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Factors for Science Park Planning

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Abstract : The importance of a science park as an instrument of economic development has been realized by developed economies for past three decades. To comprehend the same, developing economies are also planning and implementing science park ventures. However, in terms of planning, science parks are not objects of global consensus because unlike hotel and restaurant chains, which could be planned with similar standards in different regions or countries, there is no single global standard that can be best-fit for science parks. To meet the need for a better understanding of planning, this research studied science parks in developed and developing economies to identify factors that are globally used in this context. This research also extends our knowledge of best practices for growth, governance and sustainability in science parks, and highlights future trends and external factors that may contribute significantly during planning.

Keywords: Science Park, Planning, Governance, Growth, Sustainability, Future trends, External factors

1. INTRODUCTION

Developed economies have been setting up projects to plan and build science parks since 1970s (Kim and Jung 2010; Hu et al. 2013; Yun and Lee 2013). They realized the primordial importance of innovation after the oil crisis of 1970 and science parks emerged as viable instruments for its implementation (Kim and Jung 2010; Salvador and Rolfo 2011; McCorkle 2012). These parks proved beneficial not only for economies but also facilitated innovation at local and international levels (Fukugawa 2006; Kim and Jung 2010; Wonglimpiyarat 2010; Yun and Lee 2013). Consequently, the following quarter century saw a myriad of science parks emerging within the globe.

According to United Nations Educational, Scientific, and Cultural Organization (UNESCO), there are over 400 science parks worldwide and their number is still increasing. The United States of America leads with more than 150 science parks and Japan comes next with 111 science parks. China began developing science parks in the mid-1980s and now has around a 100. This proliferation reflects the recognition of science parks globally and indicates that future economic growth and competitiveness lies in instituting a robust innovation driven economy through science parks (Oh and phillips 2014).

The relatively developing countries have seen a very high transmission of science parks in the last decade (Sun 2011; Fikirkoca and Saritas 2012; Zhang and Wu 2012; Yun and Lee 2013; Jongwanich et al. 2014). Incorporation of science parks by India, Iran, Egypt, Morocco, Tunisia, and many more has resulted in fostering regional innovation and economic development, which subsequently created several thousand new jobs, R&D opportunities, entrepreneurship, and emergence of small and medium enterprise (SME) with increased role of information and communication technologies (ICT). Egypt's science and technology venture known as Smart Villages opened in 2003. It gave a 14.6 percent boost to the ICT sector in 2009 and heavily contributed in sustaining Egyptian economic growth in the

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face of the 2008 world economic crisis. Currently the Smart Villages have over 35,000 employees on site (Bearingpoint 2012).

Some South Asian economies like Pakistan, Bhutan, and Bangladesh are currently analyzing a variety of strategies to build science parks in their regions to gain similar benefits (Vaidyanathan 2008; Hashmi and Shah 2012). At inception stage, the strategies will focus on selection of factors that may influence planning of a science park. Section 2 presents such factors and related best practices of science parks around the globe and section 3 concludes the paper.

2. FACTORS FOR SCIENCE PARK PLANNING

Some organizations can have a global presence under the same operation model, e.g. chains of hotels or restaurants. In terms of planning, science parks are not objects of global consensus because there is no single comprehensive global standard that can be best-fit for a science park (Zhou 2005; Vaidyanathan 2008; Albahari et al. 2013; Chen, Chien and Lai 2013; Yun and Lee 2013). However, this research identifies globally used factors in this context and as per functional specification of a science park, divides them into domains of Governance, Growth, Sustainability, and Future Trends and External Factors (see <Fig. 1>).

