

THE PATH FROM INTELLECTUAL CAPITAL TO INNOVATION: A RESEARCH WITH THE OIL COMPANIES AFFILIATED TO THE NATIONAL OIL CORPORATION (NOC) IN LIBYA*

ENTELEKTÜEL SERMAYEDEN İNOVASYONA UZANAN YOL: LİBYA'DAKİ ULUSAL PETROL KURUMUNA BAĞLI PETROL ŞİRKETLERİ İLE BİR ARAŞTIRMA

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Abstract

This study aims to determine the role of intellectual capital on different types of innovation. In this context, an empirical research was conducted with executive managers of oil companies affiliated to National Oil Corporation (NOC) in Libya. Data of the study was collected via a questionnaire. Components of intellectual capital explained in the literature as human capital, social capital and organizational capital. Besides, for innovation activities, many researches in the literature distinguish types of innovation as product innovation, process innovation, marketing innovation and organizational innovation. Variables of the study were accepted using these classifications and hypotheses were tested through regression analyses. Findings revealed that human capital has a positive significant effect on product innovation and process innovation, and social capital has a positive significant effect on process innovation, whereas there isn't observed any significant effect of organizational capital on different types of innovation.

Keywords: Human Capital, Social Capital, Organizational Capital, Innovation.

JEL Codes: O30, O34, O39.

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Öz

Bu araştırma, entelektüel sermayenin farklı inovasyon türleri üzerindeki etkisini belirlemeyi amaçlamaktadır. Bu bağlamda Libya'da Ulusal Petrol Kurumu'na bağlı firmaların üst düzey yöneticileriyle ampirik bir araştırma yürütülmüştür. Araştırmanın verileri anket tekniği ile toplanmıştır. Entelektüel sermayenin bileşenleri literatürde insan sermayesi, sosyal sermaye ve örgütsel sermaye olarak açıklanmıştır. Bununla birlikte, inovasyon faaliyetleri için, literatürdeki birçok araştırma inovasyon türlerini ürün inovasyonu, süreç inovasyonu, pazarlama inovasyonu ve örgütsel inovasyon olarak sınıflandırmıştır. Araştırmanın değişkenleri bu sınıflandırmalar kullanılarak belirlenmiş ve hipotezler regresyon analizi aracılığıyla test edilmiştir. Bulgular, insan sermayesinin ürün inovasyonu ve süreç inovasyonu üzerinde ve sosyal sermayenin süreç inovasyonu üzerinde pozitif anlamlı etkisi olduğunu ortaya koymakta iken yapısal sermayenin farklı inovasyon türleri üzerinde herhangi bir anlamlı etkisi gözlemlenmemiştir.

Anahtar Kelimeler: İnsan Sermayesi, Sosyal Sermaye, Yapısal Sermaye, İnovasyon.

JEL Sınıflandırılması: O30, O34, O39.

1. Introduction

Intellectual capital (IC) is a highly significant intangible wealth of a company that is somewhat more significant as compared to tangibles. It improves efficiency while achieving the organization's objectives and ultimately, it focuses on how to generate a genuine and sustainable competitive advantage. In the post-modern business, it is the most significant tactical positive feature for any firm/business organization and value-creation resource, and it is the lifeblood of the knowledge intensive and high-tech organizations (Khaliq, Shaari, Isa & Samad, 2013). To maintain a competitive edge for increasing the performance level and providing high-quality products with reduced cost, companies should be innovative in their activities and show sufficient flexibility to fulfill the stakeholders' expectations. Economists established the fact that IC is a vital asset that helps firms to create value and enables them to be innovative.

The relationship between IC and innovation is considered relatively modern in contemporary administrative thought, where the interest in it started developing in the nineties; however, it needs further exploration in the context of Arab countries and their organizations. Developing commercial environments and making quick technological growth particularly pertaining to energy companies such as petroleum companies is somewhat essential because of growing global competition between major companies. The oil sector is a big as well as a vital economic sector in Libya and it contributes 70% of the total Gross National Product (GNP), so, Libyan oil companies must focus on investment to IC that leads to more innovation. This study is mainly structured for determining the relationship between IC and different types of innovation in oil companies affiliated to the National Oil Corporation (NOC) in Libya. Understanding IC in these companies through its components and understanding its effect on the development of innovative capabilities in the mentioned companies is essential. It is aimed in this study to add new insights into the literature related to the relationship between IC and innovation.

