A review on attraction factors of science and technology parks to firms in health sector

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Abstract:

BACKGROUND: Over the past few years, a rapidly growing number of science and technology parks (STPs) in health sector have emerged across the world. There has been little discussion in the literature to show how STPs could make an attractive environment to absorb and retain potential firms. This is even more challenging for specialized STPs in health sector. The aim of this study is to identify the attractive factors for firms in a STP in health sector.

MATERIALS AND METHODS: A scoping review method was undertaken to review the literature on seven databases (ScienceDirect, Scopus, ProQuest, Google Scholar, EconPapers, PubMed, and ISI Web of Science) for peer-reviewed articles published until 2019. The search results were screened against the inclusion of criteria to ensure they met the objectives. The eligible papers were then assessed on the basis of the full text, and finally the results were extracted.

RESULTS: The attractive factors for firms and talents in multidimensional STPs and those in health sector are extracted and summarized. The attractive factors of multidimensional STPs, which includes health sector firms, and those specialized in health sector are summarized in three main categories; factors created by government and universities, and factors related to STP policies and those expected by the firms.

CONCLUSION: To make STPs attractive for firms in health sector, there is a list of factors that are required to be done not only by STP itself, but also by the national and local government and industries. It is important to consider the factors that are expected by the firms to be implemented. The results of this study suggest that making STPs attractive for health sector firms needs close collaboration between government, universities, related industries, and STPs all together.

Keywords: Attraction factors, firm, health sector, science and technology park

Introduction

Science and technology parks (STPs) were formed in 1950s in the United States as an essential tool to boost university and industry collaborations. The higher interaction brings up more support for knowledge-based firms, high-tech industries, and university spin-offs. To attain this goal, numerous efforts are made in other countries to foster economic development through STP implementation. To achieve its goals, a science park stimulates the knowledge flow between universities, research and development institutions, businesses, and related markets. In addition, it facilitates the formation and development of innovation-based firms through incubation and spin-off processes along with high-quality services and environment.

Some empirical studies show that settlement in the park could be beneficial for the firms for several reasons such as foreign cooperation, which may lead to the positive impacts on the firm’s output, research performance improvement, and support.
in patent application. However, due to heterogeneity within park, not all the firms located in a park will equally benefit from that. The capacity of absorption is an important concept here. The ability of a firm to recognize the value of new external information, absorption, and its application in business goals. Cohen and Levinthal express that this ability is mainly due to the firm’s accumulated knowledge and R&D.

Unlike the absorption capacity of firms, the attractiveness of STPs is the less-discussed issue in the literature which could be created through undertaking attractive features and policies within park and region where the park is located in order to attract firms and talents with high absorptive capacity. Characterizing the factors which make STPs attractive for firms is necessary for a better operation and functioning of both STPs and firms. This is not only important for scaffolding new STPs but also helps forming highly motivated firms to be part of the STPs. Consideration of attractive factors for firms in STPs would obviously gather more motivated firms and guarantee their success. Highlighting these factors helps local and national governments to plan and provide their supports in line with the STP needs as well. This study is a literature review on identifying these important attractive factors in general STPs and more specifically in STPs active in health sector.

University partnership with pharmaceutical industry in Brazil studied by de Medeiros Rocha et al. points out, since this partnership is mainly through public universities; therefore, the government has a very prominent role in promoting drug innovation. The results showed that from the university perspective, the best instrument for the government to undertake is to promote innovation programs, support more startup firms in drugs field, in the Technology Innovation Centers, and financial support or tax breaks. Some other tools were considered in this study such as increasing the regulatory process speed and promotion of private-public partnership to develop drugs that are remained neglected; however, they were not considered as important as the three tools mentioned earlier. It is also suggested in this study that the government needs to reconsider the academic output measurement, which is mainly on publications, as sometimes the efforts to develop a new medicine is ignored by the academics as it might have the risk of not being accepted by the stakeholders. Moreover, the Technology Innovation Centers may not be completely aware of the public demand or the real market demand, which highlights the importance of the university to be in a closer cooperation with the government and the market.

The results of this study not only help STP managers but also local and national government, health sector policymakers, firms, and health sector innovators to create an efficient innovation environment.

**Materials and Methods**

In this study, the scoping review approach was undertaken, and the academic journal articles were searched in title and abstract in EconPapers, Google Scholar, ProQuest, PubMed, ScienceDirect, Scopus, and ISI Web of Science in October 2019. The following terms were included in the search: (“science park” OR “techno park” OR “technology Park” OR “Research Park” OR “Innovation Center” OR “High-Tech Park”) (As the definition of UNESCO shows: The term “science and technology park” encompasses any kind of high-tech cluster such as: science park, hi tech (industrial) park, innovation center, university research park, research and technology park, technology park, techno park, etc.) AND (firm OR tenant OR company) AND health. However, as including “health” resulted in only a few records, therefore, the search was repeated without it to make sure that no relevant article was missed. No date restriction has been considered in the search results. The details of the searched terms in each database is provided in Table 1. The selected papers at the first stage are based on the title/abstract, and the list is shortened in the next stage based on their relevance in full text.

**Characteristics of selected papers**

The literature review in this study reveals that the attractive factors of a STP for a firm are often discussed under other topics which need to be extracted from these papers. The topics such as success factors of STPs, geographical location of a STP, challenges of STPs, challenges of knowledge-based firms, etc. The screening process is shown in Figure 1. As the first step, the duplicate articles were identified and removed. The obtained articles were then screened in full text, which resulted in excluding 349 articles due to being irrelevant. In this process seven more records were identified from other sources, which included in the articles reviewed in this study.
While attractive factors of STPs for firms are supposed to be promoted by the STP itself, however, the role of STPs are mainly to facilitate the novel ideas to be developed and supported to get in the right line and eventually create wealth for the society; there are also other pillars in the country in which their role in the abovementioned goal is undeniable such as government, universities, and industries. In fact, a STP is not simply a landlord of high-quality buildings and offices, rather, a complex organization with multiple owners, but they are all in line with the economic development goals drawn by public sector.\(^9\)

As a result, the full capacity of STPs in being attractive to firms is only achieved when all the players are performing the expected policies in the right direction. Therefore, the retrieved papers were categorized into studies where the role of governments and universities in creating attractive factors were identified; those studies that focus on the role of STP itself in creating an attractive atmosphere for firms, and finally those studies that consider the firms expectations. The next section reflects the findings from these three dimensions.