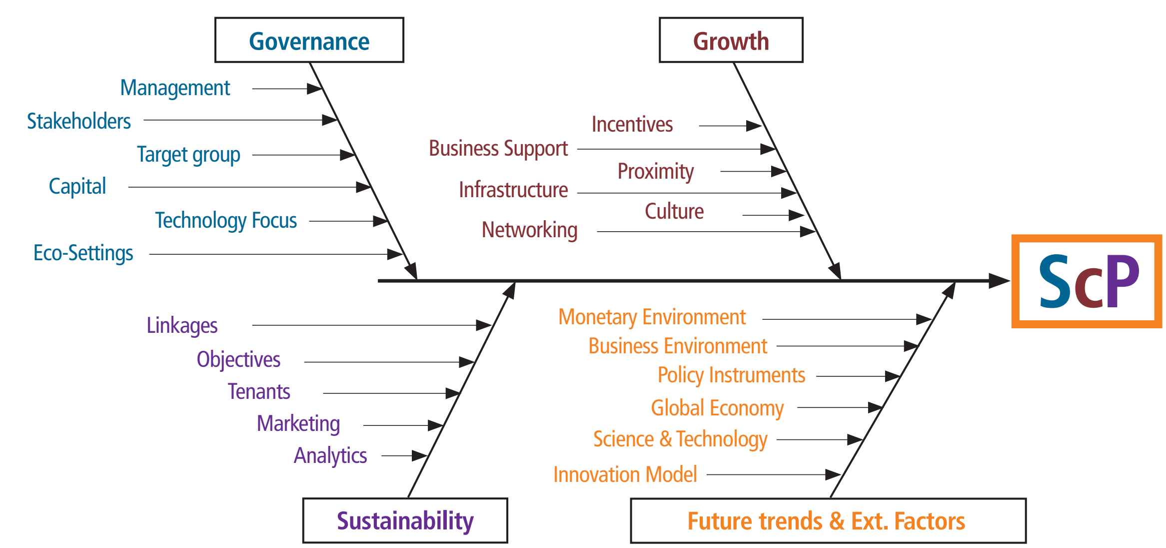

Fig. 1. Factors for Science Park (ScP) Planning

2.1 Governance

Science park governance involves planning and setting up an environment for autonomous firms that are to be located in a science park and are to be engaged in explicit or implicit contracts to coordinate and safeguard knowledge exchanges. Factors that are related to planning and setup of such environment are illustrated by the author in <Fig. 2> and discussed below.

2.1.1 Management

Management of a science park refers to the team of individuals that governs planning, development, administration, and operation of a science park. A successful management team has a clear vision and mission that helps in fulfillment of the objectives that aid in science park development and growth. Moreover, they are responsible for planning and formulating science park policies, undertaking risk analysis, drawing subsequent mitigation plans, and devising cost structure and rev-

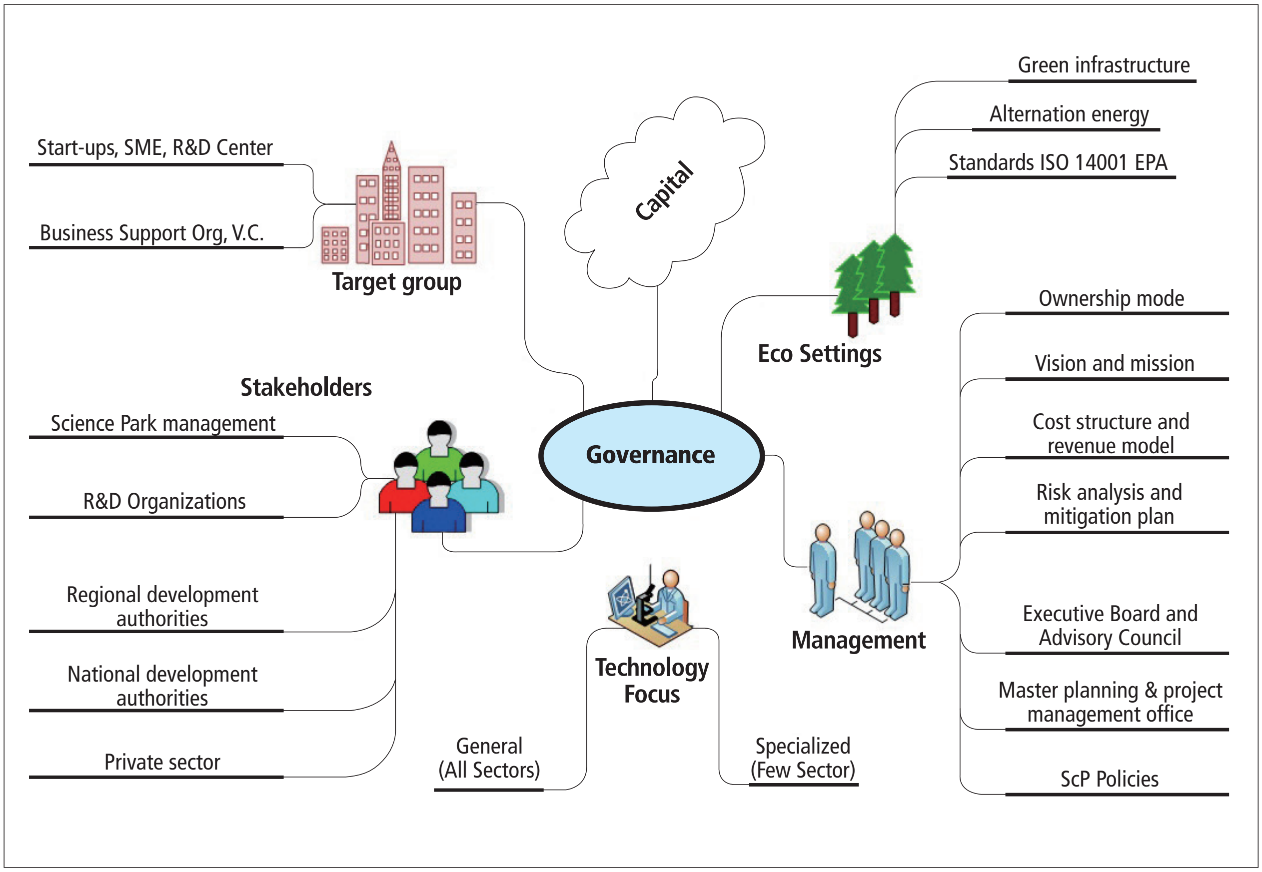

Fig. 2. Factors for Science Park (ScP) Governance

enue models. The composition of a management team varies among science parks and depends upon the management model selected during planning phase of a science park.

