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Technological Innovation concepts and risks

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Abstract

In this research paper, we aim to clarify the general framework of technological innovation in institutions and to study the degrees of risk associated with it. In our study, we adopted the descriptive approach to list the most important aspects and concepts related to technological innovation, and the analytical approach to analyze and show the risks of this innovation. Through this study, we concluded that technological innovation is the process that achieves coordination and integration between the different activities of the institution in order to create new ideas and working methods and embodying them into a new product (product innovation) or develop the current product; and to introduce a new production process (process innovation) or develop an existing production process to meet the ever-changing needs and wants of customers. Innovation involves great number of risks that can lead the institution into a catastrophic situation in the absence of an appropriate risk management strategy.

Keywords: technological innovation, product innovation, process innovation, innovation risks.

Jel Classification Codes : O31 , O32 , O33.

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1. INTRODUCTION

Change is considered the most salient feature of the business environment and growth is a factor of competitiveness. Successful companies are those based on creativity and innovation which become the most important assets and its basic structure. Thus today, the technological innovation is considered a decisive factor in the ability of the company to survive and grow as well as to the development and improvements of the products that are presented on the market. Innovation has become the main Philosophy of the existence of any business organization in a highly volatile global market (Idea to Value, 2016).

Innovation is crucial for an institution in further satisfying the expectations of its customers (Kylliäinen, 2019). To present high quality products which meet the needs and the new wants of different customers, the companies need to increase the strategic creative performance and to see the future with a deep vision to build new experience that has a great presence in the business world. It has become an obligation to care about the innovation and the creative people to improve the product quality in a continuing way to get the competitive success (Abbas F., 2013).

Nowadays, the innovation has become the key determinant of any institution, that involves different concepts based on the application through the product and service life-cycle. Technological Innovation has become the governing factor out of all which ensures the success of the Innovation. However, Innovation infolds several risks that even lead an organization into a catastrophic situation. Therefore, the knowledge of the different risks associated with technological innovation, and determining the degree of risk is essential during the process of decision making, and in developing a risk management strategy. Thus, in this study we try to answer the following question:

What is the importance of technological innovation and what are the risks associated with it?

To answer to the above problematic and to reach the study goals we adopted the descriptive approach to list the most important aspects and concepts related to technological innovation, and the analytical approach to analyze and show the risks and the degree of risk related to this innovation. This study is considered as an enrichment of previous studies on this subject.

2. Technological innovation concepts

2.1 Definition of Technological innovation

Researchers have given several definitions to technological innovation. (Leavitt&Whisler,1958) pointed out that the frequency of technological innovation pushes companies to develop new ways of working, build equipment and adopt more technology to stay in the market under the competitive environment.

(European Union, 1995) has defined it as Generating new techniques and processes in producing goods and services. The majority of companies could not survive in the market if no new changes are made in the production method and organizational aspects. In fact, these changes are considered as an innovation with different types. The type which concerns us in this research is technological innovation which is a new type, and it is defined as the process of developing and improving the existing product, or launching a new product (Elamiri, 2005).

Technological innovation has connected the world together enhancing the efficiency and effectiveness, breaking all the physical boundaries and language barriers, which have changed the ways and means of doing the businesses (ScienceDirect topic, 2008).

(Kartus & Kukrus,2013) stated that technological innovation involves all the products and the new processes or changes made to the products and the current operations.

(Echaar & Ennadgar, 2015) emphasized that technological innovation is a technology of designing, manufacturing and business operations technology that is related to first business application and new operations.

From the point of view of (Turki, 2017) technological innovation

is the process that achieves coordination and cooperation between the company's activities in order to adopt new ideas and procedures and translate them into a new product (good or service), develop a product, use a new production process, or advance in a new production process, in order to meet the customer requirements, and to make it the best in the competitive market.

