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A Proposal for Architects' Design Performance Assessment Using Objectives Matrix

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Abstract
The overall intent of this research is to provide clients and architects with basic evaluation system that can be used to understand and improve task performance of architects so as to optimally satisfy the client's requirements and achieve high quality overall project performance. By means of 5 typical design goals, i.e. *Aesthetics, Functionality, Buildability, Economics*, *and Environmental Sustainability* a basic 'objectives matrix' is formulated to exemplify the assessment of architects' design performance. As an outcome of the study, a basic model for evaluating architects' design performance is pointed out with the potentials in the industry. It is concluded that a generally accepted evaluation system for architects will be beneficial to quantify project performance within the construction industry.

Keywords
Architects' design performance, Objectives matrix, Assessment, Performance criteria, Turkey

1. Introduction

Designing buildings to satisfy various design goals which could be intangible and yet contradictory is a complex process. Besides, as design objectives are usually interrelated, or even competing, a clear understanding of architects' design objectives and performance become necessary. Clients, architects, engineers and contractors in both the private and public environments dedicate all their efforts to convey and operate successful projects. Industry participants are committed to the ambition of having projects turn out well. However, the industry's track record is problematic in Turkey. In fact, recent history is filled with the examples of projects that have not succeeded even on basic premises. In many occasions, critical aspects of design were either poorly executed or ignored. In some projects, the consequences were severe. Many such failures resulted in excessive costs such as unexpectedly high operating expense, etc.

In publication 8-1 of the Construction Industry Institute (CII) (1986) design mission is defined by as follows;*"…design is perhaps the most central point of meaning for a project in that ideas and information are transcribed to paper in the form of specific and coordinated instructions for the project's construction and documentation."*. Even though design processes and routines have been developed over the years, the idea expressed by that statement still applies.

This research is about Architects' Design Performance on delivering the project with the definition of: "*the degree to which the architects' design effort achieves project value objectives*". The research conducted here relatively narrow in scope for demonstration purposes and, did not reflect many subsequent criteria that can enhance the evaluation of design performance in a real case.

2. Problem Description

Every building design is so called tailor made and unique, since designers have to adapt their designs to fit different circumstances as of various site conditions. In addition, the task of designing buildings could often be an fuzzy activity since the process of architectural design is an intricate task which entails the design team to satisfy numerous interrelated or competing requirements (Yamakawa, 1997; Wong *et al.,* 2008). Also, designs of modern buildings are fused with multi-disciplinary professional knowledge, and design teams of architects possibly spend a lot of power and effort in coordinating a wide variety of expertises. Moreover, conflicting requirements imposed by many stakeholders make it highly important to understand the client requirements and the design trade offs to achieve success in projects. (Wong *et al.,* 2008)

Design may be defined as a creative and repetitive process utilizing the available technical and managerial resources to produce diagrams and specifications to satisfy the client's needs on a project, while dealing with *physical, financial,* and *environmental* constrains. For the most part of clients, designers, and contractors design activity is defined as an endeavor that encompasses:

- Preliminary Design
- Detailed Design (placement can be changed according to the procurement system)
- Project Management and Controls
- Procurement

Accomplishing quality among these stages and finally realizing a project success is a major topic of interest among researchers. Several researches have been conducted about how to achieve building design quality on projects. Wong *et al*., (2008) gives a brief list of these studies. Some of them are mentioned as follows.

- Nelson (1996) suggested well-ordered approaches which include the use of ISO9000 from an auditing perspective.
- Low and Yeap (2001) proposed the adoption of Quality Function Development (QFD) or the so called 'House of Quality' matrix in the building design process, which relates customer needs on the most important and beneficial features so that quality efforts can be focused. However, QFD technique is found as a tedious job for building design purposes since it is initially developed for the automobile and manufacturing industries which are mass production techniques.
- A recent toolkit for improving the design of buildings is the Design Quality Indicator (DQI) which provides feedback and requesting perceptions of design quality through a questionnaire that is administered by project stakeholders. A 'Spider Diagram' is used to summarize results in respect of *Functionality, Build Quality* and *Impact.* (Gann *et al.,* 2003; Wong *et al.,* 2008).

By means of the words of Wong *et al*.,(2008) and Markus (2003) *"Whilst QFD is a forward looking tool in the design phase, its use in the construction industry is limited to date, perhaps due to the numeracy involved in calculating ratios and weightings. The DQI, whilst evolving in the right direction in sparking discussions and debate on design issues and quality, is still wanting in the suitability of feedback provided to the design team, in addition to the problematic resolution of diverse views of different stakeholders."*

As an alternative of these studies, by adapting the Balanced Scorecard methodology Wong *et al.,* (2008) proposed an optimisation approach for design management, as a versatile aid to prioritise clients' requirements. The Balanced Scorecard provided a framework and modified to achieve design aims by optimising different design objectives in their study. The proposal of Wong *et al.,* (2008) is successful since it is simple to understand and adapt for different purposes but can be questioned for larger sets of performance value objectives.

The major parties on the project such as; client, designer, contractor, and sometimes even the sub-contractor and vendors are involved in the design tasks mentioned above, with varying degrees of emphasis and necessities.

At this point, it is understood that the more simplistic the tool, the more effective use is achieved in the construction industry. So, in this study a basic method is suggested to measure design performance by introducing objectives matrix which is a versatile tool and could cover several areas, from cost/time/quality of the design itself, to the construction processes. This tool is expected to improve the project design excellence with enhancing the effectiveness of design.

3. Developing Objectives Matrix for Quantifying Design Performance

Quantitatively comparing unique projects in the construction industry, especially "creative" components such as design, has been a challenge for executives (Broaddus, 1991). The need for benchmarks, however, is paramount for tracking performance and identifying areas in need of improvement. After all, problem-finding is the first step in problem-solving.