The Surrey Research Park of the United Kingdom is an example of university-led Science Park with single ownership model with the university as the proprietor. The required initial development capital was raised by land lease to an anchor tenant. This transaction was sufficient to set out an initial phase of infrastructure and enabled the first phase of buildings without the need of a partner. All subsequent funding of buildings by the University Development Team has been based on loan finance from a number of banks and these loans have been secured against the income stream from let buildings (Parry 2012).

Joint venture model enables third party investment and overtly minimizes cost and risk for a science park in comparison to the single ownership model. The composition of management team can be determined by the level of investments made by each party. In 1999, Manchester Science Park (MSP) in the United Kingdom formed a joint venture with a regional builder-developer, Pochin Plc. This venture successfully developed three buildings for Manchester Technopark Limited (MTL) on a site adjacent to the main campus (Wessner 2009).

2.1.2 Technology Focus

Science parks face a number of crucial strategic choices, both at their planning stage and later on as they develop. One of them is to choose whether to have a strong technology focus or have a more generalist approach. The choice of being either specific or general mainly depends upon the economy sectors that are to be provisioned at a science park.

In specialized technology focus, a science park is predominantly oriented towards specific economy sectors, companies, or functions of companies. University of Maryland Science Park was focused to lead in ICT, bioscience, biotechnology, and nanotechnology. The Zhangjiang High-Tech Park in China emphasizes three major areas: life science—which accounts for about 50 percent of revenues—software, and information

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technology (Wessner 2009). Conversely in generalized technology focus, a science park is designed to offer its services in all economy sectors, thus becoming technologically promiscuous. In Surrey Research Park, the tenants are free to work in technologies of their own or of the University's interest (Parry 2012).

2.1.3 Target Group

A target group is defined as a group of customers towards whom a science park decides to aim its services. This group may comprise startups, spin-offs, small and medium enterprises, privately or publicly owned R&D centers, business support agencies (e.g. law firms), venture capital companies, etc. Clearly defining target groups at planning stage can help a science park to make appropriate arrangements for the target group.

Science Park managements justifiably tend to target customer groups that can be helpful in achieving their objectives. As different science parks have different developmental objectives, their target groups also differ accordingly. Science & Technology Park of Attica (TESPA) ''Lefkippos" in Greece aims at supporting the development of new companies and reinforcing their efforts to exploit commercially innovative ideas and high-end technologies. Consequently, TESPA targets entrepreneurs with innovative ideas for products, processes and services with potential to contribute through the development of their ideas, to create new markets and to improve the national economy. TESPA accepts both mature companies and start-ups as tenants and aims at their further development, the production of a viable business plans, and the commercial exploitation of their innovative ideas (Evangelia and Nicholas 2007).

2.1.4 Stakeholders

A stakeholder is an entity or an individual that has an investment, share, or interest in a science park. As per distinct objectives and management model, stakeholders' composition in a science park is of assorted nature. Besides the management team of a science park, tenant companies, R&D organizations, regional and national development authorities, and private sector are key stakeholders in planning of a science parks.

In Surrey Research Park, the three stakeholders are the University of Surrey, local government, and tenant companies—a typical instantiation of the Triple helix model. The main role of the Surrey University as per its objective is to create some independent income for the University of Surrey and create opportunity for academic staff to secure additional income by working with companies established on the park, to create an opportunity for technology transfer from the University and other sources into the commercial domain, to raise the profile of the University of Surrey as a center of excellence in technology. The local government acts as the planning authority and its main function was to assist in the process of the economic development of the region and locality. Tenant companies are there to establish a business in an environment that favors their development and growth and acquire competitive advantage through access to skills and technology (Parry 2012).

2.1.5 Capital

Capital refers to wealth in the form of money or other assets that is required by a science park during development and operations. Seed capital can be acquired from grants, loans, leasing etc., whereas, working capital can be generated against offered services or incentives at a science park.

For Surrey Research Park, land lease to anchor tenant[1] was used as the option to obtain the seed capital (Parry 2012). Monterrey Research Park in Mexico benefited when Mexico government began providing tax incentives for those who invested in R&D (Wessner 2009).

2.1.6 Eco-settings

Eco-settings in a science park refer to eco-friendly relationship between a science park and environment (Chen, Chien and Hsieh 2013; Yan and Chien 2013). This relationship commonly develops and evolves under the genre of Green Park or Green Tenant. In Green Park, science park management prioritizes environment-friendly arrangement in the park as per the local environmental standards. In addition, it can also take initiative for improving the environment by taking proactive measures like use of cleaner and renewable energy sources, etc..

Hong Kong Science Park is a perfect example of Green Park Model as it supports "solar energy and green building" initiatives. The park has roof gardens in different buildings to

[1] Usually the first, and the leading, tenant in a science park whose prestige and name recognition attracts other tenants.

