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Building the Link between Technological Capacity Strategies and Innovation in Construction Companies

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Abstract

Interest in construction industry innovation has been growing with the globalization and in parallel with change of the building production processes. However, despite its potential for gaining sustainable company performance, many construction companies have failed by management of innovation. In this context, the main theme of this study is to examine how technology capacity in construction companies changes according to the main innovation areas. The technology capacity and the integration of technology to organization is one of the main determinants of construction innovation. The main purpose of this study is to determine how the existence of different innovation areas in construction companies is related to the technology capacity features. A questionnaire survey was conducted to collect data from construction professionals, and they were asked assess their company's current position about technology capacity and activity level of predicted innovation areas—product, process, and organization. Independent sample t-test was employed to see the differentiation of technological capacity among different innovation types. The results indicate that the technology capacity of the construction companies, which are active in the fields of product, process, and organizational innovation, is in a varying strength.

Keywords: construction company, innovation, technology capacity, product innovation, process innovation

1. Introduction

Construction activity in Turkey is undergoing a transformation due to changing lifestyles and evolving needs. In recent years, intelligent building systems, environmental buildings, modern living spaces, home-office systems, and entertainment and activity centers have become indispensable for modern projects in the direction of new tendencies in the sector. The importance of urban transformation in Turkey increased in housing market. In the first three quarters of 2017, the annual real growth by 10.2% in the domestic construction sector exceeded GDP growth of 7.4%. Turkish construction companies continue to operate actively in domestic as well as abroad. In 2017, the total value of projects undertaken by Turkish contractors increased by USD 1.6 billion compared to the previous year and amounted to

USD 14.7 billion. The construction sector is highly sensitive to economic activity. Production in the sector is generally in line with economic activity. However, in the recent years, activities in the sector depend on the internal dynamics of the market conditions.

When we compare the Turkish construction sector with other sectors, it is observed that it is slow in terms of innovative trends, and technology-oriented innovation development and adaptation remains to be seen. According to the research results of Genç et al., only 14.8% of Turkey construction sector professionals are sufficient with innovation level in the construction sector [1]. However, in today's market conditions, innovating and adapting to it is critical for sustainable firm performance. The construction sector, which also triggers the internal dynamics of the markets in the country, is expected to show improvement in innovation areas.

Drucker emphasized that innovation is a major responsibility of management in all industries [2]. With the new dynamics of competitive international markets, the importance of this responsibility has also increased for construction companies. As a result of rapid developments in technology, changes in the number and quality of the connections of the sub-markets in different geographies of the construction sector have been actualized. This change allows firms to participate in international competitive environments, creating different competitive conditions and making innovation an important means of competition. As Carbonara and Pellegrino indicated that market concentration seems to be positively correlated to the innovation in construction industry; however, the internal technology capacity is also a necessity. For example better innovation opportunities are created through new contracting systems, such as BIM-based procurement procedures [3]. Bengtsson emphasized the importance of coordinated construction logistics that might not only be to increase productivity but also to facilitate collaboration, learning, and innovation between interorganizational actors [4].

In this context, the main theme of this study is to examine how technology capacity in construction companies changes according to the main innovation areas. Technology capacity of the construction company is a decisive force for product, process, and organizational innovations. Effective use of technology in products and processes is a decisive factor in ensuring collaboration that ensures the innovation process. It is unrealistic for the construction company to manage the complex processes of construction project without technology support and to be successful in collaboration. In that case, the size of the innovation in the construction company is strongly linked to the technology capacity. However, there is a lack in literature on how technology capacity need is transformed among different innovation types. So the main purpose of this study is to determine how the existence of different innovation areas in the construction companies is related to the technology capacity features. Searching for answers on how the differentiation for technology capacity requirements for innovation types in construction companies can be called as sub-purpose of this study. Product, process, and organizational innovations have diverse technology needs for formation in construction business.

The technology capacity and the integration of technology to organization is one of the main determinants of construction innovation. As Holt insisted that "radical innovations are the result of technological impetus, whereas minor innovations that follow arise in response to market demand" [5]. In that case, innovation in construction is a phenomenon that takes place with technology capacity within the organization and market pressure. Market and customer demands create beginnings and opportunities for innovation, but they are not enough. Findings of the work will provide important practicalities for future theoretical work on innovation in construction.

