

Exploring the Association Between Knowledge Management and Innovation Capability in R&D Centers

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Abstract

Businesses striving to survive in today's highly competitive market conditions are continuously trying to utilize innovation related strategies to sustain their position and competitiveness. Knowledge management, on the other hand, has been shown to have a significant influence on the innovation capability of the organization. Thus, the aim of this study is to examine the relationship between knowledge management practices and innovation capability in research and development (R&D) centers operating in Istanbul and Kocaeli / Turkiye through an empirical study. The data used in the study was collected from the managers of R&D centers using a web-based questionnaire, as well as face-to-face meetings. A complete census method was used as the sampling technique, and 220 R&D center managers in the region were contacted. Among the managers contacted, only 182 managers provided data and were included in the study. Multiple hierarchical regression analysis was used to analyze the data obtained. As a result of the analyses, it is found that the knowledge acquisition dimension has a significant positive relationship with the learning capability, production capability, marketing capability and strategic planning capability. In addition, the results revealed that storing and sharing knowledge have significant and positive relationship with production capability, and transforming knowledge has a significant and positive relationship with both marketing and organizational capability. In particular, it is concluded that knowledge acquisition and sharing are important in terms of learning, production, marketing and strategic planning dimensions of innovation capability specifically in R&D centers.

Keywords: knowledge management, innovation capability, R&D centers, Turkiye

1. Introduction

Businesses trying to survive in today's rapidly changing market conditions and highly competitive conditions are constantly in search of innovation and mostly use product and service differentiation strategy to create a difference to hold on to the market more. Innovation capability plays an important role in this strategy. Thanks to their innovation capabilities, organizations are able to introduce innovative practices in their processes and products and thus have the chance to sustain their success in a dynamic structure that is open to learning (Calantone et al., 2002).

R&D (Research and Development) centers are among the most important departments / organizations for obtaining and developing innovation capability, which has an impact on the efficiency and success of organizations. R&D centers are active in researching and developing designs, products and processes in order to produce technological knowledge in organizations, to innovate in production processes, to improve product quality and standards, to increase productivity and to reduce costs. In this framework, R&D centers contribute greatly to organizations' sustainable competitiveness in national and international markets through the innovation capability they provide. Therefore, organizations operating in almost every field and sector establish R&D centers in order to acquire and use such an important capability. With the technological services and contributions they provide, R&D centers are seen as a triggering factor for producing what is different and new for the use of innovation capability (Colombo & Garrone, 1996).

Despite the fact that R&D centers are so important, especially in increasing the innovation capabilities of organizations and using them effectively, it is seen that academic research on the studies of R&D centers in

regional terms and increasing their innovation capabilities is somewhat limited in Türkiye. In this study, in order to close this gap and to reinforce the relationship between knowledge management and innovation capability with an applied study, we have focused on the R&D centers operating in Istanbul and Kocaeli and investigated the impact of knowledge management on the development of innovation capabilities of these centers.

Utilization of R&D centers in Istanbul and Kocaeli, which are cities in the Eastern Marmara Region of Türkiye, has developed very rapidly during the recent years due to several reasons, including (1) this region is at the center of the logistics distribution networks, (2) several techno parks, universities and technology based industrial regions operate in the region, and (3) this region has come into prominence as the industrial and economical center of the country. The fact that most of the companies in the list of "Turkey's top 1000 exporters" are located in the Istanbul and Kocaeli is another indicator that this region is the locomotive of our country in terms of development and sustainability. For this reason, in this study, we have considered this region, whose importance and influence in terms of both industry and trade is gradually increasing. We have investigated an issue that will further reinforce the importance of the region and will highlight the benefit and effectiveness of R&D centers in the region, which will promote innovation capability.

Today, especially with the fast development and spread of information and communication technologies, data and information continue to increase rapidly in every field. The important issue is the correct and reliable use of this data and information. Within the framework of all these objectives, in our research, we specifically explored the relationship between knowledge management and innovation capability in R&D centers operating in Istanbul and Kocaeli.

2. Theoretical Background and Hypotheses Development

2.1 Dynamic Capabilities Framework

In the present study, we have embraced the conceptualization and operationalization of dynamic capabilities as articulated by Teece and his colleagues. This framework includes the identification of opportunities to fulfill customer demands, the mobilization of resources to exploit these opportunities, and the continuous renewal through transformative actions (Teece, 2007, 2012, 2014, 2023; Teece et al., 1997).

The term dynamic capability encompasses a firm's proficiency in assimilating, cultivating, and restructuring its internal and external competencies to navigate rapidly changing environments. Unlike operational or "ordinary" capabilities, which focus on the current operational activities of an organization, dynamic capabilities highlight the organization's potential to deliberately generate, expand, or adjust its resource base (Helfat & Winter, 2011). The fundamental premise of the dynamic capabilities framework posits that core competencies ought to be leveraged to adjust immediate competitive standings, which can subsequently facilitate the establishment of enduring competitive advantages. According to Eisenhardt and Martin (2000), dynamic capabilities encompass recognized organizational and strategic processes, such as alliances and product development, whose strategic significance is derived from their capacity to transform resources into value-generating strategies. These capabilities develop through established learning mechanisms.

