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Organizational learning and performance improvement in civil engineering design firms

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Abstract

Learning rapidly and competently has become a pre-eminent strategy for improving organizational performance in the new knowledge era. Improving dynamic learning capability is an exclusive strategy for corporate success in construction industry. Thus engineering design firms should implement OL to accomplish a state of readiness for change and develop a competence to respond and identify future business potentials. This study aims to analyze the relationship between organizational learning (OL) and performance improvement (PI) in civil engineering design firms of Turkish construction industry. OL structure in engineering design firms incorporates five constructs: organizational environment, strategy development and implementation, supportive leadership, leveraging knowledge, and learning capability. The empirical data was collected through a questionnaire survey conducted to engineering design firms registered to the Turkish Chamber of Civil Engineers. The hypothesized model relationships were tested using Structural Equation Modeling (SEM). The results show that each of the variables has a different role and significant positive impact on the OL process and organizational PI. The variables "Supportive leadership" and "Learning capability" proved to be strongly significant and positively related to organizational performance in engineering design firms. In engineering design firms, supportive leadership is needed in order to establish a participative cultural environment that helps design a new form of organization which emphasizes learning, flexibility, and rapid response. Learning capability is the potential to explore and exploit knowledge through learning flows that make possible the development, evolution and use of knowledge stocks enacting engineering design firms and their members to add value to the design business.

Keywords: Organizational learning, Performance improvement, Civil engineering design firms, Construction industry.

1. Introduction

The importance of OL for the success and survival of organizations is widely recognized in the engineering-procurement-construction industry of the 21st century. Over the years learning has become increasingly important due to rapid changes in the market conditions, competition and technological developments, which leads to changes in the work and the way work is organized. Organizations are increasingly required to be learning systems if they wish to thrive in dynamic business arena. The ability and rate at which organizations can learn and react more quickly than their competitors, has emerged as a pre-eminent sustainable source of competitive advantage [1-2]. Learning by organizations as well as their individual members is critical for success in the future. The need for learning increases as engineered systems grow in complexity. Product and process complexity require specialization and approaches that integrate many different interdependent aspects of development. This increases information processing loads on developers and managers and thereby retards OL [3]. Therefore a primary constraint on improving products and processes can be the ability of engineering organizations to learn [4].

Learning processes are necessary to transform and refine a firm's knowledge resources in accordance with the environmental conditions. This link between knowledge and learning processes is often associated with the organizational capability to learn [5-6]. The link between OL and business performance has been discussed in recent literature [7-16], and there are also studies that analyze how organizational knowledge affects business performance [17-23]. Ford et al. [4] noted that the lack of OL ability is one of the primary constraints against contracting organizations' PI after

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analyzing some United Kingdom based case studies. Ruuska and Vartiainen [24] suggest that PI in construction projects is related to the contracting organizations' learning from performance feedback derived from the project monitoring system. Kululanga et al. [25] summarized the concept of organizational learning as the progress from a doing to a thinking workforce, from a reactive to a proactive readiness to change, from loss to gain of competitive advantage, from status quo to continuous improvement.

Learning rapidly and competently has become a pre-eminent strategy for improving organizational performance in the new knowledge era. Improving dynamic learning capability is an exclusive strategy for corporate success in construction industry. Thus engineering design firms should implement OL to accomplish a state of readiness for change and develop a competence to respond and identify future business potentials. No research has so far been conducted to study this relationship through competitiveness framework within engineering design firms in Turkish construction industry. This study aims to analyze the relationship between OL and PI in civil engineering design firms of Turkish construction industry. This study is the first attempt made to develop and apply a measurement tool to assess OL in the engineering design sector of Turkish Construction Industry.

2. Theoretical background

2.1. Organizational learning

OL is a complex process that refers to the development of new knowledge and has the potential to change behavior. Firms that have developed a strong learning culture are good at creating, acquiring and transferring knowledge, as well as at modifying behavior to reflect new knowledge and insight [26]. There have been numerous attempts to define OL and its various aspects. Senge [27] defined OL as "a continuous testing of experience and its transformation into knowledge available to whole organization and relevant to their mission", while Huber [26] saw it as a combination of four processes: information acquisition, information distribution, information interpretation and organizational memory. Argyris and Schön [28] declared that OL emerges when organizations acquire information (knowledge, understandings, know-how, techniques and procedures) of any kind by any means. Jones [29] emphasizes the importance of OL for organizational performance. He defines it as a process through which managers try to increase organizational members' capabilities in order to better understand and manage the organization and its environment".

Morgan and Ramirez [30] suggest that OL occurs when members use learning to solve a common problem they are facing. Every organization will develop the most suitable learning method taking into consideration the needs and characteristics of the organization itself [31]. Researchers also noted that organizations display different practice patterns described as OL type [32-34]. OL type can be defined as the manner in which an organization applies the imbibed knowledge for improvement actions [32]. A number of OL types were identified in previous studies [28],[35]. Argyris and Schön [28] identified that organizations mainly exhibited three major types of learning style, namely: single-loop learning, double-loop learning and deutero learning.