2. Theoretical Framework

2.1. Intellectual Capital

The environment of global business has become a lot more dynamic, complex and more competitive. So, businesses have forced to differentiate. For keeping pace to the developments in their environment, organizations should pay attention to IC to improve competitiveness (Zerenler, Hasiloğlu & Sezgin, 2008). IC is also a significant topic of academic interest because it hastens the performance-driving strategies of organizations (Zeglat & Zigan, 2014). This concept firstly appeared in 1969 as a term “IC” by an economist John Kenneth Galbraith, who wrote to Michael Kalecki and in this way, he taught the academic communities how to explain the book and market value gap (Gupta & Singh, 2015). IC determines the knowledge which transforms the raw materials to the good things that are more valuable (Stewart, 2003). IC has been defined as the sum of non-monetary or non-physical resources that an organization controls either partially or completely (Ayache & Adjali, 2015) and showing how knowledge becomes important IC creates value for the organization (Stewart, 2010).

There are different views by authors and researchers about the IC. Being frequently cited in researches related to IC, Subramaniam and Youndt (2005) determined different aspects of IC as human capital, social capital and organizational capital. *Human capital (HC)* is the highly significant intellectual component that contains many things that connect employees in an organization in terms of tacit experiences, competencies, knowledge, skills, and experience (Bontis & Serenko, 2009). HC exists in the knacks of employees (Sydler, Haefliger & Pruksa, 2014). *Social capital (SC)* is part of community studies and focuses on mutual respect and the link between the people, which influences behaviors. The institutionalized knowledge and experience are saved into main databases such as work-routines, patent rights, technical manuals, and structure-formations (Nahapiet & Ghoshal, 1998). Social capital plays its role as a facilitator rather than a regular IC component. It is behind networking connection and so, it needs rules for facilitating interactions, relationships, and cooperation (Subramaniam & Youndt, 2005). *Organizational capital (OC)* consists of knowledge assets like patents/copyrights, trademarks, processes, models, legal paperwork, knowledge artifacts, information technology networks including software, and/or administration systems (Stewart & Ruckdeschel, 1998). OC exists even if all workers leave a firm; so, it is employee-independent. It consists of organizational knowledge, which is the business’ own possession. The distinctive features of OC represent dependence on patents/licenses (Hansen, Nohria & Tierney, 1999). Thinking from different viewpoints, many IC scholars observed that they see IC as a strategic instrument, which has the potential to increase an organization’s value (Subramaniam & Youndt, 2005).

IC can be the primary source of continuous organizational performance (Chaharbaghi & Cripps, 2006; Petkovic, Krstic & Radenovic, 2021; Dzenopoljac, Kwiatek, Dzenopoljac & Bontis, 2022). It can be concluded that the value-addition of IC should be shown in terms of organizational performance (Wang & Chang, 2005). Researchers deemed IC as a value-driver for organizations (Stewart, 1997; Stewart & Ruckdeschel, 1998; Abeysekera, 2021; Ali & Anwar, 2021; Jordao & Novas, 2022). Many researchers like Bontis, Keow, and Richardson (2000), de Castro and Saez, (2008), de Pablos (2003), Ismail (2005) and Khalique, Shaari, Isa, and Alkali (2012), and many others (Quintero-Quintero,

Blanco-Ariza, & Garzon-Castrillon, 2021; Shafiee, 2021) found that IC depends on intangibles, which help to create value by adding profitable offers. It can be considered as transferable knowledge that can be transferred for producing high-value assets (Abeysekera, 2006).

2.2. Innovation

The concept of innovation has been taken from the Latin word *innovare*, which means recover or visibly interested in novelty, newness, or renewal in human activity; therefore, innovation is quite necessary for humanity (Likar, Fatur & Mrgole, 2013). Schumpeter (1942) argues in his opinion that innovation is an economic driver for capitalism, and the economic activities are based on restructuring of ideas, destruction, and creation of new ones (Hagedoorn, 1996). Drucker (1998) believed that innovation requires work rather than genius. Innovation means incorporating novel ideas, processes, and/or products, which are created for the benefit of the firm and the society (Zschockelt, 2009). It is important for successful competition within the ever-changing global economy, as the incentive of economic development, and it is very important for achieving social prosperity (Baldwin & Hanel, 2003).

Innovation is a strategy to attain some kind of competitive edge to meet the market requirements (Lord-Tarte, 2012; Kanbur & Şen, 2020). It is necessary to show the complexity of the knowledge acquisition process, and introduce the idea that companies need to acquire new knowledge from many internal and external sources for generating innovations (Svetina & Prodan, 2008). The innovative process is a combination of various internal/external sources (Kanbur & Kanbur, 2014). The internal sources have a major contribution to the total innovations an organization utilizes and they prove to be productive when mediated by proficiency in resource allocation, marketing and organization (Baark, Lau, Lo & Sharif, 2011). Post-modern understanding of innovation and problem-solving require interaction in both directions between knowledge institutions, industrial actors and institutions (Svetina & Prodan, 2008). So, external innovation sources became important elements to the internal capabilities of the companies (Chesbrough, 2006).

