



Assessing Performance Dimensions in Architecture, Engineering and Construction Organizations

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ABSTRACT

The collaborative nature of the project environment of the Architecture, Engineering and Construction (AEC) industry necessitates close and prolonged collaboration of diverse organizations in order to execute a project. For the duration of the project, a certain degree of strategic alignment amongst the participating organizations often becomes necessary for the successful execution of the project. The impact of such strategic alignments on the organization's own performance, is often inevitable. While the performance criteria for the project may be clearly defined along with the project's program and specifications, the performance criteria that each participating organization has set for itself are not always as evident or articulated to others. In this paper, the results of an exploratory field research are presented. The data analysis revealed that both shared and unique dimensions of performance apply to Architecture, Engineering and Construction organizations. The research findings are significant in that they provide a framework for assessing the degree of compatibility, in terms of shared strategic goals, for firms engaging in projects networks and alliances.

Keywords: Performance, Dimensions, Organization, Architecture, Engineering, Construction and Project.

INTRODUCTION

In the current global project environment where multiple AEC firms from diverse cultures and countries form networks and consortia to carry out major projects, it is imperative that a clear understanding exists as to what is meant by performance and how the various parties identify, measure and prioritize firm performance. In this paper, the findings of an exploratory research on performance dimensions in the AEC are presented. These findings are part of a larger qualitative field research undertaken to examine the relationships amongst key organizational variables (Katsanis, 1998). While the performance of an organization is often assessed in terms of project outcome or its own financial performance, these dimensions reveal a part of the organizational attributes that provide insight both in the organization's emphasis on a particular output and the make up of key structural components. Such knowledge is paramount in order to make appropriate choices in selecting appropriate project teams and in establishing networks towards the development of long term working relationship. The findings provide a broader understanding of how AEC firms view their own performance and those that – in their view – have greatest impact on their success. Additionally, the findings provide a foundation for further research in AEC firm performance as it relates to networks, joint ventures and collaborative undertakings.

ANTECEDENTS

The Random House dictionary defines performance in the context at hand as: "the manner in which or the efficiency with which something reacts or fulfills its intended purpose". In the organizational context, the notion of performance provides the key variable for evaluating the effectiveness of individuals, leaders, groups and organizations. In fact, it serves as the vehicle for judging effectiveness and when performance is satisfactory the organization is judged to be successful (Alhosani et al. 2017,). Dimensions of performance can be very diverse and even subjective because, as the definition suggests, performance is context-sensitive, so, for example, a design architect may view performance in the context of the aesthetic value of the design whereas a managing partner may view performance in terms of fees generated for the design effort. The importance of performance as a measure of organizational effectiveness in design and construction industry organizations, particularly in the context of collaborative schemes (e.g., DB, BOT, DBFOT, etc.) has been identified as a critical research issue (Mohsini and Davidson 1992; Mohsini, 1989; Moore and Dainty, 2001; Chinowsky and Meredith, 2000). These studies have focused on the organization and management of the construction process and the interorganizational conflicts among the network organizations that inevitably affect performance in a negative way.

In a seminal work examining the organizational behaviour of AEC firms, Mohsini and Davidson (1992) correlate key structural variables (measures of conflict) of the firm to the performance variables of the project. In building their model, through critical examination of the construction process, they identify disparities between two levels of organizational objectives that the network organization is continuously confronted with: (1) The temporary objectives of the project and the organization that is set up to construct it, and (2) the permanent objectives of the individual participating organizations. The second level of objectives includes those that are typical of all organizations, namely, their survival in the marketplace, the enhancement of their domains, and their position within this domain.

It is in response to the need for tools that can be used for identifying measures of performance as "health indicators" of task organizations that often have a contagious effect on the "health" of the network organization that provides the impetus for this research.

METHODOLOGY

The research design is considered an exploratory multiple case study research (Yin, 2018). It seeks to explore issues pertaining to 'who', 'what', 'why', and 'how' business development takes place in the principal AEC firms. In this research, the unit of analysis is the firm. The chosen informants were individuals intimately involved in the operation of their specific firms; they were in most cases the principal(s), or senior associates. This choice ensured that elements of task interdependence across sector boundaries were included in the responses.