OL is learning that occurs as knowledge is transformed from an individual to a collective level [6]. Dixon [36] and Snell and Chak [37] suggest that OL entails meaningful change in the processes, structures or concerns connecting individual members. Easterby-Smith [38] suggests that OL is a process of organizational transformation and argues that individual and collective learning, fostered by learning activities, play a key role to furthering this process. According to Stewart [39], OL is a type of collective cognition where individuals constantly make sense of the environment and negotiate each other's learning experiences. Wong et al. [22] defines the organization learning process of the contracting organizations as a process of imbibing knowledge uncovered from past experiences and/or information gathered from external sources. The knowledge imbibed is subsequently captured by contracting organizations for improvement actions as and when they become necessary [32].

2.2. Relationship between organizational learning and performance improvement

Organizational learning establishes a relationship between environmental change and business strategy, or even attributing OL the capacity to change that relation over time is a way of recognizing that organizational learning is strategically relevant. Organizational learning seems to develop competencies that are valued by the clients, hardly imitable, and, as a consequence, they contribute to the competitive advantage of the firm [40]. Company performance should be analyzed with respect to important performance measures, and so identify learning disabilities and performance gaps. Such anomalies would be investigated and viewed as learning opportunities, and would be assimilated for effective actions. A linkage between strategy, actions, and measures is essential [41].

OL in construction has been defined as a process of applying the imbibed knowledge for PI by Kululanga et al. [25] and Kululanga et al. [33]. Murray and Chapman [34] stressed that facilitating the organization learning process is a fruitful mission that construction practitioners should aim to achieve. Generally, the implementation of OL has been advocated as one of the key constructs for the success of continuous improvement [1]. Some studies in OL identified the contingent effect of different learning styles on outcomes [34],[42]. These studies affirm the proposition that the practice of different OL styles affects the attainment of PI [43-45]. Skerlavaj et al., [20] present and test a model of organizational PI based on the impact of OL culture. Wong et al. [21] reported a study aiming to test the positive effect derived performance feedback on performance, and to identify the extent to which the learning types have significant impact on PI. Wong et al. [22] seeks to verify and examine the relationships between practicing different OL styles and the success of continuous improvement in construction projects.

3. Conceptualization of the research model and hypotheses

3.1. Operationalization of the measurement constructs

In this study, a research model is presented and empirically tested. Figure 1. depicts a model that includes five key constructs, "Organizational environment", "Strategy development and implementation", "Supportive leadership", "Leveraging knowledge", and "Learning capability", and the instrumental learning outcome "Organizational performance improvement". The measurement constructs used in the empirical study and hypotheses of the structural equation model are discussed. The following measures were constructed based on operational definitions developed from the literature review.

3.1.1. Organizational environment

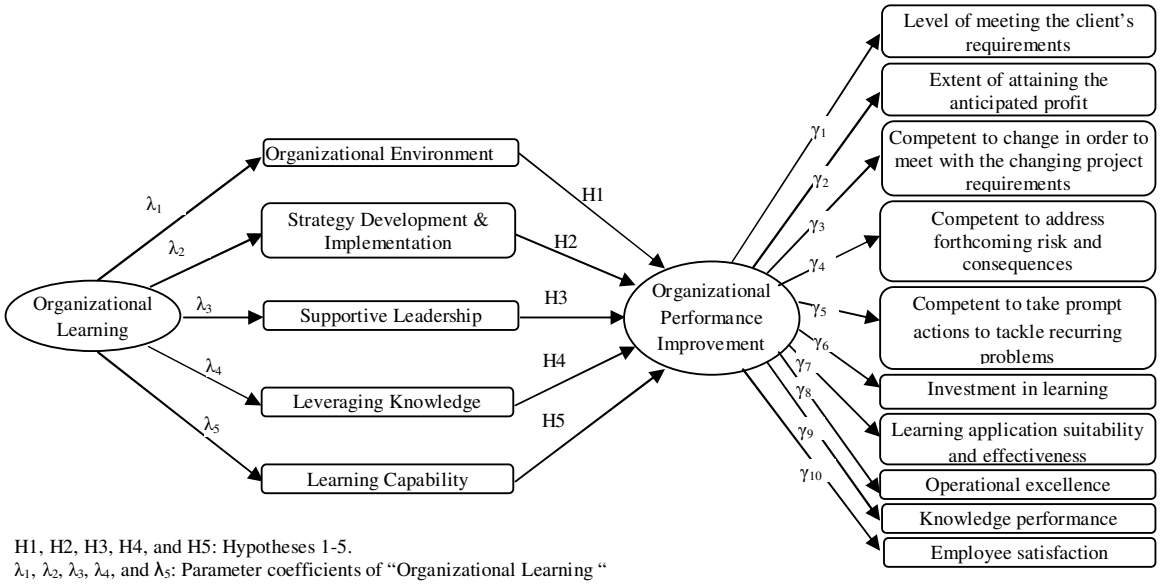
Today's engineering design firms operating within the industry deals with the continual changing environment to facilitate the learning process, creates and distributes information and knowledge. Roth [46] recognizes the importance of creating the right enabling environment to facilitate the learning process. Awareness for the need of different levels of learning, knowledge sharing use in practice is paramount. Every member within the organization should be willing and prepared to undertake learning, knowledge sharing, adaptation, and change. Commitment to learning and to continuous improvement through learning will be demonstrated in a culture of openness and without boundary, to remove barriers to learning and foster a participative work [47]. Organizational environment is evaluated by assessing the openness of communication within the firm, the positive attitude of professionals to change, continuous self-development, satisfaction with the work environment, and commitment to complete work together [48]. Construction managers who would like to facilitate learning in the organization, improve performance and promote a better organizational environment will show their commitment to learning, provide incentives to use that learning and use a more collaborative approach.

