathered for analysis and decision making, it is placed in the group of evaluation researches. From another point of view, this research can be considered as a developmental research, because it assesses performance by combination of project management principles and ANP. However, in terms of research methodology, since this study is based on data gathering and data analysis, it is considered a descriptive research of survey type, because by study of the status quo, i.e. various indices of project management processes, it describes and interprets the things exist in reality and uses this information for evaluation of urban projects management performance in Zone 1. In this direction, to complete the calculations, a questionnaire is prepared which gives rise to survey nature of the research. Variables of this research have been identified based on PMBOK standard. In general, based on PMBOK standard, project management is divided into initiating, planning, executing, controlling and termination groups in each one of which, some or all areas of project management knowledge including integrity management, scope management, time management, cost management, quality management, human resource management, communication management, risk management, and procurement management are involved. Provision of 9 knowledge areas in project management processes in this standard leads to identification of indices in project management processes and these indices are evaluated as research variables in this research (table 1). Research model is shown in figure 3. Given that according to PMBOK standard, project management processes have internal relationship with each other (figure 1), therefore ANP has been used in this study, and this internal relationship has been represented as an inward flesh in figure 3.

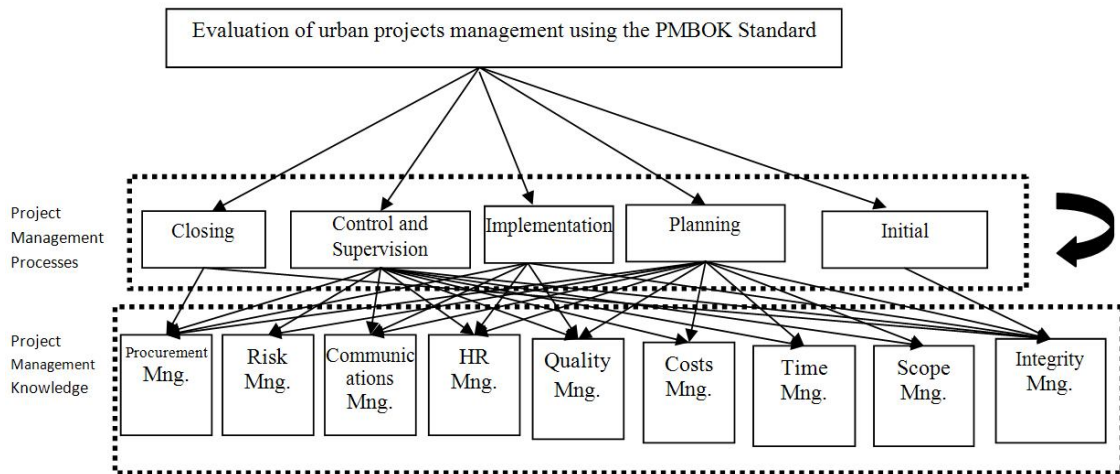


Figure 3: Research model

4. An application of research model

Zone One of Tehran Municipality has numerous urban projects. In this paper, first, by the questionnaire of paired comparisons through ANP, importance and weight of all dimensions of the model are specified in order to determine weight of project management areas. Next, by evaluating state of each index by the questionnaire with Lickert Scale, state of these indices and consequently state of urban projects management performance in Zone 1 of the municipality is specified. And due to questioning of all the statistical population, this research does not need sampling and is free from statistical tests.

4.1. Specification of project management dimensions weights in Zone 1 of Tehran Municipality

Figure 4. It should be noted that inconsistency rate of the whole paired comparisons matrix is smaller than 0.1, indicating consistency in judgments.

