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## Providing a Model for Commercialization of Knowledge-Based Ideas in Companies Located in Science and Technology Parks

Homayoun Asadi<sup>1</sup>, Majid Fattahi<sup>\*2</sup>, Maryam Taghvaie<sup>3</sup>

1. PhD Student in Entrepreneurship, Department of Entrepreneurship, Sari Branch, Islamic Azad University, Sari, Iran.

2. Assistant professor, Department of Business Management, Sari Branch, Islamic Azad University, Sari, Iran. (Corresponding Author) Email: Majid.fattahi@iausari.ac.ir

3. Assistant professor, Department of Educational Management, Sari Branch, Islamic Azad University, Sari, Iran.

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### ABSTRACT

The purpose of this article is to present a model for the commercialization of knowledge-based ideas in companies located in science and technology parks. The methodological framework used is the Grounded Theory with a qualitative approach and systemic view. The statistical population includes experts in the area of science and technology parks and CEOs of knowledge-based companies based in these park. Using theoretical sampling, after conducting 15 in-depth interviews, the research findings reached theoretical saturation. Data analysis was performed in three stages of open, axial and selective coding and the final theory was formed round the axial categories of "innovation" and "market orientation". The generated theory was modified in several steps through member review strategies and negative case analysis in terms of credibility. Also, in order to meet the reliability criteria, the data analysis process until the formation of the theory was described as much as possible. The results show that the axial categories are identifiable based on the factors individual competence, team competence, nature of innovation and technology, market readiness, technology readiness level, and support factors. In addition, these constructs, under the influence of environmental, political-administrative, sociocultural, economic-financial, technological and legal interfering conditions and the contextual organizational conditions of knowledge-based companies, the role of technology parks and government support and the application of commercialization strategies, lead to sustainable entrepreneurship, product quality improvement, sales and profit promotion, and better serving the society.

**KEYWORDS:** Commercialization; Knowledge-Based Ideas; Science and Technology Parks

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## 1. Introduction

In our country, commercialization is the chief missing link in the chain, from research to production, and finding suitable grounds to carry research over to the field of business and commerce is of particular importance (Dehdashti Shahrokh, Z., et al., 2019. P.3). As Ganz and Stern (2003) noted in this regard, paying more attention to the issue of commercialization and the choice of the appropriate commercialization model and strategy is important in that acquiring the ability to transform market-oriented research ideas into documented technical and economic technologies can raise a third-world country from a raw material seller to the position of an advanced country and the seller of technical-economic knowledge (Mirghafouri, S. H., et al., 2018. P.109). Therefore, commercialization of technology-based products is today a top priority in the country to improve the economic cycle (Keikhai Farzaneh, M., et al., 2019. P.185). According to Desouza and Awazu (2006), knowledge-based businesses can play an important role in production effectiveness, knowledge crystallization in new products and services, promotion of the economy and welfare, and wealth generation and added value in society (Habibi, R., et al., 2018. P.2). As noted by Pakzad et al. (2015), foundation of knowledge-based companies in science and technology parks for commercialization purposes is one of the first serious works undertaken in the country to scientifically transform innovations (innovative ideas) into technology (Mirghafouri, S. H., et al., 2018. P.109).

Since the introduction of the topic technology commercialization in research institutes, regardless of their size or area of expertise, managers have always been confronted with some key issues, such as the frequent failure in commercialization and delivery of the research results to the end consumer in the market or society despite the many research results generated by researchers in the country's knowledge-based companies. What have been the causes of this failure? Are the infrastructures and processes used in knowledge-based companies as well as their level of maturity adequate for the commercialization of technology? Considering the current state of the national innovation system of the country and the lack of commercial utilization of many of these results in practice, it is evident that no scientific and clear answer or solution has been provided for any of them in order that the administrators of these bodies make the necessary arrangements, accordingly (Yahyaee, M. and Hassanzadeh, A., 2018. P.65).

