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Building Effective Bridges between Science Parks and Universities

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Abstract
This paper examines begins by examining the priorities of the different stakeholders in universities. It then lists some unique technology transfer models practiced by both universities and companies. This is followed by a discussion on the current models of universities and businesses, and science parks and universities. The paper then recommends a new model for science park university engagement that includes six initiatives to make science parks more relevant to universities.

Keywords
Science park 3.0, Science park-university collaboration

1. BACKGROUND

Early Science and Technology Parks were housed near prominent universities to increase the interaction between industry and academia. The role of universities in transforming societies has been reported in Brennen, King and Lebeau (2004). Links between universities and high tech firms has been reported in Westhead and Storey (1995).

A number of researchers have studied the role and impact of Science and Technology Parks. Researchers such as Miller and Cote (1985), Castells and Hall (1994), UKSPA (1996), Lee and Yang (2000), Macdonald and Deng (2004), and Zhongguancun Science Park Management Committee (2004), Inkpen and Tsang (2005), Battelle Memorial Institute (2007), Wessner (2009) have described Science Parks in different locations and some have even offered comparisons. Link and Scott (2006) discussed research parks run by universities.

The role of Science Parks in innovation has been reported by van Dierdonck, Debackere and Rappa (1991), Felsenstein (1994), Leydesdorff and Etzkowitz (1998), Tan (2006), Etzkowitz, et al (2007) and Narasimhalu (2013). The relationship between Science Parks and economies have been studied by Cox (1985), Druilhe and Garnsey (2000), Phan, Siegel and Wright (2005), and Almeida, Santos and Rui Silva (2008).

The influence of Science Parks on Businesses has been addressed by Löfsten and Lindelöf (2003), Monck, Porter, Quintas, Storey and Wynarczyk (1988), Westhead (1997), and Westhead and Batstone (1998). The impact of Science Parks on entrepreneurships, startups and new technology based firms has been analyzed by Ferguson and Olofsson (2004), Löfsten and Lindelöf (2002) and McAdam and McAdam (2008).

Some researchers such as Bakouros, Mardas, and Varsakelis (2002), Massey, Quintas and Wield (1992), Quintas, Wield and Massey (1992) have reported little or worse still negative effect that Science Parks have had in the transfer of inventions from universities to local, regional or global economies.

Characteristics of communities in which Science Parks were located, was reported by Peddle (1988). Siegel, Westhead and

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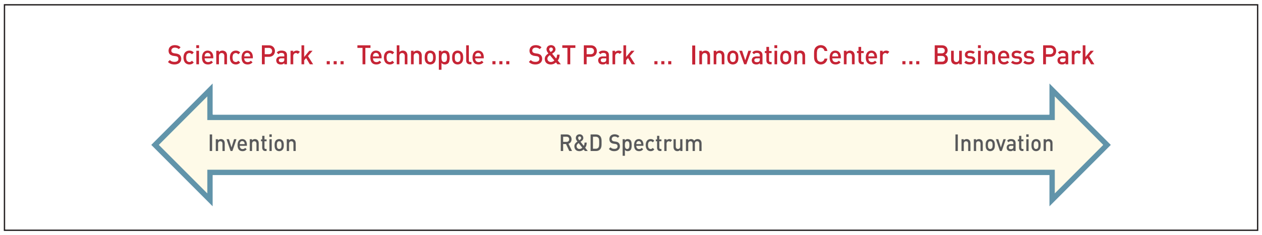

Fig. 1. Categorization of Science and Technology Parks

Wright (2003) gave an insight into the impact of Science Parks on the research productivity of firms.

Almeida, Santos and Rui Silva (2008) defined a continuum of Science and Technology Parks as shown in <Fig. 1>. These parks ranged from Science Parks focusing on invention to Business parks that focused more on innovation and production.