Technological innovation can be sub-divided into **Radical**, and **Gradual Innovation** of the product or process. Radical innovation is seen as to rely on a new technology to create a new demand which is unknown from customers and markets, so it involves several risks. However, Gradual innovation seeks to benefit from the skills and the present knowledge to present other products which have been changed or improved for keeping up with the customer's needs and wants, and for sure this involves less risk (Echaar, 2014).

(Krasadakis, 2017) defines technological innovation as a new or improved product or process whose technological characteristics are significantly different from before. Technological Innovation happens when there is a need of a new product or shaping out an available product to match with the present needs. It creates opportunities in being competitive in the current market as well as entering into new market segments. Further new technologies are introduced to the economic system through the process of Technological innovation (Krasadakis, 2017). Moreover, technological advancements play a crucial role in enhancing the living standards of human being during the journey of evolution (Krasadakis, 2017). One of the most important contributions of technological innovation is enhancing the competitiveness among international economies (Krasadakis, 2017).

However, technological innovation involves great amount of risk and the main cause for this risk is the gap between the newly introduced technology and the reaction of the market towards the innovation.

2.2 Technological innovation importance

Technological innovation has become an unavoidable obligation, especially with the intensification of the competition in the market. The competitive factor is now based on the capability of innovating and the use of the creative talents completely according to the prevailing rules of the environment in which it acts. These talents and creative capacities have become one of the most reliable criteria to see from one side the corporation performance and on the other side the competitiveness. We cannot ignore the technological innovation importance especially in accomplishing the sophistication to several societies and industrial companies where it plays a major role in featuring the company performance, and reinforcing its competitive capacity through the following (Djadi, 2014):

- **Stimulating the demand especially in the saturated markets:** innovation is based on strengthening the first demand through a new offering as well as the second request through presenting new products, and removing the old ones.
- **Stimulate supply and create new sources of income:** industrial companies are always looking to develop, and innovation is considered an important resource for developing their activities. By sending new products, by increasing the offer but also by responding to new market requirements, by diversifying the company's activities and by creating new income resources for the company in order to fuel its progress.
- Increasing the industrial company capacity for competition.
- Attracting the customers and getting their satisfaction through presenting effective and developed products.
- Giving the industrial company the opportunity to be dominant in the market.
- Maintaining the survival and continuity of this company.
- Innovation generates innovation when another innovation follows it, as it arises from the same creative thought, and aims to satisfy the same needs.
- Innovation works to achieve sustainable development.

2.3 Technological innovation types

Through reviewing previous author's views, and some literary research closely related to technological innovation, we found that they agree in classifying technological innovation into four categories:

i. Offering a new product: means making a changes in the future products to meet some of the wants, or needs of customer in a better way. It basically aims to offer products in the market which they are new compared with existing products in the market. Innovation could be existed in the product's process or in its using conditions. In general, technological innovation to products concerns three main sides:

- Innovate the professional synthesis of the product as inventing a new one or make some changes.
- Innovate the professional synthesis of the product; It is specialized with the technical features of the product.
- Innovate the elements or characteristics; it concerns the form how the product is presented.

The new product is considered as a main factor of survival and continuity of the companies unlike some other companies which change their products. In rapidly changing industries, the new product is considered as a fundamental factor for the survival of companies, therefore, it has been made some improved entries to introduce new products. The last could be limited to the employment operations existing in the recent technology. Among the most important supporting reasons for developing the recent product or introducing a new one is: economic changes, demographic and sociological changes, technological changes, international relations, government legislation and political changes. (Handal, 2013)

ii. Improving the authentic product: The companies make some improvements and changes on its recent foundation in order to reduce costs, and increase the additional value for customer's or encounter the competition in the market. The importance of improving the recent product has been increased due to the customer's demand in the industrial environment on several types of products, and the quick

shift from a particular product to another one which has technical features. Among the main reason for developing the recent products done by companies we have:

- When the recent product does not meet the company aims and objectives.
- The quick change in customer's wants and needs.
- Economical consideration.
- Meeting the competitive threats.
- Discovering alternative raw materials with less cost.