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### Table 1: Search strategy details in seven databases and the number of records retrieved

| Database     | Search strategy                                                                 | Document type  | Records       |
|--------------|--------------------------------------------------------------------------------|----------------|---------------|
| ScienceDirect | A. Title, abstract: (“Science park” OR “techno park” OR “technology park” OR “Research Park” OR “Innovation Center” OR “High-Tech Park”) AND (firm OR tenant OR company) | Document type: Research article | 114 records   |
|              | B. Find articles with these terms: Health Title, abstract: (“Science park” OR “techno park” OR “technology Park” OR “Research Park” OR “Innovation Center” OR “High-Tech Park”) AND (firm OR tenant OR company) | Document type: Research article | 28 records    |
| Scopus       | A. Title, abstract: (“Science park” OR “techno park” OR “technology Park” OR “Research Park” OR “Innovation Center” OR “High-Tech Park”) AND Title, abstract: firm OR tenant OR company | Document type: Article | 598 records   |
|              | B. Title, abstract: (“Science park” OR “techno park” OR “technology Park” OR “Research Park” OR “Innovation Center” OR “High-Tech Park”) AND Title, abstract: Firm OR tenant OR company | Document type: Article | 13 records    |
| ProQuest     | A. In Abstract: (“Science park” OR “techno park” OR “technology Park” OR “Research Park” OR “Innovation Center” OR “High-Tech Park”) AND (firm OR tenant OR company) OR In Document title-T1: (“science park” OR “techno park” OR “technology Park” OR “Research Park” OR “Innovation Center” OR “High-Tech Park”) | Source type: Scholarly journals | 101 records   |
|              | B. In Abstract: (“Science park” OR “techno park” OR “technology Park” OR “Research Park” OR “Innovation Center” OR “High-Tech Park”) AND (firm OR tenant OR company) AND health OR In Document title-T1: (“science park” OR “techno park” OR “technology Park” OR “Research Park” OR “Innovation Center” OR “High-Tech Park”) | Source type: Scholarly journals | 69 records    |
| Google scholar | Allintitle: “Science park” OR “techno park” OR “technology Park” OR “Research Park” OR “Innovation Center” OR “High-Tech Park” | Only english | 1680 records: 184 were selected |
| EconPapers   | A: Free text search (firm OR tenant OR company) AND (health) Keywords and Title: “science park” OR “techno park” OR “technology Park” OR “Research Park” OR “Innovation Center” OR “High-Tech Park” | Journal articles | 397 records-10 records selected |
|              | B: “Science park” “techno park” “technology Park” “Research Park” “Innovation Center” “High-Tech Park” AND (firm Tenant company) | Journal articles | 76 records    |
|              | C: “Science park” “techno park” “technology Park” “Research Park” “Innovation Center” “High-Tech Park” AND (health) | Journal articles | 20 records    |
| PubMed       | A: Title/abstract: (“Science park” OR “techno park” OR “technology Park” OR “Research Park” OR “Innovation Center” OR “High-Tech Park”) AND Title/abstract: (Firm OR tenant OR company) | Journal articles | 0 results     |
|              | B: Title/abstract: (“Science park” OR “techno park” OR “technology Park” OR “Research Park” OR “Innovation Center” OR “High-Tech Park”) | Journal articles | 140 records-4 items were selected |
|              | C: Title/abstract: (“Science park” OR “techno park” OR “technology Park” OR “Research Park” OR “Innovation Center” OR “High-Tech Park”) AND Title/abstract: health | Journal articles | 47 records-2 items selected which were already in the above search where 4 items selected |
| ISI web of science | Title: (“Science park” OR “techno park” OR “technology Park” OR “Research Park” OR “Innovation Center” OR “High-Tech Park”) | Journal articles | 150 records/95 records selected based on title |

Source: Authors
Results

The review of selected papers is conducted by categorizing them into three broad scopes; the role of national and local governments and universities in creating attractive factors in STPs for firms; the role of STP policies in creating those factors, and ultimately the expectations by firms and talents on what make a STP attractive for them to move-in and operate. The findings from the review of selected papers in the three abovementioned dimensions are discussed in this section.

Science and technology parks and the role of government and university

It is clear that there are some vital characteristics of a country and a region where a STP operates and makes it attractive for international and regional inventors; however, the management framework of STPs and policies of government and universities have an important role in the attractiveness of STPs for firms and talents. Zhang[10] examines the critical factors of science park management and finds Park location, Park preparation (the stage before opening a science park), and having a very professional and committed management team are vital in attracting high-quality firms and park’s success. Huibing and Nengli[11] suggest a number of strategic advices to develop science parks in China such as “Strategic positioning” within an industry and applying “branding strategy” to remain in the current high competition market.

A science park has a multidimensional aspects and economic, political, and social activities affects the social face and the reputation of the park.[12] Wasim[13] believes that “external factors” including monetary environment, business environment, policy instrument, global economy, and innovation model needs to be considered among other issues. Hladchenko and Pinheiro[14] discuss that the Triple Helix model implementation depends on the institutional logic of the state, that is, “knowledge” is the key factor for economic growth, which in nonwestern societies might be different from western societies. Machado et al.[15] highlights the role of civil society as another active agent besides firms, universities and government. Rowel[16] believes that STPs need to carefully select the new knowledge based industries and tenants within that industry to remain sustainable. Leyden et al.[17] provides an approach to find the optimal number of firms locating in a park.