Innovation types have been classified but each type has been defined in such a different way that understanding each type is difficult (Rowley, Baregheh & Sambrook, 2011). The first effort to promote innovation was made in 1934 when “Schumpeter” presented a very early model containing five innovation types (new goods, new methods of production, new places to sell, newer supply sources and new organization methods) (Hagedoorn, 1996; Günday, Ulusoy, Kılıç & Alpkan, 2011). The number, proportion, and innovation types lead to different outcomes. If firms want to continue growing in the competition, they should invest in different innovation types, because it has different effects and different results (Simpson, Siguaw & Enz, 2006).

According to the review of innovation stages in the light of opinions of researchers in the last decades (Rowley, Baregheh & Sambrook, 2011), it can be noted that most of the classifications agreed only in two ways. However, the OECD Oslo Manual (2005) introduced four types of innovation and added organizational innovation and marketing innovation to the existing knowledge (Bloch, 2007) for standardizing concepts and methodologies to explain innovation (Bernardo & Medeiros, 2021). This classification mostly used in innovation studies as a guide for collecting data about innovation (Abd Elkader, Morales & Singh, 2021;

Glor, 2021; Miroshnychenko & Galetic, 2021; Perani, 2021; Rydvalova & Skala, 2021). In this context, Oslo Manual (2005) was taken as a reference in the current study for describing and classifying types of innovation. *Product innovation (PtI)* is the execution of a good product or service, which improved significantly whether as per characteristics or intended uses that hold important technological modifications, specifications, components, materials, programs, and ease of use (user-friendliness). *Process innovation (PsI)* means “process” to implement the method of production/delivery of a new or improved product/service. *Marketing innovation (MI)* is implemented in a new way of marketing, which includes major product changes, using new concepts for promoting goods/services, new pricing strategies, opening newer markets, or new situations for the products in the market and it aims to give a better deal to meet the needs of customers. *Organizational innovation (OI)* is a process of using new/latest organizational methods, implementing novel business practices, organizing the workplace, or using a new approach to manage external relations (Oslo Manual, 2005). There are many key factors behind successful innovation, but organizational success depends on innovation type and proportionality between features of innovative process (Boer & During, 2001).

2.3. Relation Between Intellectual Capital and Innovation

Theory of Reasoned Action assumes that an individual’s behavior is defined by his intention to perform it (Houran & Lange, 2013). It can be explanatory in a company’s decision to move towards innovation. Moreover, the intention of innovation should be supported by the right infrastructure (Dobni, 2008). Resource-based theory suggests that there is a relationship between competitive advantage and the resources and capabilities used (Shan, Luo, Zhou and Wei, 2019). Innovation as a pillar of organizational success can be attributed to the use of resources in terms of resource-based theory. The survival and growth of a company generally based on how it is creating new resources, how it is developing existing ones, and how it is maintaining its core capabilities (Ray, Muhanna & Barney, 2005; Yang, 2008). Companies seek to explore and develop their intangible resources as well as their physical and financial resources, and these intangible resources are seen as IC (Özdemir, 2017).

All forms of “intellectual material” must be able to create more wealth like other assets. If any organization has IC in all three aspects as HC, OC, and SC, it gains exceptional power to add value; however, the primary innovation and customization sources are HC and SC (Stewart, 1997). The output in PtIs depends on modes and new uses. Codified information (procedures, mapping, warehouses, etc.) acts as a root of an innovative processes. Organizations pay attention to SC in their operations and their suppliers, customers, advisors, experts, etc. (Walliser & Mignon, 2015). IC aspects gather and distribute the knowledge differently through networks, employees, or systems (Subramaniam & Youndt, 2005). Researches in the literature also examine the relation between IC and innovation (Zerenler, Hasiloğlu & Sezgin, 2008; Basta & Bertilsson, 2009; Zschockelt, 2009; Al-Fawaeer, 2013; Subramaniam & Youndt, 2005; Zambon & Monciardini, 2015; Prester, Podrug & Darabos, 2016; Agostini, Nosella & Filippini, 2017; Obeidat et al., 2021; Kasych, Horak, Glukhova & Bondarenko, 2021; Li, Nosheen, Haq & Gao, 2021). IC can be accepted as an important antecedent of implementing innovation. In this context, three main hypotheses of this study composed as below and each of them has four sub-hypotheses.

H_1 : Human capital has a positive significant effect on types of innovation in oil companies of NOC.

- ▶ H_{1a} : Human capital has a positive significant effect on product innovation.
- ▶ H_{1b} : Human capital has a positive significant effect on process innovation.
- ▶ H_{1c} : Human capital has a positive significant effect on marketing innovation.
- ▶ H_{1d} : Human capital has a positive significant effect on organizational innovation.

H_2 : Social capital has a positive significant effect on types of innovation in oil companies of NOC.