3.1.2. Strategy development & implementation

If engineering design firms are to become adaptive and responsive to the environment then they have to rethink their approaches so that learning can become an organizational norm and the vision of building a learning organization can be actualized. This may require engineering design firms to revisit their approaches to organizational survival, strategy development, and organizational change. OL process includes strategies and policy making to be structured ensuring involvement of all members. Company vision emphasizes learning and knowledge development, resources to support learning, active involvement in educational programs, and rewarding successful learning [27],[49]. The vision and mission should clearly reflect the direction and purpose of the organization and must be communicated and supported by individuals [47]. Long-term commitment to learning is supported by clear strategic direction. Training needs should be determined, and training systems should be continuously evaluated for effectiveness. Through training and education, employees will be equipped with tools for self-monitoring and self-correction, leading to continuous learning and improvement.

3.1.3. Supportive leadership

Good leadership is needed in order to establish a supportive and participative organizational environment that helps design a new form of organization which emphasizes learning, flexibility, and rapid response [47]. Leaders focus on building relationships, creating shared vision and strategy, and



H1, H2, H3, H4, and H5: Hypotheses 1-5.
λ_1, λ_2, λ_3, λ_4, and λ_5: Parameter coefficients of "Organizational Learning "
γ_1, γ_2, γ_3, γ_4, γ_6, γ_7, γ_8, γ_9, and γ_4: Parameter coefficients of "Organizational Performance Improvement"

Fig. 1. Hypothesized model

empowering people to enhance commitment to learning. Leadership commitment indicates the attitudes of a firm's leaders in supporting learning. The leader's role is to develop a shared vision, provide the resources needed, delegate authority, and celebrate learning successes [27]. For successful learning, Appelbaum and Reichart [49] stress that leadership has a profound impact on the organization. Leaders who recognize knowledge as a critical resource have a positive attitude towards OL [50].

3.1.4. Leveraging knowledge

For engineering design firms competing in the knowledge economy, the capacity to leverage knowledge is critical. To thrive in the new environment, engineering design firms must invest in knowledge tools and processes that contribute to strategic direction, while overcoming knowledge gaps [51]. The OL process is measured by determining how learning activities occur within the firm. This includes three phases: knowledge acquisition, knowledge sharing, and knowledge utilization. Knowledge acquisition is measured by how much new knowledge has been created or acquired by individuals in the firm, how much the staff have improved their professional knowledge, how often they reflect on their work, and learn from experience. Knowledge sharing is assessed by how quickly a new skill or knowledge can be disseminated throughout the firm, how much and often knowledge is shared among the professionals, and how much the staff learns from this exchange. Knowledge utilization considers how much professional staff tries new approaches in their jobs, and how often they change their design methods or work process [52].

3.1.5. Learning capability

Learning capability has been measured as a multidimensional construct in which knowledge stocks and learning flows are considered as representative dimensions [15]. Knowledge stocks in organizations exist at several levels [52] the individual, the group and the organizational levels. Obviously, organizations learn through their individual members, which develop knowledge through their personal experiences. Some individual knowledge may be applied directly to perform the assigned task, but much of it is shared with other individuals in a group before becoming a basis for action. This way, individuals inside groups develop knowledge in common in order to perform tasks in a coordinated fashion. Similarly, groups in an organization interact and communicate their knowledge to other groups, and acquire from them knowledge required to put their own knowledge into action. As a result, knowledge becomes integrated in the organization, and embedded in its systems, routines and values [6]. Learning flows in organizations are aimed at both the exploration and the exploitation of knowledge. Exploration flows occur when individual members generate new knowledge, and the groups and the organization progressively integrate it. Exploitation flows encompass processes that take and transmit embedded organizational knowledge that has been learnt from the past down to groups and individual members [53].