The Objective Matrix was introduced by Riggs in 1985 which allows for the relative assessment of a project objective based on the weighting and scoring of elements or "indicators" of objective. The Objectives Matrix consists of four elements: *the criteria, weights, performance scale, and performance index*. The criteria define the object being measured, the weights tell the relative importance of the criteria to one another, and the performance scale compares a criterion's value to a selected benchmark. The three components are used to calculate the performance index, which is used as an index to track performance (Broaddus, 1991).

According to Riggs (1985), when selecting the criteria for an objectives matrix, they must be*: Specific, Measurable, Acceptable, Realistic, and Time-terminated*. Criteria must be specific and well-defined to avoid misinterpretation. They must be measurable to gauge them against a benchmark (even qualitative criteria can be measurable if the benchmarks are set properly). The criteria must also be acceptable (or achievable) and realistic, as measuring unattainable or unreliable criteria would distort the objective's matrix results. Finally, the criteria values must be bound by time, as an infinitely changing criterion cannot be used for benchmarking. One more factor that is important in the development of the objectives matrix is independence of criteria. Interdependence would violate the concept behind creating an index score from independent components (Riggs, 1985; Broaddus, 1991).

Determining the criteria weights is an exercise by itself. Many methods can be used to determine the weight values. One approach would be the use of Analytical Hierarchy Process (AHP), which is a tedious process, or other, simpler methods of weight determination can be applied. These involve using simple scales such as (low, medium, high) and involve little iteration. Some methods rely on a small group of experts to assemble the relative weights, with some methods asking the experts to reach a consensus, and others simply averaging their responses (Broaddus, 1991). In this study weights are assigned by the author to reach a basic model.

The design objectives can be altered across different projects according to the clients' preferences or project values. However, in this study a generic Objectives Matrix is developed for a standard public design project by using the 5 typical design objectives, i.e. *Aesthetics, Functionality, Buildability and Economics*, *Environmental Sustainability* as a demonstration of its use (Figure 1).

The performance score for a criterion can be determined through judgment, a quantitative score, or a combination of sub-criteria in sub-matrices. The judgmental approach can be applied to some or all the criteria, despite its drawback of subjectivity, since the use of multiple criteria and different weights would still make it a valid application (Tucker, 1986). The quantitative score utilizes a set of quantitative values to benchmark against the criterion's value. The sub-criterion or sub-matrix method relies on using the same process of the objectives matrix to determine the score of criterion: by using a set of weighted sub-criteria to produce a sub-index. This sub index would be used as the criterion's score. In the case of quantitative criteria, it becomes harder to set up a performance scale. One way to approach the problem is to construct a scale for measuring the criterion on general terms. By defining a number of meaningful levels (Worst, Low, Medium, High, and Best), one can have a basis on which to score the qualitative criterion. The descriptions of each level can be a set of qualifications or examples (Clemen and Reilly, 2001).

PERFORMANCE CRITERIA (Project Value Objectives-Defining Product Quality)					
AESTHETICS	**FUNCTIONALITY**	**BUILDABILITY**	**ECONOMICS**	**ENVIRONMENTAL SUSTAINABILITY**	**SCORES**
			X		6
					5
	X	X			4
					3 (average)
X					2
				X	1
					0
2	4	4	6	1	SCORE
15	40	10	20	15	WEIGHT (total=100)
30	160	40	120	15	VALUE

Performance Index Of The Project 365	
Max. Performance Index	600
Min. Performance Index	0
Average	300

Figure 1: Example of an Output Objectives Matrix

The qualifications approach is similar to the sub-matrix method in quantitative criteria, while the example approach is closer to the benchmark method. Finally, the performance index is the result of multiplying the criteria weights by their scores, and summing the results. The performance index will have a maximum value of the sum-product of the criterion's maximum scores by the weights. In figure 1, an example is shown by just 5 major project values where the performance scale is 0-6, with 3 as an average, while the weights sum to 100. As such, the maximum performance index value is 600, while the average is 300. These boundaries can be used to track and benchmark the performance index.

In Figure 1, a basic use of objectives matrix is shown to measure design performance defining product quality by introducing 5 project value objectives i.e. *aesthetics, functionality, buildability, economics and* *environmental sustainability*. It is explicit that here the tool is simplistic and versatile to be customized for different circumstances.

4. Conclusion

Design Performance Measurement can help in maximizing project values. This research specify to provide a model for implementing Design Performance for projects of varying size and scope across all construction industry. Key conclusions from this study can be listed as follows:

- Too often, design is not as successful as needed and maximum project value is not achieved. Direction and guidance are needed to achieve targeted value.
- Design Performance can be defined as the degree to which the design effort achieves Project Value Objectives.
- Once calculated a generalized Performance Index by using an objectives matrix, can be utilized for a variety of purposes, including (1) monitor and control; (2) incentive and approval; (3) pre-selection; and (4) technical evaluation.
- With an aim to devise a more informed framework for evaluating Design Performance, semi-structured interviews can be carried out to establish a list of criteria and subsets; suitable for evaluating architect's performance for different processes and clients.

In this study an 'objectives matrix' for the assessment of architects' design performance is exemplified with some sample data input. However, clients can set up their own criteria, weightings, and customize the formulae proposed in this paper to compute the performance score for their projects. Moreover, the performance scores computed through the same model (with constant benchmarks), can be stored in a centralized database so that the performance information can be shared for different projects. The overall performance scores can in turn be used for different purposes including monitor and control, incentive and approval, pre-selection, and technical assessment. It is anticipated that the use of performance scores could promote continual improvement in architects' design performance.

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