- ▶ H2a: Social capital has a positive significant effect on product innovation.
- ▶ H2b: Social capital has a positive significant effect on process innovation.
- ▶ H2c: Social capital has a positive significant effect on marketing innovation.
- ▶ H2d: Social capital has a positive significant effect on organizational innovation.

H_3 : Organizational capital has a positive significant effect on types of innovation in oil companies of NOC.

- ▶ H3a: Organizational capital has a positive significant effect on product innovation.
- ▶ H3b: Organizational capital has a positive significant effect on process innovation.
- ▶ H3c: Organizational capital has a positive significant effect on marketing innovation.
- ▶ H3d: Organizational capital has a positive significant effect on organizational innovation.

3. Methodology

3.1. Aim and Research Model

This study began with the thought that IC is an antecedent of implementing innovation. From this point of view, it is also thought that different aspects of IC can be antecedents of implementing different types of innovation. Due to this assumption, this study is mainly structured for determining the effect of IC on different types of innovation in oil companies affiliated to NOC in Libya.

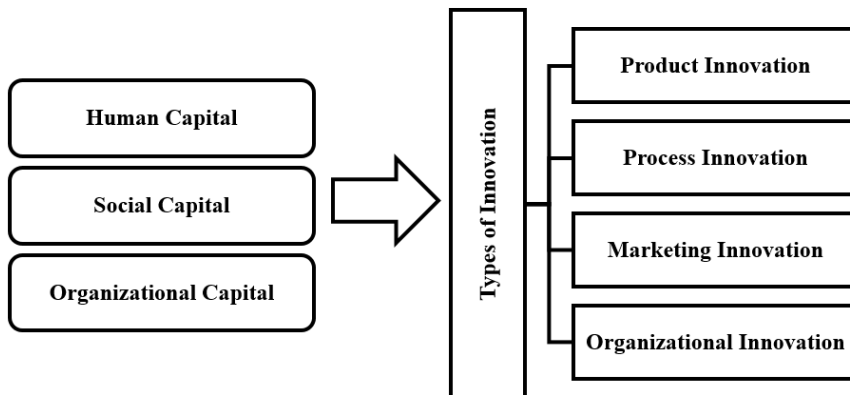


Figure 1: Research Model

IC consists of three components suggested in the literature and they were accepted as independent variables in the model. So, independent variables of the model were represented by means of HC, SC and OC. Besides, many types of innovation have been examined in the literature. Being as the foremost international source of guidelines for the collection and use of data on innovation activities in industry, Oslo Manual (2005) distinguish four types of innovation as PtI, PsI, MI and OI. Thus, dependent variables of the model were represented by means of these types of innovation.

3.2. Sample and Data Gathering

In this study, population represents senior department managers of fully owned oil companies affiliated to NOC in Libya. As it is required to explain briefly, NOC started operations in 1970 and replaced the General Libyan Petroleum Corporation that was overseeing oil sector operation. Therefore, NOC started oil extraction and exploration through its affiliated companies with service-contractor companies and petroleum marketing companies. This is in addition to marketing operations of oil and gas, locally and abroad. For this purpose, NOC has its own fully owned companies which carry out exploration, development and production operations, in addition to local and international marketing companies (NOC, 2019). Fully owned Libyan oil companies affiliated to NOC can be specified as Sirte Oil Company, Arabian Gulf Oil Company, Ras Lanuf Oil and Gas Processing Company, Zawia Oil Refining Company, Brega Petroleum Marketing Company, National Oil Wells Drilling and Work over Company, Jowfe Oil Technology Company, National Oil Fields and Terminals Catering Company, North Africa Geophysical Exploration Company, Taknia Libya Engineering Company and Petro Air Company. In this study, out of these 11 companies, 7 companies were selected randomly. Data of the study was collected via a questionnaire from managers of these seven companies and statistical package programs such as SPSS were used in data analysis. The questionnaire of the study distributed all of the managers of the seven companies of NOC which take part in the research. Thus, the total number of 140 questionnaires were distributed due to full counting sampling and 135 of them were received back. Due to unfilled parts in the received questionnaires, number of the valid questionnaires were 129, which was a good return rate as well as an adequate representation of the population. Therefore, the sample consists of 129 managers (including 7 chairpersons, 38 supervisors, and 84 managers). Chairpersons, supervisors and senior department managers were chosen as participants for the study. The reason behind choosing these three groups as participants was the belief that these groups have the most valuable knowledge about NOC in Libya.