2. Technology capacity and innovation in construction companies: theoretical framework

Technology capacity is the managerial and organizational skills that an organization needs to efficiently utilize hardware and software technologies and to complement technological change processes [6]. Technology capacity, which we can define as the ability to find and use technology to maintain and achieve competitive advantage, is the use of the company's technical resources and all its technical functions to enhance and modernize the company's productivity and performance [7]. Whereas innovation is the application of new knowledge to the industry, this practice can take place in the forms of product, process, social, and organizational change.

Technology capacity develops in company's processes and is reinforced with the old experience of the company. Jin and Zedtwitz propose three basic steps to describe the technology capacity in organizations: acquisition, analogy, and technology development [8].

- Acquisition: Companies choose technologies from developed countries and acquire mature technology from multinational companies to reduce their entry risks and R&D investments.
- Analogy: Companies absorb the transferred technology and distribute the technology into the company.
- Technology development: Firms develop and innovate their own new technologies, ultimately enabling domestic technology to compete with top-notch innovations in developed countries [9].

In developing countries such as Turkey, construction firms often develop technology capacity in the forms of acquisition and analogy. "Technology development," which includes pure innovation, is proceeding in the form of purchases from developed countries and other sectors.

Technology capacity is an array of information that includes both practical and theoretical knowledge as well as methods, procedures, experience, and physical devices and equipment. Technology capacity includes the company's superior and heterogeneous technical assets and is closely related to product technologies, design technologies, process technologies, and information technologies [8].

Technology capacity, in this context, can be considered as the core capability that enables firms to develop and sell products and services valued by targeted customers and to manage customer relationships more effectively [10].

Technology capacity also refers to the ability to develop and design new products. It processes and updates the information about the physical world in unique ways and ensures that this information is converted into the desired designs and instructions. Thus, not only the technological capabilities but also the capabilities to expand the basic competencies effectively mobilize the technology flow and technological resources [11]. Moreover, technology capacity requires a deep scientific understanding. Unlike science, technology capacity is often implicit in firms' experiences and skills, as well as the ability to produce new knowledge [7].

For this reason, we can say that the strong tendency toward technology capacity will increase innovation efficiency. Innovation process and the ability to change construction companies are slower than in other manufacturing sectors. Adaptation of new ideas to the process and product is more difficult and slower [12]. Construction companies do not do laboratory work to develop radical new ideas,

but instead develop innovative solutions to solve everyday management problems. Innovation activity takes place in fractional and gradual stages in the construction companies' process [13].

The innovation in construction often has a particular tendency to be developed specifically at the project level (*ad hoc*), whereas in other production sectors, innovations are being developed in line with the ideas of employees, with their experience in production and service provision, and the challenges they face. In present market conditions, innovation and innovation management are admitted as an important tool in determining competitive advantage and organizational performance.

Barret et al. pointed out that there are many differences regarding innovation between the construction sector and other production sectors [14]. For example, in the building life cycle, the construction industry is constantly active and influential as a system; hence, a much larger proportion of the stakeholders must be involved in the innovation process, and innovation can arise in any area. Innovation in construction involves many actors, including governments, building material suppliers, designers, general contractors, specialist contractors, the labor workforce, owners, professional associations, private capital providers, end users of public infrastructure, vendors and distributors, testing service companies, educational institutions, certification bodies, and others. In their study on the role of stakeholder engagement in construction innovation, Widén et al. emphasized the need to develop communication plans as well as the formation of stakeholder engagement plans and strategies for prominent stakeholders as an integral part of construction innovation [15]. Therefore, innovation in construction takes more than the changes in people or ideas; the whole company must be organized in this direction, and the technological capacity of the company is one of the most important sources of innovation.