In this paper we wish to propose some recommendations to strengthen the relationships between Universities and Science Parks. We use the term Science Park to refer to the entire set of parks ranging from Science Park to Business Park as shown in <Fig. 1>. In this paper we shall first present the priorities of the different stakeholders within a university followed by unique examples of technology transfer models that have been observed over the last two decades. This will be followed by a discussion on currently popular models of interaction between universities and businesses and a brief summary of the interaction between universities and Science Parks. We finally introduce the new model for interaction between the universities and Science Parks followed by a summary.

2. PRIORITIES OF DIFFERENT STAKEHOLDERS IN THE UNIVERSITIES

In this section we will first report universities priorities followed by the role of technology transfer

2.1 Universities' priorities

An International Research Project Synthesis Report by Brennan, King and Lebeau (2004) claims that universities' priority was to be the transformation agent for the following four requirements:

- Economy: the formation of human capital;
- Polity: the creation and sustenance of state and civil institutions; the selection and socialization of political and social elites;
- Social structure: the basis of social stratification, the extent and mechanisms of mobility for different groups;
- Culture: the production and dissemination of ideas, exerting influence upon and providing critiques of the above.

The Task Force on Higher Education (TFHE 2000) sees higher education as making a vital contribution to all four of the above requirements and emphasizes the 'public interest' case for investment in higher education as lying in higher education's ability to:

- unlock potential at all levels of society, helping talented people to gain advanced training whatever their background;
- create a pool of highly trained individuals that attains a critical size and becomes a key national resource;
- address topics whose long term value to society is thought to exceed their current value to students and employers;
- provide space for the free and open discussion of ideas and values (TFHE 2000).

A World Bank report in 2002 identified four essential functions of higher education in supporting knowledge-driven economic growth:

- the capacity to train a qualified and adaptable labour force – including high level scientists, professionals, technicians, teachers for basic and secondary education, as well as future government;
- the capacity to generate new knowledge;
- the capacity to access existing stores of global knowledge and adapt it to local use;
- the transmission of norms, values, attitudes and ethics as the foundation of the social capital necessary to construct healthy civil societies and cohesive cultures, 'the very bedrock of good governance and democratic political systems' (Harrison et al, cited in The World Bank 2002).

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2.2 Universities and technology transfer

Association of University Technology Managers (AUTM 2005) defines technology transfer as a process of moving scientific findings from one organization to another for the purposes of further development and commercialization. They go on to say that such a process typically includes:

- Identifying new technologies
- Protecting technologies through patents and copyrights
- Forming development and commercialization strategies such as marketing and licensing to existing private sector companies or creating new startup companies based on the technology

They further go on to state that academic and research institutions engage in technology transfer for a variety of reasons, such as:

- Recognition for discoveries made at the institution
- Compliance with federal regulations
- Attraction and retention of talented faculty
- Local economic development
- Attraction of corporate research support
- Licensing revenue to support further research and education

Studies such as AUTM (2005), McAdam et al. (2005), and Anderson et al. (2007) have shown that not all universities are able to staff their technology transfer or licensing offices (TTOs / TLOs) with the right type of personnel. Most of the employees in a TTO or TLO have administrative background and do not have sufficient understanding of how to move an invention to market. They are often rule bound and bureaucratic.

2.3 Faculty members' priorities

Most faculty members choose an academic career since it gives them the opportunity to pursue independent and open ended research. Their promotion and tenure metrics are determined by their research, teaching and service effectiveness. So, faculty members have no incentive or inclination for spending some part of their time helping with technology transfer if there is no explicit recognition of such efforts and their outcomes.

3. UNIQUE TECHNOLOGY TRANSFER MODELS

3.1 Corporate examples

Companies such as Apple and British Telecoms are known to have paid significant sums of money to get the right to station their representative at university departments of interest to them, such as the MIT media lab. Such presence gave them a ringside seat to observe emerging intellectual property (IP) with commercial promise and to prepare for the adoption and adaptation of such IP into their product and service lines. Media Lab would initiate projects that they considered interesting and the on-site industry observers evaluated the relevance of research outcomes to their respective companies. The programs were also useful to identify talents for recruitment.