So, improving the recent product means making some changes and improvements on this product in order to present it in the market with a new form to meet customer's wants and needs. We have to point out that the procedures and methods that the company use for developing its products and presenting it in the market are considered as fundamental factor in the developing process of the product. The technological progress the market change and the product's life circle have become pressure factors on the companies in order to improve their products, and providing the help for developing more qualified products through making some improvements on the products (Djadi, 2014).

iii. Designing and using new process: the aim of designing a new process is to choose and specify the best way to produce the product or service, thus process planning and design is concerned with specifying the detailed description of the job operations to produce the product, and specifying the ongoing relationships between job processes to design the most qualified method to produce the product.

There are many activities that should be done during the designing of the production process are:

- Analyzing the product.
- Analyzing the production process.
- Selecting the production process type.
- Design work methods for each process or production step.

The main purpose of process design is to identify or organize the

financial resources of the business to realize greater benefit. When designing a new production process, it is necessary to define all the requirements for the production of the new product such as: preparation, creation of inputs and what is necessary to convert the processes into manufactured products according to customer needs (Handal, 2013).

iv. Enhancing the existing process (The recent one):

Anything new or changed in the production process is aimed at improving or reducing the cost of production, improving the performance of the technical method of production which results in positive outcomes from the quantity sold. Thus, improving the production process through the use of technological innovation leads to an increase in the efficiency of the production device and an improvement in the quality of production, which leads to more profits and ensures a continuous competitive advantage for industrial companies. The subject of technology and continuity has so far become one of the main things that the company needs to provide the novelty required by the consumer to produce the product with good characteristics and descriptions of a new technical process, so from there, the technology base will be related to new product innovation or product development based on data provided by vendors or marketing research.

Industrial companies in developing countries need automation to beat the competition as some of these companies are making it one of their strategies to differentiate themselves from other competitors. Process improvement provides the opportunity to achieve a consistently high level and quality of process performance. This is evident in productivity improvement which aims to drive high value in process performance and increase throughput power to meet changing customer needs (Djadi, 2014).

2.4 The effective factors on technological innovation

Technological innovation may be affected by a set of rules which

(Houssein, 2010):

i. Technology: it represents the knowledge, the creativity, and the mental capacity which contributes in finding the machines and equipment, tools, and methods that contribute to the development of societies. Technology is considered as an important element in surviving and success and the growth of any business that constantly keeps pace with technology, and it is sure to satisfy the customer who is looking for all that is new in services, new features and practice.

ii. Research and development: represents the process of discovering and consolidating knowledge, discovering new ideas and concepts, and then developing them. In addition to demonstrating organized efforts to increase scientific knowledge or product or process innovation. Companies are largely concerned with research and development activities to meet the rapidly changing needs and wants of customers, especially in innovating products or services and processes that make them competitive in global markets, and interacting with the environment by exploiting the abilities of the company and facing continuous changes. There are many different classifications of research, but the classification agreed upon by many authors and researchers is as follows:

- **Main research:** aim to reveal the authentic thoughts for the technique, and applicable enhanced knowledge in the future.

- **Applied research:** aim to find solution to the practical issues that may face when transforming thoughts into new products.

- **Development:** is the activity that transforms a set of technologies into preferred designs and processes in order to improve the quality and design of the product, and the development of the process with marketability and ease of production.

iii. Technological innovation succeful strategy: Technology strategy focuses on developing the product or service that differs from the

existing one or presenting something different and new. All companies are forced to choose the obvious strategy of standards in the field of innovation and creativity in order to link production technologies or service to the nature of technological development on the one hand and to the requirements of the market on the other. These companies have realized that the particular path of business innovation strategy is to pursue all that is different and new. (Hagedoom, 1988) pointed out that there are six types of technological innovation strategies:

- Penetration innovation strategy.
- Defensive innovation strategy.
- Imitated innovation strategy.
- Reliable innovation strategy.
- Traditional innovation strategy.
- Opportunity innovation strategy.