Teece (2017, 2023) emphasizes that processes and learning, which are vital aspects of knowledge management, constitute key dynamic capabilities for organizations. The knowledge that organizations generate is embedded within their routines, which are characterized as established interaction patterns that effectively resolve particular problems. These patterns are evident in collective behaviors, while some sub-routines may be associated with individual conduct. In addition to the learning process, the creation of strategic assets, such as information and knowledge, represents another crucial dynamic capability. For instance, routines related to alliances and acquisitions can facilitate the incorporation of new strategic assets from external sources into the organization as being done in knowledge management processes.

The interplay between dynamic capabilities and innovation capabilities warrants careful consideration. Helfat and Winter (2011) characterize dynamic capabilities as an organization's ability to intentionally create, enhance, and alter its resource base. In contrast, we previously noted that innovation capabilities may be classified as either dynamic or non-dynamic (Teece et al., 1997). The authors argue that conventional innovation endeavors, including product development and research and development, do not inherently possess dynamic qualities unless they foster a sustained ability to adjust to evolving environmental conditions. Innovation capabilities can function effectively even in relatively stable environmental contexts, or they may not possess the essential characteristics required for the reinterpretation and reconfiguration of knowledge and resources in response to environmental changes and instabilities. Furthermore, they may lack the capacity to influence the environment itself. Conversely, as highlighted by Lawson and Samson (2001) and Terziowski (2007), innovation capabilities can also be highly dynamic, facilitating significant reinterpretation, recombination, and transformation of an

organization's knowledge and resources, thereby enabling adaptation to evolving environmental conditions.

In conclusion, we assert, consistent with Teece (2012), that the integration of specific routines, processes, and methodologies inherent in knowledge management, alongside a vigorous entrepreneurial management function, is likely to foster the development of dynamic innovation capabilities over time.

2.2 Innovation and Innovation Capability

Although it has been defined in several different ways, innovation can be stated simply as the introduction of new methods in the social, cultural and administrative environment of organizations (Erturk, 2012). The start of industrialization has caused globalization to be felt strongly throughout the world. With industrialization, technology has also developed rapidly, creating a competitive environment in the fields of import, export, trade, marketing and sales. The acceleration of the intensely competitive environment has necessitated diversity in the field of production, and the search for the newer and better has begun. New ways of doing things do not only apply in production but also in different systems triggering various ways and ideas that pioneer the development of innovation. The value and importance of innovation in the development of business in an intensely competitive environment has been growing steadily. Organizations have seen innovation as a means to grow and survive in the competitive market. They have explored plans to gain higher profits from the market by offering better and higher quality products (Maravelakis et al., 2006). Organizations have started to benefit from innovation in order to create a difference among their competitors by applying different strategies. The fact that innovation can be applied to almost every field has made it a priority to be differentiated in the eyes of the customers (Vila & Kuster, 2007). Positive and significant influence of innovative approaches even in managerial & leadership processes have been shown in many studies, and demonstrated to promote fairness, motivation, commitment, communication, satisfaction, and organizational identification (e.g., Alper, 2007; Aksoy & Ertürk, 2014; Ertürk et al., 2005, 2018; Karakitapoglu-Aygun et al., 2023; Tekin & Ertürk, 2014).

Organizations that focus on innovation have focused on developing new models by turning to the research centers they have invested in. In this respect, innovation has become a management function rather than just an approach. It has also been applied in SMEs and has proven to increase efficiency and effectiveness in all manners (Rosenbusch et al., 2011).

Although the impact of innovation on organizations varies according to the size and industry of the organization, it has provided a positive contribution to all businesses. While the target customers of small organizations include people in a certain region, large companies operate in a broader sense. Those characteristics also affect the decisions of where and how to apply innovation in the processes (Martinez-Olvera & Davizon-Castillo, 2015; Rosenbusch et al., 2011). Application of innovation and innovative approaches has been proven to be effective in almost all sub-functions and processes of the organizations, such as logistics, supply chain management, production, human resource management, and information technologies (Badillo et al., 2015; Ertürk & Alkhayat, 2021; Fish, 2015; Tekin et al., 2015; Tozan & Ertürk, 2015).

2.3 Knowledge Management

The concept of knowledge is defined as the entire experience of the person who is understanding and making the sense of values and opinions necessary for the implementation of knowledge management (Rubenstein-Montano et al., 2001). Knowledge is the ability to interpret and give the meaning of the data that people acquire and use (Grant, 1996). Knowledge is the collection of tools that are effective in solving problems and, at the same time, can be expressed in terms of resources (Gupta et al., 2000).

Knowledge management, on the other hand, can be explained as the preparation of all the necessary infrastructure to proceed to the implementation phase by evaluating the necessary tools, techniques, methods, as well as the data itself in order to realize organizational goals and objectives. This process will be achieved by obtaining the necessary data, establishing the control mechanisms and monitoring this process to maintain its continuity (Lee & Suh, 2003). Knowledge management can also be considered as the maintenance of processes that are required by the organization in the processing of data & information, establishing strong communication, providing human resources, determining financial needs, and finally providing and making all necessary components available (Fugate et al., 2009).