Intel Lablets

Intel had a different approach – it built on the strengths of a chosen university as reported in Vijayan (2005). It set up 'lablets' at leading universities such as University of California, Berkeley with an intent to identify and investigate technologies that merited acceleration and amplification. Their presence on a university campus gave them the opportunity to recruit the right collection of students and faculty to be involved in their projects on-site. Their Berkeley lablet leveraged on TinyOS, TinyDB and Tiny Application Sensor Kit leveraging on the university's strengths. Its lablet at the University of Washington focused on the valued derived by marrying RFID and Data mining technologies which again were the strengths of the university. Cambridge based lablet focused on highly distributed applications such as Xen and the Carnegie Mellon University based lablet leveraged the university's strength in software for widely distributed storage systems.

Later, Intel changed its strategy in 2011 and defined three types of research engagements with universities of interest, Focused Research, Exploratory Focused Research, Exploratory Research and Programs (Mims 2011). Targeted research aimed at pushing technology beyond its known limits. Exploratory Research focused on the collective wisdom of top researchers from across academia and within Intel, to explore and uncover not only new answers, but new questions. Programs were used to quickly transfer research results and Intel's latest technology into the classroom, in an effort to enhance student learning.

3.2 University Examples

Indian Institute of Technology Madras' research park has a scheme that extends special privileges to companies that engage in supervising or funding research projects conducted at the different schools. The scheme offers a tiered set of benefits for different levels of participation and contribution to teaching and research. This is an instance where a university builds a research park with a specific aim of attracting industry partners to contribute to its educational programmes in exchange for presence in the research park on favorable terms.

Karolinska Instituten in Stockholm uses a model similar to Venture Lab concept. It engages retired or displaced senior executives of pharma companies to actively manage the translation of their scientific discoveries into licensable products. One retired executive may be deployed to manage two or more projects at the same time in order to keep them engaged and costs low. Their scheme allows generation of data from the translational projects to be used by the academic community to meet their publication requirements, goals and targets. Karolinska had set up Karolinska Innovation to actively identify research results with commercial potential and Karolinksa Development which would then manage the commercial development of the research results generally at a fraction of the cost incurred by venture capitalists.

Singapore Management University invited a bank to establish an innovation lab in one of its schools. The bank would sieve through hundreds of innovation ideas from their employees and shortlist some of them for building prototypes in the innovation lab called iLab, using the students and faculty of the school. The bank created a sense of competition and encouraged excellence in outcomes by instituting prizes for the best performing teams. Members of the winning teams were eligible for internship and Management Trainee positions at the bank. This is an example of how businesses are encouraged to identify applications and solutions of interest to them and use the faculty brainpower and students' energy to produce proof of concept implementations that can be evaluated for full scale development by the bank.

4. CURRENT MODELS OF ENGAGEMENT BETWEEN UNIVERSITIES AND BUSINESSES

<Table 1> shows popular models used for university industry engagements. At the lowest level there is no intervention from an industry partner. Individual professors and research students identify problems they consider are begging for solutions based generally on literature surveys and produce outcomes that are reported in relevant conferences or journals. A University's Technology Transfer office normally leaves it up to the individual student or Professor make a declaration whether the research outcomes have commercial value and whether they merit protection for either sale or license.

Table 1. Popular models for university industry collaboration

Model	University's contribution	Industry's contribution
Model	Bottom up individual driven	None
Open ended research	Define areas of interest to companies	Funding
Research Projects and Programs	Involve a resident company representative in a research team	Funding plus place a person on campus
Supervised research projects	Allow companies to buy out professors and students' time for on-site research	Money, Direction, Supervision
Managed research projects	A team that could relocate	Funding, Direction, Supervision and employment

The second model represents a situation where a company identifies a professor who is an expert in an area of interest and funds him or her for conducting a research of interest to the company. Such an arrangement involves the office of research of the concerned university and there is usually a contract that specifies the IP arrangements between the company, university and the researchers involved in the project.

