

The Effect of Intellectual Capital Components on Technological Innovation through Synergy Mediation

By

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Abstract

The idea of this study came to investigate the impact of intellectual capital via its components on technological innovation by mediating synergy. The questionnaire was used as a tool for measuring and collecting data on the study sample of 80 individuals. The questionnaire was distributed to 5 bodies affiliated with the surveyed organization (the Oil Exploration Company), and a number of statistical measures were used, such as the arithmetic mean, standard deviation, regression coefficient, and path analysis. The questionnaire was also subjected to a validity and reliability test to ensure the validity of the statistical results. In the light of the statistical analysis and its results, a number of conclusions were reached, the most important of which was the presence of a significant effect between intellectual capital and technological innovation, and also the effect of intellectual capital on technological innovation increases with the presence of the mediation variable (synergy). I concluded the research with a set of recommendations, the most important of which was the employment of the synergistic relationship between the components of intellectual capital and its active effect on the technological innovation, the employment of impact relationships between intellectual capital and technological innovation in formulating the plan of the researched organization and making organizational changes that increase its achievement.

Keywords / intellectual capital - synergy - technological innovation.

The first topic / Research Methodology

First / The Research Problem

The difficulty of finding the synergistic relationship among the components of the intellectual capital leads to the backwardness of technological creativity. This problem is suffered, to some extent, by the Iraqi Oil Exploration Company, as the researcher noticed through field cohabitation in the aforementioned company and a meeting with a number of its officials that there is a weakness in the knowledge of Intellectual capital and a weakness in knowing its components, which indicates negatively the technological innovation in the surveyed organization, and the consequent failure to keep pace with development in its field of work.

In view of the importance of the aforementioned research problem, the researcher wanted to address it and discuss it in the Iraqi Oil Exploration Company, which represents a major and important source of budget revenues. For the purpose of framing the problem, the following questions must be raised:

1. To what extent is the researched and surveyed organization aware of the importance of intellectual capital?
2. To what extent is it aware of the components of intellectual capital and its importance in the field of technological innovation?

3. To what extent is the researched and surveyed organization aware of the importance of synergy between the components of intellectual capital?
4. To what extent does the researched organization benefit from human, structural and relational capital to find and sustain technological innovation?

Secondly, the importance of research

The importance of the research comes from the importance of its variables, as intellectual capital is an organizational resource, so tangible resources are no longer the resources that the organization adopts only, as attention shifts to intangible resources expressed in intellectual capital components that help organizations achieve creativity, improve efficiency and effectiveness, and find technological innovations and knowledge support.

The investment of synergy between the components of intellectual capital will increase the effectiveness and efficiency of the organization, and will give it a strategic dimension.

The importance of research can be summarized in the following points

1. It includes a scientific addition by addressing an important aspect, which is the synergistic relationship between the components of intellectual capital and its impact on achieving technological innovation.
2. It gives a wide scope for students to know the impact of the components of intellectual capital and synergy in areas other than the technological innovation, such as increasing the effectiveness and efficiency of the organization.

Research objectives

The research seeks to achieve the following goals

1. Knowing the results of synergy between the components of intellectual capital in the Iraqi Oil Exploration Company, which is being researched as a model for other Iraqi organizations.
2. Testing the effect relationship and finding out its strength between the components of intellectual capital (human, structural and relational) among the dimensions of technological innovation (process creativity - tasks - product creativity -) with an explanation of the nature of this effect
3. Enhancing the organization's interest in the intangible resources of intellectual capital and its components, because it is a source of knowledge that can be embodied in the form of new creations that put the researched and surveyed organization at the forefront of its counterparts.
4. Enhancing interest in human capital as a focal point for the rest of the components of intellectual capital, if its outputs are properly exploited.
5. Directing the attention of the surveyed organization and other Iraqi organizations to the extent of the importance of the research variables and the importance of the results achieved from the impact of one on the other.

The hypothetical scheme of the research

In light of the research problem and objectives, the researcher developed a procedural scheme for the research, and Figure 1 illustrates this.