2.5 Technological innovation types

If we had shown the most important technological innovation in history, we would have found that. Each one has a story explains it's happening sometimes these stories are wearied if not all cases, innovation comes as a result of specific planning and guided done effort directly to get that innovation. It has been produced many new products and added some features to existing ones or it has been innovated new process, or made significance improvements on preceding operations as a result to chances offered to company, or passed through unexpected circumstances. In general, we can rely on resources specified by (Drucker) in his book (Innovation and entrepreneurship) that can be relied on in many literary researches that address the subject as a determinant of these sources (Elamiri, 2005):

i. Unexpected events: There are many companies that innovated new products by one of their engineers or some research teams by coincidence, even some of these companies double their profits as in case of (Don Cullen of Transmit Corporation) which has discovered a type of aluminum that would be used in house roofs, or as it happened with the discovery of plastic that leads to many uncountable benefits.

ii. Controversial: this resource is common in providing the atmosphere, or new innovative creative opportunity, so diversity between what is really

happening and what is assumed to happen, or the difference between the planned and the actual performance is considered as a chance that through it may show some important technological innovation.

iii. Production process requirements: The serial production processes that ends with presenting the final product was a resource for artist and engineers who have the skill and long-term perspective for developing processes or products through observing the operation with high accuracy and the focus on change that may occur on the entrances when transforming them to output.

iv. Market or industry change: It is obvious that many changes happen in the economic sectors progressively, invisibly as a result of several factors as: industry nature, technological progress, consumer's tastes … soon. So, to keep up with these changes, the company should be creative and presentable all what is new. According to the recent world, Innovation and Creativity are the precious process in the new economic, and without flow of ideas businesses will be judged as undeveloped.

v. Demographic shift: the increase in the population, its professional and age composition, its geographical distribution, its level of education, its income and its level of employment, all these factors offer opportunities to introduce many technological innovations in the field of health, education, housing and other serious problems resulting from the increase in population.

vi. New knowledge: The great progress in the practical knowledge quantity and quality has led to the possess of many products especially the electronic ones, and communication tools. These innovations are the result of new thoughts and knowledge which are being processed with new professional tools and methods the quantity of knowledge in any field has been increased in less time as it was in the past, and this increases the opportunities of creativity and innovation.

3. The risk in technological innovation

3.1 The risk related to technological innovation

One of the fundamental form of technological innovation process is the uncertainty around the process and its future. Uncertainty is a feature that sticks in all the company's decisions in today world as a

result to environment dynamic, and the development speed in all areas. The cultural technological, law, social, political, and economical change must affect effectively the technological innovation process and its accomplished objectives. We already know well that one of the innovation requirements is the agreement on its different steps, which means holding big costs before arriving to result that could fulfill these costs in the future. For sure if the innovation was authentic or lead to overcome difficult problems, costs would be expensive as well as the risks around them. In other words, the risk suits the nature of the innovation. In the following we summarize isks related to technological innovation based on the Literature

Table 1: Risk related to innovation technology

The risk related to innovation technology	The Author
• The institution has limited technical capacity, so technological innovation poses a risk. • Innovation strategy is not aligned with the institution's long term goals. • If the institution does not follow good marketing methods, or if its market position is inaccurate or inappropriate. • The absence of an efficient risk controlling mechanism, since risk management needs to be combined with institution's development plan, strategies, investments of human resources and funds. • Not adopting the principle of "learning through Experiment". • Not generating the technology idea through customer feedback, research and creativity resulted in an innovation that does not solve the customer's problem.	(Wen & Li , 2010)
• Risk of material resource. • Not evaluating the innovation idea in terms of financial, marketing, structural, and technological abilities.	(Sidhu, Lavian, & Howell, 2015)
• Not properly aligning the development,	(Voigt, Baccarella,