3.3. Measures

Data of the study was collected through questionnaire. For gathering the data, "Human Capital Scale", "Social Capital Scale", "Organizational Capital Scale" and "Types of Innovation Scale" were utilized. For understanding whether the data set have normal distribution, normality tests were also performed in the study. Kolmogorov-Smirnov and Shapiro-Wilk test values for the scales used in the research were calculated as tests of normality. Findings revealed that test values were over 0.05 significant level and data set of this study is not significantly and statistically different than normal distribution. In addition, skewness and kurtosis values calculated for each item in the research questionnaire and support the normal distribution of the data set. To test the structural validity

of the scales, confirmatory factor analysis was utilized for each scale and fit values of the model were examined (Schermelleh-Engel, Moosbrugger & Müller, 2003). Besides, for testing reliability of the scales, internal consistency (reliability) analysis was utilized for each scale and Cronbach Alpha coefficient value was examined (Hair, Black, Babin & Anderson, 1998). Findings of these analyses indicate that the data obtained from questionnaire are valid, reliable, and suitable for further analysis.

Human capital scale: HC is clearly accepted in the literature as a main element of IC of a company. In this study, the “Human Capital Scale” developed by Subramaniam and Youndt (2005) was used. It consists of five items with one dimension and it is a five-point Likert-type scale. Its items are used for measuring overall skill, expertise, and knowledge levels of an organization’s employees. Confirmatory factor analysis of the scale in the current study show that it has acceptable fit values. Fit measures calculated as RMSEA value .034; CMIN/DF value 1.152, GFI value .983; NFI value .971 and CFI value .996. Therefore, it can be clarified that the Human Capital Scale has confirmed its one-dimensional factor structure and it is in good fit with the original scale. Internal consistency analysis of the scale was based on the Cronbach Alpha coefficient and the Cronbach Alpha coefficient value was measured as 80.5%.

Social capital scale: IC is classified into three elements in the literature and one of these elements includes SC. Researchers who are interested in understanding IC inevitably confront the concept of SC. In this study, the “Social Capital Scale” developed by Subramaniam and Youndt (2005) was used. It consists of five items with one dimension and it is a five-point Likert-type scale. Its items are used for measuring an organization’s overall ability to share and leverage knowledge between networks of employees, customers, suppliers, and alliance partners. Confirmatory factor analysis of the scale in the current study show that it has acceptable fit values. Fit measures calculated as RMSEA value .033; CMIN/DF value 1.142, GFI value .986; NFI value .979 and CFI value .997. Therefore, it can be clarified that the Social Capital Scale has confirmed its one-dimensional factor structure and it is in good fit with the original scale. Internal consistency analysis of the scale was based on the Cronbach Alpha coefficient and the Cronbach Alpha coefficient value was measured as 79.6%.

Organizational capital scale: OC identifies one of the main determinants of IC. Taking into consideration the accepted aspects of IC in the literature, the notion of IC without OC is unimaginable. In this study, the “Organizational Capital Scale” developed by Subramaniam and Youndt (2005) was used. It consists of four items with one dimension and it is a five-point Likert-type scale. Its items used for measuring an organization’s ability to appropriate and store knowledge in physical organization-level repositories. Confirmatory factor analysis of the scale in the current study show that it has acceptable fit values. Fit measures calculated as RMSEA value .079; CMIN/DF value 1.806, GFI value .974; NFI value .950 and CFI value .976. According to these results, it can be said that the Organizational Capital Scale has confirmed its one-dimensional factor structure and it is in good fit with the original scale. Internal consistency analysis of the scale was based on the Cronbach Alpha coefficient and the Cronbach Alpha coefficient value was measured as 79.3%.

Types of innovation scale: In this study, the “Types of Innovation Scale” was used for measuring different types of innovation implemented in a company in views of participants. This scale is developed by Günday,

Ulusoy, Kılıç and Alpkın (2011) to understand innovation types. Their measure was also chosen as a measure for its accordance with the classification of innovation types in Oslo Manual (2005). Therefore, types of innovation were accepted as PtI, PsI, MI and OI in the scale. The scale consists of 24 items, 5 of which measures PtI, 5 of which measures PsI, 5 of which measures MI and 9 of which measures OI. It is also aimed at the scale to measure innovation types implemented in a company during the last three years. Besides, the scale is structured according to five-point Likert-type scale (5=Implemented and 1=Not Implemented). Confirmatory factor analysis of the scale in the current study shows that it has acceptable fit values. Fit measures calculated as RMSEA value .026; CMIN/DF value 1.084, GFI value .882; NFI value .889 and CFI value .991. According to these results, it can be said that the Types of Innovation Scale has confirmed its four-dimensional factor structure and it is in good fit with the original scale. Internal consistency analysis of the scale was based on the Cronbach Alpha coefficient and Cronbach Alpha coefficient value was calculated for overall of the scale and its dimensions. Cronbach Alpha coefficient value was measured as 93.7% for overall of the scale and 84.8% for PtI, 85.3% for PsI, 87.2% for MI and 92.2% for OI.

4. Findings

The underlying rationale for the current study is to explain the effect of different aspects of IC on types of innovation. Accordingly, the framework of this research is rooted in the premise that HC, SC and OC reinforce innovation. For testing the hypotheses of the study according to variables in the research model (HC, SC, OC and PtI, PsI, MI and OI as types of innovation) regression analysis was utilized.