3.1.6. Organizational performance improvement

PI was identified as the ultimate goal of OL [54]. PI is an instrumental learning outcome defined by changes in the organization, products, services or processes. Contracting organizations are assumed to learn by adapting to the changes in market demand for PI [28], [1], and [34]. Performance was assessed by the contracting organizations' achievement in terms of meeting the client's requirement as well as the profit target [55]. PI can be assessed by the level of competence of contracting organizations in responding to the changing project requirements [1], [42] addressing the risk and consequences [42], [44], taking prompt actions to tackle recurring problems [56]. Other relevant measures of PI are investment in learning, learning application suitability and effectiveness, operational excellence, knowledge performance, employee satisfaction [47].

3.2. Research hypotheses and model

Review of the literature indicates that there are significant positive relationships between the learning organization constructs and the instrumental learning outcome, organizational performance improvement. The relationship between the dependent variable, organizational performance improvement, and the independent variables of the organization learning constructs, will be identified to explain the theory underlying these relationships and to describe the direction of the relationships. Figure 1. illustrates the conceptualized research model in which all the main constructs are shown together with the hypothesized relationships among them. In this context the following hypotheses are put forward:

H1. Organizational environment has significantly positive effect on organizational performance improvement.

H2. Strategy development & implementation has significantly positive effect on organizational performance improvement

H3. Supportive leadership has significantly positive effect on organizational performance improvement

H4. Leveraging knowledge has significantly positive effect on organizational performance improvement

H5. Learning capability has significantly positive effect on organizational performance improvement

4. Research framework and methodology

4.1. Measures

The constructs and variables used to operationalize the research were developed following the generally accepted guidelines of reliability and validity for multiple-item measures. A literature review was conducted for the concepts of the constructs, on the basis of which variables of the constructs were developed.

"Organizational environment" construct includes five variables aiming to capture the perceptions from the respondent about the extent to which creating the right enabling environment to facilitate the learning process is practiced in the organization. "Strategy Development &

Implementation" construct contains four variables aiming to measure the extent of organizations rethinking their approaches for organizational survival, strategy development, and organizational change. "Supportive leadership" construct includes nine variables aiming to measure the extent to which an organization's leaders emphasize the value of knowledge and are committed to knowledge management in the firm, vision of learning and knowledge development, resources to support learning, active involvement in educational programs, and rewarding successful learning. "Leveraging Knowledge" construct includes three main items involving 13 variables aiming to capture the perceptions from the respondent about the extent to which investment in knowledge tools and processes that contribute to strategic direction, the capacity to leverage knowledge, and learning activities occur within the firm. "Learning capability" construct includes two main items, knowledge stocks measured through 15 variables and learning flows measured through ten variables aiming to measure the extent to which the potential to explore and exploit knowledge through learning flows that make possible the development, evolution and use of knowledge stocks that enact organizations and their members to add value to the business in organizations. The instrumental learning outcome "Organizational performance improvement" includes 14 variables aiming to measure the extent to which the changing actions and cognitive maps of members of the organization, the organization's ability to defend, capitalize and apply knowledge that it creates in combination with other resources and competences of the organization, and in agreement with its strategic direction.

4.2. Sampling

The study was focused on engineering design firms that are registered with the Turkish Chamber of Civil Engineers (TCCE). Only the Istanbul, Izmir, Ankara, and Antalya regions were targeted in the survey, as these areas constitute the most populated and the most active regions in construction engineering. A list of civil engineering design firms within the construction sector was obtained from the TCCE. The list consisted of 267 engineering design firms. The sample includes relatively small to large firms. Firm size is determined by the number of professional staff, number of construction projects per year, and the size of a typical project in US dollars. A firm with more than 10-25 employees is defined as large – 20 percent were large size firms. The number of projects per year ranged from 25 to 115 projects; 75 percent were involved 25 to 50 projects. Project design costs ranged from $5,000 to $50,000 (90 percent) and to over $100,000 (10 percent).

4.3. Data collection

The empirical data was collected through a questionnaire survey, which was administered to engineering design firms registered to the TCCE. During the survey, only the firms from Istanbul, Ankara, İzmir and Antalya region were contacted and asked by the TCCE to participate in the study. They were then fully informed of the research objectives, that the research was a strictly scientific and confidential and that their anonymity was assured. A total of 205 completed questionnaires were received, giving a high response rate of 77 percent indicating that the sampling procedure was effective and that the respondents perceived the research to be relevant and worthwhile. The respondents were asked to rate the extent to of agreement with each statement based on a five point Likert scale of 1 (strongly disagree) to 5 (strongly agree). Contact personnel in the firms for the questionnaire survey were either the top management or senior management, therefore their level of knowledge expected to provide responses was acceptable for the purpose of validity of the survey results.

The hypotheses were examined using data collected in the questionnaire survey. The questionnaire was developed on the basis of a thorough literature review. The questionnaire consisted of 65 statements involving the variable items of the OL constructs, and organizational PI. In the questionnaire, each variable item is used for measuring the extent to which the firms improving dynamic learning capabilities for corporate success in construction industry. All the variable items in the questionnaire have been adapted from empirical studies cited earlier. This method increases the reliability and validity of the survey items. The question items for the above mentioned constructs are provided in Appendix.