Knowledge management provides the establishment, management and execution of the infrastructure that is crucial for meeting the requests and expectations of the organization's management, employees and customers. For that purpose, the data obtained is transformed into information in the form of different dimensions for the most benefit of the company, as well as other stakeholders (Gupta et al., 2000). Within the scope of knowledge management, all established processes to successfully manage and utilize the data also provide important

opportunities for businesses to align their strategic long-term goals with short-term targets, and to attain a sustainable competitive advantage (Biloslavo et al., 2019).

Organizations' innovation capabilities, as explained above, constitute the driving force for economic growth and development. The most important resource required for organizations to use this driving force is the knowledge and the effective management of this knowledge. It has been shown in the literature that organizations, which do not implement good level of knowledge management practices, cannot utilize their innovation capabilities effectively to foster their performance (Sancho-Zamora et al., 2021).

Organizations' ability to capture, evaluate and utilize new information suitably has led to the development of innovation capability (Sancho-Zamora et al., 2021). Organizations' willingness to innovate requires them to use existing knowledge and to utilize their capabilities to obtain new knowledge. R&D capability provides a very important tool and infrastructure for organizations that aim to obtain accurate and right data, and to transform that data into information, and knowledge. According to Narasimhan et al. (2006), organizations that use R&D capability are found to increase their innovation capabilities and, indirectly, their "profitability" ratios, and it is also emphasized that profitability ratios are related to the rate of "technological change."

2.4 Hypothesis Development

The relationship between knowledge management, innovation capability and the financial and non-financial success of the business have been discussed in many studies and put forward in different ways. These studies clearly demonstrate that when knowledge management and processes are properly designed and used effectively, they provide opportunities for more effective innovation capability, which in turn has a direct and strong impact on the success of businesses.

Lane et al. (2006) has shown that the knowledge management process, especially the process of transforming knowledge, should be operated effectively and correctly, so that this process makes a difference even on the motivation of employees, and that for this reason, it is necessary to be "attentive, meticulous and questioning" to ensure organizational success. Todorova and Durisin (2007), on the other hand, have drawn attention to the effects of knowledge preservation, and effective sharing of knowledge within the organization on learning and R&D capability by demonstrating that R&D capability positively affects organization performance in highly competitive markets. In their study, it has also been yielded that the preservation of knowledge helps the organization differentiate the data to be obtained and thus positively contributes to the value of the organization in the market (Todorova & Durisin, 2007).

According to Zahra and George (2002), the applicability of knowledge contributes to the creation of an environment of trust in organizations and, thus, to the development of the ability to learn by acquiring new knowledge without negatively affecting the processes. According to Flatten et al. (2011), the provision of resource allocation capability contributes to the growth and development of the organizations by enabling the acquisition of knowledge and helping the organization take one step further to achieve their goals. According to Kostopoulos et al. (2011), organizations that transform data into knowledge through acquiring new data improve their production capabilities by expanding their capacities. They have also concluded that resource allocation capability creates an advantage for innovation to promote their value in the market, and thus increase their financial performance.

According to Wang and Han (2011), the applicability of knowledge directly increases the performance of innovation capability. Organizations that process and utilize knowledge effectively with the help of technology have a significant increase in their innovation capabilities, from resource allocation to production capabilities. Similarly, in their study Camison and Fores (2010) have revealed that the increase in the competitiveness of organizations in the global competitive environment and the sustainability of this competitiveness are directly related to the correct and effective use of knowledge management and innovation capabilities. Nemanich et al. (2010) have also shown that knowledge management contributes to the emergence of a skilled workforce, thus providing a significant opportunity for economic benefits.

According to Hsu and Fang (2009), when production capability provides applicable knowledge, continuous innovation increases and benefits are created. Thus, new product development strategies should be promoted to contribute to the sustainability of organizations' competitiveness in the market. Some other studies have also revealed that innovation capability provides organizations with different entry routes to the market, allows them to use different marketing methods, and thus creates advantages to hold on to the market against existing competitors (Jansen et al., 2005; Narasimhan et al., 2006).

Keskin (2006) has found a significant positive link between market orientation, learning, and innovation

capabilities in SMEs. Forsman (2011) has investigated the innovation patterns prevalent in SMEs, concluding that the differences between manufacturing and service sectors were not substantial, with more significant variations occurring between different industry sectors (Forsman, 2011). In addition, Hertog et al. (2010) have formulated a conceptual framework for the capabilities required to manage service innovations, specifying six dynamic capabilities that are vital for effective service innovation management.

Oskaya et al. (2015) have contended that innovation capabilities mediate the relationship between knowledge and product innovation, as well as the connection between inter-functional cooperation and product performance. In parallel, Stronen et al. (2017) have explored the relationship between dynamic capabilities and innovation capabilities in organizations, discussing the extent to which innovation capabilities can be viewed as a subset of dynamic capabilities.