This article with the purpose of explaining the concept of "companies located in science and technology parks" tries to achieve a model that, in addition to generalizability, is able to make logical predictions and provide a new and broad field to entrepreneurship researchers. This research is also important in that it can show how science and technology parks can help commercialize the products of the companies that have a major problem in entering the market. To this effect, this study seeks to explore and identify the ways of commercializing entrepreneurial ideas in knowledge-based companies so that the companies in science and technology parks can easily use these findings to improve their state of commercialization of ideas and secure their survival as start-ups.

## 2. Theoretical framework and research background

Technology commercialization involves the transfer of an innovation from the organization, where it originated, to the markets, where it can make money, and successful commercialization is achieved when economic benefits are generated (Kim, M., et al., 2019. P.4). Mitchell and Singh (1996) defined the concept of commercialization as the process of acquiring ideas, reinforcing them with complementary knowledge, developing and producing products for the market, and ultimately selling those products. This view considers the management of technology commercialization activities to be critical to the successful development and sales of a product and providing a competitive advantage (Kim, J. H., et al., 2020. P.8). According to Goldsmith (2003), commercialization, in the broadest sense of the word, is the process of developing a business by studying the feasibility of an idea and its application to market acceptance (Seif, M. H., et al., 2019. P.67).

Commercialization is the key to understanding the relationships between innovation management processes and success in launching new products. In addition, according to still (2017), commercialization

in technology transfer is particularly challenging and is the most important driver of change (Nieto Cubero, J., et al., 2021. P.128). According to Ulrich and Appinger (2016), commercialization is the last stage of a development process, and according to Kim et al. (2019), it involves the transfer of an innovation from the organization from which it originated to the markets from which it can generate earnings. Successful commercialization is achieved when economic benefits are generated (Rutley, N., 2021. P.2). According to OECD (2013), Given its relevance and complexity, most advanced countries make the promotion of science commercialization a central feature of government policy including the United Nations' sustainable development goals. For instance, the world's largest publicly funded research program, the European Union's Horizon 2020, explicitly supports research commercialization activities (Fini, R., et al., 2018. P.5).

In their review of prior research, Nieto Cubero et al. (2021) highlighted the commercialization models and main constructs affecting technology commercialization process as follows: market orientation, market learning, user's involvement, market configuration, adoption networks, stakeholders, and innovation transfer. Their proposed integrated commercialization model has three steps: (1) Concept/value proposition validation; (2) Business model validation and market creation; and (3) Creating sales in the majority market which is created for innovations with high uncertainty (Nieto Cubero, J., et al., 2021. P.127). Lasambouw et al. (2021) in a study addressed the commercial model requirement in commercialization of knowledge-based products. The obtained results from this study were grouped into four main sections: 1. Availability of research output product for commercialization; 2. Commercialization process; 3. Availability of technology transfer office, business incubator, teaching factory, and innovation center (organization readiness); and 4. Readiness for Commercialization (Lasambouw, C. M., et al., 2021. P.1). Tawate et al. (2019), using a multi-purpose case study design, developed a commercialization model that identified six new subprocesses and three valleys of death. This model of technology commercialization includes opportunity identification, market and business evaluation (idea generation process), technical feasibility, market feasibility and business feasibility (feasibility process), small-scale production, infrastructure creation, business start-up (development process), small-scale production, infrastructure creation, business start-up (introduction process), large-scale production, infrastructure diversity, infrastructure diversity, business growth (growth trend), production support, infrastructure renewal, and business maintenance (continuity process) that help managers and entrepreneurs in the path towards commercialization (Tawate, S., et al., 2019. P.1).