Yang and Lee[18] evaluated the management performance of the Hsinchu Science Park, as the first science park in Taiwan, which is fully government oriented. Land development, tax exemption and infrastructure-related facilities determined as the favorable incentives to support early-stage startups in order to promote regional industry development.

“Government-led infrastructure provision” is identified as one of the most important growth mechanisms for STPs in the study of Koh et al.[19] This has been mainly the case in many Asian countries where the governments were eagerly investing in STPs to attract multi-national companies to their country and therefore, strengthen their STPs. However, for European STPs, agglomeration effect was considered more important as created a very competitive and innovative environment for tenants to grow through factors such as knowledge spillover or informal exchange of ideas.

In summarizing the government policy tools in the literature in supporting the new technology-based firms, the study of Ghoronh et al.[20] provides four major types of policy tools: Regulatory tools, financial tools, information tools, and administrative tools. In considering the role of government, the report of Rowel[16] argues that there are two important dimensions which make it difficult to have a clear answer for this question. The first dimension is the stage of development where the STP is located, and the second dimension is the nature of the innovation system where the STP works. Whether the innovation system is advanced or weak would suggest different issues that need to be considered. The study of Lindelof and Lofsten[21] differentiates the required supports for new technology-based firms in STPs based on their origin. The NTBFs are considered to be either university spin-off or corporate spin-offs and because of different origins required different supports and services. For instance, firms owned by experts in academia may perform less than those firms owned by professional businessman either because academicians already have the university income and are not financially dependent on the firm’s revenue or they simply focus on the research and technology of the firm instead of its growth and revenue. Phillimore[22] argues that the interaction is not just from university to industry, and the interaction and networking within STP and between STP firms and universities are required.[23]

Attractive science and technology park policies for firms and talents

As quoted from Phan in Salvador[24, p. 227] “You can’t just ‘build (a park) and they will come’ –you have to make it attractive in the first place.” Surprisingly, only a limited attention has been paid to the firms’ required supports and services[25,26] and what makes STPs attractive for potential firms and talents. The summary of the literature review on the role of STP policies to attract firms and talents is provided in Table 2.

Attracting existing firms into science park is considered as a generic aim for most of the science parks as pointed out by Guy et al.[29,p. 87] besides other aims such as promoting start-ups or so called the new technology-based firms.
| Author(s)             | Study approach/country | Selected attractions/services                                                                 | Classification of attractions/services       | Study objective                                                                                      |
|----------------------|------------------------|-------------------------------------------------------------------------------------------------|-----------------------------------------------|-----------------------------------------------------------------------------------------------------|
| Jamil et al.[27]     | Systematic approach    | Property development                                                                           | To promote commercialization                  | Review the commercialization tools and the role of university incubators and STPs to promote it      |
|                      |                        | Interaction with local and international markets                                               |                                               |                                                                                                     |
|                      |                        | R and D                                                                                         |                                               |                                                                                                     |
|                      |                        | Proximity to university                                                                         |                                               |                                                                                                     |
|                      |                        | Providing advanced equipment                                                                   |                                               |                                                                                                     |
|                      |                        | Managerial support                                                                             |                                               |                                                                                                     |
|                      |                        | Institutional reputation                                                                       |                                               |                                                                                                     |
|                      |                        | Government encouragements                                                                      | External factors to improve academic entrepreneurship | To find the factors affecting the academic entrepreneurship                                         |
|                      | Practical, descriptive/Iran | Competitors and competitiveness (accepting university as a major player in economic growth) |                                               |                                                                                                     |
|                      |                        | Technological advances                                                                         |                                               |                                                                                                     |
| Tajpour and Hosseini[26] | Practical, descriptive/Iran | Shortages expressed by firms                                                                  | Shortages of turin STP reflected in firms' responses | To find whether STP is a good brand name for university spin-offs                                  |
| Salvador[24]         | Empirical/Italy         | Shortages expressed by firms                                                                    |                                               |                                                                                                     |
|                      |                        | Funding support                                                                                |                                               |                                                                                                     |
|                      |                        | Managerial support                                                                             |                                               |                                                                                                     |
|                      |                        | Hospitality                                                                                    |                                               |                                                                                                     |
|                      |                        | Tutor services                                                                                  |                                               |                                                                                                     |
|                      |                        | Lack of information on sources of finance                                                       |                                               |                                                                                                     |
| Chan and Lau[28]     | Empirical/Hong Kong     | Pooling resources (trainings, exhibitions, etc.)                                                | Assessment criteria of incubators             | To assess technology incubators in science park                                                      |
|                      |                        | Consulting                                                                                    |                                               |                                                                                                     |
|                      |                        | Public image                                                                                   |                                               |                                                                                                     |
|                      |                        | Networking                                                                                    |                                               |                                                                                                     |
|                      |                        | Clustering                                                                                    |                                               |                                                                                                     |
|                      |                        | Geographic proximity (access to market, university, etc.)                                      |                                               |                                                                                                     |
|                      |                        | Costing                                                                                       |                                               |                                                                                                     |
|                      |                        | Funding                                                                                       |                                               |                                                                                                     |
| Cattapan et al. [30] | Case study/Italy        | Innovation brokerage² activities (such as TTS as a European best-practice innovation broker) | Brokerage activities                          | To study the effects of innovation brokerage activities on innovation and growth of small and medium enterprises |
|                      |                        |                                                                                               |                                               |                                                                                                     |
| Şimşek and Yıldırım[31] | Case study/Turkey      | Confidentiality and conservativeness of the firm                                              | Constraints to open innovation                | To examine the constraints for the firms to use open innovation in STP                              |
|                      |                        | Human resources, brand and image                                                               |                                               |                                                                                                     |
|                      |                        | Resources and costs                                                                            |                                               |                                                                                                     |
|                      |                        | Management and organization                                                                    |                                               |                                                                                                     |
|                      |                        | Market, partnership, and technology sources                                                    |                                               |                                                                                                     |
|                      |                        | Administration                                                                                 |                                               |                                                                                                     |
| Liefner et al.[32]   | Survey/China            | Cooperation with foreign companies (helps to get new ideas)                                   | Cooperation                                   | To find how cooperation patterns benefit firms in developing countries                              |
|                      |                        |                                                                                               |                                               |                                                                                                     |
| Narasimhalu[33]      | Review                 | Access to early adopters                                                                        | Key factors for open innovation in STPs (critical success factors for STP) | To review key elements of STPs related to open innovation                                           |
|                      |                        | Accounting                                                                                    |                                               |                                                                                                     |
|                      |                        | Business consulting                                                                            |                                               |                                                                                                     |
|                      |                        | Flexible physical infrastructure                                                                |                                               |                                                                                                     |
|                      |                        | Food and beverage                                                                              |                                               |                                                                                                     |
|                      |                        | ICT infrastructure                                                                             |                                               |                                                                                                     |
|                      |                        | Industrial design                                                                              |                                               |                                                                                                     |
|                      |                        | Intellectual property                                                                          |                                               |                                                                                                     |
|                      |                        | Investment community                                                                           |                                               |                                                                                                     |
|                      |                        | Legal                                                                                         |                                               |                                                                                                     |
|                      |                        | Market research                                                                                |                                               |                                                                                                     |
|                      |                        | Networking sessions                                                                            |                                               |                                                                                                     |
| Author(s)          | Study approach/ country | Selected attractions/services                                                                 | Classification of attractions/services | Study objective                                                                 |
|-------------------|-------------------------|-------------------------------------------------------------------------------------------------|----------------------------------------|----------------------------------------------------------------------------------|
| Jin and Lingyan   | Review/China            | Patent attorneys, Public and media relations, Science and technology consulting, Security, Shared lab and other facilities, Transportation | University STP service organization    | Design and role of university STP in China                                       |
| Corrocher et al.  | Empirical/Italy         | The strength of research networks plays an important role on innovation performance of tenants | Overall effectiveness of STPs         | To find the effect of STP on innovation performance of on-park tenants             |
| Fikirkoca and Saritas | Literature survey/Turkey | Complementarity (activity of firms in relation to related industries [value chain]), Networking | Success factors for policy design of STP | To report a foresight exercise in developing a business model and research strategy for Ankara university |
| Cadorin et al.    | Case study/Sweden       | Coordinating all types of connection with university, Approaching international organizations and firms to establish in the park (CEOs, board members, etc.), Recruiting high quality managers and leaders to complete start-up teams, Facilitating the connection of students with the park | Four cases of talent attraction and recruitment | How to attract and develop talents in STPs and the related issues |
| Alishiri et al.   | Case study/Iran         | Human resources factors, Business environment and investment, Supports and services of incubators, Organization and management factors, Location factors | Success factors of business incubators in STP (ranked factors based on their rating) | To identify and prioritize success factor of STPs, a case study |
| Weng et al.       | Case study/China        | Construction of infrastructure in the park and its surroundings, Industrial chain and enterprise development, Capability to support scientific and technological innovations, Park management and public services, Government support | Success factors of private STP starting from brownfield regeneration | To identify the success factors of private STPs transforming former factory sites abandoned around urban space |
| Shams et al.      | Literature review and questionnaire/Iran | Marketing facilities and supports, Keep business secrets, Communication services, Funding and investment sources, Legal support, Contract supports, The availability of technomart data bank, Providing technology data bank including technology owners, etc., Supporting firms' financial needs, Suitable administrative process for banking and investment issues | The most important supports out of 79 required supports based on their priority | To identify and prioritize the required supports for new technology-based firms |