2.1 Basic innovation areas in construction companies

There are different ways to classify innovation in project-based organizations. A common classification originating from manufacturing studies is to separate between product and process innovations [4]. The first is product innovation. Products of construction are mostly durable so that it is usually possible to defer replacement of an existing structure. Another reason is that products of construction are usually costly investments. Product innovation represents innovative product/service development and delivery to the marketplace. The product may be a physical one, or it may be a combination of physical product and service as well as construction. In the context of the construction company, the application of innovative design trends, the application of new materials, and the implementation of technological innovations that will increase productivity are possible activities in this innovation area. From another perspective product innovation in construction is knowledge about design science (knowledge of behavior of the nature and knowledge of strength, stability, cost, esthetics, and function of the combined materials in the nature) and the knowledge about construction materials [16]. Kuznets also pointed out the central role of product innovation in long-term economic growth [17]. Nam and Tatum pointed out that product innovation is perhaps the most important contributor to the technological progress of the construction companies [16]. Some of the product-focused innovations described by managers involved in this study's field work include the development of new construction methods in seismic isolator structures, hard fill applications, the development of new materials in prefabrication and the design of better fasteners, and the development of sustainable building materials.

Nam and Tatum identified four key factors in product innovation in construction: owner's demands, problems, designer's bank of technology, and contractor's process technology [16]. The owner's demands are the key initiator of the innovation process for a constructed product. In a design company, key employees' technological capability is a reference point for innovative buildings.

The second basic innovation area is process innovation that is related to its capacity to be fast and flexible in construction processes. The knowledge about construction process—the methods for combining the materials, labor, equipment, tools, energy, new procurement systems, and other resources complete the basic elements of process innovation. It is able to provide standardization in building products and express the rapid adaptation of the changes in the project process in the organization. Being able to make different ways of construction methods from others is also considered as an important process innovation. Process innovation implies the development of internal processes and capabilities, including reengineering. Expert participants of this study indicated that enterprise resource planning (ERP) and system analysis and program (SAP) development applications for the organizational innovation in construction work, new hardware/software portfolio management information models, and proactive digital marketing strategies are developing elements for process innovation. Construction management; computer applications in design and construction, notably in computer-aided design and drafting (CADD); and integrating engineering and management data bases are also some examples for process innovation in construction. It is possible to say that lean construction and adaptation to Industry 4.0 area rising trends in the sector.

Finally, in the scope of this study, organizational innovation is discussed for the last basic innovation area. Organizational innovation can be interpreted as bringing the organizational structure into an innovative structure in general. It is important to design a target-oriented project organization structure. The development of collaborative work environments, major changes to the organizational structure, introduction of cross-functional teams, and outsourcing of major business functions are the other areas of activity to improve the technological infrastructure of communication channels and improve organizational structure.

It also deals with the implementation of a new or significantly changed corporate strategy and is about advanced management techniques, for example, knowledge management systems, Investors in People, etc.

3. Methodology

This study is a descriptive research. The descriptive research study is typically concerned with determining the frequency with which something occurs or the relationship between variables to make predictions [18]. After conducting an extensive literature review, the problem statement, research framework and measurement parameters for research construct were determined. To predict the differentiation of technological capacity among different innovation types like product, process, and organization in construction companies, a sample survey such as a cross-sectional study was conducted.

To assess the reliability of the research, Cronbach's alpha coefficient was employed. The reliability of the scales was measured by Cronbach's alpha, and these were compared to those in previous studies. The fact that the factor structure of a scale is appropriate for the theoretical underpinnings is a desirable component of studies on validity and reliability. Cronbach's α , as a measure of internal consistency, was also used to examine the reliability of the measurement scales. This value

is expected to be over 0.60 [19]. The reliability test results for the scales used in the research were above 0.60, which indicates that all factors have internal consistency ($\alpha = 0.944$).

3.1 Field research: innovation areas and technology capacity link

The survey asked construction professionals to assess their company’s current position about technology capacity. This survey consisted of four sections: (1) demographic data of the respondents (specialization, education background, age, etc.), (2) company information (size, location, market, etc.), (3) assessment the levels of technology capacity of the construction company, and (4) assessment the applied innovation types. Survey questions of technology capacity were asked using a seven-point Likert scale (1, strongly disagree and 7, strongly agree). The presence of different innovation activity types were asked as dichotomous questions (0, Active and 1, Non-active).

In this study, Wang’s technological capability measurement scale (with Cronbach’s α value of 0.90) [10] was employed to assess the construction company’s technological resources and abilities (Table 1). Wang’s technological capacity measurement scale consists of 10 parameters referring to technological capability of the construction company like investment in R&D activities, on-the-job training opportunities, etc. Figure 1 states the research framework of the study. According to the framework, this study assumed that technology capacity is a strong predictor for being innovation active in three basic innovation activity areas: product, process, and organization.