The method of sampling used was a combination of snowball and purposive sampling. Purposive sampling is defined by Babbie (2017) as a sample of observations believed to yield the most comprehensive understanding of the subject of study. An initial list of "potential" sample firms was compiled with the assistance of two expert informants familiar with the industry in the metropolitan area where the interviews took place. These two informants were not affiliated with any of the participating firms. The result was a sample of firms considered to be "representative", these with longevity in the marketplace e.g., for over 15 years, and "name

firms” (well-known to all in the industry). The snowball sampling was ascertained through a list of firms identified by the participants.

The types of *firms* included in this study were design organizations in architecture and engineering, as well as construction organizations. The *individuals* interviewed were either the principals of the firm, firm associates, or other senior personnel. Eight firms were included (3 engineering, 3 architecture, and 2 general contractor) with 20 completed interviews, ranging in duration from 30 minutes to two hours. Table 1 summarizes key characteristics of the firms.

Table 1. Characteristics of Sample Firms

	Firm A1	Firm A2	Firm A3	Firm E1	Firm E2	Firm E3	Firm GC1*	Firm GC2*
Type of Service	Full Service Architecture*	Full Service Architecture	Full Service Architecture	M&E Engineering	M&E Engineering	Civil, Structural Engineering	General Contracting	General Contracting
Years in Business	20+	50+	35+	40+	40+	30+	45+	35+
Number of Employees	20	35	15	90	70	20	25	40
Number of Informants	3	3	3	3	1	1	3	3

- ♣ Both the general contractors (GC) firms fall in the upper 30th percentile of the firms listed as industry leaders in a trade publication in the metropolitan area where the study was conducted. The volume of annual contracts for firms in this percentile ranges from \$80M to \$500M (in 2020 CA\$). Industry ranking and sales volume not available for other firms.

* Full-Service Architecture refers to a firm’s capacity to provide a range of services from programming to concept to construction documents to supervision of the works.

It should be noted that interviews were difficult to obtain due to the general unwillingness of companies to participate; one reason for this is the intense competition in the industry, and the “smallness” of the industry with only a few major competitors - leading to fears about revealing key indicators. The firms’ lifespan: endurance and success ranged from 15 to over 50 years.

The longevity of the organizations was used as a measure of the ability of the firm to successfully weather the adverse effects of the economic cycles.

The unit of analysis was the firm. Data was collected by interviewing key informants in selected firms, and through the use of documentary evidence, where applicable and where it could be accessed for consultation. This kind of multiple data use ensured triangulation of the data (Miles et al., 2014). A strict research protocol was followed. With respect to confidentiality, no reference to a firm, individual, or city was made. All interviews were conducted in the same geographic area in and about a major North American city.

FINDINGS AND DISCUSSION

Performance dimensions are output measures that allow firm's executives to assess directions and strategies against both internal targets and (for comparative purposes) on aggregate industry output. The performance dimensions that ensue from the statements and comments of the participants of the interviews are grouped into three categories that correspond to the various objectives of the firms. For the two sectors of the industry, which comprise the professional organizations (architects and engineers), the following categories are pertinent:

- **Business orientation**
- **Practice orientation**
- **Project orientation**

While the *business* and *project* orientations of a firm are easier to understand, e.g. profitability is a business orientation that also constitutes a measure of a firm's performance, and similarly project quality is a project orientation as it affects the project as a product. The *practice* orientation is however, more nebulous. Practice orientation at its most extreme form (likely amongst architects) focuses on design aspects such as design aesthetics and design excellence often to the detriment of other considerations (AIA, 2001). The concept of practice has its roots in long standing traditions of guilds and later in professional design practices). Architects are more likely to put emphasis on practice orientations than engineers. This tendency is revealed in the ranking of dimensions by firms shown in Table 2.