Contd...
| Author(s)            | Study approach/country | Selected attractions/services                                                                 | Classification of attractions/services | Study objective                                                                 |
|----------------------|----------------------|------------------------------------------------------------------------------------------------|----------------------------------------|----------------------------------------------------------------------------------|
| González-Masip et al. | Secondary database/Spain | Corporate social responsibility practices positively moderate the relationship between locating in a STP and talent attraction | Talent attraction                     | To propose that corporate social responsibility by STP firms can attract talented human resources |
| Kharabsheh et al.    | Interviews/Jordan    | Lack of entrepreneurship culture (weakness of education system) and Lack of independence of STP from university and government and Lack of the required number of STP firms to create enough synergy and Lack of similarities between the STPs’ stakeholders vision | STP success obstacles                  | To find obstacles of STP success in Jordan                                        |
| Ng et al.            | Empirical/Netherlands | Being near to clients (for more commercially oriented firms) and Cost benefits (younger firms)   | Important benefits of STP for tenants  | To gain insights on how STP firms perceive the benefits associated with various supports and services |
| Albahari et al.      | Case study/Sweden    | A configuration-oriented component (during planning STP): Amplifying agglomeration effects, increasing availability of venture capital funding, proximity to a major university and A process-oriented component: Incubation, training and networking | Business support (two components)     | How STPs create value for tenants, a case study                                     |
| Cadorin et al.       | Case study/Sweden    | Headhunting key personnel for start-ups and Facilitating exchange of knowledge and talents with universities and Organizing required platforms for foreign companies to establish | Talent attraction activities           | To explore activities done by the STPs to attract talents for their tenant firms |
| Cabral and Dahab; Cabral | Case study/Brazil; Review | Highly qualified R and D personnel and A suitable market to be accessible Managerial and marketing skills supports (especially for younger firms) Industrial secrecy and patents Selection of firms (based on market potential and being in line with the performing area of STP) Having a clear identity for STP Good management Backing by a dynamic institution A great mediator manger between university an industry Service and consultation firms | STP success factors (10 items)       | Suggesting necessary success conditions for a STP                                |
| Cadorin et al.       | Empirical/Sweden     | Involving major stakeholders (university and government) in STP activities and Characteristics of talents important for the success of firms and Creating effective links with universities as the major source of talents | Collaboration and talents in STP success | To investigate how the success of STP is affected by the collaboration of stakeholders and the characteristics of talents |
| Eckardt             | Empirical/Netherlands | STP functional effects and Regional upgrading effect and External attraction effect and Personal attraction effect | A new multidimensional model           | To find the attractive effects of STPs on international knowledge migrants (human capital) |
| Roldan et al.        | Bibliographic research and interviews/Brazil | Support services and Physical infrastructure and Networking with other firms and Networking with other universities | Favorable conditions for innovation   | To find the favorable conditions for innovation in STPs                            |
It is, however, globally acknowledged that it takes time for STPs to emerge, and they do not produce instant results, that is, the costs incur up-front. In the study of Alishiri et al.\[38\] among the support and services factors, “supporting the commercialization of research results” was ranked highest. Tang et al.\[52\] highlight the importance of quality of services provided for the firms in China and conclude that the business and technology expertise of the government is weak. Based on two case studies in Denmark and UK, Hansson et al.\[53\] introduce a new mediating role for STPs as creating grounds for development of social capital required for facilitating entrepreneurship in networks, beside the known mediating role for STPs (science-industry relationship). Tenant firms have different characteristics, and the STP managers need to consider the real needs of their tenants when performing the talent attraction policies.\[43\]