Statistical analyses were undertaken using the Statistical Package for the Social Sciences (SPSS). Independent sample t-tests were performed to test whether the mean values on each TC parameter for the groups were equal for:

- a. Product innovation active and non-active
- b. Process innovation active and non-active
- c. Organizational innovation active and non-active

Technological capability measurement scale
TC1. We always make relatively heavy investment in R&D activities
TC2. We have accumulated stronger and various technological skills
TC3. On-the-job training is provided frequently in our firm to improve the technical skills of employees
TC4. We are qualified to attract and motivate talented experts
TC5. We have the ability to accurately predict future technological trends
TC6. We are skillful in applying new technology to problem solving
TC7. We are one of the leaders in construction industry to establish and upgrade technology standards
TC8. We always lead technology innovation of the principal industry
TC9. Compared with our major competitors, we have competitive and powerful technology strategy
TC10. We have strong capability to integrate external technological resources with in-house resources of our firm

Table 1.
Wang et al. [10] technological capability measurement scale.

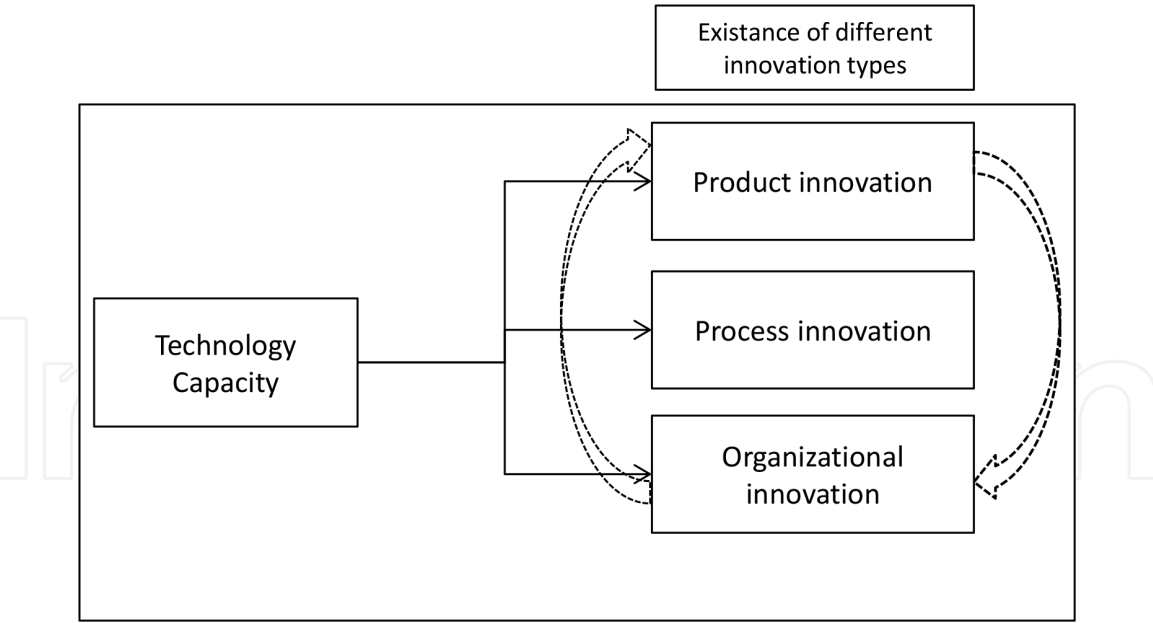


Figure 1.
Research framework.

3.2 Sampling and data collection

Regarding the scope of the study, the survey was sent to 150 members of the Turkish Contractors Association (TCA) and 150 members of Association of Turkish Consulting Engineers and Architects (ATCEA) via e-mail in a digital survey format. These associations represent a major portion of the civil engineering professionals in Turkey [20]. The pilot survey also revealed that most of the construction companies in Turkey apply innovation practices in a quantifiable manner. So there is no limitation for company size in this research as Mansfield suggests that the size of firms has little effect on innovation, at least when a firm is above some threshold size [21].