5. Analysis and results

LISREL 8.8 statistical software package was used to test the hypothesized model shown in Figure 1. The Descriptive statistics and Pearson correlation were calculated first, after which the structural equation model (SEM) was analyzed. SEM approach bridges theoretical and empirical knowledge to allow a better understanding of the real world. This analysis establishes causal relationships among the latent variables and observed variables. The model specifies how latent variables or hypothetical constructs depend upon or are indicated by the observed variables. Figure 2. illustrates the results of hypothesized model used in this work, which represent the standardized structural coefficients. The magnitude of the coefficients of the variables reflects their relative importance.

5.1. Descriptive statistics and correlation analysis

Table I. shows the means and standard deviations as well as the interfactor correlation matrix for the study variables with the aim of valuating the significance level of the relationships exist. The correlation analysis highlights the relationships among the independent, and dependent variables examined in this research. All the constructs are interrelated and focus on "Organizational performance improvement". The significance of relationship can be expressed by a ρ -value. When ρ-value is <0.05, the relationship between the two sets of ratings is considered as significant. Examination of the correlation matrix shows that there are significant and positive linear associations among factors representing the variables such as "Supportive leadership", Learning capability", and "Organizational performance improvement".

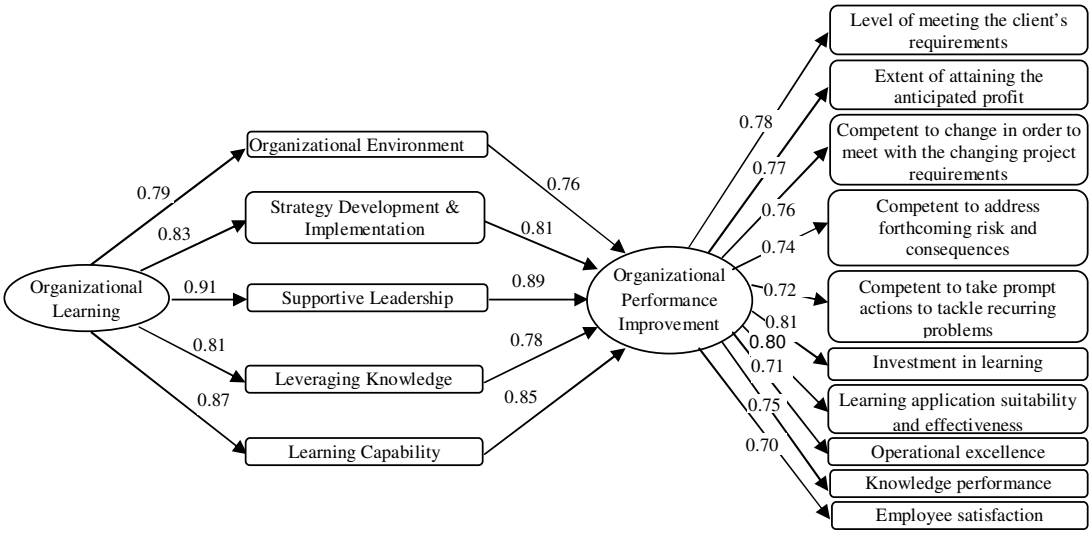


Fig. 2. Results of structural equation model

5.2. Factor analysis and reliability

Factor analysis was used to determine the key dimensions in the variables of the OL constructs. The variables of the OL constructs were empirically tested and validated by principal component factor analysis. The variables and concerned highest values of the factor loadings are shown in Table II. Overall and individual measures of sampling adequacy were computed to assess the appropriateness of the data for factor analysis. Values greater than 0.5 are considered acceptable. The reliability for each of the extracted factors is established by checking these factors for internal consistency using Cronbach's alphas. Cronbach's alpha (α) is based on the average correlation between variables within each factor where a value of 0.7 is the minimum acceptability value. Examination of the Cronbach's values revealed that all of the reliability coefficients α for the constructs listed in Table II. have acceptable levels of reliability. Some constructs were more reliable than others. The constructs "Supportive Leadership", "Learning Capability", and "Strategy development & implementation" have the highest reliability coefficients α with values 0.919, 0.895, and 0.843 respectively.

5.3. SEM analysis

The hypothesized model illustrated in Figure 2. presents the results of the relationships between the exogenous and endogenous variables. The model illustrates the hypothesized relationships among the OL, and organizational PI. The sample (n=205) was used to test the hypothesized relationships. The hypothesized model was tested using statistics indicating acceptable model fit, and was demonstrated to have a significant chi-square statistic (X^2=13.67 with df =7; ρ<0.01). The goodness-of fit indices (GFI), adjusted goodness-of-fit index (AGFI), normed fit index (NFI), and comparative fit index (CFI) values exceed the cut-off value of 0.90, demonstrating that the hypothesized model has statistically significant model fit.