Among the domestic studies, the findings of Ansari et al. (2020) indicated that the causal categories (knowledge of market needs, intellectual property protection, and adoption of marketing outlook), the central categories (creativity and idea formation, idea applicability, idea formation support and risk-taking), strategic categories (training, research and development, management mechanisms, and identification of customer needs), contextual categories (environmental studies, financial and human resources, and organizational contexts), intervening categories (legal infrastructure, social, economic and cultural factors, and technology development), and outcome categories (higher sales and profit, customer satisfaction, innovation and service development) influenced the commercialization of the idea of selling knowledge-based products (Ansari, M., et al., 2020. P.۳۳۵). In another, Safarzadeh et al. (2020), using exploratory and confirmatory analysis found (1) individual indicators, (2) managerial and organizational indicators, (3) cultural and social indicators, (4) regulations and permissions, (5) Financial and economic indicators, (6) marketing and sales capability, and (7) technological capabilities as the major explanatory components of commercialization. In addition, they identified the indicators (1) managerial and economic, (2) international, (3) national production, (4) strategic and (5) consumption pattern as the components of the resistive (resilient) economy and, based on the importance-performance matrix, they rank-ordered and prioritized them (Safarzadeh, H., et al., 2020. P.3). Dehdashti Shahrokh et al. (2019) presented a process-based model of service commercialization in the selected knowledge-based companies. The main stages of the model are: marketing research (need assessment), idea generation (formation), financial analysis and financing, human resources recruitment and training, comprehensive feasibility study, formulation and implementation of marketing and advertising strategies, production,

testing, improvement and promotion, quality control, obtaining licenses and standard certificates, and formulation and implementation of pricing, sales and distribution strategies (Dehdashti Shahrokh, Z., et al., 2019. P. 1). Therefore, commercialization is a crucial issue that takes a special place in such companies and requires a model which should be developed in correspondence with the structure of such organizations and the other factors affecting the activities of companies located in these parks as well as the issue of commercialization of knowledge-based ideas. Therefore, in view of the above issues, the present article seeks to provide a model for the commercialization of knowledge-based ideas in companies located in science and technology parks.

### 3. Research methodology

The present study, in terms of purpose, is a basic research with a qualitative approach and an exploratory orientation. It uses the Grounded Theory strategy based on the systematic approach to data analysis proposed by Glasser and Strauss (1967). The information was collected through semi-structured interviews with experts and specialists in the field of commercialization of knowledge-based ideas.

**Table 1. Research methodology**

Philosophy	Type of research			Research strategy	Data gathering method	Statistical population	Sampling method	Sample
Symbolic interpretation	Purpose	Result	Approach	Classical Grounded Theory	Semi-structured interviews	Commercialization experts	Purposive, judgmental up to saturation point	15 persons
	Basic	Exploratory	Qualitative					
	Applied							

Given to the research subject, the statistical population included experts, scholars, and CEOs in the main fields of the research constructs. Using theoretical sampling, the required data were collected through semi-structured interviews with 15 people selected from the target population. The reason for using semi-structured interviews is that they allow to get tacit information and knowledge revealed (Bell et al., 2019. P.436). The open and semi-structured interviews with the experts were conducted following a purposive judgmental sampling. Having interviewed 15 experts, the theoretical saturation was reached. Each interview lasted 2 to 3 hours on average and the data saturation process began from the 12th interview. The categorization and coding process continued until the data were best explained.

Research experts were divided into two groups: the first group included senior administrators and experts in the area of science and technology parks who had the necessary knowledge about the commercialization of knowledge-based ideas, and the second group was made up of CEOs of companies located in science and technology parks who were implementing the commercialization of their Knowledge-Based ideas. Lastly, the data analysis was performed through three stages of open coding (study of the phenomenon by absorbing the information and forming the categories), axial coding (selecting an open coding category which is most relevant to other categories based on the data analysis) and Selective coding (model development on the relationship of the categories obtained in the axial coding pattern).



**Figure 1. The process of data classification and transfer in three in coding stages**

Next, the obtained data from the interviews were subjected to expert review in which the views of both participating and non-participating experts were consulted (three CEOs of knowledge-based companies and three experts in commercialization of knowledge-based ideas) and after receiving their comments and feedbacks hereon the necessary corrections were made and the final model was presented.