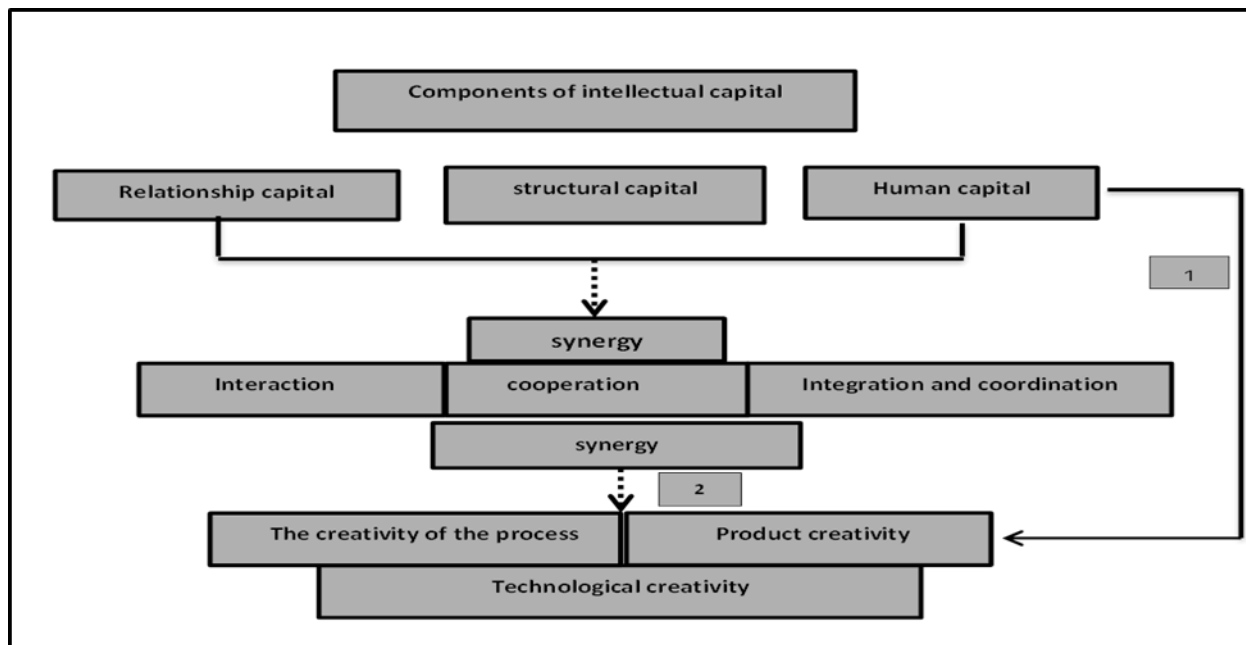


Diagram (1) - Hypothetical chart for the research

Research Hypotheses

Based on the hypothetical plan of the research, the following hypotheses have been placed :

First hypothesis

There is a statistically significant effect of the components of intellectual capital (human capital, structural capital, relational capital) on organizational creativity dimensions (product creativity and process creativity)

Second Hypothesis

The effect of the dimensions of intellectual capital increases in the dimensions of technological innovation by mediating synergy (integration, interaction, coordination, cooperation) between the components of intellectual capital and technological innovation.

Procedural definitions of research

The independent variable: Intellectual capital: It is the set of knowledge existing in the organization, whether explicit or implicit, and the ability to generate it, which affects the future capabilities and potentials of the organization in achieving its effectiveness and ability to survive (Jones. R. 2019:91)

* Intellectual capital variables

1. Human capital: the implicit knowledge of the individuals in the organization, and the organization cannot possess it except by transferring the implicit knowledge from human capital to structural capital.
2. Structural capital: Infrastructure gives strength to human capital to perform its functions, including trademark, computers, calculator programs, accounting information systems, databases, and expert systems.

3. Relational capital / It means the parts that relate to the customer's satisfaction, retention, empowerment and involvement in the organization's business and commercial qualities, and the exchange of information and ideas with him.

Mediation variable / synergy is a set of planned information and continuous efforts aimed at achieving cooperation, coordination, interaction and integration to achieve the goals of the organization at all levels with high efficiency and effectiveness. As for its dimensions, they are:

- Interaction, the interaction of two or more intellectual capital resources in organizations, which enhances the combined effect of value creation and competitive performance that is greater than the combination of individual effects.
- Cooperation / as a collaborative act for a group of effects and actions in a specific way so that the total effects are greater than the group of each effect taken as a unit.
- Coordination: increasing the internal efficiency of sharing common ways of working, methods, policies and information technology systems (Van Weele: 2010)

Dependent Variable

The dependent variable is characterized with technological innovation, which can be defined as (it is a human activity carried out by an individual or individuals who have characteristics that distinguish them from others by providing something new, whether it is a commodity, a service, or an idea that achieves economic or social benefit for the individual and society. As for its dimensions, they are:

- Creativity of the process: It is represented in the practice of performing activities and activities within the organization to ensure the continuity of continuous improvement based on and existing (Terziovski, et al: 2001:
- Product innovation: Refers to the occurrence of changes in existing products to ensure continued innovation and improve performance in it (Ettlie, et al 2001

Research methodology

The researcher relied on the analytical descriptive approach, which does not stop at collecting data and information for analysis, but rather means analyzing the researched phenomenon and reaching the facts through the collected data and extracting its implications and knowing the factors affecting it. For the purpose of reaching objective results to present recommendations to solve the problem.

Research tools

A number of data collection and analysis tools were used to reach the final results of the study, as follows:

1. Various scientific sources / a group of foreign literature has been reviewed, including books, periodicals, university dissertations, and research related to the nature of the study.
2. Questionnaire: The questionnaire is an important source for collecting descriptive data (opinions - directions - points of view and ideas) obtained from the study sample. The questionnaire consisted of 4 parts, the first part included 5 items devoted to general data, and the second part included (18) items distributed on intellectual capital variables.