The third model represents a situation where a company

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sponsors a suite of research projects with rights to the resulting IP and has an employee located at the university to supervise the research projects. MIT Media Lab has examples of such supervised research. The supervision is a light touch in nature and the company's employee plays an observers role with occasional intervention.

The fourth model involves significant investment from a company that provides investment and on-site personnel, buy the time of professors and students to work on projects which are defined by the company. This is often referred to as directed research. In many instances the company has either exclusive IP rights or first right of refusal for the IP rights.

The last model is rare. It allows a company to fund one or more research projects with the aim of recruiting some or all of the project team members. Such a team may consist of one or more faculty members along with graduate and undergraduate students. At times, the sponsoring company would at the outset express their interest in recruiting the students who worked on the project along with consulting time of faculty. This is probably most effective method for companies which are clear on the research outcomes they wish to get from such investments.

5. SCIENCE PARKS AND UNIVERSITIES

Several Science Parks were located nearer to research universities with the aim of accelerating technology transfer from the universities into the companies.

Massey, Quintas, and Wield (1992) was critical of such efforts, calling such parks high tech fantasies that had only a small effect on promoting technology transfer. Felssenstein (1994) while agreeing that the universities had a seeding effect with respect to innovation through new technology based firms, Science Parks did not appear to have similar impact and if at all there was an impact it was marginal. He found that new firms were a minority in such parks and a very small minority in celebrated business parks. He also found that most occupants of Science Parks had their origins outside of these parks. Wallsten (2001) reported that Science Parks had a negative effect on regional economic development and rates of innovation.

Science Park 1.0 was generally a real estate play where companies large and small were co-located with service providers. They largely focused on production, including assembly of already designed products. Science Park 2.0 as in Fusionopolis and Biopolis in Singapore and Sophia Antipolis brought public and private research labs and incubators and accelerators into Science Parks. Sophia Antiplois is an example of a Science Park that had focused on an industry vertical, telecommunications in her case. Fusionopolis and Biopolis are co-located close to Block 71 and Sophia Antipolis houses PACA/EST.

However, the interaction between universities and the residents of the Science Parks was very anemic if at best as presented in <Fig. 2>. The main reason is lack of common interest. It is time we examine how Science Parks and universities can strengthen their engagement with a view of increasing the flow of IP from the universities to the Science Park residents.

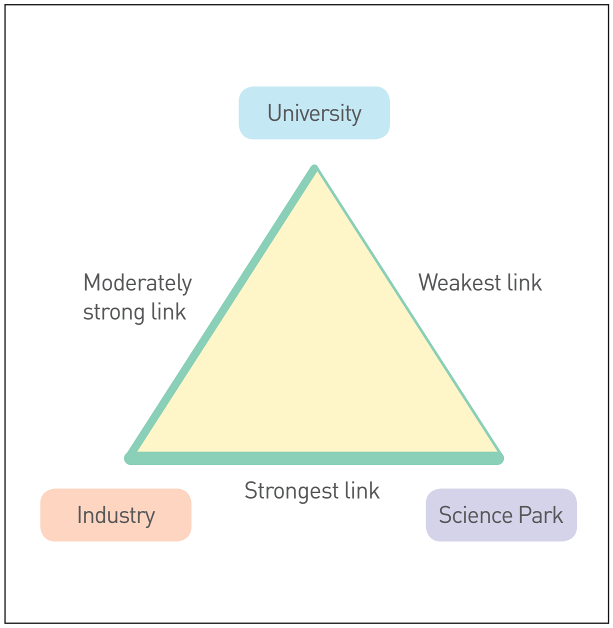

Fig. 2. Strength of relationships of University, Industry and Science Park

6. NEW MODEL FOR SCIENCE PARK UNIVERSITY ENGAGEMENT

It is important to find new ways of enhancing the impact and value created from the interaction between a university and its neighboring Science Park and not allow past findings to discourage such interactions. A new model of university Science Park engagement can be developed if each of the three players- Science Parks, Businesses and Universities, understand and agree with their well-defined primary roles in such a relationship.