**4. Data analysis**

**Research findings**

In this section, given the nature of the research, the findings are reported separately in three stages of open coding, axial coding and selective coding.

**Findings of open coding stage**

In the open coding stage, the initial data coding was performed in MAXQDA software by repeatedly reviewing and analyzing the collected data. This stage involved a line-by-line analysis technique, whereby the documents were compared in terms of similarities and differences and based on the analytical notes, the initial data was encoded and 467 codes were extracted. Table 2 presents some examples of how the concepts were extracted from the interviews in the open coding stage.

**Table 2. Examples of the concepts extracted from the interviews**

Source	Quotation	Nr. of reference	Code	Descriptive code	Core concepts
Interview with Knowledge-Based enterprises	The elites in these enterprises constantly explore the latest scientific research and think about innovation and seek to produce (develop) a new product based on knowledge.	17	T4	Creativity and innovation	Innovation - orientation
Interview with executives of park	They should always have new ideas and need to know their customers and based on their needs, present new ideas the life curve of which is exponential, and this is the nature of these enterprises.	29	T12	Having new ideas	Innovation - orientation

### Findings of axial coding stage

At this stage, due to the key role of the constructs 'innovation' and 'market orientation' and their frequent processing in different stages of the research, they were selected as axial categories and other categories after modification and correction were organized in a systematic design framework, as shown in figure 2.

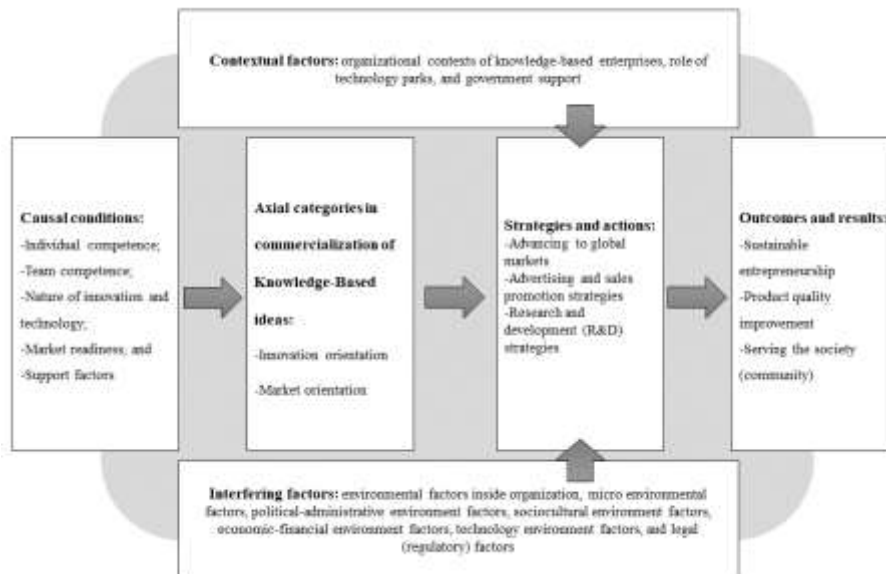


Figure 2. Theoretical model of knowledge-based ideas commercialization

### Findings of selective coding stage

At this stage, using abstract writing methods, the generated theory is explained and statements are made on the assumed relationships between the categories. Further, the reports on the dimensions central category, causal conditions, strategic category, interfering conditions, contextual category, and outcomes are modeled based on the Grounded Theory approach.