4.1. Human Capital and Types of Innovation

The purpose of this study is to determine whether HC, SC, and OC have a positive significant effect on different types of innovation. Thus, the first hypothesis, and its subhypotheses were composed for understanding this effect on the HC side. For testing these hypotheses, regression analysis was utilized and findings of regression analysis in the HC side were presented below (Table 1).

Table 1: Regression Analysis for Human Capital and Types of Innovation

Independent variable: <i>Human Capital</i>						
Dependent variables	Adj.R ²	F	β	t	p	DW
<i>Types of Innovation</i>	.041	6.503 (.012*)	.221	2.550	.012*	1.654
Independent variable: <i>Human Capital</i>						
Dependent variables	Adj.R ²	F	β	t	p	DW
<i>Product Innovation</i>	.074	11.162 (.001**)	.284	3.341	.001**	1.935
<i>Process Innovation</i>	.083	12.608 (.001**)	.301	3.551	.001**	1.811
<i>Marketing Innovation</i>	.013	2.632 (.107)	.142	1.622	.107	1.605
<i>Organizational Innovation</i>	.001	.816 (.368)	.080	.903	.368	1.514

*p<0.05; **p<0.01

As presented in Table 1, findings of regression analysis between independent variables (human capital) and dependent variables (types of innovation) show that HC explains the 4.1% ($R^2=.041$) of the variance of types of innovation. Durbin-Watson test value found between 1.5-2.5 and it can be said there is no autocorrelation in residuals of regression analysis. With regard to the first main hypothesis based on HC, it is obvious that HC has a positive significant effect on types of innovation in oil companies affiliated to the NOC in Libya. In this context, first main hypothesis (H_1) of the study is supported.

In the second phase of the regression analysis, it is aimed to better understand how HC predicts PtI, PsI, MI and OI. Findings show that HC explains the 7.4% ($R^2=.074$) of the variance in PtI. Similarly, HC explains the 8.3% ($R^2=.083$) of the variance in PsI. Durbin-Watson test values of these regression models were found between 1.5-2.5 and it can be said there is no autocorrelation in residuals of regression analysis. On the other hand, HC seems not able to explain the variation in MI and OI. According to these findings, it can be seen that HC has a positive significant effect on PtI and PsI whereas it has no significant effect on MI and OI. Thus, amongst sub-hypotheses of the first main hypothesis of the study H_{1a} and H_{1b} are supported, but H_{1c} and H_{1d} are not supported.

4.2. Social Capital and Types of Innovation

The purpose of this study is to determine whether HC, SC, and OC have a positive significant effect on different types of innovation. Thus, the second hypothesis and its subhypotheses were composed for understanding this effect on SC side. For testing these hypotheses, regression analysis was utilized and findings of regression analysis in the SC side were presented below (Table 2).

Table 2: Regression Analysis for Social Capital and Types of Innovation

Independent variable: <i>Social Capital</i>						
Dependent variables	Adj.R ²	F	β	t	p	DW
<i>Types of Innovation</i>	.023	4,054 (.046*)	.176	2.013	.046*	1.692
Independent variable: <i>Social Capital</i>						
Dependent variables	Adj.R ²	F	β	t	p	DW
<i>Product Innovation</i>	.009	2.178 (.143)	.130	1,476	.143	1.957
<i>Process Innovation</i>	.024	4.091 (.045*)	.177	2.023	.045*	1.860
<i>Marketing Innovation</i>	.001	.882 (.349)	.083	.939	.349	1.618
<i>Organizational Innovation</i>	.018	3.394 (.068)	.161	1.842	.068	1.513

*p<0.05; **p<0.01

As presented in Table 2, findings of regression analysis between independent variables (social capital) and dependent variables (types of innovation) show that SC explains the 2.3% ($R^2=.023$) of

the variance of types of innovation. Durbin-Watson test value found between 1.5-2.5 and it can be said there is no autocorrelation in residuals of regression analysis. With regard to the second main hypothesis based on SC, it is obvious that SC has a positive significant effect on types of innovation in oil companies affiliated to the NOC in Libya. In this context, second main hypothesis (H_2) of the study is supported.

In the second phase of the regression analysis, it is aimed to better understand how SC predicts PtI, PsI, MI, and OI. Findings show that SC explains the 2.4% ($R^2=.024$) of the variance of PsI. Durbin-Watson test values of this regression model found between 1.5-2.5 and it can be said there is no autocorrelation in residuals of regression analysis. On the other hand, SC seems not able to explain the variation in PtI, MI and OI. Due to these findings, it can be seen that SC has a positive significant effect on PsI whereas it has no significant effect on PtI, MI, and OI. Thus, amongst sub-hypotheses of the second main hypothesis of the study H_{2a} is supported, but H_{2b} , H_{2c} and H_{2d} are not supported.