A total of 91 construction professionals actively working at construction companies in Turkey responded. Therefore, the survey's rate of response was 40%. The respondents were senior- and middle-level managers of construction companies listed in TCA and ATCEA.

According to the demographics of the survey, 45.7% of the respondents were in the age range of 25-35 years, while 31.9% were in the age range of 36-45 years. About 58.6% of respondents were civil engineers and 13.8% of them were architects. When the survey participants' characteristics were examined, it was observed that 71.6% had more than 400 employees and 75.9% had a parent organization. The fields of activity of the participating firms are several such as housing construction, heavy construction, construction except housing, construction management, and design.

4. Basic research findings

4.1 Link between product innovation and technology capacity

Product innovation represents the development and introduction of innovative products and services. According to the results of the study, 34 of the 91 production companies reported to be active in the field of product innovation. There were two ways of interpreting the results of the t-test. The first method was to compare the test significance level against the level of significance, which was set at 0.05. The

alternative method was to compare the test t-statistics against the critical t value. It can be seen from **Table 2** that all the technology capacity parameters have significant level <0.05 . When the technology capacity indicators of the companies that are active and not active in product innovation are examined, it is observed that the technology capacity of firms active in product innovation is high. To realize product innovation in construction companies, the parameters TC6 “the ability of application of new technologies in problem-solving” and TC5 “the ability to determine future technology trends and to determine the technology standards of the sector” become prominent. According to the empirical results, R&D investments and technology leadership strategies are ineligible in firms where product innovation has not been realized. The technology capacity of construction companies where the product innovation took place differentiates statistically ($p < 0.05$) in all technology capacity criteria from the companies that do not realize product innovation (**Table 2**).

4.2 Link between process innovation and technology capacity

Process innovation involves reengineering function which means the development of internal operations and capabilities. According to the results of the study,

Technology capacity parameters	Product innovation	Mean	Levene's test for equality of variances		t-test for equality of means		
			F value	Sig.	t value	Sig. (two-tailed)	Mean difference
TC1	Active (34)	5.50	3.277	0.074	5.582	0.000	2.06
	Non-active (57)	3.43			5.96	0.000	
TC2	Active	5.85	19.232	0.000	4.818	0.000	1.73
	Non-active	4.12			5.324	0.000	
TC3	Active	5.26	4.465	0.037	2427	0.017	0.96
	Non-active	4.29			2.545	0.013	
TC4	Active	5.79	11.510	0.001	4.290	0.000	1.44
	Non-active	4.35			4.748	0.000	
TC5	Active	5.88	5.337	0.023	5.150	0.000	1.86
	Non-active	4.01			5.810	0.000	
TC6	Active	6.00	14.521	0.000	4.11	0.000	1.36
	Non-active	4.63			4.72	0.000	
TC7	Active	5.67	12.830	0.001	4.91	0.000	1.85
	Non-active	3.82			5.53	0.000	
TC8	Active	5.50	4.496	0.037	5.389	0.000	1.99
	Non-active	3.50			5.935	0.000	
TC9	Active	5.70	5.301	0.024	4.154	0.000	1.53
	Non-active	4.17			4.588	0.000	

Table 2.
Independent sample t-test analysis results for product innovation.

47 of the 116 construction companies participated in the study reported that they were effective in the field of process innovation. When the technology capacity indicators of the companies that are active and not active in the process innovation are examined, it is observed that the technology capacity of the companies active in process innovation are higher in accordance with the results obtained in the product innovation. In order to realize process innovation in construction companies, the parameters TC5 “the ability to accurately predict future technological trends,” TC10 “strong capability to integrate external technological resources with in-house resources of our firm,” and TC9 “strong technology strategies” are fundamental. In the companies where process innovation did not take place, there was insufficient development in the field of innovation-oriented R&D investments and strong/various technical capabilities. In this type of construction companies, the intention of human resources to create initial ideas for innovation is weak. On the other hand, technology capacity of the construction companies where process innovation took place differentiates significantly ($p < 0.05$) in all TC criteria from the companies that did not perform process innovation (Table 3). Some examples