### Axial category

It is a category that always appears in the data and other categories are related to it. Based on the analysis of the interviews with experts and specialists, the axial category of the commercialization model of knowledge-based ideas in companies located in science and technology parks includes innovation- and market orientation. Thus, the participants in the interview process referred to these categories as the necessary conditions for the commercialization of knowledge-based ideas. The axial category 'innovation' is further identified with the following elements: creativity and innovation, innovative spirit, preventing the obsolescence of ideas, having new ideas, being goal-oriented, fundamental change in production, change of idea, idea development, idea growth and development, continuous evaluation of ideas. Innovation and new product development is an important feature because the environment is constantly changing. The law may open new avenues or close other venues, for example, by increasing the requirements for environmentally friendly products. Competitors may introduce new products that pose a major threat to existing market positions. In all of these ways, companies need the ability to respond through product innovation (Tidd, J., and Bessant, J. R. 2020. P.5). One of the interviewees admitted that the owners of knowledge-based ideas generally have an innate interest in research and always try not to distance themselves from the knowledge environment. He added, "They are always on the study and are able to update their information, and given their inherent creativity, they seek to come up with a new idea as soon as an idea becomes obsolete so that they can catch up with market competitors."

Another axial category, market orientation, is specified with the following elements: up-to-date market knowledge and information, the ways to enter the market, market size, market knowledge and assessing

its needs, market elasticity and supply and demand analysis. Proper knowledge of the needs in the knowledge-based market and the adequate product supply, and the right way of attracting capital are the prerequisites that must be pursued scientifically and in principle by any knowledge-based company (Arabi, A., et al., 2021. P.433). For instance, one of the interviewees opined: "It is true that if you are going to make something to sell, it is necessary to first find its market and identify the ways to enter it, and then you move to make an assessment of the needs and conduct a feasibility study in regard to this market. Next, you go down this path step by step until you finally find a product."

### Causal conditions

Causal conditions are events that give rise to situations, topics, and issues concerning the phenomenon. In other words, by causal conditions, events or happenings are meant that affect the phenomenon and lead to its occurrence. Based on the data analysis, the components that contribute to formation of commercialization of knowledge-based ideas and examples of the facts extracted from the interviews are presented in table 3.

**Table 3. Causal factors and sample facts extracted from interviews (source: research findings)**

Causal factors	Sample facts
Individual competence and personality traits of founders	T6: they are open minded and have the necessary courage in their works as startup businesses always involve many risks and if they lack agility and high intelligence, they will certainly fail and go out of the market very soon.
Team competence	T5: if we want to be successful in technology development and commercialization, we need to arrange a variety of factors in place, e.g. appropriate technical knowledge (know-how) in knowledge-based companies owing to a group of specialists with knowledge and expertise and creative thinking who have teamed up with each other.
Nature of innovation & technology	T7: the product of knowledge-based companies needs to be of high-tech nature or caliber, i.e. these companies should have high technical sophistication in terms of product design knowhow.
Market readiness	T3: there was a target market for me and this became a reason that drove me to produce this product.
Support factors	T4: a good advisor (consultant) and a real expert can significantly assist companies in commercialization.

### Contextual conditions

Contextual conditions are the conditions that affect strategies and actions in a cohesive way. Hence, we put the questions implicitly to the interviewees whereby three categories were identified as the components of the contextual conditions.

**A. Organizational contexts of knowledge-based companies:** One of the contextual categories that affect commercialization strategies is the organizational contexts of knowledge-based companies. To achieve technological efficiency and effectiveness, a knowledge-based company must acquire the necessary capabilities in respect with product changes, materials, processes, and business-related technologies and be informed of them. Organizational contexts serve to help companies have the necessary knowledge regarding their technological environment and to adapt to this environment.

**B. The role of science and technology parks:** The key components of this category are: the link between university and industry, the synergy among knowledge-based companies, having a coordinating role in the area of innovation and technology, performance of incubation centers and science and technology parks, the park's material and spiritual support program, the organizational contexts existing in science and technology parks, and collaboration in the commercialization of ideas at the request of the technology unit. Science and technology parks serve as a context to develop knowledge-building, and enhance network building and innovative and economic performance of companies and regions (Ng, W. K. B., et al., 2020. P.1).

**C. Government Support:** The key components of this category are: support through the Vice Presidency for Science and Technology and the role of the players connected to the government commercialization programs for knowledge-based companies. Countries adopt fairly diverse support policies for promotion of innovative activities and economic value creation they run economics through innovation. Since 1980s, technology startups have been among the main targets of government support for innovation which has been pursued in different ways depending on the contextual features and institutional conditions of countries (Eshraghi, A., et al., 2021. P.37).