As for the third part of the questionnaire, it included 12 items distributed on the variables of technological creativity, while the fourth part included 24 items distributed on the variables of synergy. The response scale that will be used is seven-fold, and these paragraphs have seven levels ranging from (completely agree) to (absolutely disagree), as shown in Table 1

Table 1 *The answer scale for the questionnaire*

completely agree	Agree	Somewhat agree	Neutral	Somewhat disagree	Disagree	Absolutely disagree
7	6	5	4	3	2	1

Measuring the validity and reliability of the questionnaire

1. Reliability: After designing the questionnaire, it was presented to a group of arbitrators, as in Appendix (1), with different expertise and specializations, to find out their opinions on the clarity and interdependence of the questionnaire paragraphs, and the extent of their suitability for measuring the required variables. Its development is restricted to ensure more accuracy in the scale. To further ensure the reliability of the questionnaire, the response scores for the scale statements were arranged in ascending order. It was divided into two groups equally, and 27% of the highest scores and 27% of the lowest scores were taken, then the difference between the two groups at significant level 0.01 was measured using the Mann-Whitney test coefficient to calculate the significant differences.

2. The stability of the questionnaire / The split-half method was used to measure the stability, which is summarized by finding the correlation coefficient in the Spearman-Brow equation. If the stability coefficient is 0.67 according to the equation, then it is sufficient for research for which the questionnaire is used as a tool. When applying this method, it was found that the correlation coefficient of the questionnaire was 0.96, which means that it has high stability with its various measures and can be adopted at different times and for the same individuals and give the same results.

The Alpha - Cronbach coefficient was used for the purpose of ascertaining the stability coefficient of the questionnaire. The total value of the questionnaire items was 0.98, and this clearly indicates a high degree of stability of the questionnaire.

Tenth: Statistical methods and tools - used

A number of descriptive and analytical statistical methods have been employed for the purpose of analyzing and processing data through the statistical program SPSS and as follows:

1. Percentages to describe the data related to the selection of the research sample
2. The coefficient of variation to determine the most consistent variables according to the answers of the research sample
3. The arithmetic mean and the standard deviation to find the coefficient of variation through them
4. Simple regression coefficient to measure the effect of independent variables
5. Path analysis to determine the direct, indirect and total impact of the independent variables on the dependent variable.

Eleventh / the research community and its sample

The oil sector was chosen, represented by the Oil Exploration Company, to apply research to this sector, which is of great importance to all other sectors and to support the national economy. The place of conducting the research was completed on all the 5 public bodies affiliated to the Oil Exploration Company. The research community reached 450 individuals.

A random sample of 80 employees was selected and (general manager - assistant general manager - department manager - division manager - organizational unit official - technical observer or work supervisor) were chosen. The test of this sample is compatible with the variables of the research that needs a degree of understanding and comprehensiveness in perception and the ability to evaluate others, so the research sample included senior management, middle management and supervisory management.

80 questionnaires were distributed to the sample, 80 questionnaires were obtained, and 3 questionnaires were neglected because they did not meet the requirements.

The theoretical framework of the research

The first topic / intellectual capital

First: the concept of intellectual capital

Organizations need to explore all of their resources in order to continue to succeed. Intangible (non-physical) assets, along with tangible (physical) assets, have become important to any organization, and these intangible assets are called intellectual capital (IC).

Stewart (2019:67) defines intellectual capital as the intellectual material, knowledge, information, intellectual property, and experience that is put to use to create knowledge. As defined by (Daft, 2021: 313)) as a set of informational resources consisting of two types of sources, apparent knowledge that is easy to express or write and then transfer to others in the form of documents, general instructions and tacit knowledge, which is knowledge based on personal experiences, intuition and personal judgment. And it is difficult to write it down or code it, but it settles in the human mind and in the minds of the individuals who work and develop the information, and it is difficult to communicate it to others.

Intellectual capital has been defined with its components, as (Malthotra, 2021: 5) defines it as encompassing human capital, structural capital, and customer capital. Despite the multiplicity of trends that came to develop a concept of intellectual capital, some writers tried to distinguish it through its unique characteristics, and among these characteristics set by (Mett Anen, Lonn avist, 2019: 14), namely:

- 1- Intellectual capital is something invisible.
- 2- Intellectual capital is closely related to the knowledge, information and experiences of users, as well as the traditions and technology of any organization.
- 3- Intellectual capital gives any organization better chances of success in the future.
- 4- Intellectual capital does not include financial and monetary assets.

Second: the importance of intellectual capital

(Daft, 2021: 295) believes that the reason for the interest in intellectual capital is:

- a. The rapid progress in information and communication technology.