Demand side expectations: Science and technology park attractions expected by firms

Zhang\[54\] studies the demand side factors expected by the knowledge-based SMEs in Malaysia and classifies the expectations as follows: Good basic infrastructure, advanced technological infrastructure, tax incentives, venture capital, rental subsidies and grants, growing publicity, and support services including technological, administrative, and secretarial.

Ustundag and Kilinc\[55\] identify the critical and important decision criteria for start-up firms to select a STP as it becomes a major decision for this kind of firms. The criteria are cost, physical and technical infrastructure, consultancy and services, and location characteristics. The details of these items are listed in Table 3.

The university spin-off’s may also have their own criteria to select a STP which is listed in Calvo et al.\[56\] as to identify a business opportunity, to increase the participation in the market, partnerships with universities and companies, and obtaining support in management, consulting and market research activities.

The motivations of firms to settle in a STP and expectations of established firms in a STP are studied.
Table 3: Evaluation criteria of science and technology parks by start-up firms

| Criteria                        | Attribute                                          |
|--------------------------------|----------------------------------------------------|
| Cost                            | First cost, rental cost, general expenses          |
| Physical and technical infrastructure | Lab facilities, IT infrastructure, sufficient area for expansion, architectural structure, age of building |
| Consultancy and services         | Technology transfer, finance and accounting, marketing, management, consultancy, preparation of project proposals, venture capital, intellectual property, patent, trademark, export and import |
| Location characteristics         | Market, financial institutions, human resources, industrial clusters |

Source: Ustundag and Serdar Kilinc. STP=Science and technology parks, IT=Information technology

by Castonguay et al. By conducting 12 semi-structured interviews with managers of established organizations in seven science parks in Canada they found six major motivations to settle in a science park: (1) availability of premises and equipment, (2) availability of skilled human resources, (3) financial incentives, (4) reputation of the park, (5) geographical proximity with specific actors, and (6) geographical positioning of the park. Once the decision to settle in is made, they then found eleven expectations of the science park’s contribution: (1) to develop a network, (2) to be accompanied, (3) to have access to business people from foreign countries, (4) to increase their credibility, (5) to develop a competitive advantage, (6) to improve recruitment and retention of human resources, (7) to access new knowledge, (8) to access equipment and premises, (9) to access financial benefits, (10) to collaborate on the park’s strategic planning, and (11) To benefit from an ecosystem that is conducive to innovation.

Three main aspects of factors motivating firms to move in a science park in China are pointed in the study of Yang et al.: (i) motivation of technology gain, (ii) motivation of penetrating market such as acquiring high-quality marketing human resource, and (iii) motivation of policy gain.

The literature review in this study highlighted different aspects of STP attractive factors to be done by the government and universities and those elements to be done by STP. An overview of the areas, in which the major pillars have the capacity to provide services to achieve the goal of STPs in being highly attractive to firms is presented in Table 4.

The investigation showed the limited sources of studies in the area of specialized STPs in the health sector. In addition to the above mentioned attractive factors in the Table 4, there are some other factors specific to the health sector which are summarized in Table 5.

Discussion

There are more and more specialized STPs growing in developed and developing countries, especially in health sector. The specialization decision is considered by McCarthy et al. as a form of selection, which makes it easier for the park to have a successful performance by more concentration. Moreover, the specialization in a specific industry by a university research park is driven by the internal capabilities within the university, the management team along with the capability of the local environment where the park is located. There are a number of implications of specialization; first, as the tenants are active only in one specific industry, therefore, they would need similar resources, and this increases the efficiency of the provided resources by the park. For instance, a university research park focused on biotechnology would provide access to biotechnology laboratories and the related scientific equipment. This is proven to be attractive and beneficial for the tenant firms. From the economic point of view, specialization increases returns as offering similar resources which leads to higher efficiencies in terms of budget allocation and infrastructure maintenance. Second, specialization narrows the pool of potential tenants, which increase the risk of not filling the required positions within the park which may lead to underutilization of the park and moreover makes the park vulnerable to industry-specific recession or crisis. Finally, as the firms are in the same field and use the same resources and networks, high competence against each other may influence the networking benefits.

Specialization in healthcare for a STP would surely enhance and transform the developments in this industry by more healthcare-specific innovation environment and promote regional, national, and even global economic development and human welfare. The number of STPs and innovation centers focused in this area are currently limited but highly increasing (Some popular health science and technology parks are: Granada Health Technology Park [Spain], Illinois Medical District [Chicago, USA], BioRio [Brazil], Genopole [France], Leiden Bioscience Park [Netherlands] Biomed [Taiwan], Hsinchu [China]).