According to Knockaert et al. (2014), making effective use of knowledge management and technology-supported innovation capability leads to the accomplishment of significant results and indirectly increases organizations' capacity. Innovation capability has also been shown to positively contribute to the realization of organizations' strategic plans by facilitating knowledge acquisition in the process required for innovation (Li, 2011). In another study conducted by Hervas-Oliver et al. (2011), it is argued that organizational innovation capability contributes to the introduction and marketing of products that provide appropriate price advantages in order to meet customer expectations. Thus, it is possible to create innovative models that meet the market's expectations. According to Rothaermel and Alexandre (2009), the effective use of knowledge in the right fields by using organizational capability eliminates customer-related and organizational uncertainties. In their study, Lau and Lo (2015) have also demonstrated that the proper operation of the knowledge acquisition process improves strategic planning capability, which directly contributes to sales and marketing strategies. Nemanich et al. (2010) have yielded that strategic planning capability is directly related to the improvement of production technology. In addition, increasing new market share is possible by obtaining and transforming important information from critical sources and thus increasing strategic planning capability. This strategic planning capability helps organizations to grow in the market and strengthen their competitive position against their competitors.

Yam et al. (2011) have also revealed that, with strategic planning capability, organizations can improve their financial and non-financial performance. By using existing resources correctly, in other words "exploitation", and generating and utilizing new resources, in other words "exploration", they can gain superiority in the market in terms of time and cost and increase their profitability. According to Xia and Roper (2008), with strategic planning capability, product quality is improved, and customer demands are met at a high-quality level. Quality can be achieved easily and in a more efficient way in organizations that use strategic planning capabilities. In a recent study, Sancho-Zamora et al. (2021) have also demonstrated the strong relationship between knowledge management, in terms of organization's absorptive capacity and the innovation capability.

In a more recent study, the orientation towards knowledge management has been identified as a factor that amplifies the positive and significant effects of innovation capabilities in small and medium-sized enterprises (SMEs), primarily through enhanced management and integration of critical internal and external knowledge (Ferraris et al., 2021). Furthermore, research has established a positive relationship between knowledge management behaviors and innovation performance in SMEs (Zia, 2020). In their investigation of SMEs in China, Yao et al. (2020) have also found that knowledge sharing and effective knowledge management significantly bolster the innovation capabilities of these organizations.

The research conducted by Chatterjee et al. (2021) indicates that the activities related to knowledge sharing among the subsidiaries of multinational enterprises are vital for driving product and process innovation. Moreover, the firms' absorptive capacity plays a significant role in shaping the relationship between knowledge-sharing efforts and various dynamic capabilities. In a more recent investigation, Gui, Lei, and Le (2024) have found that knowledge management capabilities have a direct and positive influence on process innovation, which is further enhanced through CSR initiatives, as reported by Gonzalez-Ramos et al. (2023). A variety of other studies have also highlighted the positive and significant correlation between knowledge management and innovation capabilities, often through mediating or moderating mechanisms (e.g., Shehzad et al., 2023; Song, 2023; Zhou et al., 2023).

In the light of all these studies, it is plausible to hypothesize that:

Our Hypothesis: knowledge management sub-dimensions positively and significantly contribute to organizations' innovation capabilities.

3. Research Methodology

3.1 Data Collection and Procedure

The scope of the research covers the R&D centers of the companies operating in Istanbul and Kocaeli, cities in the Eastern Marmara Region of Türkiye, which is considered the center of industry and technology-oriented businesses. In order to identify the companies that will be included in this study, the list of companies operating in Istanbul and Kocaeli and having R&D centers was obtained through the database of the Ministry of Industry and Technology. Invitations to participate in our research were sent to the managers of all the R&D Centers, selected using the complete census method, in which we select all participants.

A total of 220 R&D centers were included in the data collection process. E-mail was preferred and used as the data collection method. Participation in the study was entirely voluntary; no explicit identification information was requested about the participants or the companies, and the study was conducted anonymously. Participants were given a commitment that the data to be obtained in the study would only be used within the scope of this study and would not be shared with any third party or organizations without taking their written consent, except the academic outputs, such as academic journal publications or conference presentations. E-mails that included all the explanations and invitation to participate to the study along with a link to our questionnaire were sent to the managers of all R&D Centers. In addition, we also visited the companies, from which we did not have any reply, to encourage their participation. After this process, data was collected from 182 managers in total and included in the analysis. We tried to reach the managers who are at the highest seniority level possible, as managers at the senior level should have the most sufficient and accurate information about their organizations.

Within the scope of the research, to measure the variables in our research, we used scales which showed high validity and reliability in the literature. The scale consisting of 13 questions used by Lau and Lo (2015) was adapted and used to measure knowledge management in terms of organizations' absorptive capacity. The 24-question scale used by Yam et al. (Yam et al., 2011) was used to measure innovation capability. In addition to the variables, information about the sector in which the organization operates, number of employees, capital etc., was also obtained from the managers.