- b. The shift of interest in managing organizations from natural resources to intellectual resources. (vij, 2019: 15) mentioned that intellectual capital provides a competitive advantage for the organization, which lies in the ability of workers to learn quickly. It becomes clear through this the need for an effective management of intellectual capital, because the success of the organization and the secret of its survival lies in its correct investment of its intellectual energies in a way that enhances its care and preservation. The importance of intellectual capital can be liberated as follows:
- 1- Intellectual capital is considered the real wealth of the organizations for the cleverness that the employees of the organization enjoy.
 - 2- It is the basis for creating successful business organizations, as in Western society there are examples of those who have minds and ideas that enabled them to establish large companies (Boedker, Christion, 2018: 221)
 - 3- Intellectual capital in today's knowledge economy (knowledge economy) has become the biggest source of competitive advantage from other organizations.
 - 4- The main weapon of the organization in today's world is the fact that intellectual assets are a hidden force that guarantees the survival of the organization.

Third: the components of intellectual capital

There was no consensus among writers on defining the components of intellectual capital, but (Mckenzie, Ferrie: 2002, 22) found that classifying intellectual capital into groups achieves two purposes:

- A- These classifications help individuals and organizations determine what kind of intellectual capital the organization possesses, and then give the opportunity to compare different organizations.
- b- It provides them with the basis upon which the systems and processes are built in managing this intangible asset.

Despite the different points of view of writers regarding the classification and naming of these components, many of them defined intellectual capital in its components (human, structural, and client), and many writers agreed on this (Martinez, Torres, 2018: 175).

We will briefly discuss the components of intellectual capital

1- Human Capital (HC) the man Capital

Everyone agrees that human capital is the basis of intellectual capital, as human capital is defined as a term that includes specializations, high skills, and motivations for workers possessed by organizations (BDL, 2007: 9), and (Royal & Donnell, 2008: 669) considers it a part of capital. Intellectual, which includes previous knowledge, understanding, and skills possessed by workers, and represents the real value of organizations. It is a group of working individuals who possess rare and valuable knowledge, skills, and capabilities for the company to increase its material and economic wealth.

Human capital is the collective ability of the organization to extract the best solutions from the knowledge of its employees (Tgnideh, 2013: 252), it is the source of creativity and strategic renewal, whether it is from brainstorming or in research laboratories, re-engineering of new processes, improving personal skills or development that leads to new sales. Although the human brain can be considered the main source of knowledge creation, the organization can follow the accumulation of knowledge and its techniques and store the individual knowledge in databases, procedures and structures depending on the nature of this knowledge (Delgado, 2011, 4).

2- Structural Capital

It is a major component of intellectual capital and is also called organizational capital. It is defined as all internal operations and the infrastructure that supports these operations, which includes digital files, information systems, and preparatory programs (Phatak, 2003, 6). Intellectual (Swart, 2005: 20).

Structural capital consists of the structures and processes of developing employees in order to be productive (Boedlker et al, 2005: 13). This includes, for example, patents, organizational culture, management philosophy, new product development, information systems and operations.

3- Relational Capital (RC)

Relational capital can be considered as the link that brings together the components of intellectual capital among themselves on the one hand and stakeholders on the other hand. (Martienz, 2007: 617) indicates that there is a basic link between the components of intellectual capital, which has a positive impact on its structure, and is a major part of it. (Bonits, 2011: 200) believes that it consists of a number of parts related to satisfaction of customer satisfaction and retention, empowerment and involvement in the organization's business and commercial qualities, and the exchange of information and ideas and exchange ideas and information with them. According to what has been said that CRC considers as a nets for internal and external communication employed to support the organization internally and externally.

Technological Innovation

First: the concept of technological innovation

Innovation is a phenomenon with multiple faces and dimensions. For this reason, opinions differed and there were many points of view on presenting a specific and clear concept of the term innovation. Management literature was full of many jurisprudences, although the term creativity is still one of the most common terms at the present time in administrative thought.

Innovation is not the introduction of a new product, exciting service, or distinctive technology, as innovation must include a deep consideration of all elements of the organization's business model, including (Loewe & Dominiquini, 2006: 31) what should be offered to customers, and whether new markets can be excited . Innovation indicates work based on presenting an idea or something new that is qualitatively different from the existing forms (Collin: 1995:148).

As for the word technology, it refers to the total knowledge, experience, technical practices and interrelationships between the sub-systems of work. Technological innovation (H. H, et al, 2001: 536) is defined as being related to production and productivity, meaning that every innovation may not lead to the improvement of the production process or the use of production elements, not even the provision of new products or the improvement of existing products is not considered technological innovation in the proper sense (Benedetto, 2000, 16)

Second: the Importance of Technological Innovation

The importance of technological innovation has increased in light of the intensification of competition between organizations, especially international ones, in order to avoid failure and declining. It is the spark that keeps organizations and individuals moving forward (Boyce, 2012, 87).

Without innovation, new goods or services or modern methods of doing business cannot emerge. In light of knowledge economies, organizations must constantly develop their strategies by applying innovative mechanisms to acquire and disseminate knowledge and convert it into intellectual capital and assets or intangible assets (Boyce, 2012: 87).).