5.4. Goodness-of-fit test

The results of goodness-of fit indices, GFI, AGFI, NFI, and CFI exceed the threshold value of 0.90 and the hypothesized model revealed good fit. A ratio of model fit statistics based on degree of freedom below 3 indicates adequate model fit (X^2/df = 1.95). RMSEA value reached an acceptable value of 0.069. Specifically, the GFI, CFI, AGFI, NFI, and NNFI values reached an acceptable value of 0.9 (0.95, 0.94, 0.94, 0.93 and 0.93, respectively). The hypothesized model in Figure.2 thus can be classified as closely fitting the data. Table III. lists the results of the goodness-of fit measures of the hypothesized model.

5.5. Hypothesis test

To test Hypotheses 1 through 5, the hypothesized model was tested using LISREL 8.8, where the paths between the OL constructs; organizational environment and organizational PI

Table 1. Descriptive statistics and pearson correlation analysis

Variable	Mean	S.D	1	2	3	4	5	6
1. Organizational Environment	4.94	0.91	1.000					
2. Strategy Develop.& Implementation	5.07	0.86	0.491**	1.000				
3. Supportive Leadership	5.23	0.77	0.513***	0.485***	1.000			
4. Leveraging Knowledge	4.98	0.89	0.445**	0.421**	0.477**	1.000		
5. Learning Capability	5.11	0.82	0.501***	0.533***	0.545***	0.557	1.000	
6. Organizational Performance Improve.	5.21	0.79	0.510***	0.525***	0.537***	0.517***	0.533***	1.000

*ρ < 0.1, **ρ < 0.05, ***ρ <0.01, n=205

(H1), strategy development & implementation and organizational PI (H2), supportive leadership and organizational PI (H3), leveraging knowledge organizational PI (H4), learning capability and organizational PI (H5) were estimated. The hypotheses regarding the relationships were tested based on the associated t-statistics. T-values exceeding 1.65 or 1.98 or 2.576 were considered significant at the 0.10, 0.05, and 0.01 levels, respectively. OL constructs; organizational environment, strategy development & implementation, supportive leadership, leveraging knowledge, learning capability, all have significantly and positively influenced ($\rho < 0.01$) the organizational PI with values respectively (H1= 0.76, t-value = 4.69, H2= 0.81, t-value = 4.94, H3= 0.89, t-value = 5.73, H4= 0.78, t-value = 4.85, H5= 0.85, t-value = 5.57). Thus, Hypotheses 1–5 were supported. Table III. Lists the results of the parameter estimates of the hypothesized model. Considering the standardized parameter estimates, the results show that five hypothesized relationships were classified as significant. Table IV. Lists the standardized structural coefficients of the variables, OL and Organizational PI, representing the magnitudes that reflect their relative importances of the relationships. "Supportive leadership" holding the highest significance of the relationship reveals that the role of a leader is vital in promoting learning. The roles of a leader consist of developing vision, empowering, inspiring, and stimulating people. By doing so, a leader would be the driving force for learning. "Learning capability" holding the second highest significance of the relationship is therefore one of the mechanisms that make organizations remain viable in terms of continuously producing new ideas and suggestions for changes that contribute to better organizational performance.

6. Discussion

Considering the above findings, all the hypotheses on the reliability and validity is supported and each of the organizational learning independent and dependent variables from both a theoretical and statistical perspective form solid constructs. There is support in the literature that the proposed hypotheses have implementation constructs and measurement items that cover these dimensions. The proposed hypotheses

Table 2. Factor analysis and reliability test

Construct and Outcome	Variable	Factor Loadings (Highest Value)	Cronbach's α
Organizational Environment	Positive attitude to change	0.753	0.764
Strategy Development & Implementation	Statement of vision	0.799	0.843
Supportive Leadership	Personnel in charge	0.893	0.919
Leveraging Knowledge	Change methods	0.775	0.822
	Learn from each other	0.621	
	Improve knowledge	0.569	
Learning Capability	Knowledge Stocks		0.895
	Being knowledgeable and qualified about work	0.831	
	Develop a common knowledge about work	0.819	
	Have a structure that allows working effectively	0.801	
	Learning Flows		
	Individuals share knowledge as they work within groups	0.793	
	Policies and procedures guide individual work	0.781	
Performance Improvement	Investment in learning	0.845	0.862

Table 3. Parameter estimates for structural equations model

Hypothesized model	Parameter coefficient	t-value
Construct relationship		
H1: Organizational Environment → OPI	0.76***	4.69
H2: Strategy Development and Implementation → OPI	0.81***	4.94
H3: Supportive Leadership → OPI	0.89***	5.73
H4: Leveraging Knowledge → OPI	0.78***	4.85
H5: Learning Capability → OPI	0.85***	5.57
Fit Indices: X^2=13.67, df=7, GFI=0.95, CFI=0.94, AGFI=0.94, NFI=0.93, NNFI=0.93, RMSEA=0.069		
*$\rho < 0.1$, **$\rho < 0.05$, and ***$\rho < 0.01$.		

have validity since they measure the theoretical constructs that they were designed to measure. The constructs of the OL were structured by component factor analysis. Factor loadings (highest values) are shown in Table II, and were well accepted.