The data obtained in the study was analyzed using the SPSS 23.0 statistical package. During the data analysis, exploratory factor analysis was used to test the validity of the scales used in the study. The reliability of the scale was evaluated using Cronbach's Alpha coefficient. Correlation and regression analyses were used to test our research hypothesis that claims significant and positive relationships between Knowledge Management processes and the sub-dimensions of Innovation Capability. The Cronbach's alpha coefficient was calculated to ensure reliability of the study components. The results were evaluated at a 95% confidence interval and thus at the significance level of $p < 0.05$.

3.2 Factor Analysis

We used the Kaiser-Meyer-Olkin (KMO) Measure and Bartlett's Sphericity tests to assess the adequacy of our sampling to proceed with the factor analyses.

KMO measure is a statistical indicator that shows the proportion of variance in your variables that might be caused by underlying factors. High values of KMO (close to 1.0) generally indicate that a factor analysis might be used with the relevant data. Thus, one can conclude that the closer the KMO test result is to 1, the more adequate the sample is. Hair et al. (2014) suggests accepting a value of $KMO > 0.5$. Values between 0.5 and 0.7 are mediocre, and values higher than 0.7 are very good. The generally accepted value is greater than 0.5.

The Bartlett's test of Sphericity, on the other hand, is an important measure used to test the null hypothesis if the correlation matrix is an identity matrix. It tests whether a matrix (of correlations) is significantly different from an identity matrix (filled with 0). The test computes the probability that the correlation matrix has significant correlations among at least some of the variables in a dataset, a prerequisite for factor analysis to work. An identity correlation matrix means your variables are unrelated and not ideal for factor analysis. A significant statistical test (usually less than 0.05) shows that the correlation matrix is indeed not an identity matrix, and the factor analysis can be applied to the data.

For the sample of our study, as seen in Table 1, since the KMO value obtained for Knowledge Management dimensions was 0.83 and the Bartlett's test was significant at $p < 0.01$ level, it was concluded that the sample was sufficient for factor analysis of Knowledge Management. Similarly, the KMO value obtained for Innovation Capability dimensions was 0.54 and the Bartlett's test was significant at $p < 0.01$ level, and thus we could conclude that the sample was sufficient for factor analysis of Innovation Capability.

Table 1. KMO and Bartlett’s Test

		Knowledge Management Dimensions	Innovation Capability Dimensions
Kaiser-Meyer-Olkin (KMO) Test	Coefficient	0.83	0.54
	Chi-Square	281.80	697.22
Bartlett’s Sphericity Test	df	78	276
	Sig.	0.000	0.000

Based on the results from KMO and Bartlett’s tests, we applied exploratory factor analysis to test the dimensions of knowledge management and innovation capability. Factor loadings obtained for knowledge management components are presented in Table 2 below. According to the findings, it was concluded that the data conformed to the factor structure in the literature for knowledge management components. It was seen that each of the factor loadings was above 0.5. Looking at the averages of knowledge management dimensions, it was also seen that knowledge management dimensions had a mean value close to 4 in all 182 R&D Centers that provided feedback. The reliability coefficient of Cronbach’s Alpha scale was above 0.70, which was acceptable according to the literature (Hair et al., 2014).

On the other hand, factor loadings obtained for innovation capability dimensions are presented in Table 3. According to the findings, the data was largely in line with the factor structure in the literature, but the Learning and R&D capability dimensions were combined under one dimension. It was seen that all but two of the factor loadings were above 0.5. Not to lose the meaning of the relevant factors, we also decided to keep two items in the analysis, which had factor loadings of 0.47 and 0.49, as their loadings were close to 0.5. Looking at the mean values of the dimensions of innovation capability, it was seen that all of the dimensions were close to 4. Cronbach’s Alpha reliability coefficients for the dimensions were also above 0.70, which was acceptable.

Table 2. Factor Loadings of Knowledge Management Dimensions

Dimensions	Factor Loadings			
ACQK1	0.71			
ACQK2	0.88			
ACQK3	0.64			
ACQK4	0.56			
ASSK1		0.71		
ASSK2		0.79		
TRK1			0.55	
TRK2			0.64	
TRK3			0.65	
EXPK1				0.81
EXPK2				0.80
EXPK3				0.66
EXPK4				0.82
Mean	3.76	3.92	3.87	3.84
St.Dev.	0.95	0.06	0.10	0.14
Cronbach Alpha	0.74	0.81	0.82	0.81

ACQK: Acquisition of Knowledge, ASSK: Assimilation of Knowledge, TRK: Transformation of Knowledge, EXPK: Exploitation of Knowledge

Table 3. Factor Loadings of Innovation Capability Dimensions

Dimensions	Factor Loadings			
LEC1	0.79			
LEC2	0.85			
RDC1	0.78			
RDC2	0.81			
RDC3	0.80			
RAC1		0.80		
RAC2		0.83		
RAC3		0.68		
RAC4		0.65		
MNC1			0.69	
MNC2			0.47	
MNC3			0.54	
MRC1				0.67
MRC2				0.64
MRC3				0.49
MRC4				0.70
ORC1				0.81

ORC2						0.80
ORC3						0.82
SPC1						0.62
SPC2						0.86
SPC3						0.56
SPC4						0.54
SPC5						0.71
Mean	3.73	3.68	3.92	3.81	3.89	3.82
St.Dev.	0.05	0.22	0.07	0.14	0.18	0.16
Cronbach Alpha	0.93	0.77	0.79	0.71	0.86	0.77

LEC: Learning Capability, RDC: R&D Capability, RAC: Resource Allocation Capability, MNC: Manufacturing Capability, MRC: Marketing Capability, ORC: Organization Capability, SPC: Strategic Planning Capability

3.3 Correlation and Regression Analyses

Table 4 below presents the results of the correlation analysis between the sub-dimensions of Knowledge Management and the sub-dimensions of Innovation Capability.