This competitive structure indicates that creativity and innovation are among the main initiatives to increase continuous organizational performance to maintain excellence and improve management in creative ways to exploit organizational capabilities and thus develop internal entrepreneurship. (Hartjes, 2010:10). In general , the importance of the technological innovation is as follow:

- 1- Expression in the structure, method of work and management, and in creative ways to keep pace with technological development.
- 2- The technical and technological development in commodities and services and their production methods must match that innovation.
- 3- Continuous improvement through flexibility and adaptation to the needs of customers on the basis of what is known as customer service.
- 4- Develop and accumulate personal skills.
- 5- Improving the productivity of the organization by achieving efficiency and effectiveness in performance.
- 6- Innovation works to find solutions to internal and external problems faced by organizations.

Dimensions of technological innovation

Technological innovation has been classified according to its use, the nature of its impact, and its sources. However, the researcher saw that the classification of technological innovation according to its uses is its dimensions. Technological innovation has been classified within this approach into two types, as mentioned by (Langtey et al, 2005: 25) , the first one is product innovation, which is directed towards a change in the final product or final services offered by organizations.

As for the second type, it is process innovation, which is the implementation and adoption of new or improved production methods or delivery methods on the production process to change the final product or final services. For example, in the early twentieth century, the American “Henry Ford” applied the principle of the main assembly line in a very large way to produce the first cheap car, which is the Ford model, and among the researchers who adopted this classification (Macadam et al, 2000: 40) and (Bikalvi, 2007: 22).

Synergy

First: the concept of synergy

The synergy is deemed as the main driver of organizations performance and the basic differentiating relationship for all government organizations and the private sector. Specialized researchers dealt with the concept of synergy, as (Bik Falvi, Andera, 2007, 30) mentioned that synergy arises by taking advantage of the resources represented by skills, methods, and work procedures between the units of the organization.

It was also (Juga, 2020, 45) mentioned that it is a collaborative action for a group of effects and actions in a certain way, so that the sum of the effects is greater than the sum of each effect separately. (Naude, Heyns, 2020: 87) indicated that it is the ability of two or more organizations to generate a value larger in working together than if they work separately.

We note from the above that the researchers took to give a unified definition of synergy, some of them considered it efforts for coordination, mutual cooperation and joint work between the various sub-systems, and some of them believed that synergy exists through the use of resources represented by skills, methods and work procedures between the units of the organization.

Second: the importance of Synergy

Synergy as a concept gained momentum from the administrative literature, and the topic of synergy opened up new horizons and creative steps towards improving the gains from reaping the harvest and benefits in the field of (Effectiveness, Economy and Efficiency).

Synergy is an important concept for managers because it reinforces the need to work together in a cooperative manner. Collective cooperation tends to enhance performance and increase efficiency and profitability than the work done or the idea presented individually, and the various synergic departments can combine efforts so that their products are arranged, classified, and delivered in a more efficient and effective way than when each organization was working individually and independently from the other.

Third: the dimensions of synergy

Synergy has four dimensions: coordination, interaction, integration, and cooperation, and we will address each dimension briefly.

1- Coordination:

It is a set of mechanisms used in the organization to link the actions of the sub-units and put them in a fixed pattern and make their activities more effective.

(Shelly, R. 2012: 135) indicated that coordination is important to achieve increase in value in the organization and it strengthens the bond between units that work independently by enhancing the effectiveness of the relationship between them. Coordination produces synergy by encouraging dialogue, discussion, innovation, creativity and learning both within and across organizational units, and includes coordination and plan-making by the organization's departments together and the development of a structure that encourages communication.

2- Cooperation:

The term synergy is based on the concept of cooperation between the partners willing to work together towards a common goal to achieve outputs that are beyond the reach of the individual efforts of the partners.

(Anseel & Gash, 2007: 550) indicated collaboration always requires investment, which is justified if the partners realize the goals and value that partners working alone cannot achieve, and yet the collaboration may run into risks before it achieves its goal, and this is among the many reasons which leads to the cessation of cooperation before the goal is achieved.

3- Integration

The extent to which synergy is achieved depends on how the organization is managed, and this organizational integration, which is defined as the degree of interaction and coordination between the two organizations participating in the integration process, or in the organization itself (Pablo, 2015: 820), so many patterns of organizational integration processes that are characterized by high and low degree of integration.

(Haspeslagh & Jemison, 2021: 19) indicated that the degree of integration has a direct impact on the performance of organizations. Organizational integration is divided into:

- 1- The degree of interaction between the partners through the merger
2. The extent of the coordination effort to improve the quality of this interaction through specific integration and advance planning

B- Interaction:

The interaction between two or more people communicating or responding to each other, (Gupto, Roos, 2018: 211) indicated that the interaction between two or more intellectual capital resources in large organizations enhances the joint effect of creativity value for individuals to compete and effect and what is formed from that is greater than the total of the effects, if they were singular. The key to the synergistic relationship is the required interactions of the resources and these interactions can occur in many forms. The organization is seen from the point of view of intellectual capital, as it consists of a package of tangible and intangible resources, and looking at these resources as static and within themselves, they do not create the value (Kong, E, 2018: 97) and instead, their value comes through their interaction .