Technology capacity parameters	Process innovation	Mean	Levene's test for equality of variances		t-test for equality of means		
			F value	Sig.	t value	Sig. (two-tailed)	Mean difference
TC1	Active (47)	5.19	3.27	0.074*	5.72	0.000	2.03
	Non-active(44)	3.15			5.69	0.000	
TC2	Active	5.76	19.23	0.000*	6.37	0.000	2.06
	Non-active	3.70			6.27	0.000	
TC3	Active	5.29	4.46	0.037*	3.54	0.001	1.32
	Non-active	3.97			3.52	0.001	
TC4	Active	5.68	11.51	0.001*	5.22	0.000	1.63
	Non-active	4.04			5.15	0.000	
TC5	Active	5.59	5.33	0.023*	5.21	0.000	1.82
	Non-active	3.77			5.17	0.000	
TC6	Active	5.80	14.52	0.000*	4.31	0.000	1.37
	Non-active	4.43			4.26	0.000	
TC7	Active	5.44	12.83	0.001*	5.38	0.000	1.92
	Non-active	3.52			5.32	0.000	
TC8	Active	5.27	4.49	0.037*	6.13	0.000	2.11
	Non-active	3.15			6.09	0.000	
TC9	Active	5.46	5.30	0.024*	4.18	0.000	1.49
	Non-active	3.97			4.13	0.000	
TC10	Active	5.57	10.76	0.001*	4.71	0.000	1.50
	Non-active	4.06			4.64	0.000	

*Statistical significant at level of <0.05.

Table 3.
Independent sample t-test analysis results for process innovation.

of technological innovations adapted to management processes include adaptation of software portfolio management modules to integrated management systems, BIM maturity level, design, and development of ERP systems in the management of cash flows.

4.3 The link between organizational innovation and technology capacity

The organizational innovation field can be interpreted as bringing the organizational structure into an innovative structure in general. When the link between management innovation and technology capacity is explored, it is understood that the existence of management innovation in the construction firms is directly linked to the technology capacity. The maturity level of the technology capacity of construction companies that make the management innovation is significantly different from the firms that tend to stay traditional in terms of management. Innovation in the field of management is triggered by the use of new technologies to correct problems and activities in the construction process (TC6).

As Hartman stated out that the problems in construction business have a dependency of constructional tasks on clients or a dependency of constructional tasks on locations [22]. The changing demands of clients may lead to problems that may offer opportunities to propose a solution with new technologies that meets the demands best and create innovations. In addition to being influenced by technological capacity, innovation in the organizational field provides a convenient structure in its application. An investment that can be developed and implemented for a single project will not be feasible for both the firm and the investor.

The strong technological capabilities of the company are a prominent parameter for innovation in the field of management (TC4). The technological skills such as programming, project management, analysis of big data, data models, business intelligence, information security applications, etc. that the construction company own are also providers for innovative organizational structures (**Table 4**).

Ranking of the most differentiated technology parameters among different innovation areas.

A ranking of the working technology capacity parameters was carried out to determine the relative importance of the various TC parameters as perceived by the respondents (**Table 5**). This ranking is shown in **Table 4**. This shows that the four most important attributes identified were “TC6. We are skillful in apply new technology to problem-solving,” “TC5. We have the ability to accurately predict future technological trends,” “TC2. We have accumulated stronger and various technological skills,” and “TC4. We are qualified to attract and motivate talented experts.”

4.4 Limitation of the study

As with many studies of the construction industry, the selected research methods and data used in the studies can inhibit the generalization of the findings beyond the study sample [23]. First limitation effect on the study is the data gathering procedure. The surveys were not distributed to a random sample of the construction industry. And the second limitation of this study is that it was based on the measurement of the research constructs TC and INVACT using the survey respondents' own, perhaps biased, perceptions. Therefore, this research needs to be further examined using proper qualitative and quantitative measures instead of a self-assessment approach. Another significant point is that a larger sample size would provide greater reliability in the results.