Table 2: Ranking of Dominant Performance Dimensions

Category	Dimension	Dimension Ranking by Firm		
		Architect	Engineer	Contractor
Business Orientation	Financial Performance	2	1	1
	Business Volume Growth			3
	Client Base Growth	2	NR	
	Staff Growth			NR
	Subcontractor satisfaction			3
	Continuity/Future/Stability	3		NR
	Reputation/Image			NR
Practice Orientation	Design Quality - Prestige	1	NR	
	Reputation/Excellence		2	
	Employee/Self Satisfaction	2	2	
	Process of Architecture/Relations	3		
	Inventiveness	3		
	Create Ageless Projects	2		
Project Orientation	Project Quality	1	3	2
	Client Satisfaction	2	NR	2
	Subcontractor performance			4

NR – Not ranked. 1 = Most Important

For the design firms shared structural components give rise to all three broad performance orientations: **business**, **practice** and **project**. For the construction firms the performance orientations are as follows: **business**, and **project**. These orientations are identified in Table 3.

Table 3. Dominant Performance Dimensions Grouped by Category

Category	Dimension	Apply to Firm of:		
		Architect	Engineer	Contractor
Business Orientation	Financial Performance	▲	■	◆
	Business Volume Growth			◆
	Client Base Growth	▲	■	
	Staff Growth			◆
	Subcontractor satisfaction			◆
	Continuity/Future/Stability	▲		◆
	Reputation/Image			◆
Practice Orientation	Design Quality - Prestige	▲	■	
	Reputation/Excellence	▲	■	
	Employee/Self Satisfaction	▲	■	
	Process of Architecture/Relations	▲		
	Inventiveness	▲		
	Create Ageless Projects	▲		
Project Orientation	Project Quality	▲	■	◆
	Client Satisfaction	▲	■	◆
	Subcontractor performance			◆

Cross Case Analysis – Architecture Firms

Business Orientation

With respect to the firms of architects the *Business Orientation* dimensions articulated were as follows:

Level of profit and financial performance: When one informant was asked: why is it that financial considerations were not given top ranking? he replied: “We have given up on getting rich! We try not to lose money. [...] You can either ‘do’ architecture or make money”. Amongst the architects (nine informants) who participated in this research, not one ranked profit as the number one dimension of success, in contrast to (a) the engineers who - in the large majority

(four out of five informants) - identified it as such, and as it will be seen below, to (b) the contractors (five informants) who unanimously identified profit as the dimension ranked in the first place.

Client base: According to one respondent, "Profitability and a sufficient client base are essential business elements that result in a sense of confidence; having a broad client base is more important than having a broad project base." This appears to be a typical response for architecture firms.

Personal satisfaction: One informant expressed what appears to be a shared opinion: "There is a certain value in personal satisfaction. The ability to create jobs is awfully important, and so is creating an environment where people work and feel safe. In order to get this sense of satisfaction, it is necessary that quality of product, profitability and continuity are all present."

View to the future: Another dimension of success is being in a position to plan for the future and to formulate a vision that assures continuity. "We talk with prospective partners; we look at mergers that will allow us to broaden our client base..."

Practice orientations

Reputation for quality of work and quality of product

One of the difficulties with the concept of "quality of work" is that it is a composite of mostly qualitative measures; additionally:

"...it is difficult for the architect to assess whether there is enough, or too little quality with respect to the scope [of a project] and the corresponding fee, and to the potential risk for problems that might result in litigation and loss of reputation". On the other hand, "product quality is a matter of honor and self respect for the architect."

Peer recognition

Awards as a measure of recognition by other members of the profession are a significant measure of success for the architecture firm. Apart from the fact that they provide a very essential element for the next dimension (satisfaction), these awards have a strategic value because of the "weight" they carry in obtaining future commissions.

Personal satisfaction

One informant commented on this dimension as follows: "A certain value is perceived deriving from the ability to create jobs and maintain our office environment where [employees] work and feel safe."