The practical side

Through this chapter, the researcher seeks to present and analyze the results using statistical and mathematical means, according to the answers of the research sample.

For the purpose of achieving this goal, this research includes the following:

- 1- Diagnose the research variables and describe them in the researched organization.
- 2- Testing the effect hypotheses among the variables using simple linear regression analysis.
- 3- Testing the direct and indirect effect relationships using the path analysis method.

First: diagnosing the research variables and describing them in the researched organization

This research aims to present the level of research variables and diagnose them in their location according to the answers of those involved in the research sample by using descriptive statistical methods such as the arithmetic mean and standard deviation. If the variable fails an arithmetic mean higher than the hypothetical and standard mean, which is (4), then this indicates the availability of a good level for this variable, and this reflects the interest of the research sample and vice versa, as follows:

Diagnosing the arithmetic mean, standard deviation, and coefficient of variation for the dimensions of intellectual capital.

Table (2) shows the arithmetic mean, standard deviation, and coefficient of variation for the intellectual capital variable and its dimensions depending on the coefficient of difference ratios.

Schedule (2) *The arithmetic mean, standard deviation, and coefficient of variation Intellectual capital variable and its dimensions*

Series	Dimensions of intellectual capital	Mean	Standard deviation (SD)	Coefficient of Variance (C.V)
1	Human capital	5,325	0.880	%16,25
2	structural capital	5.121	0.929	%18.04
3	Relationship capital	5.195	0.771	%14,89
4	total intellectual capital	5,213	0,737	%14,13

It is clear from Table (2) that the total intellectual capital variable amounted to (5,213), which is higher than the value of the hypothetical mean, which indicates that there is an acceptable level of intellectual capital in the researched organization. The total standard deviation of intellectual capital was (0.737), and this indicates that there is a slight dispersion in the sample's answers on intellectual capital. As for the dimensions of intellectual capital, the values of the coefficient of variance showed that the relational capital dimension had the lowest ratio of the coefficient of variance, which is (14.84%), which indicates that it is the most consistent, appropriate and important from the point of view of the sample from the other dimensions of intellectual capital. The reason for this is that it obtained the highest arithmetic mean and the lowest value of his standard deviation.

Diagnosing the level of technological innovation and describing it in the Oil Exploration Company.

Table (3) *shows the values of the arithmetic mean and standard deviation of the technological innovation variable and its dimensions depending on the coefficient of variance*

Series	Technological Innovation dimensions	Mean	Standard deviation (SD)	Coefficient of Variance (C.V)
1	Product innovation	5.29	0.688	%13
2	The innovation of the process	5.28	0.673	12%,74
3	The total of Technological Innovation	5.285	0.580	%10.97

It is clear from Table (3) that the total technological innovation variable obtained an arithmetic mean of (5.285), which is higher than the hypothetical mean value, which indicates that there is an acceptable level of technological innovation in the researched company, and the standard deviation of the total technological innovation reached (0.580). It indicates that there is a slight dispersion in the sample's answers to the questions of the technological innovation variable. As for the dimension level of technological innovation, the value shows that the process innovation dimension has obtained the lowest ratio of coefficient of variance, which is (12.74%), which indicates that it is the most homogeneous, and appropriate according to the sample point of view of other dimensions of technological innovation.

Diagnosing and describing the level of synergy in the oil exploration company.

Synergy, which is the mediating variable, included four dimensions (interaction, cooperation, coordination, and integration). Table (3) shows the arithmetic mean, standard deviation, and coefficient of difference for the above-mentioned dimensions of the synergy variable.

Table (4) *Values of arithmetic mean, standard deviation and coefficient of difference of synergy variable and its dimensions*

Series	Synergy Dimensions	Mean	Standard deviation (SD)	Coefficient of Variance (C.V)
1	Interaction	5.53	0.818	%14.79
2	Cooperation	5.37	0.725	%13.5
3	coordination	5.89	0.710	%12.3
4	integration	5.77	0.639	%11.07
	Total of synergy	5.64	0.566	%10.03

It is clear from Table (3) that the total synergy variable obtained an arithmetic mean of (5.64), which is higher than the hypothetical arithmetic mean, which indicates that there is an acceptable level of synergy in the researched company. The standard deviation of the total synergy was (0.566), which indicates that there is a slight dispersion in answering the questions of the synergy variable. As for the dimensions of synergy, the values of the coefficient of variance showed that the dimension of integration has obtained the lowest ratio of the coefficient of variance, as its value reached (%11.07), which indicates that it is the most consistent, appropriate and important from the point of view of the research sample from the perspective of the other dimensions of synergy. The dimension of coordination obtained a percentage slightly higher than the coefficient of variance for other dimensional variables, as it obtained (%11.07).

Second: Test hypotheses of direct and indirect effect

Testing hypotheses of effect between variables using simple linear regression analysis.