4.3. Organizational Capital and Types of Innovation

The purpose of this study is to determine whether HC, SC, and OC have a positive significant effect on different types of innovation. Thus, the third hypothesis and its subhypotheses were composed for understanding this effect on OC side. For testing these hypotheses, regression analysis was utilized and findings of regression analysis in the OC side were presented below (Table 3).

Table 3: Regression Analysis for Organizational Capital and Types of Innovation

Independent variable: <i>Organizational Capital</i>						
Dependent variables	Adj.R ²	F	β	t	p	DW
<i>Types of Innovation</i>	.008	.000 (.999)	.000	.001	.999	1,709
Independent variable: <i>Organizational Capital</i>						
Dependent variables	Adj.R ²	F	β	t	p	DW
<i>Product Innovation</i>	.005	1.582 (.211)	.111	1.258	.211	1.959
<i>Process Innovation</i>	.000	1.001 (.319)	.088	1.000	.319	1.862
<i>Marketing Innovation</i>	.008	.027 (.869)	.015	.166	.869	1.625
<i>Organizational Innovation</i>	.004	1.540 (.217)	.109	-1.241	.217	1.589

* $p < 0.05$; ** $p < 0.01$

As presented in Table 3, findings of regression analysis between independent variables (organizational capital) and dependent variables (types of innovation) show that OC seems not able to explain the variation in types of innovation. With regard to the third main hypothesis based on OC, it is obvious that OC has no significant effect on the types of innovation in oil companies affiliated to the NOC in Libya. In this context, the third main hypothesis (H_3) of the study is not supported.

In the second phase of the regression analysis, it is aimed to better understand how OC predicts PtI, PsI, MI, and OI. Findings show that OC seems not able to explain the variation in PtI, PsI, MI, and OI. Due to these findings, it can be seen that OC has no significant effect on PtI, PsI, MI, and OI. Thus, amongst sub-hypotheses of the third main hypothesis of the study no one (H_{3a} , H_{3b} , H_{3c} and H_{3d}) has found any support.

5. Discussion

Findings obtained from regression analysis for testing the hypotheses of the study emphasized that HC and SC have a positive and significant effect on types of innovation overall whereas OC does not have any significant effect on types of innovation overall. While, Elsetouhi's study (2014) found a significant effect of IC on all three types of innovation, PtI was the most significant than OI, and PsI is least significant in his study. Also, Prester, Podrug, and Darabos (2016) acknowledged the significant effect of components of IC on two innovation types (PtI and PsI). It is widely recognized different components of IC play crucial roles in different types of innovation. This is in line with findings of this study.

Findings of the study for testing the first hypothesis reveal that HC has a positive significant effect on PtI and PsI whereas it has no significant effect on MI and OI. It is contrary to what Subramaniam and Youndt (2005) found in their research, HC negatively influences innovation. Nevertheless, its positive and significant influence exists on incremental innovation. Similarly, first hypothesis of the study agrees the findings of Zerenler, Hasiloğlu and Sezgin (2008), who claimed that HC had a significant and positive relation with innovation. Basta and Bertilsson (2009) explained that HC had the most important effect on the success of the companies. Also, Delgado-Verde (2011) claimed that HC is positively linked with radical innovation. Thus, findings of this study can be compatible with Santos-Rodrigues, Faria, Cranfield, and Morais (2013), who claimed that there is a relationship between HC and an organization's innovation creation. HC acts as a starting point of innovation in SMEs and the growth of these companies (Gonzalez-Loureiro & Figueroa-Dorrego, 2012). Findings of this study related to HC explain that Libyan oil companies affiliated to NOC depended on HC more than SC and OC. HC played a significant role in enhancing innovation activities and leads to the important result that HC enhances product and PsIs. In this sense, through its positive effect, HC helps improving product and PsI. This clearly shows that Libyan oil companies should create an appropriate organizational infrastructure for improving their employees' capabilities, promoting creativity, and encouraging innovation. HC creates ideas, which evolve into innovation. Employees' skill-sets, training and education boost innovation and these characteristics become innovative tools if they are extended to the organizational level.