### Interfering factors

based on the analysis of data obtained from the interviews with experts and specialists, the interfering factors affecting the commercialization strategies of knowledge-based ideas in companies located in science and technology parks include environmental factors within the organization, micro environmental factors, political-administrative environment factors, sociocultural environment factors, economic-financial environment factors, technological environment factors, and legal factors. Crowne (2002) described a startup company as an organization with limited experience, working with insufficient resources and influenced by numerous factors such as investors, customers, competitors, and the use of dynamic product technologies (Tripathi, N., et al., 2019. P.2). Competitors may introduce new products that pose a major threat to existing positions in the market. In all events, companies need the ability to respond through product innovation (Tidd & Bessant, 2020. PP.5-6). One of the interviewees noted about this strategy: "Now, in the whole world, especially in Silicon Valley, technologies are so fast that upon the moment an idea comes to one's mind, they quickly turned it into a product. That is to say, the speed of environmental and technological change has become super-fast. Undoubtedly, these technological changes can be crucial for getting started, as knowledge intensive companies are typically innovative and look for change."

### Strategies

Strategies are plans and actions that help implement the commercialization of knowledge-based ideas in enterprises based in science and technology parks. Strategies are specified by the following components or features:

**A. Intelligent risk-taking:** One of the operational strategies for implementing the model of knowledge-based ideas commercialization is intelligent risk-taking". One interviewee noted here about, "By intelligent risk taking, you weigh the potential advantages and drawbacks of an action or choice for accepting the calculated risks. Therefore, knowing the risk profile of the company, the team and yourself is important."

**B. Advancing to Global Markets:** One of the important solutions that increases company efficiency is international cooperation in trade and knowledge globalization. The changes in competition that are seen to constitute both the result and the conditions of globalization. The structure and rigor of competitive struggle directly affect the international development strategies of companies. Competition on a global scale creates new communication systems and introduces a new dimension in quality of technological advancement and new ways of achieving a competitive advantage (Rzepka, A., 2017. P.161). One interviewee, in this regard, said that if you manage to produce a high quality and high-tech product, with an appropriate planning, you can obtain a share of the global market, and by exporting your product, you cause a flow of foreign currency into your country and help its economic prosperity."

**C. Advertising and sales promotion strategies:** according to Janash and Summerlate (1999) and Powell et al. (2003), companies that spend more on innovative products earn more sales revenue and make a better chance of taking the global market. According to a Fortune survey conducted by Arthur de Little Consultants, innovative firms have maximum shareholder return. However, according to McMath (2011) and Powells et al. (2003), the worrying point is that the innovation failure rate is very high as it varies from 33 to 60 percent, and this rate has remained constant over the past few decades. According to Yenipazarli (2015), consumers typically evaluate innovation based on its perceived or subjective value

rather than the product real or objective product. Two prominent communication tools, advertising and sales promotion, help businesses improve the subjective value of their innovation. Therefore, advertising and new product promotions strategies act as an effective medium to increase demand without provoking any risk of failure. According to Kim, Hong, and Lee (2014), they normally assess product information through mass communication such as media advertising (print media, Internet, etc.) and through interpersonal communication (word of mouth, etc.) which is disseminated on social media. (Anand, A., et al., 2020. P.1). Therefore, managers of knowledge-based companies should examine their advertising strategies more carefully as it greatly affects the success of their new product. "Good advertising is a standard thing, and it has been proven that companies in the world have now reached a point that spend something between 15 and 40% of their revenue on advertising," said one interviewee.