The impact hypotheses identified by the research will be selected for the purpose of determining the possibility of judging them with acceptance or rejection. It will be investigated according to the calculated (F) value and the level of significance through the value of the determination coefficient (R²).

The first hypothesis states (there is an effect of the components of intellectual capital on the dimensions of technological innovation).

Table (4) shows the level of effect of intellectual capital on technological innovation. The following results appeared:

There is a statistically significant effect of the total intellectual capital on the total technological innovation at the level of significance (0.01), as the calculated (F) value appeared (39.827), which is greater than the tabular (F) value of (4.9). The effect of power of the

intellectual dimension through the value of influence coefficient (R²) amounted to (0.347) and this indicates that intellectual capital is able to explain (34%) of the changes that occur in technological innovation. As for percentage (65%.3) it is attributed to random variables that did not appear in the regression. .

Table (4) *The level of effect of the components of intellectual capital on technological innovation*

effect variable	Constants		R ²	F	Technological innovation
	a	b			
Intellectual capital	2.900	0.464	0.347	39.827	

* Testing Significant F- at the level of 0.01

* Testing Significant t- at the level of 0.01

The level of positive impact was at the level of ambition for the following reasons:

- 1- The researched organization showed good interest in the intellectual capital variables.
- 2- The components of intellectual capital have received the attention of the organization, so, the impact of intellectual capital on technological innovation was good. To complete the picture, we find that the regression equation is (technological innovation = 2.900 + intellectual capital (0.464), which means that technological innovation is equal to (2.90). Even if the value of intellectual capital is equal to zero, we find that the value of technological innovation is (0.464), which represents the amount of effect of one unit of intellectual capital that affects technological innovation by (0.464).

Based on the above, it can be said that the greater the interest in intellectual capital Increased impact on technological innovation.

Testing the direct and indirect effect relationships of intellectual capital using the path analysis method.

The second hypothesis states that the effect of the dimensions of intellectual capital increases in the dimensions of technological innovation by mediating the synergy (integration, interaction, coordination – cooperation) between the components of intellectual capital and technological innovation .

In order to enhance the image of the direct and indirect effect of intellectual capital (independent variable) in this hypothesis on the responding variable (technological innovation (dependent variable) in the presence of synergy (as an intermediate variable), the direct and indirect effect of intellectual capital on the effect of synergy were measured using the Path Analysis method.

Figure (3) shows the effect of the total components of capital intellectual on technological innovation through synergy, this will lead to a direct effect on technological innovation (0.345) and also has an indirect effect on technological innovation through interaction (0.002) and through cooperation (0.181) and by coordination by a negative amount (0.138) and by integration (0.197), and accordingly, the total indirect effect of the total intellectual capital on technological organizational innovation through synergy reached (0.242).