Table 4. Correlation of Study Variables

	ACQK	ASSK	TRK	EXPK	LRDC	RAC	MNC	MRC	ORC	SPC
ACQK	-									
ASSK	0.51**	-								
TRK	0.40**	0.48**	-							
EXPK	0.41**	0.37**	0.35**	-						
LRDC	0.33**	0.28**	0.22**	0.28**	-					
RAC	0.32**	0.29**	0.31**	0.34**	0.33**	-				
MNC	0.49**	0.31**	0.48**	0.41**	0.31**	0.41**	-			
MRC	0.48**	0.46**	0.41**	0.44**	0.39**	0.34**	0.29**	-		
ORC	0.47**	0.38**	0.51**	0.45**	0.44**	0.33**	0.27**	0.36**	-	
SPC	0.47**	0.37**	0.36**	0.42**	0.29**	0.28**	0.25**	0.28**	0.34**	-

** p<0.01

ACQK: Acquisition of Knowledge, ASSK: Assimilation of Knowledge, TRK: Transformation of Knowledge, EXPK: Exploitation of Knowledge,

LEC: Learning Capability, RDC: R&D Capability, RAC: Resource Allocation Capability, MNC: Manufacturing Capability, MRC: Marketing Capability, ORC: Organization Capability, SPC: Strategic Planning Capability

Table 5 showed that the Acquisition of Knowledge variable (ACQK) had a positive and statistically significant correlation with all innovation capability sub-dimensions, with the highest correlation with Manufacturing Capability. Similarly, the Assimilation of Knowledge variable (ASSK) had positive and statistically significant correlations with all innovation capability sub-dimensions. Among those, it had the strongest relationship with Marketing Capability.

Transformation of Knowledge variable (TRK) also had statistically significant and positive correlations with all innovation capability sub-dimensions, but most significantly with Organization Capability. In parallel to those results, Exploitation of Knowledge variable (EXPK) also had statistically significant and positive associations with all innovation capability sub-dimensions, with the strongest relationship with Organization Capability.

In our study, regression analysis was conducted to determine the effects of knowledge management dimensions on innovation capability dimensions. The regression analyses in which each innovation capability dimension was a dependent variable are presented in Table 5 below. Nevertheless, before proceeding to the regression analyses, tolerance and VIF values of knowledge management dimensions were checked. The highest tolerance value was 0.45, and the highest VIF value was 6.15 (for Exploitation of Knowledge). Thus, we concluded that there was no serious potential threat for multicollinearity among the independent variables in our research model.

According to the regression analysis results presented in Table 5, the regression model between Knowledge Management dimensions and Learning and R&D Capability was significant (R-Square = 0.41; p<0.01). As a result of the analysis, the links from Acquisition of Knowledge ($\beta = 0.45$, p<0.05) and Assimilation of Knowledge ($\beta = 0.33$, p<0.05) to Learning and R&D Capability were found to be significant.

Table 5. Regression Results for Knowledge Management and Innovation Capability Dimensions

Dependent Variable: Learning and R&D Capability							
Independent Variables	R ²	Adj. R ²	Sig.	β	Std. Error	T	p
Model	0.41	0.39	0.000				
Constant				0.20	0.16	0.03	0.97
ACQK				0.45*	0.36	2.16	0.03
ASSK				0.33*	0.25	2.02	0.04
TRK				0.09	0.28	0.33	0.74
EXPK				0.06	0.12	0.09	0.92
Dependent Variable: Resource Allocation Capability							
Model	0.26	0.24	0.000				
Constant				0.19	0.11	0.67	0.54
ACQK				0.31*	0.24	2.15	0.03
ASSK				0.28*	0.19	2.04	0.04
TRK				0.07	0.25	0.29	0.77
EXPK				0.11	0.21	0.73	0.46
Dependent Variable: Manufacturing Capability							
Model	0.34	0.33	0.000				
Constant				0.20	0.18	0.25	0.88
ACQK				0.36*	0.16	2.24	0.03
ASSK				0.30*	0.19	2.39	0.02
TRK				0.04	0.17	0.12	0.84
EXPK				0.24*	0.18	1.99	0.04
Dependent Variable: Marketing Capability							
Model	0.27	0.25	0.000				
Constant				0.18	0.15	0.51	0.61
ACQK				0.43**	0.15	2.85	0.00
ASSK				0.32**	0.10	4.07	0.00
TRK				0.08	0.11	0.75	0.45
EXPK				0.15	0.25	0.61	0.55
Dependent Variable: Organizational Capability							
Model	0.32	0.30	0.000				
Constant				0.26	0.13	1.231	0.22
ACQK				0.21	0.15	0.59	0.12
ASSK				0.48**	0.17	3.08	0.00
TRK				0.06	0.11	0.75	0.45
EXPK				0.38*	0.36	1.98	0.04
Dependent Variable: Strategic Planning Capability							
Model	0.37	0.36	0.000				
Constant				0.25	0.12	1.32	0.19
ACQK				0.33*	0.17	2.09	0.04
ASSK				0.18	0.12	1.08	0.15
TRK				0.19	0.14	1.22	0.14
EXPK				0.22	0.29	1.12	0.23