6.1 Universities' primary role

Universities are primarily knowledge and human capital generators and should treat any revenues from their IP as a bonus and not consider them as a key revenue source. Universities with good reputation and excellent working relationship with companies are known to receive significant research investments and gifts for building and other programmes which are often larger than the revenues from monetizing their intellectual property. Universities could benefit from their interaction with businesses in three important ways. Firstly, universities can get businesses to identify problems of industrial importance and use their faculty and student power to find novel and affordable solutions to such problems. Challenging problems and ensuing solutions will contribute to further enhancing the reputation of the university. Secondly, universities should also define their IP commercialization policies to encourage businesses to invest in research projects as a means of increasing a university's research budget and hence possibly the research prowess. It would be prudent for universities to trade their IPs for research investments, internships, scholarships and other type of gifts from the companies. Such a positioning would over time ensure that the research funding of a university from the businesses would be larger than their funding from different government agencies. Thirdly, given that most of the intellectual property generated in universities lie idle in their technology transfer or licensing offices, universities may wish to consider liberal IP ownership policies so that their faculty and students will find it attractive to take the IP to market.

6.2 Business' expectations

Companies often work with universities with some expectations. One of the reasons companies work with universities is to keep abreast of some of the emerging research results and to be able to assess and harness such results either by funding directed research programmes, engaging faculty as consultants or recruiting students who had worked on the research projects. Companies often perceive universities as their extended invention and innovation partners and may establish focused or directed research, exploratory research or applied research programs. Some companies or their founders, especially alumni also contribute to university endowments to promote scholarship in specific areas. This is more philanthropic in nature in most cases.

6.3 Identifying the role for Science Parks

The key question remains what additional value Science Parks can offer to enhance the flow of IP to create a positive impact on the local, regional, national and global economies over and above what the businesses and universities can achieve directly. We need to understand the challenges faced by universities and businesses in their current model of engagement in order to suggest improvements.

Universities are often saddled with a large number of IP in the form of patents and manage to get only a fraction of them leveraged through either licensing or sale. They would have invested significant sums of money in securing these patents. A number of technology transfer offices generally end up being cost centers and those who are successful are known to have a big play once a few decades. A few universities are exceptions to this observation. Hence, any solution that a Science Park can offer to university owned IP to market will be warmly embraced by the universities.

Universities often have a space crunch. Every university outgrows its built up areas sooner or later, often sooner than later. Hence, any solution that Science Parks can offer to alleviate the space crunch would welcome by universities.

Faculty and students in universities create technologies and scientific discoveries that are often considered to belong to the proof of principle category. These are often too raw for immediate consumption by businesses. Often times, the initial applications that were the drivers of the technologies and discoveries may not be the most commercially rewarding opportunities. Any Science Park that can offer resources to advance the deployment of the proof of principle technologies and discoveries to the next level, a level closer to commercialization would be warmly welcome by universities.

6.4 Making Science Parks relevant for universities

All discussions here relate to independently run Science Parks that are located close to universities. The three areas which may be of interest to a number of universities discussed in the previous section are realizing the value of IP, helping manage space crunch and moving the IP beyond proof of principle. The following initiatives by all the three stakeholders, Universities, businesses and Science Parks that will help address these issues will be a first step in defining the role of Science Parks in their next stage of evolution.