"green" the environment, integrated photovoltaic system which converts solar energy into electricity, electronically controlled water taps, flushing sensors and weather stations for controlling the irrigation system, and compact treatment of recyclable and non-recyclable wastes. In addition, Hong Kong Science & Technology Parks Corporation (HKSTPC) endorsed the 'Clean Air Charter' and 'Carbon Reduction Charter' pledging to control indoor air quality, reduce air pollution, adopt energy-efficient measures in daily operations, and identify and encourage air pollution control. HKSTPC has also undertaken energy audit and exercised stringent control in terms of energy management. Finally, as a unique initiative, HKSTPC has undertaken a study to plan for the improvement of cycling facilities in the Science Park to encourage use of bicycles as a zero carbon emission transportation alternative to motorcars (Hong kong Science and Technology Parks 2012). In Green Tenant, initiatives are taken by tenant companies on the park for improving environment (e.g. following EPA standards). In Leiden Bio Science Park, Netherlands, tenants tend to have ISO 140001 certification for Environmental Management System (Leiden Bio Science Park 2009).

2.2 Growth

Growth of a science park is enabled by the services it offers to its target group. Commonly these services include: networking support throughout its value chain, infrastructure for desirable quality of life and work ambience, access to business opportunities that lie inside/outside a science park, economic incentives, access to eminent organizations, and culture with general familiarity with entrepreneurial behavior and ethics. Factors that are related to growth of a science park are illustrated by author in <Fig. 3> and discussed below.