Regression model between Knowledge Management dimensions and Resource Allocation Capability was significant (R-Square = 0.26; $p < 0.01$). As a result of the analysis, effects of two out of four Knowledge Management dimensions, namely Acquisition of Knowledge ($\beta = 0.31$, $p < 0.05$), and Assimilation of Knowledge ($\beta = 0.28$, $p < 0.05$) on Resource Allocation Capability were significant. In a similar manner, regression model between Knowledge Management dimensions and Manufacturing Capability was also significant (R-Square = 0.34; $p < 0.01$). As a result of the analysis, effects of three dimensions, namely Acquisition of Knowledge ($\beta = 0.36$, $p < 0.05$), Assimilation of Knowledge ($\beta = 0.30$, $p < 0.05$), and Exploitation of Knowledge ($\beta = 0.24$, $p < 0.05$) on Manufacturing Capability were found to be significant.

Regression model between Knowledge Management dimensions and Marketing Capability was significant (R-Square = 0.27; $p < 0.01$). As a result of the analysis, only the effects of Acquisition of Knowledge ($\beta = 0.43$, $p < 0.01$) and Assimilation of Knowledge ($\beta = 0.32$, $p < 0.01$) on Marketing Capability were significant. Similarly, regression model between Knowledge Management dimensions and Organizational Capability. was also significant (R-Square = 0.32; $p < 0.01$). As a result of the analysis, only the effects of Assimilation of Knowledge ($\beta = 0.48$, $p < 0.01$) and Exploitation of Knowledge ($\beta = 0.38$, $p < 0.05$) on Organizational Capability were significant. Finally, regression model between Knowledge Management dimensions and Strategic Planning Capability was significant (R-Square = 0.37; $p < 0.01$). As a result of the analysis, only the effect of Acquisition of Knowledge ($\beta = 0.33$, $p < 0.05$) on Strategic Planning Capability was significant.

4. Conclusions and Discussion

With the applied study conducted within the scope of this research, the relationship between the concepts of Knowledge Management and Innovation Capability was empirically examined by considering the R&D Centers in Istanbul and Kocaeli. R&D Centers emerge as centers based on the use of technology and economic investment, which provide opportunities for encouraging innovation and the development of innovation capabilities of organizations, as well as the use of information and knowledge. They play a key role in shaping the national economy and supporting industrial activities (Tripsas et al., 1995).

Knowledge management is a very important process that enables businesses to use the data they obtain practically and quickly. It plays an important role in focusing on business environment without difficulty, facilitates decision-making processes, and has an impact on achieving sustainable competitiveness, improving organizational structure and gaining & maintaining control over processes & activities. Knowledge management supports the use of technology that helps organizations determine financial values, maintain competitiveness, and retain skilled and knowledgeable human resources (Alavi & Leidner, 2001). In this context, it emerges as an important question and research area as to what effect the dimensions of knowledge management might have on the ability of these centers to create and manage innovation, especially in R&D centers that consider knowledge as the most important resource.

Based on the studies conducted in the literature, it has been suggested that knowledge management is very crucial in the development of organizations and sectors, as well as in the emergence and management of innovation capability. Innovation capability, which is one of the main lines of our study, can be generalized as the techniques and methods that are effective in the progress of reconstructed values, transformed products and processes that are different within the scope of innovation (Calantone et al., 2002).

Our study has been carried out in R&D Centers operating in Istanbul and Kocaeli, which are cities playing a very important role in the development and growth of the country and host several industrial and technological organizations and companies. In our research, the relationship between knowledge management and innovation ability was investigated. Within the scope of our research model, knowledge management is considered in four dimensions: Acquisition of Knowledge, Assimilation of Knowledge, Transformation of Knowledge, and Exploitation of Knowledge. Innovation capability is defined in six dimensions: Learning Capability, R&D Capability, Resource Allocation Capability, Manufacturing Capability, Marketing Capability, Organizational Capability, and Strategic Planning Capability. For the empirical study of our research, we employed quantitative research methods.

Based on the results of our analyses, the Acquisition of Knowledge has emerged as the most influential dimension by positively and significantly effecting five out of six dimensions of innovation capability. Innovation capability is a process that is carried out and managed based on knowledge. In this context, it is inevitable that the quality, accessibility, reliability, accuracy and timeliness of the data & information obtained will affect all the processes of R&D centers, which carry out knowledge-intensive activities such as research and development (Sancho-Zamora et al., 2021). The success of other phases of knowledge management also depends on how successful the knowledge acquisition phase is. Thus, the effectiveness of the dimensions of innovation capability will also depend on how accurately and effectively the data to be used is collected. The fact that the knowledge acquisition stage emerges as the area with the highest impact on innovation capability, especially in R&D centers, once again shows the importance of this stage, which forms the basis of knowledge management and all other processes of innovation capability.