The findings highlight that organizations are trying to anticipate and to react to fast changing external and dynamic competitive environments in a positive and proactive manner. In an organizational environment there must be certain degree of trust and openness between the members, of commitment and motivation, of risk taking mentality. This environment influences organizational processes such as problem solving, decision-making, communications, coordination, controlling, and processes of learning, creating, motivation and commitment.

The findings are in congruence with literature that engineering design firms are trying to explore many alternative strategies, structures, technologies, and business practices in their current turbulent environments. Engineering design firms review their internal and external environment to determine the knowledge required to enhance its competitiveness. Organizational strategy is conceived as a kind of planning aimed at formulation broad polices based on appreciation of firm's position in relation to its markets, competitors, technologies, materials and skills. Effective strategy tends now to be seen as requiring continual development of new understandings, models, and practices.

The results reveal that in engineering design firms, supportive leadership is needed in order to establish a participative cultural environment that helps design a new form of organization which emphasizes learning, flexibility, and rapid response. This leadership builds relationships, creates shared vision and strategy, supports for processes of change, and empowers people to enhance commitment to learning. The leaders, who act as mentors and coaches in construction processes, assess the adequacy of his organization's culture and can foster a learning culture by envisioning it.

The findings prove that leveraging knowledge throughout the engineering design firms enlarges the knowledge base and develops a sharing culture that is a stimulus to organizational learning. Knowledge-based structure for organizational learning process consists of three stages: knowledge acquisition, knowledge sharing and knowledge utilization. The engineering design firms were found to acquire new knowledge through multiple methods. Training courses provided basic information and up-dates on issues such as legislative change and thus helped to adapt operational processes to environmental change. Knowledge sharing was facilitated through more informal mechanisms, such as mentoring and coaching. In utilizing knowledge, engineering design firms use information technology tools and techniques for the application of knowledge to daily business processes.

The findings reinforce the literature on learning capability as the potential to explore and exploit knowledge through learning flows that make possible the development, evolution and use of knowledge stocks enacting engineering design firms and their members to add value to the design business. Therefore learning capability encompasses dynamically evolving knowledge stocks that continually flow both upward and downward all of individuals, groups and the overall organization. Learning capability gathers together both knowledge stocks and learning flows. Within the engineering design firms there are internal changes that lead to a continuous improvement allowing the organizational activities to be maintained, improved or adapted according to the environmental conditions. Engineering design firms try to make knowledge stocks through learning flows as a competitive advantage. These learning flows generate new knowledge stocks that are relevant in the strategic context of the organization.

Table 4. Parameters and relationships

Constructs and Outcome	Variable	Parameter	Standardized structural coefficient
Organizational Learning	Organizational Environment	λ_1	0.79***
	Strategy Development & Implementation	λ_2	0.83***
	Supportive Leadership	λ_3	0.91***
	Leveraging Knowledge	λ_4	0.81***
	Learning Capability	λ_5	0.87***
Organizational Performance Improvement	Level of meeting the client's requirements	γ_1	0.78***
	Extent of attaining the anticipated profit	γ_2	0.77***
	Competent to change in order to meet with the changing project requirements	γ_3	0.76***
	Competent to address forthcoming risk and consequences	γ_4	0.74***
	Competent to take prompt actions to tackle recurring problems	γ_5	0.72***
	Investment in learning	γ_6	0.81***
	Learning application suitability and effectiveness	γ_7	0.80***
	Operational excellence	γ_8	0.71***
	Knowledge performance	γ_9	0.75***
	Employee satisfaction	γ_{10}	0.70***

***$\rho < 0.01$.

The results reveal that investment in learning is vital for both survival and progression of the engineering design firms in the highly competitive construction market. Learning application suitability and effectiveness is a necessity for organizations to attain sustainable PI. Identifying the changing projects requirements and market demands, engineering design firms try to increase their level of competence in order to meet the clients' requirements. Thus achievement of measurable benefits, attaining the anticipated profit, and addressing the forthcoming risks will be the engineering design firms' learning outcomes as a benchmark for PI.

7. Conclusion and recommendations

This study analyzes the relationship between OL and organizational PI in civil engineering design firms of Turkish construction industry. OL structure in engineering design firms incorporates five constructs: organizational environment, strategy development and implementation, supportive leadership, leveraging knowledge, and learning capability. Using SEM method for analysis, the study explores how these constructs enforce the learning culture for engineering design firms to increase their OL competence and hence enhance PI.

Limitations that could lead to future research include two primary issues. First, this study took place within the frame of reference of one branch (engineering design firms) of a complex system (the construction industry). Second, this study examined only local organizations, excluding inter-organizational and international relationships.