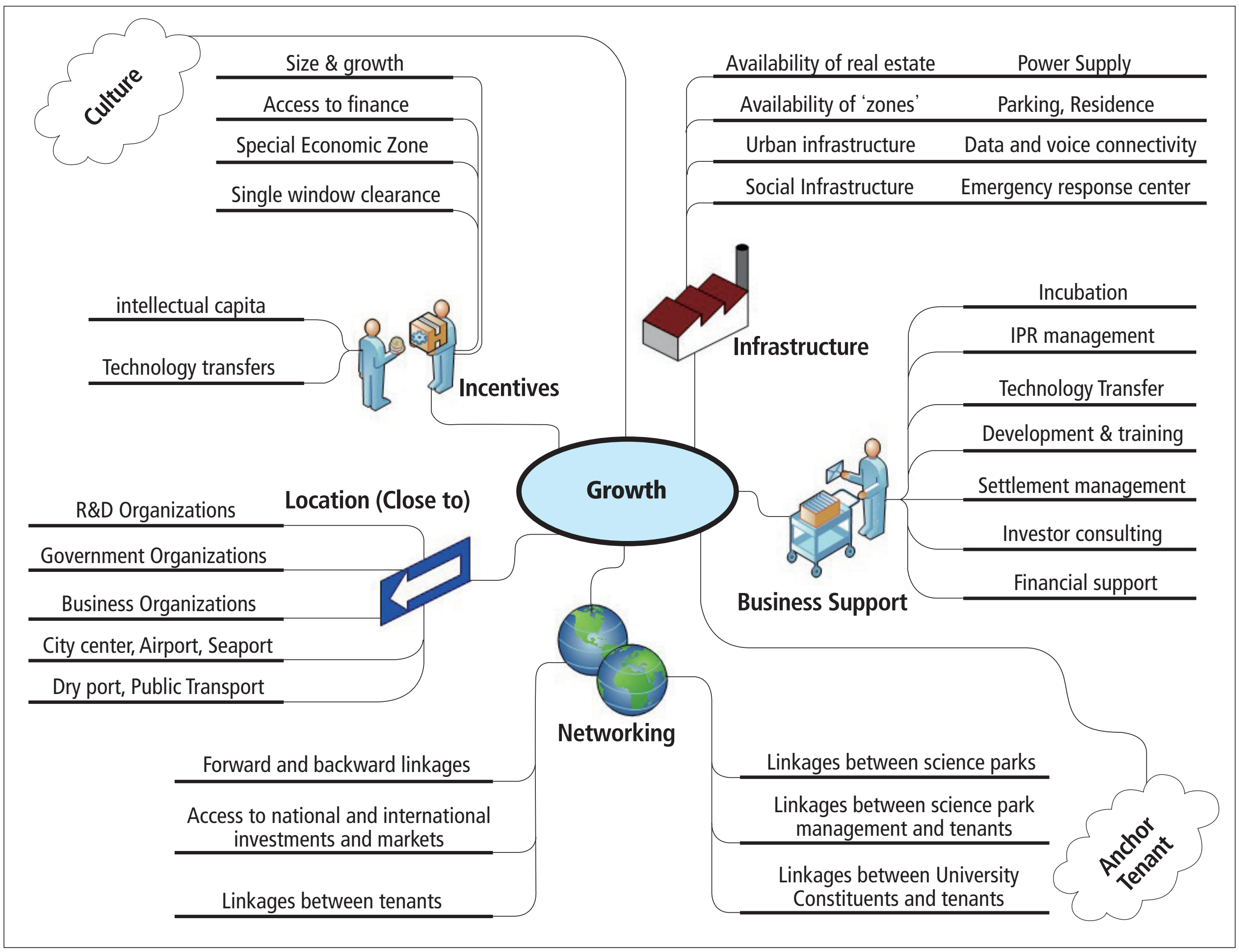

Fig. 3. Factors for Science Park (ScP) Growth

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2.2.1 Networking

Science parks, that are built through collaboration and shared resources, understandably require strong networking roots (Yun and Lee 2013; Kocak and Can 2014). Networking initiatives are in the forms of making arrangements to ensure linkages between different science park constituents that include but are not limited to the linkages between different science parks, between science park management and tenants, and among tenants themselves; and if university is one of the stakeholders then linkages between university constituents and tenant companies in a science park (Malairaja and Zawdie 2008). For tenants, networking is vital (infoDev/World Bank 2008; Chung et al. 2011) as it provides forward and backward linkages of a value chain and access to national/foreign investments and markets (Liefner et al. 2006).

At Daresbury Science and Innovation Campus (Daresbury SIC), United Kingdom, a concept of 'Business Breakfast Networks' has been introduced to attract maximum attendees each month from across the network. It is a focused networking event that has a short interlude to introduce key people, events or programs to the network including intermediary organizations, investor community and blue chip companies, new tenant companies, and funding or support programs. A news hub was also established to allow stakeholders to share information with each other through blogs or tweets (Leake and Treloar 2010).

At Mjardevi Science Park (Sweden), networking is mainly supported by two main organizations, namely Center for Innovation and Entrepreneurship (CIE) and Association for Small Business Development in Linkoping (SMIL). These organizations stimulate the activities of firms by creating fruitful interactions integrated with research on technology based entrepreneurship within the university by organizing lunch meetings with speakers from the world of trade and industry and the university (Hommen et al. 2006).

Zhongguancun Science Park of China enables global networking by using returnee enterpreneurs (Dai and Liu 2009). Returnee entrepreneurs benefit other non-returnee firms in the same high-tech industry through knowledge spillovers. By possessing advanced technology and having access to global networks, returnees act as 'knowledge brokers' who facilitate international knowledge flows. Hence, their impact is not limited to their own firms. They can also affect the technological base of high-tech industries in their home country and generate positive technology spillovers to other local firms in the same sector (Filatotchev et al. 2011).

2.2.2 Business Support

Business support services refer to services provided in relation to business operations at a science park (Berbegal-Mirabent et al. 2012; Vanderstraeten and Matthyssens 2012; Hu et al. 2013). These services include but are not limited to incubation, business development and training, IPR management, technology transfer, financial support, settlement management, and investor consulting.

Dingman Center for Entrepreneurship at School of Business, University of Maryland USA, mainly focuses on financial support, business development and training, and incubation. Foremost features of this center include a network program to improve capital access, an executive mentoring program, and the weekly "pitch Dingman" competitions in which competitors pitch their business idea for the chance of winning a $500 prize (Mote 2008).

University of Warwick Science Park, United Kingdom, offers business support in the form of financial support, technology transfer, and investor consulting through a) Local Investment Networking Company which provides access to a network of business angels willing to invest both development capital and commercial expertise and can help to unlock finance from banks and venture capital providers, b) Techmark, a subsidized scheme for assisting small, innovative companies to market their products or technologies to Europe, and c) the Science Park's internationally experienced marketing team which investigates and assesses the commercial opportunities and agrees on an action plan with the client, which can range from licensing deals, technology transfer, and agency arrangements through selling and distribution (Diefendorf 1997).

2.2.3 Infrastructure

Infrastructure of a science park can be divided into three major streams of physical, social, and communication infrastructure. Availability of space and land to accommodate the expected needs of potential tenants and the availability of urban infrastructure services including but not limited to streets, parking facilities, water distribution system and sewers, and an uninterrupted power supply are the foremost requirements of any science park and come under the umbrella of physical infrastructure. Social facilities like sports ground, medical center, emergency response center, gymnasium, kindergarten, shopping center, food court, clubhouse, multiplex dormitories and apartments, and immigration services, etc. can help to uplift parks' brand value. In terms of communication infrastructure, a science park should be able to provide high speed intra-park, domestic and international data and voice connectivity, IPbased plug and plug services, high tech data centers, etc.

Science parks mostly tailor their infrastructure to match needs of potential clients. This approach not only eases early park occupation by suitable tenants but also provides tenants with better chances to flourish. Technopolis Science Park in Oulu, Finland is one of the very first and leading science parks in Nordic countries. It offers modern business premises tailored to each company's specific needs. Similarly, Madison University Research Park, United States, also focuses on providing flexible premises with offices and laboratories designed especially for its tenants, considering it to be one of the major contributors to its success (Ylinenpää 2001). Surrey Research Park in England uses a more specialized approach towards tailoring its science park's infrastructure in accordance with its potential tenants. Through the help of telephonic survey of 100 technological enterprises, the parks management laid the foundation of a well-thought-out infrastructure that has client centric foundations. In this regard, Surrey Research Park management was able to divide its infrastructural facilities into specific zones that were tailored to accommodate small, medium and large enterprises (Parry 2012).