As highlighted in Tseng et al. digital health is an example of an increasingly growing healthcare sector around the world. However, there are still several challenges with testing and implementing the digital health innovation outcomes. In addition, the inventors of new digital health ideas are not much familiar with the health system requirements. They may not have a clear understanding about the time required to test the digital health products. The inventors may also find working with medical academics difficult due to possible different
Mohammadzadeh and Javanmard: Attraction factors of STPs

Table 4: A framework on the major pillars and the directions on making science and technology parks attractive for all kind of firms (including health related firms)

| Major pillars | Areas of intervention/management/policy |
|---------------|----------------------------------------|
| Government (local/national)/parliament | “Knowledge as the key factor for economic growth” implemented in the institutional logic of the state |
| | A strong regional and national innovation system |
| | Suitable business and monetary environment |
| | Geographical proximity (between academic and business communities) |
| | Supportive legislation (business, customs, taxation, finance, etc.) |
| | Net trade balance of the region |
| | Desirable living environment (transportation, close to airport, markets, etc.) |
| University/research institutions | Facilitating the connection of students with the park |
| | Revising the academic output measurement from publications to STP firm’s improvements |
| | Creating effective links with industry |
| | Market oriented research |
| | Provision of laboratories for STP firms |
| Industry/large companies | Effective relationship with a high quality research organization/university |
| | Complementarity: activity of firms in relation to related industries (value chain) |
| | Establishment of international organizations and firms (CEOs, board members, etc.) in the park |
| | Corporate social responsibility practices |
| | Proactive R and D units |
| | Offering professional laboratories |
| | Support national ideas and risk it |
| STP/innovation centers/etc. | Strategic positioning within an industry |
| | Branding strategy considering the high competition market |
| | Applying an appropriate innovation model |
| | Dynamic interaction with civil society, local and international private sector |
| | Careful selection of new knowledge-based tenants (based on market potential, performing area, etc.) |
| | Setting out objectives and strategies in line with the innovation system |
| | Promoting the social face and reputation of park |
| | Optimal number of tenants in park to create enough synergy |
| | Management structure like an independent private firm (depends on the source of firm; university or industry) |
| | Innovation broker |
| | Cooperation with foreign companies |
| | Mature commercial and financial facilities and consultancies |
| | Venture capital |
| | The availability of technology data bank including technology owners |
| | Independence from university and government |
| | Similarity between the vision of STP stakeholders |
| | Headhunting key personnel for start-ups |
| | A clear identity for STP |
| | Focused on the limited number of technological sector |
| | Balance between startup firms and established firms |
| | Low rental cost |
| | Creating grounds for development of social capital required for facilitating entrepreneurship |
| Demand side expectations/motivations | Proximity to potential customers |
| | Access to business networks from foreign countries |
| | Increase the credibility of the tenants |
| | Performing in an innovation leading environment |
| | Penetrating into market |

There are some overlaps on the role of each pillar which are unavoidable due to the nature of the STPs but ignored here for the simplicity. Source: Summary of the literature review by the authors. STP = Science and technology parks, CEO = Chief Executive Officer

Agriculture/seafood and medical services are among the major elements of the Thai economy, therefore, the promotion of biotechnology innovations which will serve these two sectors is significantly supported by the government. The study of Chanvarasuth and

cultures related to the workplace or other reasons. Moreover, many health systems are suffering from the shortage of standardized approaches in relation to digital solutions in different stages such as identification, development, validation, or deployment.[64]
Few studies have examined the health technology innovators and the way they deal with the economic actors and health systems through the social constructing of their firm. To fill this gap the study of Beaulieu and Lehoux[^66] aimed to find the differences between the health technology startups (HTS) and other startups by testing a conceptual model on five firms (listed in the Toronto Stock Exchange) including three HTS. The study examined the social emergence of HTS by considering their media coverage, press releases and their observable market actions from the neo-institutional theory perspective. The organizational response to pressures was also studied considering the type of firm, health or non-health and the stage of activity, whether established or startup. The results showed that regulatory bodies and health professionals had more content and control-related pressures on the HTS firms compared to non-health firms. In the use of symbolic actions and marketing, health startups focused more on cognitive and pragmatic legitimacy rather than moral judgments or actors’ self-interest. While during the expansion phase, the non-health firm had more emphasis on marketing, possibly due to the larger and more heterogeneous actors, the health firms had more marketing during the stable phase with more simplified actions to help the availability of firm in the memory of the observers.

**Conclusions**

Health sector STPs such as other multidimensional STPs need to attract high-quality potential start-ups and firms to locate into the park. The health sector has more complications due to dealing with the health of the population, and any innovation in this sector needs to be highly monitored and supported. The aim of this study was to fill this gap. The literature review conducted in this study showed that it is not only the STP that requires to take actions in creating an attractive atmosphere for firms but there are other players such as government, universities and industries that have a great potential to catalyze STP policies in providing an attractive environment for firms. It is also important to consider what is demanded by the firms to make the STP attractive as well. The items which are retrieved from the review are listed in the finding section; however, it appears that having a knowledge-based economy plays a leading role in the effective corporation of abovementioned players. Beside the attractive factors mentioned for multidimensional STPs, which are applicable for the health sector, some factors which might be more specific to the health sector were explained. It appears that brokerage services in health sector are one of the requirements to commercialize novel ideas in this sector and thus make STPs an attractive place for firms.

The results of this study would mainly help the STP managers, local and national governments, universities and industries to have a better understanding of firms needs in health sector and apply that in their policy and decision making. While the attractive factors of STPs for firms were retrieved from the literature review in this study, however, the importance of each factor for firms remains to be identified by conducting extensive interviews with the active firms in the health sector in future studies.

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**Table 5: Science and technology parks attraction factors more specific to health-related firms**

| Attractive factors | |
|--------------------|---|
| Concentration on health sector (or specific health industry) makes STP attractive for all potential firms and talents due to similar laboratory equipment and needs | |
| Performing in health-care innovation environment enhances health-related ideas | |
| Supportive policies on the required time for testing and implementation of health-related outcomes | |
| Specific services to familiarize non-health innovators with the health sector working conditions when working with experts in this sector | |
| High-quality experts to create standardized approaches to enrich the health system, for instance, in relation to digital health solutions in different stages such as identification, development, validation, or deployment | |
| Public university partnership with health-related industries to promote innovation programs | |
| Increasing the regulatory process speed | |
| To reconsider the academic output measurement | |

Source: Summary of the literature review by the authors. STP=Science and technology parks
Conflicts of interest
There are no conflicts of interest.