This study provides empirical evidence for the importance of the relationship between OL constructs and the learning outcome, organizational PI. The results show that each of these variables has a different role and significant positive impact on the OL process and organizational PI. Pearson correlation coefficient indicates that most of the independent variable constructs had significant positive correlation with each other. Considering these research findings, all hypotheses, testing the reliability and validity, and the positive relationship between the OL constructs and the learning outcome, organizational PI, are supported.

Relationship assessment revealed that one construct, "Supportive leadership", proved to be strongly significant and positively related to organizational performance in engineering design firms. Supportive attitudes, behaviors and incentives will follow this commitment. This will create an organizational environment in which knowledge acquisition, sharing and utilization will be facilitated. The organizational structure and operations should also be designed in such a way to maximize the interaction among staff in terms of knowledge and learning. Another important emphasis is the "Learning capability". Thus, it is found that learning and development is the most significant predictor of learning organizations. Consequently, engineering design firms must focus initially on this fact to aid in the transformation from the current state to that of a learning organization.

In Turkish construction industry, the uniqueness and temporality of the project organization bring their own challenges and difficulties. Engineering design firms consider issues of learning and knowledge sharing as a strategic organizational concern. There are ongoing processes of learning taking place in all construction projects, in the individual work, within communities of practice, and between some of the professional groups. Knowledge and lessons learned from the past that belong to individuals are converted into organizational property, made accessible to the other members of the organization. Organizational culture plays an important role in shaping the members' behavior and creating the learning environment. An appropriate organizational design will enable an organization to execute better, learn faster, and change more easily. Thus the desire for learning and its application to change processes and behaviors lies at the heart of the learning organization and forms the foundation for the drivers pushing a learning organization culture.

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Appendix: List of Measurement Items

OL1 - Organizational Environment

OE1	Positive attitude to change
OE2	Climate of open communication
OE3	Continuous self-development
OE4	Satisfied work environment
OE5	Commitment to complete work together

OL2 - Strategy Development & Implementation

SDI1	Statement of vision
SDI2	People involvement
SDI3	Performance measurement
SDI4	Training evaluation

OL3 - Supportive Leadership

SL1	Personnel in charge
SL2	Company's vision
SL3	Leader involved
SL4	Appreciate successful learning
SL5	Mentoring and coaching
SL6	Flexibility
SL7	Rapid response
SL8	Building relationships
SL9	Enhance commitment

OL4- Leveraging Knowledge

Knowledge Utilization

LKKU1	Change methods
L KKU2	Try new way
LKKU3	Change procedures
LKKU4	Apply new knowledge

Knowledge Sharing

LKKS1	Learn from each other
LKKU2	Exchange knowledge
LKKU3	Knowledge sharing easily
LKKU4	Knowledge sharing frequently

Knowledge Acquisition

LKKA1	Improve knowledge
LKKA2	Develop new knowledge
LKKA3	Self-reflect
LKKA4	Improve competence
LKKA5	Learn new knowledge

OL5 - Learning Capability

Knowledge Stocks

Individual-level knowledge

LCKS1	Being knowledgeable and qualified about work
LCKS2	Have skills and competences for working properly
L CKS3	Being aware of critical issues that affect work
LCKS4	Feel confident about doing work
LCKS5	Feel a sense of responsibility on work

Group-level knowledge

LCKS6	Develop a common knowledge about work
LCKS7	Have capability to make decisions concerning work
LCKS8	Have capability for effective conflict resolution
LCKS9	Properly coordinate and organize their work
LCKS10	Successes and failures shared within the groups

Organizational-level knowledge

LCKS11	Have a strategy that positions well its future
LCKS12	Have a structure that allows working effectively
LCKS13	Have management methods that allow working efficiently
LCKS14	Have systems and documents containing worthy information
LCKS15	Culture is properly distinctive

Learning Flows

Exploration

LCLF1	Individual lessons learnt are exchanged within their work group
LCLF2	Individuals share knowledge as they work within groups
LCLF3	Individuals have input into the organization's decisions
LCLF4	Organization puts in operation suggestions made by groups or individuals
LCLF5	Organization do not "reinvent the wheel"

Exploitation

LCLF6	Policies and procedures guide individual work
LCLF7	Internal training and work training are provided within the organization
LCLF8	Interdisciplinary training, work rotation and special assignations are usual
LCLF9	Individuals know and put in operation group decisions
LCLF10	Past experiences influence on organizational future behavior

PI - Performance Improvement

PI1	Level of meeting the client's requirements
PI2	Extent of attaining the anticipated profit
PI3	Competent to change in order to meet with the changing project requirements
PI4	Competent to address forthcoming risk and consequences
PI5	Competent to take prompt actions to tackle recurring problems
PI6	Investment in learning
PI7	Learning application suitability and effectiveness
PI8	Operational excellence
PI9	Knowledge performance
PI10	Employee satisfaction