Creating a city within a science park is the most comprehensive approach towards infrastructural development. These parks contain all three dimensions of infrastructure, namely: physical, social and communication, and help to attract tenants to even remote areas. In Patras Science Park, Greece, a range of facilities are available ranging from availability of land and office space, parking space, hosting of visitors, water and air treatment units, emergency response center, R & D organizations, information and communication (post, telephone, fax and e-mail) (Evangelia and Nicholas 2007).

2.2.4 Incentives

Incentives refer to financial or nonfinancial benefits offered to tenants of a science park (Wang and Liu 2009; Li and Ni 2012). For instance, science parks that are linked with universities can provide their tenants the access to university assets such as R&D equipment, skilled human resource, and employ training and counseling activities. Companies located on the park can also receive financial benefits in the form of access to funds and grants, tax waivers, subsidies on R&D activities, single window clearance, etc. In addition, government can also assist science parks to widen the horizon of incentives for tenant.

Thessaloniki Technology Park (TTP), Greece, has a Technology Transfer Unit that serves as industry-research liaison, performs partner searches, executes assessment and exploitation of research results, and assists with R&D proposal preparation, submission and project management. The unit undertakes measurement and testing of quality control. TTP also promotes international technology transfer between Greece, the EU, the USA, Eastern Europe, and the Balkans (Evangelia and Nicholas 2007).

The Surrey Research Park provides its tenants with skilled work force that has been established because of the presence of the University of Surrey in Guildford for over 40 years, which helped to build a well-educated community. Companies on the park not only get benefits from trained business community that has been supportive of the companies on the Park but also they can gain easy access to international market because of the park's close proximity to international nodes of communication. In addition, the Office of Research and Enterprise Services helps companies connect with the intellectual and technology base in the University. Added to this the management of the Park also has a progressive approach in dealing with emerging technology companies (Parry 2012).

University of Warwick offers student project schemes to its tenant companies under which students carry out work of the tenant companies with ideas of the park companies, which could not be developed given the time or resources (Diefendorf 1997). The Trieste AREA Science Park, Italy, through its "Innovation Campus" offers continuous training and supportive workshops for national and international operators and agencies. It provides higher education courses, specialist studies, shadowing and consultancy on technology transfer themes and projects (Magalhaes and Zouain 2008).

In Zhongguancun Science Park, when firms are qualified as high-tech, they receive preferential treatment from the government. They can get their first three-year of taxes waived, with a 50% reduction for the next three years (Wright et al. 2008). Similarly, the Qatar Science and Technology Park, with the support of its government, facilitates a tripartite partnership of companies, government agencies and academia to promote research and innovation. The Park is also a 'free zone' that offers access to foreign companies (Kanwar and Daniel 2008).

2.2.5 Anchor Tenants

Anchor tenant(s) is usually the first and the leading tenant in a science park whose prestige and name recognition attracts other tenants, and thus plays key role toward growth of a science park.

The Research Triangle, USA, recorded the substantial growth in 1965 because of the US government's announce-

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ment that the U.S. Department of Health, Education, and Welfare had selected the Research Triangle Park for its $70 million National Environmental Health Sciences Center and launch of IBM 600,000-square foot R&D facility in the Park. As a result, new tenants continued to enter the Park over the ensuing decades and accelerated development and growth of the park (Link and Scott 2003). Likewise, the science park in Oulu region, Europe is a topic choice by potential tenants of electronic industry as per presence of NOKIA Corporation as anchor tenant (Ylinenpää 2001).

2.2.6 Location

Location refers to geographical proximity of a science park to organizations and infrastructure prompting trade and commerce. They include but are not limited to industries, R&D organizations, government agencies, universities, city center, airport, seaport, railway, etc.

In Greece, two science parks, namely Technology Park of Attica "Lefkippos" and Technological and Cultural Park of Lavrion, were positioned close to the center of Athens and near the new international airport of Athens, respectively. This helped them not only to get fast access to the new international airport of the city but also easy access to a new major motorway connecting east and southeast Attica that helped them to connect with rest of the country. In addition to geographical proximity, tenants in both parks get technological and organizational proximity as well. This helps them to connect with a major industrial area as well as to best science laboratories in the country. They also take advantage of being near to major research universities that cover all natural and social sciences (Evangelia and Nicholas 2007).

2.2.7 Culture

Culture of a science park refers to an environment that fosters knowledge exchange while meticulously adhering to intellectual property rights (IPR). Mjardevi Science Park, Sweden, maintains such a culture with help from a number of local organizations linked to the Park. These organizations acquaint the start-ups in a science park with entrepreneurial behavior, culture and IPR principles (Hommen et al. 2006). Likewise, Bristol and Bath Science Park, UK, has a dedicated knowledge exchange team that organizes workshops, networking events and face-to-face meetings for tenants to understand legal, ethical, and moral responsibilities toward knowledge exchange (Bristol and Bath Science Park 2011).