Relations between firm and client

Maintaining good relations is a measure of success as it enhances the image of the firm and increases the potential of repeat business or new business through referrals and recommendations.

Stability of staff – Institutional memory

The stability of office staff is viewed as a function of the ability to maintain a steady volume of work ostensibly as a result of success in other dimensions. The stability of staff ascertains that project experience from previous commissions of the firm is active in the institutional memory of the firm (staff).

Ageless project (design and materials)

Being able to look at past projects and feel that they still make as important a contribution as they can at the time they were built.

Project orientation dimensions

Project quality

It was ranked as the most important dimension of success by all the architects who participated in the study. “[The clients] have the impression that we [the Architects] are interested in the aesthetic approach; in reality this is not true, we organize space [...] There is a whole spectrum of responsibilities. The user [and] the public [do] not necessarily appreciate the effort that goes into making the place better than average: colors, atmosphere [...]; it becomes a [real] service [and] success is to do it in such a way to convince people that architecture is more than providing a shelter, [that] it is more than providing a service. This is *contre-courant*. I hope to manage to give people pleasure - as much pleasure as one can get.”

Client Satisfaction

One respondent stated clearly that “client satisfaction is proportionate to the quality of the work.” This appears to be a view shared between the three architecture firms that were studied. In recognition of this relationship, some firms are now considering the adoption of ‘formal client debriefing’ at the end of the project, so that the office receives proper feedback on both the process and on the product. However, it appears that it is not always easy to make this move when dissatisfaction is suspected, presumably for reasons of the fear of ‘raising dust’. In the words of one participant:

“If we know that they [the client] are dissatisfied with our service, I tend to be less brave and not ask for that kind of debriefing [...]. That [approach] is probably wrong; the debriefing is still necessary. Even if there have been bad problems, [debriefing can] only be positive to the client, [it shows that] in spite of everything you stayed with the problem. I have found that a lot of the consultants don’t really know how to stay with it when things got rough.”

Cross Case Analysis - Engineering Firm

Business Orientation

In investigating the dimensions of performance in the engineering organizations the responses were clear and unequivocal. In the **Business Orientation** category, one single dimension was identified by all but one of the respondents as the number one measure of success: profit (financial indicator). With almost certain bashfulness, some of the respondents felt it necessary to explain, “Without profit and [the] reputation which are necessary for the survival of the firm, the other measures of success could not exist.” In the employee-owned organization where the structure is such that employees receive profit-sharing at the end of the year; another expression of this same dimension was “rate of return to shareholders.”

In answer to the question: “How do you measure your success?” one respondent replied:

"I think the easiest measure is the bottom line and the rate of return to shareholder that [the firm] pays to shareholders. The other measure of success is how we are perceived by the business community and the industry as a whole, and in order to find that out we have a mechanism to measure the degree of satisfaction of our clients. Every time we finish a project, we send a questionnaire (one page) to find out the level of satisfaction and where we should put our efforts to best serve them. That is another way to measure our success. Our company has always been respected in the business community and by our peers [and] the architects [...] we feel it and we try to maintain it. It is not always easy but we nevertheless try."

It is worth noting, of a certain degree that a project-centrism underlies both the practice and business orientation of the engineering firms. Clearly, the element of client satisfaction is significant for reputation and professional pride, and it is therefore, an inextricable element in fashioning the requisite client base and project base.

Practice orientations

With respect to the **Practice orientations** in the engineering firms, the dimensions were: Professional reputation, referring to the perception of the firm held by peers, the business community and the industry in general. Related to this dimension are the aspects of "technical reputation" in doing challenging and prestigious projects. Employee satisfaction and morale: thus reflecting the important role of the service industry employees in the production and consumption of services; and are related to their satisfaction within the firm. Additional dimension included: Professional satisfaction and Pride in achieving professional excellence.

Project orientations

In the last category, **Project orientations**, the dimensions were: project quality, which encompasses "technical competence in work executed" and client satisfaction.