Technology capacity parameters	Organization innovation	Mean	Levene's test for equality of variances		t-test for equality of means		
			F value	Sig.	t value	Sig. (two-tailed)	Mean difference
TC1	Active (54)	5.05	0.240	0.625*	5.779	0.000	2.08
	Non-active (37)	2.97			5.794	0.000	
TC2	Active	5.59	5.550	0.021*	6.061	0.000	2.02
	Non-active	3.56			5.827	0.000	
TC3	Active	5.16	4.272	0.042*	3.260	0.002	1.24
	Non-active	3.91			3.170	0.002	
TC4	Active	5.62	6.270	0.014*	5.891	0.000	1.81
	Non-active	3.81			5.611	0.000	
TC5	Active	5.46	1.863	0.176*	5.167	0.000	1.84
	Non-active	3.62			5.101	0.000	
TC6	Active	5.75	12.772	0.001*	4.754	0.000	1.51
	Non-active	4.24			4.492	0.000	
TC7	Active	5.35	2.283	0.134*	5.744	0.000	2.05
	Non-active	3.29			5.650	0.000	
TC8	Active	5.11	0.458	0.500*	5.958	0.000	2.11
	Non-active	3.00			5.989	0.000	
TC9	Active	5.51	1.128	0.291*	5.551	0.000	1.89
	Non-active	3.62			5.419	0.000	
TC10	Active	5.53	2.813	0.097*	5.387	0.000	1.69
	Non-active	3.83			5.217	0.000	

*Statistical significant at level of <0.05.

Table 4.
Independent sample t-test analysis results for management innovation.

	Product innovative active companies	Process innovative active companies	Organizational innovative active companies
TC6	1	1	1
TC5	2	3	
TC2	3	2	3
TC4			2

Table 5.
Importance ranking of technology parameters among innovation areas.

5. Conclusion

Innovation plays an important role in successfully responding to changes in the construction company's environment. Innovation is an important competitive edge and a prerequisite for organizational success [24]. Being open to changes and,

respectively, adapting to new conditions need to be the main component of the innovation strategy in construction industry. Secondly, developing technical aids and using them for problem solving is indispensable component for being innovative in construction business. Industry relationships and client demands have an extremely significant influence on construction innovation [23, 25, 26].

In order to produce innovation in a successful organization, different factors need to come together, and the knowledge assets of innovation should be managed effectively. The technology capacity covering the majority of the information assets of innovation is an important innovation enabler for construction companies. As a result of this study, it has been determined that the technology capacity of the construction companies, which are effective in the fields of product, process, and organizational innovation, is in a varying strength.

It has been predicted that product innovation activities in construction companies have increased and become active with the application of new technologies in problem solving. The use of innovative material and construction technique indoor or outdoor applications is possible by using the company's technology to solve problems in the emergence of this new product.

Process innovation, which is another innovation area, is developing especially due to integrating external technology resources with internal resources. For example, combining different project management modules with ERP, which is a holistic management system approach, will facilitate the implementation of an innovative system in the company's processes.

Finally, organizational innovation is an essential element for the formation and development of all kinds of innovation. The companies that are in the organizational innovation process have a high capacity to apply new technologies in problem solving, similar to the construction companies that perform product innovation. This means that the organization is open to change and can adapt to change. New project delivery models and organizational models are constantly evolving in the process of complex global construction projects. At this point, the management and perfection of multiple new connections of organizational change necessitate the adaptation of new technologies. As an example, IPD system applications are becoming a rising trend in the sector and necessitate the change and renewal of organizational structures. In this type of dramatic changes, the introduction of new BIM applications in communication and contract management processes becomes important for the project success.

Unlike other sectors, the construction sector is project-based, and the challenges brought by the cooperation and collaboration of stakeholders bring innovative developments to a standstill. The strengthening of both the technological infrastructure and the human resources in the context of the technological capacities of the construction companies is the main source for product, process, and organizational innovation.

Turkey as a developing country is in the process of harmonization with the European Union. In the process, according to the Republic of Turkey Ministry of Development's Tenth Development Plan (2014–2018), placing the concept of innovation in the construction sector, the locomotive of Turkey's economy, was in the main targets.

In this context, by supplying the production and service quality of the construction sector to international standards, supply and demand must be provided with a high-value-added and sustainable structure with an innovative approach. In order to maintain competitiveness abroad, focusing on high-quality and information-intensive projects is of great importance among the targets set by the ministry [27]. In this context, the fact that Turkish construction companies are active in innovation is gaining importance in terms of the economic plans of the sector and the

country. The development of new technologies for the use of new technologies in the solution of the problems at various stages of the construction project comes to the fore in terms of both company and industry performances.

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