2.3 Sustainability

Sustainability refers to the ability of a science park to gauge its performance against given criterion (Bigliardi et al. 2006; Sun 2011; Huang 2012; Hung 2012). This relates to performance appraisal of a science park in reference to its objectives, linkages, and tenants. Based on such appraisal, science park management periodically collects and publishes performance statistics of a science park for marketing and branding. Factors that are related to sustainability of a science park are illustrated in <Fig. 4> and discussed further.

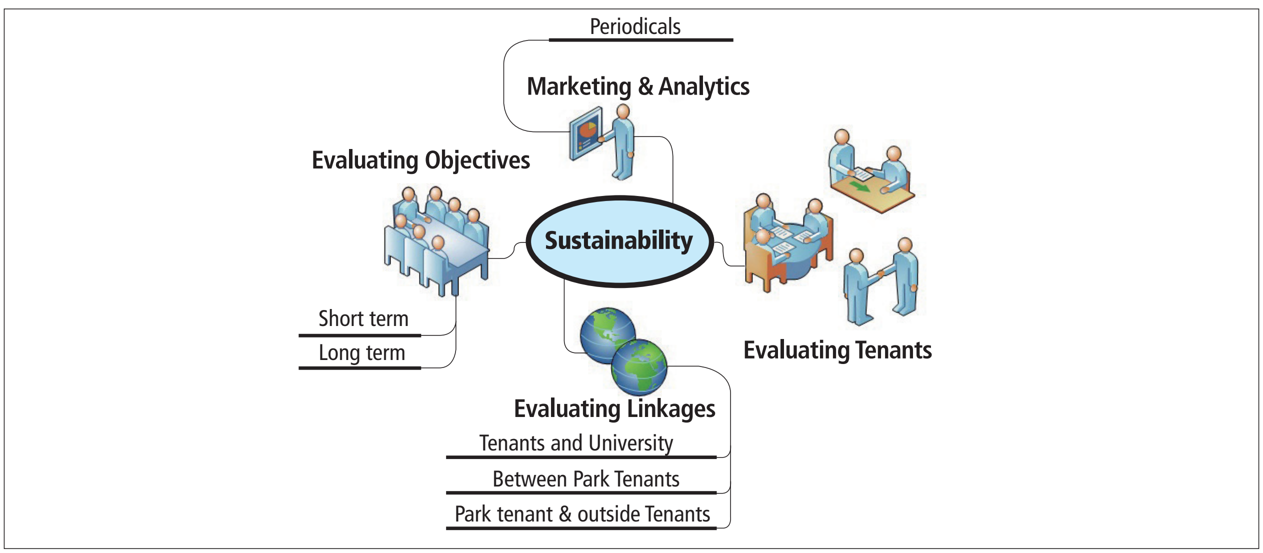

Fig. 4. Underplaying Factors for Science Park (ScP) Sustainability

2.3.1 Objectives Evaluation

Evaluating a science park against its objectives can give a clear picture of its standings and its progress towards sustainability. Evaluation should be separately performed on both short-term and long-term objectives of a science park. Short-term objectives usually revolve around established firms moving to a park, new high-tech businesses fostered, turnover/profitability of firms on park, rental income from firms on park, patents by firms on park, increase in patents, joint publications, etc. Long-term objectives, on the other hand, consider on-park employment quantity and quality, value of purchases from firms in the region, increase in region's balance of trade, increase in GDP for the region, change in relative unemployment level, etc.

The management at Manchester Science Park (MSP) uses the "strategic objectives of economic development and knowledge exchange" to evaluate success. The first metric is growth in tenant companies. Tenant companies are asked to fill out a questionnaire annually, and growth is measured by employment, company turnover, and expansion within the park. To measure innovation, companies are asked how they are developing their links with higher education, such as how many graduate students they employ. They are asked about their licensing activity, new products and services, and about sources of investment (whether friends and family, venture capital, or stock offerings), which indicate how successful they are in bringing new money into the local economy. The park management also provides assistance to its companies and even tracks the alumni companies to monitor their development. In 2007, for example, MSP found that 79 percent of the companies operating in 2001 were still in business. By comparison, the average survival rate of all firms in Manchester is 64 percent. MSP also found that 70 percent of companies that left the park were still operating in the city region (Wessner 2009).

2.3.2 Evaluating Linkages

Network analysis in reference to linkages between tenants and organizations outside the park, between tenants and associated university, and amongst tenants is vital for the survivability of a science park. In India, STP at the Indian Institute of Technology (IIT) in Madras is running an "Earning Credits System". Each tenant must earn a minimum number of credits by establishing linkages with IIT-M to stay in the park. The credit system is designed to promote entrepreneurial activity, inter-sector interaction, and partnerships. Thus, companies are given credits for the following actions: R&D projects with IIT-M, consultancy to IIT faculty, earning royalties, sponsored PhD/masters students, serving as adjunct faculty, teaching at IIT-M, mentoring PhD/MS/BTech students, and giving part-time employment to PhD/MS/Btech students (Wessner 2009).