**D. Research and Development Strategy:** The latest strategy is Research and Development Strategy. Nerkar and Paruchuri (2005) and Bettis and Hitt (1995) suggest R&D capability as one of the main characteristics that distinguishes successful companies from failed companies (Saadi, I., and Che Razak, R., 2019. P.222). One interviewee commented on the strategy: "Because product life is usually short, companies should try to increase their studies and when they see that an idea is getting old, they should quickly come up with a new and innovative idea. In doing so, they can at the right time turn those complementary ideas into products and offer them to the market."

### Outcomes and results

Outcomes and results include tangible and intangible factors that arise following the implementation of the commercialization of knowledge-based ideas in companies located in science and technology parks. In the coding process, four categories were identified for the outcomes of the commercialization of knowledge-based ideas as follows:

**A. Sustainable entrepreneurship:** job creation in parks and knowledge-based companies and technology units located in them has shown a continuous and significant growth in recent years, so that the number of jobs from 19,000 in 1391 increased to 30,000 in 1395 and 56743 in 1399, showing an approximately 200% growth during this period (Rahimi Sherbaaf, Gh., et al., 2021. P.24). According to one interviewee, when a company commercializes a product and gains customers in the market, it can expand its business and hire more people, which ultimately leads to sustainable entrepreneurship.

**B. Improving the quality level of the product:** One of the interviewees stated: "The big result that commercialization can create is that it improves the quality level of domestic products."

**C. Sales promotion and profits:** The chief components in this category are profitability, generating wealth and revenue stream, creating value and added value, achieving competitive advantage, and expanding sales. One of the interviewees noted in this regard: "The output of a knowledge-based company is the new value created by commercializing new ideas. Value creation means wealth generation and the conversion of knowledge into revenue and money."

**D. Serving the society:** the key elements in this category are: increasing the welfare of the society, preventing the departure of elites from the country, helping to have a healthy society and the potential of knowledge-based companies in times of crisis in the country. "By helping commercialization in these companies, we can expect a very good thing to happen in the country," said one interviewee. They (elites) will remain in the country and will not leave the country. The next point is that he who works and is tired does not have any time or opportunity for crime. "Crimes and negative social consequences will be greatly reduced by job creation in these companies."

### 5. Conclusion

The present study was conducted to develop a model for commercialization of knowledge-based ideas in companies located in science and technology parks. Using the obtained data from the research based on the Grounded Theory, the dimensions and components of commercialization of knowledge-based ideas were identified by accurate and coherent analysis and at the end the final model was built upon the main themes in six dimensions. It is a new model of commercialization of knowledge based ideas based on

innovation and market orientation in which companies located in science and technology parks have a key role. The model suggests that all companies must work on their capabilities and dispositions to be able to enhance their capabilities and create value for themselves and other people in the society. The main purpose of this commercialization model is to improve the quality of knowledge-based products, sustainable entrepreneurship, promote company sales and make profit, and ultimately serve the society.

### Research limitations and suggestions

Firstly, due to the novelty of the subject under study, the results of this research are not without flaws and other studies are recommended to increase the validity of the results of this study. Further, based on the research results, the following suggestions are made:

- Science and technology parks are expected to take plans and policies to innovation areas and to innovative cities and provinces. If the park plays its role as a coordinator and regulator, it will definitely be more successful.
- Park managers should give knowledge-based companies freedom of action. The founders of these companies are people who are transformational and deconstructive. If parks always want to build a structure and say you are not allowed to move beyond that structure, this would be the biggest interference in knowledge-based companies.
- In general, it should be noted that few of these knowledge-based companies have a chance to succeed in commercializing their products. Our suggestion is to have people beside knowledge-based companies to do this for them. Many companies like to outsource their marketing and commercialization jobs. It is suggested that there be service companies in the parks to inspect the knowledge-based companies in the park and connect those that are capable to the market. Therefore, there should be certain firms that provide these services in the park. These firms would examine the knowledge-based companies inside the park and connect the capable ones to the market.

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**ETHICAL CONSIDERATION**

Authenticity of the texts, honesty and fidelity has been observed.

**CONFLICT OF INTEREST**

Author/s confirmed no conflict of interest.