Cross Case Analysis -- General Contracting Firms

Business Orientation

In investigating the dimensions of performance in the general contractor firms, the responses were stated in a rather concise fashion. In the Business Orientation category, the following dimensions were identified.

Profit

Profits are assessed at two levels: at the project-by-project level and at the corporate level (aggregate). While the firms may opt for reduced profit from a particular project, they aim to maintain a balance at the aggregate level. It appears that the general contracting firms use profit as a significant measure of success and they pursue their business activities with appropriate alignment to this measure.

Growth in business volume

This dimension has a dual impact on business. It increases the potential for higher revenue and it enhances the opportunity for capturing a broader market share.

Growth in staff

This dimension is viewed as a measure of the financial strength of the firm and a reflection of its potential to assume growth and market expansion.

Expand knowledge base

This dimension measures the firm's ability to pursue business in a dynamic market unencumbered by narrow specialization.

Stability of personnel

This dimension reflects the firm's potential to undertake commitments on short notice and still ascertain the transfer of expertise required to execute the project.

Reputation

This dimension refers to the overall perception that the industry shares regarding a firm. A significant contributor to this dimension is client satisfaction, which is based on the firm's performance during construction, and on the perceived quality of the finished project. Given the business environment in which the general contractor firms operate, the firm's reputation in its respective industry is paramount for its success.

Project orientation

Quality of work

This dimension is assessed against a target of "zero defects." It is deemed to be directly proportional to client satisfaction.

Client satisfaction

Client satisfaction promotes the company's reputation, which naturally results in higher "desirability" as a bidder, leading to more invitations and to a greater negotiating power when it comes to alternative procurement methods.

Subcontractor performance

As the general contractors rely increasingly on subcontractors for the execution of the work, the performance of the general contractor firm becomes heavily dependent on the relations it maintains with its subcontractors. Thus the dimension of subcontractor satisfaction measures the potential of the kind of relationship conducive to improved profits and higher quality projects.

DISCUSSION

As it was pointed out in the introduction section, the performance dimension articulation by the informants have been grouped in three categories: Business, Practice and Project Orientation of the structure components of the firms. Framing the dimensions in the context of structure provides a diagnostic mechanism as to the fit of a firm for collaboration and joining a network. While the sample is small and the results can only be generalized as to the sample, the finding provide a foundation for future research with applications in networks and alliances. An instrument can be developed that can be used to identify the profile of an organizations and measure its fit for a project team or consortium. Examining the dimension listed in the Practice orientation in Table 3 (shown on a previous page), one observes the structural emphasis of the architect firm vs. that of the engineer firm. Such emphasis comes at a price. It may be a good fit for the requirements of a particular project and client but nevertheless it will need to be assessed on a case-by-case basis. Even more revealing is the information in Table 2 (shown on a previous page), showing the value ascribed to these dimensions by each type of firm. Compare the highest score (1) assigned by the architecture firms to both design and project quality to

Engineer and contractor assigning 1 to financial performance. Practical questions such as who is best suited to lead a team can be facilitated from the findings of this research.

CONCLUSION

In this study several sets of performance dimensions were identified for each of the three types of firms in the AEC that both confirm the prevailing anecdotal profiles of the different types of firms and also reveal the impact of structural make up of the firm and its espoused values as well as performance outcomes that are firmly tied to structural components.

It is significant to note the commonalities and differences among the design organizations (A&E). For example, expanding “client bases” appear as measures of performance in both A&E organizations and are closely related to reputation and project quality as an influence on client satisfaction. On the other hand, the Engineering organizations rank financial performance singularly as number 1, whereas the Architects place several dimensions at that rank. For Architecture firms, quality of project is the utmost performance criterion. This relative bias is reflected in the structure of the organization that is primarily set up to address the project needs. Other performance measures such as reputation, client satisfaction are also linked to predominantly project-centered structure.

As for the General Contractor firm, performance goals that include company growth in terms of dollar value and staff correspond to the changes in the industry and the need to aggressively pursue strategies that afford them early involvement in alternative procurement methods such as DB, BOT, etc.

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