2.3.3 Evaluating Tenants

Evaluating tenants refers to minimizing risk of failures for tenants of a science park. In USA, M Square (joint venture of the University of Maryland and China) apply filter with international standards for evaluation of start-ups in light of four criteria: What is innovative about this idea? What is entrepreneurial about it—i.e., how are you going to leverage your money to get this done? What kind of partnership is included that will expand your asset base? To what degree is it an international project? (Wessner 2009).

In UK, Daresbury Science and Innovation Campus evaluates businesses impacts through annual tenant survey. This has shown substantial hard and soft business impacts, e.g. minimal business failure (6 company failures in nearly 5 years of operation), accelerated business growth (in 2008, average sales growth was 67 percent and investment growth was 55 percent), increased collaboration (nearly 75 percent of companies collaborate with each other and 70 percent of companies are engaged with at least one University or research institute), increased new product and service development (over 130 new products and services taken to market), and new jobs created (nearly 100 new jobs created since moving to Daresbury with 64 in the past 12 months) (Leake and Treloar 2010).

2.3.4 Marketing and Analytics

A sustainable brand image of a science park depends upon publically available periodicals on its performance reviews. The Silicon Valley Index has been telling the Silicon Valley story since 1995. Released early every year, the index is based on indicators that measure the socioeconomic strength and highlighting challenges, and provides an analytical foundation for leadership and decision making at Silicon (Jointventure 2014).

2.4 External Factors and Future Trends

The enterprise structure of science parks that has influenced the last five decades of global innovation economy may transmute into network configuration by evolving trends in global economy, science and technology, and models of innovation (Minguillo and Thelwall 2012). For example, as the on-

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going economic recession influences financial endurance of science park tenants in developed economies, networking with R&D centers of science parks in developing economies will be a likely preference as they provide lower-cost alternatives. Moreover, from synthetic genomics (which seeks to design micro-organisms that perform useful functions) to stem cell therapy (which seeks to harness the body's own ability to heal itself), biology in collaboration with other sciences will become a central source of scientific and technological breakthroughs in future. Research at the intersection of biology, informatics, and nanotechnology will require trans-disciplinary skillsets and a new model of innovation, i.e. open innovation, among tenants of science parks.

In addition to the above discussed elements, several external factors may influence planning and development of a science park. In this research they are broadly categorized as policy instruments (Zhang and Wu 2012), business environment, and monetary environment. <Fig. 5> is an abstract illustration of these factors as their existence and influence is significantly native and relatively different among countries. The possible implications of these external factors and future trends for science park planning are crucial and should be researched in future. The current study will only limit itself to illustrating them.

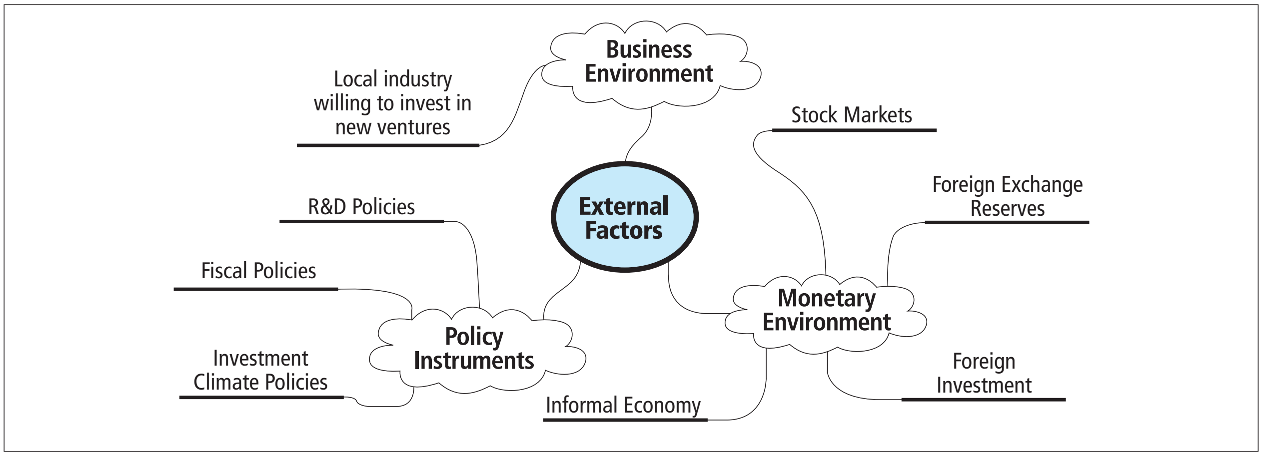

Fig. 5. External Factors

3. CONCLUSION

The main goal of this research was to provide decision makers with information about factors that may influence planning of science parks. In this regard, number of significant factors and related best practices are highlights in this research. An exclusive nature of best practices revealed that planning of science parks is subjective in nature, mainly dependent on the objectives and policy instruments deriving from the development priorities of planners, and existing monetary and business environments of the region wherein the science parks are located. Therefore, the planning authorities of science parks, after making an informed choice about factors and best practices (see section 2), must tailor these to their specific needs and requirements and adapt them in accordance to their unique regional settings.

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