Findings of the study for testing the second hypothesis reveal that SC has a positive significant effect on PsI whereas it has no significant effect on PtI, MI, and OI. In contrast, findings of Subramaniam and Youndt (2005) show positive influence of SC on both incremental as well as radical innovation types. Delgado-Verde (2011) claimed that SC has a greater influence on incremental innovation as compared to radical innovation. Dumay, Rooney, and Marini (2013) found that SC is pivotal for the success of

radical innovation; however, SC has no less importance than the other IC components. SC matters for launching new products because that necessitate different departments' and professionals' expertise. If experts hesitate to share ideas with colleagues, they may be counterproductive to organizations or for the success of radical innovation (Subramaniam & Youndt, 2005). The management of the Libyan oil companies should initiate and follow up recommended ways to improve effectiveness of SC. Moreover, partial correlation without HC/SC decreases in the case of all the innovation forms in variable proportions (Subramaniam & Youndt, 2005). Thus, it seems that social aspects of individuals are likely to be intrinsic aspects of organization's HC (Gratton & Ghoshal, 2003). Especially external SC in this dimension is important, where external SC is working to bridging or linking the internal organizational environment with the external environment. Kim and Cannella (2008), proposed that whenever a business environment starts becoming turbulent, directors should focus on creating external ties (Hillman, Cannella & Paetzold, 2000). This helps firms by reducing uncertainty associated with new strategies via the information that they gain from interlocutors who already have experience in implementing that strategy. Moreover, creating partnerships with customers and suppliers, and creating new alliances help to develop solutions. So, the main role of internal SC when its level is low must intensify positive effect of external capital, and when its level is up, it must mitigate negative effects of external SC (Barroso-Castro, Villegas-Perinan & Casillas-Bueno, 2016).

Findings of the study for testing the third hypothesis reveal that OC hasn't any significant effect on PtI, PsI, MI, and OI, which means strong support for the OC is required. Contrary to findings of this study, the findings of Subramaniam and Youndt (2005) show that OC positively influences incremental innovative capacity. Similarly, Zerenler, Hasiloğlu and Sezgin (2008) found that OC has a significant and positive relation with innovative performance. Delgado-Verde (2011) claimed that OC has a positive effect on incremental innovation rather than radical innovation. Ghorbani, Mofaredi and Bashiriyan (2012), El Telbani (2013), Wu and Sivalogathan (2013) found a significant positive relation between structural capital management and OI. Elsetouhi (2014) indicated that types of innovation have a positive relation with OC. Dumay, Rooney and Marini (2013) suggested that OC is crucial for the success of evolutionary innovation. Although these findings, a study by Santos-Rodrigues, Faria, Cranfield and Morais (2013) proved that structural capital has a direct relation with the adoption of innovation but it has no direct link with the creation of innovation. According to these findings, it can be said that broader interrelationships among individuals and groups, inside or outside the organization might not increase effectiveness because of obstructed flows of information and interactions that already occur in an organization's structured and codified procedures and rules. These institutionalized knowledge-sharing processes have weak support of their own.

6. Conclusion

This study aims to show the role of IC on types of innovation through empirical research conducted for testing the effect of HC, SC, and OC on different types of innovation in oil companies affiliated to NOC in Libya. Conducting a study about IC and innovation, particularly in the Libyan oil sector, is very important. It is believed that this study will contribute to the literature by increasing the focus on applications of IC and innovation in the oil sector in Libyan environment.

This study has discovered the IC usage and its role in innovation in the target companies in oil sector. Thus, having strong IC will help these companies by improving their ability to generate innovation to become innovative companies. Findings reveal that HC, SC, and OC have different effects on PtI, PsI, MI and OI. This study discovered that Libyan oil companies are labor-intensive, so they rely on HC, which is accepted as a component of intellectual capital. This is followed by SC as other component of IC. Finally, the last IC component which was taken little attention in Libyan oil companies is OC. The Libyan oil companies depend on HC resources more than SC to some extent while the OC needs more support from the SC. Therefore, senior managers and leaders must focus on each IC component for supporting innovation through strengthening the positive side and avoiding negative aspects that reduce innovation in all activities in the organization. Ultimately, Libyan oil companies need to be aware of the importance of IC in their companies' success.

Researchers should conduct further studies to improve the IC knowledge as well as innovative trends in Libya. This study presents a possible reference point to conduct further researches into all the industrial and services sectors in Libya. It is believed that the findings of further studies will improve the academic knowledge on IC and promote innovation in Libya, especially in the oil sector, which is a main wealth source of Libya and other industries both in public and private sector. Understanding IC and its benefits especially on innovation side, make companies to be curious about its implications and its outcomes.

Author Contribution

CONTRIBUTION RATE	EXPLANATION	CONTRIBUTORS
Idea or Notion	Form the research idea or hypothesis	Ibrahim A. H. MOHAMED Aysun KANBUR
Literature Review	Review the literature required for the study	Ibrahim A. H. MOHAMED
Research Design	Designing method, scale, and pattern for the study	Ibrahim A. H. MOHAMED Aysun KANBUR
Data Collection and Processing	Collecting, organizing, and reporting data	Ibrahim A. H. MOHAMED
Discussion and Interpretation	Taking responsibility in evaluating and finalizing the findings	Ibrahim A. H. MOHAMED Aysun KANBUR

Conflict of Interest

No conflict of interest was reported by the authors.

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