According to the results of the analysis, the second most important Knowledge Management dimension has been found to be Assimilation of Knowledge, as it also significantly and positively affected five out of six Innovation Capability dimensions. Assimilating external knowledge encompasses incorporating it into routines and procedures of the organization for analyzing, processing, interpreting, and understanding information obtained externally from outside (Sancho-Zamora et al., 2021). Knowledge assimilation represents its integration within organizational structures. As assimilating knowledge is a stage that affects all sub-dimensions of innovation capability in the theoretical sense, the fact that it affects almost all innovation capability dimensions in our study emphasizes the critical role of assimilating knowledge in the R&D centers.

On the other hand, Exploitation of Knowledge has been found to be significantly related to only two out of six Innovative Capability dimensions, namely Manufacturing Capability and Organizational Capability. Exploitation of Knowledge, in other words application of knowledge, refers to an organization's capability to apply new external knowledge to achieve organizational goals (Sancho-Zamora et al., 2021). It is comprised of both market and technological knowledge, which provides organizations with necessary information on how to

commercialize their knowledge and how to develop new manufacturing methods. Thus, as the desired outcome of exploitation is the application of new knowledge for commercial purposes, it is expected that it has a positive and significant relationship with manufacturing and organizational capability in R&D centers.

Finally, no significant relationship was found between Transformation of Knowledge and any of the Innovation Capability dimensions in our study. Transformation of knowledge is defined as the capability to combine already existing and well-established knowledge with newly acquired knowledge (Sancho-Zamora et al., 2021). This process takes place by adding newly acquired knowledge while re-evaluating and modernizing the organization's existing knowledge. Thus, R&D managers most probably are achieving this integration during the acquisition and assimilation processes, as well as utilizing it during the exploitation process. Therefore, as its meaning and implementation cannot be differentiated easily from the other dimensions, its possible effect on innovation capability dimensions might be shadowed by the other knowledge management dimensions.

One of the most important aims of this paper is to deepen our understanding of the elements that render organizational capabilities dynamic, specifically investigating the ways in which knowledge management processes, as important dynamic capabilities of the organizations, can be developed and sustained. In this endeavor, we have applied Teece's (2007; 2014) framework on dynamic capabilities as a methodological lens to refine and expand upon the existing theoretical foundations. From the perspective of dynamic capabilities, it is essential for leaders and practicing managers to focus on the following factors to enhance their organization's innovation capabilities.

First of all, leaders and managers should follow a structured approach to enhancing processes, techniques, and routines in terms of knowledge management for recognizing and exploiting opportunities. That kind of approach might involve fostering inter-group learning, evaluating barriers to innovation and their possible value, and ensuring the iterative and effective application of these initiatives.

Secondly, facilitating and cultivating entrepreneurial positions within the organization and its network of partners and stakeholders are essential, along with the effective management of these entrepreneurial initiatives to drive innovation and transformation.

Finally, leaders should put an emphasis on the cultivation of dynamic innovation capabilities, such as knowledge management processes, instead of limiting attention to functional innovation capabilities. This paradigm shift requires an emphasis on innovation at both the operational and strategic dimensions and positions innovation as a fundamental aspect of strategic management and its execution processes.

5. Recommendations for Future Studies

Although it is thought that our study has achieved its objective and revealed important results for R&D centers, the limitations encountered during the study process should be emphasized. The first limitation is about the geographical scope of our sample. We have included in our sample only the R&D centers in the organizations operating in Istanbul and Kocaeli / Turkiye based on the region's importance and role in the national economy, and the research area could not be expanded due to lack of time and cost. It is considered that more meaningful results can be obtained, and the findings of the study can be expanded when the hypotheses within the scope of this study are carried out not only in the R&D Centers in Istanbul and Kocaeli but also in all R&D Centers operating in the other regions of Turkiye, as well as in an international scope.

Secondly, the sample covers only the R&D Centers of companies. The inclusion of Technoparks and R&D Centers of universities in the study sample might increase the validity of the results and might also highlight different aspects of the relevant organizations within the perspective of dynamic capabilities.

Finally, although the study examines the possible impact of knowledge management on innovation capability from the theoretical framework of dynamic capabilities, future studies may include mediating and moderating variables that may have an impact on this relationship and thus may develop more comprehensive and holistic models explaining those associations. In addition, future studies might also apply different theoretical frameworks that might provide different explanations on the hypothesized relationships.

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Authors' contributions

Prof. Erturk was responsible for study design, data collection and analysis. Mrs. Alkhayyat was co-responsible for data analysis, drafting the manuscript and revising.

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The data that support the findings of this study are available on request from the corresponding author. The data is not publicly available due to privacy or ethical restrictions.

Data sharing statement

No additional data is available.

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