References
1. Henrique IC, Sobreiro VA, Kimura H. Science and technology park: Future challenges. Technol Soc 2018;53:144-60.
2. Diez-Vial I, Montoro-Sánchez A. How knowledge links with universities may foster innovation: The case of a science park. Technovation 2016;50:41-52.
3. International Association of Science Parks and Areas of Innovation; 2019. Available from: https://www.iasp.ws/. [Last accessed on 2019 Nov 07].
4. Albahari A, Barge-Gil A, Pérez-Canto S, Modrego A. The Influence of Science and Technology Parks Characteristics on Firms’ Innovation Results. 35th DRUID Celebration Conference 2013. Spain: Barcelona; 2013.
5. Albahari A, Barge-Gil A, Pérez-Canto S, Modrego A. The influence of Science and Technology Park characteristics on firms’ innovation results. Pap Reg Sci 2018;97:253-79.
6. Cohen WM, Levintah DA. Absorptive capacity: A new perspective on learning and innovation. Adm Sci Q 1990;35:128-52.
7. de Medeiros Rocha M, Lima GB, Lameira VD, Quelas OL. Innovation as a critical success factor: An exploratory study about the partnership among university with pharmaceutical industry in Brazil. J Technol Manag Innov 2012;7:148-60.
8. Hobbs KG, Link AN, Scott JT. Science and technology parks: An annotated and analytical literature review. J Technol Transf 2017;42:957-76.
9. Rowe D. Setting up, Managing and Evaluating EU Science and Technology Parks. Brussels: EU Commission, Forthcoming; 2013.
10. Zhang Y. Critical factors for science park management: The North American and European experience. Int J Entrep Innov Manag 2004;4:575-86.
11. Huibing X, Nengl S. Exploration of science parks. Chin J Popul Resour Environ 2005;3:55-9.
12. Ruiz MS, Costa PR, Kniess CT, Ribeiro AP. Proposal of a theoretical model for the implementation and scalability of science parks: A case study. RAI Revista de Administração e Inovação 2017;14:2-15.
13. Wasim MU. Factor for science park planning. World Technopolis Rev 2014;3:97-108.
14. Hladchenko M, Pinheiro R. Implementing the triple helix model: Means-ends decoupling at the state level? Minerva 2019;57:1-22.
15. Machado HV, Lazzarotti F, Bencke FF. Innovation models and technological parks: Interaction between parks and innovation agents. J Technol Manag Innov 2018;13:104-14.
16. Rowe D. Setting up, Managing and Evaluating EU Science and Technology Parks: An Advice and Guidance Report on Good Practice. EUR-OP; 2014.
17. Leyden DP, Link AN, Siegel DS. A theoretical and empirical analysis of the decision to locate on a university research park. IEEE Trans Eng Manag 2008;55:23-8.
18. Yang WT, Lee WH. A study on management performance of Taiwan high technology industry—the Hsinchu science park experience. J Inf Optim Sci 2000;21:19-44.
19. Koh FC, Koh WT, Tschang FT. An analytical framework for science parks and technology districts with an application to Singapore. J Bus Ventur 2005;20:217-39.
20. Ghoronh H, Tabaan SK, Bushehri AR, Ghorbani S. Identifying and prioritizing policy tools to support new technology-based firms’ cooperation with public industries in Iran, a futures studies approach. J Futures Stud 2017;22:57-72.
21. Lindelof P, Lofsten H. Academic versus corporate new technology-based firms in Swedish science parks: An analysis of performance, business networks and financing. Int J Technol Manag 2005;31:334-57.
22. Philimore J. Beyond the linear view of innovation in science park evaluation an analysis of Western Australian Technology Park. Technovation 1999;19:673-80.
23. Quintas P, Wield D, Massey D. Academic-industry links and innovation: Questioning the science park model. Technovation 1992;12:161-75.
24. Salvador E. Are science parks and incubators good “brand names” for spin-offs? The case study of Turin. J Technol Transf 2011;36:203-32.
25. Albahari A, Klofstén M, Rubio-Romero JC. Science and technology parks: A study of value creation for park tenants. J Technol Transf 2019;44:1256-72.
26. Ng WK, Junker R, Appel-Meulenbroek R, Cloudt M, Arentze T. Perceived benefits of science park attributes among park tenants in the Netherlands. J Technol Transf (published online on 28 June 2019); 45, 1196–1227 (2020). [doi: 10.1007/s10961-019-09744-x].
27. Jamil F, Ismail K, Mahmood N. A review of commercialization tools: University incubators and technology parks. Int J Econ Financ Issues 2015;5(Special Issue) 223-228.
28. Taipour M, Hossini S. A study of factors affecting academic entrepreneurship in University of Tehran Science and Technology park. Int J Case Stud 2014;3:34-41.
29. Chan KF, Lau T. Assessing technology incubator programs in the science park: The good, the bad and the ugly. Technovation 2005;25:1215-28.
30. Cattapan P, Passarelli M, Petrone M. Brokerage and SME innovation: An analysis of the technology transfer service at area science park, Italy. Ind High Educ 2012;26:381-91.
31. Şimşek K, Yıldırım N. Constraints to open innovation in science and technology parks. Procedia – Soc Behav Sci 2016;235:719-28.
32. Liefner I, Hennemann S, Xin L. Cooperation in the innovation process in developing countries: Empirical evidence from Zhongguancun, Beijing. Environ Plan A 2006;38:111-30.
33. Narasimhalu AD. CUGAR: A model for open innovation in science and technology parks. World Technopolis Rev 2013;2:10.
34. Jin C, Lingyan D. Design and role of university-based science and technology parks in China. Ind High Educ 2003;17:179-85.
35. Corrocher N, Lamperti F, Mavilia R. Do science parks sustain or trigger innovation? Empirical evidence from Italy. Technol Forecast Soc Change 2019;147:140-51.