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Initiative 1: Redefining University's IP policy

If universities allow the inventors own the IP produced during their independent work during the normal course of work, some of the faculty-student more inventors may be willing to commercializing such IP. Clearly IP resulting from externally funded research be it by private or public sectors has to be managed according to the terms of the respective research contract. This step is an essential first step in reengineering the supply side of the IP flow from the universities to the markets.

Initiative 2: Refining the tenure and promotion policy

The second key step in ensuring that more IP flows from a university to the markets is to recognize the impact created by faculty and other researchers in moving the IP to the markets. Not all tier 1 published academic papers end up changing this world significantly. They may be interim steps in creating a major change in the world. Similarly, not all contributions to commercialization may end up creating significant economic outcomes for the region or country. Both tier 1 published papers and contributions to moving the IP beyond a proof of principle ought to be considered on parity so that universities can create and motivate more change agents amongst its faculty and researchers.

Initiative 3: Reengineering Technology Transfer Offices

A majority of employees in Technology transfer offices are often administrative staff whose incentives need(s) to be reengineered. They should be experienced business development or marketing professionals who go out to promote their IP rather than wait for enquiries regarding their IP. Staffing a TTO with marketing personnel with proper incentives will galvanize the technology transfer process resulting in many more IP transferred out. This is a required change that will broaden the funnel that moves the IP from a university to the market. In fact, it might be a good idea to reformat technology transfer offices to Innovation Promotion and Management Office (IPMO).

All the above three actions are supply side related discussions. Bringing about these changes will only address one half of the IP utilization equation. The other half of this equation is to address the demand side. Clearly the current demand side model is not working well enough in a number of universities. It is in the demand creation of the IP flow we see a significant new role in Science Parks Version 3.0. Science Parks should review their mission and tenant mix in order to be more valuable to the economy. They could learn a lesson or two from shopping malls. Shopping malls often identify one or two key anchor tenants. These anchor tenants are expected to be the magnets that will bring consumer traffic into the mall. Science Parks should consider setting up three types of anchor tenants for increasing the university traffic into the Science Parks. Science Parks should give these three anchor tenants very favourable terms just as shopping malls give their anchor tenants very favourable terms.

Initiative 4: Innovation development office

An innovation development office in a Science Park will be similar to the Karolinska Development. It will be staffed by experienced displaced or retired business leaders, to be called Executives in Residence, who are given the mandate to translate the proof of principle IP or inventions created by a university into commercial strength products. The innovation development office should be a university led local and federal government partnership. It could include moving the reengineered technology transfer offices into or next to the innovation development office. An innovation development office will try to use as much of the university resources in order to keep the innovation development costs low. They will also be able to recruit resources not available from the university. Their mission would be either to license a product to an enterprise or create a company around the innovation developed by them and spin them out.

Initiative 5: Company executives in residence

An innovation development office needs to be complemented by companies in residence. These will be hot-desked co-sharing space where senior executives from different companies can use the space for selected periods of times to "snoop around" for raw technology and / or talent from the university or the license / buy products from the innovation development office. It is imperative that the company executives in residence are senior executives with decision making powers. Such senior executives could engage the professors and students of interest by offering guest lectures in courses and / or supervising projects and thesis. The active presence of such executive positions Science Parks to be catalysts for moving university IP into companies.

Initiative 6: Investors in residence

Some innovations when developed are best taken to market by start-up companies. These are mostly paradigm shifting innovations that will not be of immediate interest to companies largely because companies may not have internal business divisions that can spin-in such innovations. Investors in residence should be Series A venture capitalists. They will entrepreneurs-in-residence for an innovation that they believe holds great promise as a startup company.

7. SUMMARY

Research has shown that there is a need to strengthen the role of Science Parks in moving the intellectual property created in the universities to the local, regional and global economies. Science Park 1.0 was largely a real estate play while Science Park 2.0 brought in startups and in some cases angel investors. This paper suggests additional tweaking of Science Parks to create Science Park 3.0 which will in essence accelerate the flow of IP into the economy through Science Parks.

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