implementation and results of the whole process (incomplete information and communication problems). • Violating Intellectual rights or Intellectual property stealing. • Risk of technological advancements in the market and the emergence of new technologies. • Risks related to sources of information, including distorted market information. • shortage of institution' strength (including human resources, finance, leadership, contracts, brand recognition and a qualified supplier base).	Wassmus, & Meißner, 2011)
Shortage of institution' strength (including human resources, finance, leadership, contracts, brand recognition and a qualified supplier base)	(Choi & Krause, 2006)
• Risk of abundance, the profitable innovation today may be redundant in the near future. • Risks outside the control of the institution such as fluctuations in customer demand, the social and economic environment, national industrial policies. • Not evaluating the innovation idea in terms of financial, marketing, structural, and technological abilities. • Not generating the technology idea through customer feedback, research and creativity resulted in an innovation that does not solve the customer's problem.	(Dai, 2013)
• Problems in the research and development process, problems in inside and outside communication, inconsistencies in the institution and project management.	(Holtzman, 2008)

Source: Authors' elaboration based on literature

3.2 Degree of risk related to technological Innovation

Freeman) stated that the degree of risk related to technological innovation could be specified by six degrees and according to the radical technological innovation (Elamiri, 2005):

- Complete and Real uncertainty: this goes with the state of the original researches which want to reach to a new innovation exactly as in the domain of new inventions of devices and equipment in several fields. The risk is very expensive, and costs effort money, and time.

- Extreme High degree of uncertainty: this case happens when a company wants to enter a radical innovation in the authentic product or in known production operation but outside the company in other words it does not make the change and modification on its products or production processes, therefore the risks are high.

- **High degree of uncertainty:** It is equal to the technological innovation processes which can be in image of great modification in the product or the production process but in the same products and company. Therefore, the risk here could be less from the previous one.

- **Average degree of uncertainty**: we find in this case that when the companies produce new generations of their products that could be stable in the market and their production operations are known by their flexibility and smoothness.

- Low degree of uncertainty: low degree of uncertainty is due to the fact that technological innovation is expressed as permission to produce certain products or minor modification in the product or process as can be caused by a previous adoption or franchise of the products or current operations in other companies.

- Extreme low degree of uncertainty: this type is the least risky because it is in the production of a new type of product that is present and stable in the market or if the product itself is modified with little modification in color, weight, storage, and packaging. This could be accompanied by late adoptions of innovations made in other companies or new production processes already in place rather than just minor product modifications.

4. CONCLUSION

In this research, we have tried to highlight the frame work of technological innovation, thus we arrived to that the last is the

innovation based on producing new product, or improving the existing one, designing new operation or improving the authentic one. We find also that the technological innovation plays a major role in featuring the company performance, and reinforcing its competitive capacity through:
- Stimulating the demand especially in the markets.
- Stimulating the offer and creating new resources of income.
- Attracting customers and getting their satisfaction through presenting effective and developed products.
- Finding new opportunities for industrial companies to sell in new markets.
- Maintaining the survival and the continuity of industrial companies.

However, this effective role involves risks that can escalate to the point of putting the company in a catastrophic situation, and these risks may be related to the company's position and policy or out of the company's control, i.e., related to the external environment.

Recommendations

Through this study we can give some important recommendations

- Although the technological Innovation is important for the survival of the institution, it also carries a large number of risks; it is therefore important to have a precise knowledge of the risks and their degree in order to develop an appropriate risk management strategy.
- During the innovation phase, it is essential to evaluate the innovation idea in terms of financial, marketing, structural, and technological abilities, as well as the institution' strength.
- Innovative idea should be generated through the customer feedbacks, to meet the customer’s requirement in order to extend the market share as well as to enlarge the marketing potential of the institution globally.
- Pay more attention to research and development process issues, internal and external communication issues, inconsistencies in business and project management; this helps to identify the risks

associated with Technological Innovation, to establish an appropriate risk management strategy and to optimize the institution's resources.

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