36. Fikirkoca A, Saritas O. Foresight for science parks: The case of Ankara University. Technol Anal Strateg Manag 2012;24:1071-85.
37. Cadorin E, Johansson SG, Klofstén M. Future developments for science parks: Attracting and developing talent. Ind High Educ 2017;31:156-67.
38. Alishiri MJ, Makvandi P, Khamseh A. Identification and ranking the critical success factors of business incubator of science and technology parks – A case study: Business incubator of Baqiyatallah University of Medical Sciences. J Appl Biotechnol Rep 2018;5:64-9.
39. Weng XH, Zhu YM, Song XY, Ahmad N. Identification of key success factors for private science parks established from brownfield regeneration: A case study from China. Int J Environ Res Public Health 2019;16:E1295.
40. Shams M, Bandarian R, Behbahani FH. Identifying and ranking the policies of the science and technology parks to support new technology-based firms. Int J Technol Policy Manag 2017;17:139-58.
41. González-Masip J, Martín-de Castro G, Hernandez A. Inter-organisational knowledge spillovers: Attracting talent in science and technology parks and corporate social responsibility practices. J Knowl Manag 2019;23:975-997. [doi: 10.1108/JKM-06-2018-0367].
42. Kharabsheh R, Magableh IK, Arabiyat TS. Obstacles of success of technology parks: The case of Jordan. Int J Econ Fina 2011;3:219-26.
43. Cadorin E, Magnus K, Alberto A, Henry E. Science parks and the attraction of talents: Activities and challenges. Triple Helix 2019;6:36-68. [doi.org/10.1163/21971927-00601002].
44. Cabral R, Dahab SS. Science parks in developing countries: The case of BIORIO in Brazil. Int J Technol Manag 1998;16:726-39.
45. Cabral R. Refining the Cabral-Dahab science park management Paradigm. Int J Technol Manag 1998;16:813-8.
46. Cadorin E, Klofsten M, Löfsten H. Science parks, talent attraction and stakeholder involvement: An international study. J Technol Transf (published online on 10 October 2019);2021:46:1‑28. [doi: 10.1007/s10961‑019‑09753‑w].
47. Eckardt F. The multidimensional role of science parks in attracting international knowledge migrants. Reg Stud Reg Sci 2017;4:218‑26.
48. Roldan LB, Hansen PB, García-Perez-de-Lema D. The relationship between favorable conditions for innovation in technology parks, the innovation produced, and companies’ performance: A framework for an analysis model. Innov Manag Rev 2018;15:286‑302.
49. Guy K, Autio E, Escorsa P, Hogan B, Laamanen T, Marinazzo M, et al. The Science Park Evaluation Handbook. Innovation Programme of Directorate General XIII; 1996. Available from: http://www.technopolis-group.com/resources/downloads/reports/098a_EVALMETH_final.pdf, [Last accessed on 2019 Dec 14].
50. Triadó-Ivern XM, Aparicio-Chueca P, Jaria-Chacón N. Value added contributions of science parks—the case of the barcelona scientific Park. Int J Innov Sci 2015;7:139‑52.
51. Kang BJ. A study on the establishing development model for research parks. J Technol Transf 2004;29:203-10.
52. Tang M, Lee J, Liu K, Lu Y. Assessing government-supported technology-based business incubators: Evidence from China. Int J Technol Manag 2014;65:24-48. [doi: 10.1504/ IJTM.2014.060956].
53. Hansson F, Husted K, Vestergaard J. Second generation science parks: From structural holes jockeys to social capital catalysts of the knowledge society. Technovation 2005;25:1039-49.
54. Zhang Y. Constructing a conducive environment for the growth of knowledge-based SMEs in a science park context: A study on the demand-side perceptions in Malaysia. Int J Entrep Innov Manag 2004;4:515-28.
55. Ustundag A, Kilinc MS. Fuzzy multi-criteria selection of science parks for start-up companies. Int J Comput Intell Syst 2011;4:217-27.
56. Calvo N, Rodeiro-Pazos D, Fernández-López S. Science and technology parks as accelerators of knowledge-intensive business services. A case study. Int J Bus Glob 2017;18:42-57.
57. Castonguay Y, Saint-Yves-Durand S, Hamouti R. The expectations of businesses settled in a science park. Int J Res Sci 2018;4:1-5.
58. Yang Z, Wang Y, Pang J, editors. The Motivation of Enterprises’ Moving into Science Parks: Difference from Enterprises’ Size, Characteristic and Industry Classification. 2010 International Conference on Machine Learning and Cybernetics; 2010:3: 1373-1377.
59. McCarthy IP, Silvestre BS, von Nordenflycht A, Breznitz SM. A typology of university research park strategies: What parks do and why it matters. J Eng Technol Manag 2018;47:110-22.
60. Romer PM. Growth based on increasing returns due to specialization. Am Econ Rev 1987;77:56-62.
61. Aerts K, MatthysSENS P, Vandenbempt K. Critical role and screening practices of European business incubators. Technovation 2007;27:254-67.
62. McAdam M, Marlow S. Building futures or stealing secrets? Entrepreneurial cooperation and Conflict within Business Incubators. Int Small Bus J 2007;25:361‑82.
63. Tseng J, Samagh S, Fraser D, Landman AB. Catalyzing healthcare transformation with digital health: Performance indicators and lessons learned from a digital health innovation Group. Healthc (Amst) 2018;6:150‑5.
64. DePasse JW, Chen CE, Sawyer A, Jethwani K, Sim I. Academic medical centers as digital health catalysts. Healthc (Amst) 2014;2:173-6.
65. Chanvarasuth N, Indaraprasirt R. Thailand biotech business: Product of the national policy. J Commer Biotechnol 2009;15:66-72.
66. Beaulieu M, Lehoux P. The emergence of health technology firms through their sensegiving actions and competitive actions. Int J InnoV Manag 2017;21:1750043 (22 pages).