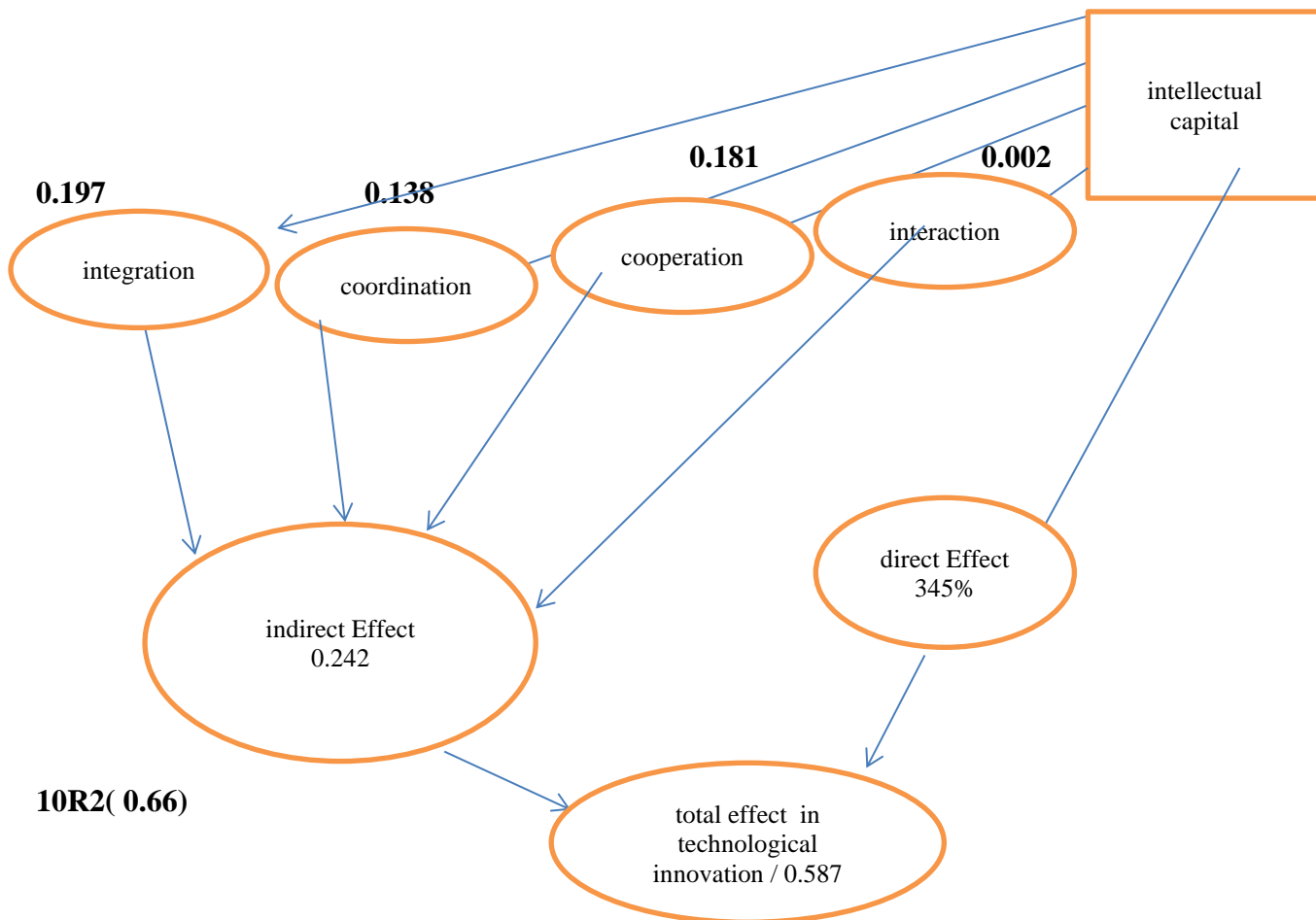


Fig. 3 / the direct and indirect effect between the intellectual capital and technological innovation.

The total effect (direct and indirect) of the intellectual capital with its components human capital, Structural capital, Relational capital) on the technological innovation amounted (0.587) and Fig. 3 explains that.

The results of the analysis showed the strength of the effect of the total intellectual capital on technological innovation through synergy (interaction, cooperation, coordination, integration) through path analysis. The value of (R²) is equal to (0.66), and this indicates that there is a percentage (0.34) that represents the effect of other factors were not included in the research model, and the model was tested, so the calculated (F) value was (53.99) and the tabular (F) value was (6.99), so the second hypothesis was confirmed.

Below is an analysis table, and table (5) shows the impact of intellectual capital on technological innovation in the presence of synergy using path analysis:

	Direct Effect	0.345
Indirect Effect	Interaction	0.002
	Cooperation	0.181
	Coordination	0.139-
	Integration	0.197
	Total	0.587

Results, conclusions and recommendations

This chapter dealt with a statement of the most important results and conclusions reached by the researcher through the theoretical and practical sides, with some recommendations that the researcher believes will contribute to strengthening the strengths of the researched company and avoiding its weaknesses.

First / Most important results

1. The researched company is interested in intellectual capital, as the results indicated its availability at a level above the mean compared to the hypothetical mean.
2. The researched company benefited to some extent from the tacit knowledge inherent in its human capital, which is represented by the innovation and skills of workers in the field of making changes in the organizational structure, culture, operations and human resource management.
3. Intellectual capital affects technological innovation, and this is consistent with the content of the first hypothesis, which emphasizes the importance of the role of intellectual capital in technological innovation, in a way that achieves the goals of the organization and what it aspires to achieve in terms of development and innovation.
4. The process of supporting technological innovation in the researched organization is not at the level of ambition for the following reasons:-
 - a. Lack of training courses for workers, which negatively affect their skills and knowledge.
 - b. The organization does not encourage the language of dialogue sufficiently between workers to exchange ideas.
 - c. Outdated work procedures greatly hinder innovation.
 - d. The new knowledge is not available to all employees in the researched organization
 - e.. The database is not working and needs to be reconsidered

Second / Recommendations and suggestions

1. Building a solid intellectual base due to the rapid changes facing the management of the Oil Exploration Company, in which a high-level cognitive knowledge and an increase in the advanced skills of individuals are required.
2. Increasing interest in intellectual capital and its management because it is an important source for the strategic direction of contemporary organizations.
3. Lacking individuals who have the necessary and appropriate practical qualifications to occupy important positions in the company.
4. Making choices (inclinations, knowledge, experience, readiness) that are the basis for providing the organization with distinguished individuals.

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Appendix (1)

Names of Messrs. Arbitrators of Survey Forms and Main Questionnaire

No.	Scientific Title	Arbitrator name	Workplace/ College of Economics and Administration- University of Baghdad.
1	Prof. Dr.	Ali Hasoon al-Ta'ee	Department of Public Management
2	prof. Dr.	Salahulddin Awad al-Kubaisi	Department of Business Management
3	Prof. Dr.	Sadeq al-Shimmari	Department of Business management
4	Prof. Dr.	Sanaa Abdul Raheem	Department of Business management
5	Asst. Prof. Dr.	Nisreen Jasim	Department of Public Management