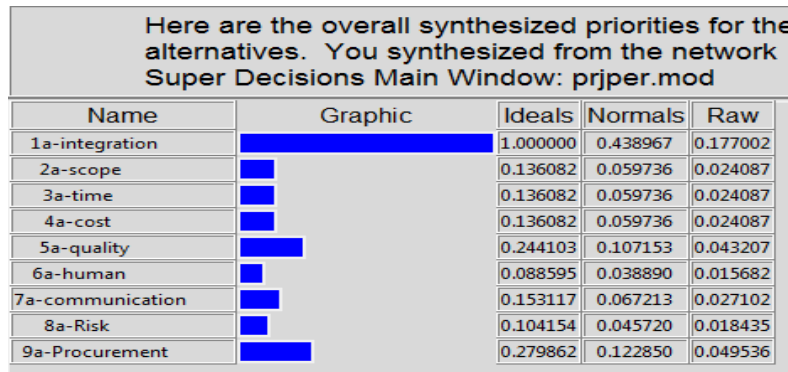


Figure 4: Results of calculations by Super Decision software

Table 2: Weights of project management knowledge areas in Zone 1 of Tehran Municipality

Knowledge areas	Weight
Integrity management	0.44
Scope management	0.06
Time management	0.06
Cost management	0.06
Quality management	0.11
Human resource management	0.04
Communication management	0.7
Risk management	0.04
Procurement management	0.12

Results of the calculations in table 2 indicate that in urban projects of Zone 1, project integrity management has the heaviest weight, and human resource management and risk management have the lowest weight, respectively. The reason for the large difference in weight of integrity management relative to other

areas is the effect this area has in all project management processes. In the meantime, development of this area of knowledge leads to development of other fields of knowledge.

4.2. Measurement of urban projects management in Zone 1 of the municipality

To evaluate urban projects management performance, it is enough to multiply the obtained mean for each knowledge area which is found through a polling questionnaire including questions about state of the knowledge in urban projects by the obtained weight in each knowledge area in urban projects of the municipality. To evaluate urban projects management performance, it is enough to obtain the sum of performances in all areas. The results are provided in table 3.

Table 3: Evaluation of urban projects management performance

Knowledge areas	Weight	Mean evaluation score	Performance
Integrity management	0.44	2.5	1.1
Scope management	0.06	3.8	0.228
Time management	0.06	4	0.24
Cost management	0.06	3	0.18
Quality management	0.33	3	0.11
Human resource management	0.08	2	0.04
Communication management	0.07	2.2	0.154
Risk management	0.04	2.3	0.092
Procurement management	0.12	3.2	0.384
Project management			2.788

As is seen in table 3, in urban projects of zone one, the state of knowledge areas integrity management, communication management, and risk management is average and lower (smaller than 3), state of scope management and procurement management is average and higher (greater than 3), state of cost and quality management is average (equal to 3), state of time management is good (equal to 4), state of human resource management bad (equal to 2), and finally the state of urban projects management in zone one is average to low (smaller than 3).

5. RESEARCH CONCLUSION

Given that the research model uses ANP for evaluation of urban projects management performance, due to taking account of internal relationships between project management processes and assigning more accurate weights to knowledge areas, it is innovative relative to prior research which employed PMBOK standard for evaluation of project management. In this research, weight of integrity management knowledge is higher than that of other areas and indicates significance of integrity management area as the linking knowledge level in urban projects. Because level of project integrity management knowledge has the task to coordinate the other knowledge levels, it leads to standardization of them. Therefore, it affects other areas of knowledge and gets affected by them. In addition, in the urban projects, after the dimension project integrity management, procurement management has the highest importance which is due to the high importance of sub-contractors in urban projects, and for this purpose, management of contractors and procurement should be performed very carefully in these projects. In urban projects, due to importance of quality in execution of project and the impact the quality of project various stages has on other stages, this knowledge is considered as the basic knowledge of project management, it is ranked as the third knowledge area. In general, given the results of the evaluation, it was found that the state the knowledge areas integrity management, communication management, human resource management, and risk management is critical, and for promotion of project management situation, it is suggested that given the importance of each weight in these areas, i.e. integrity management, communication management, risk management and human resource management, respectively, the sub-processes of this area to be improved according to table 1. In general, performance of urban projects management in Zone 1 of Tehran Municipality is at average-to-low level for improvement of which in the order of weights significance it is suggested knowledge area to be improved and in this regard, the knowledge area integrity management is of special importance.

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