The impact of higher education institutes incubator/accelerator centres to technological education advancement: a review of selected case studies

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ABSTRACT: The techno-economic support of young entrepreneurs for the creation of start-ups through incubation/acceleration centres has introduced a new economic trend in engineering education. More than 7,000 such centres exist all over the world. Numerous benefits are described for multiple case scenarios of co-operations between higher education institutions (HEIs), the private sector and government. The know-how transfer of incubator mentors provides sustainable development strategies for small business development, encouraging growth within local economies. Several university and technological education based initiatives have been made, in order to foster commercialisation of research in engineering to increase graduates' employability and to serve as an investment vehicle for involved stakeholders. An enhanced linkage between industry, capital firms and university start-ups can contribute to economic growth of converging economies. A review of selected study cases of university incubation programmes has been presented in this article in order to explore their economic lifecycle development and their benefits.

INTRODUCTION

The entrepreneurial concept of *incubator* stands for an ecosystem, where techno-economic support is offered to separate groups of people for the development of new firms. Incubators usually hold a capital share of the potential firm [1][2]. As an ecosystem, incubators involve and provide links between technological education and engineering leaders, other technology experts, legal and accountancy experts, with potential investors and venture capital firms, aiming all together to accelerate the development and the sustainable growth of new companies. The assistance provided includes the development of business and marketing plans, the building of management teams and more specialised professional services.

In addition to the intangible services provided, incubators offer space, shared equipment and administrative services [3]. Candidate teams enter incubation programmes with an initial idea or a mock-up that it has been examined from incubator candidate selection committee. After a pre-defined time period, candidate teams are expected to *graduate* with success either by convincing possible investors or with the growth of their initial sales or user-base of their product. According to the National Business Incubation Association (NBIA), 7,000 incubators exist all over the world. In 2006, in North America incubators generated more than 100,000 jobs and generated more than USD 17 billion of annual revenue. A public investment in an incubator centre provides a high return on investment (ROI) from tax revenues up to 30 times [4].

UNIVERSITY BUSINESS INCUBATORS

Technological education and engineering has played an important role in the existence of different types of incubators that have been driven by the evolution of companies' requirements, resulting in the diversity of the services that are offered. Thus, there are four main categories: business innovation centres (BICs), independent private incubators (IPIs), corporate private incubators (CPIs) and university business incubators (UBIs). The first incubation initiatives used public resources and were an effort by local authorities to boost employment, innovation and economic growth. Public incubators received fees for the services offered from local, national and international funding programmes [3][5]. Further analysis of the evolution of UBIs is provided in this section.

Universities can contribute substantially to local economies through the commercialisation of technological and engineering research, patentable inventions, faculty spin-off ventures and technology transfer [6]. UBIs emphasise the transfer of scientific innovation from universities to university spin-offs founded by students with the assistance of their professors [7]. UBIs offered services that can be divided into two categories: a) typical services, such as shared offices, business assistance, business networking and access to capital firms or funding programmes; and b) university services,

such as library services, faculty consultants, student employment through internships, academic equipment and laboratories, workshops and the university's R&D transfer [3].

CASE STUDIES OF UBIs

Georgia Tech

Georgia Tech University has focused on the production of patents in order to commercialise its engineering research. More particularly, it has been done through a faculty monitoring programme, checks on research programmes and encouragement to academic staff (faculty) to disclose inventions. Afterwards, the office of technology transfer evaluates the commercial possibilities of each proposal and if there are good perspectives, a patent is applied for. The patents are transferred to Georgia Tech's UBI, known as the Advanced Technology Development Center (ATDC), in order to provide resources for the success of the graduate companies.

It also provides an enhancement of synergies between professors, students and private venture capital firms. ATDC receives both legislative and financial support from Georgia's local authorities. ATDC was founded in 1980 and, since then, more than 150 companies have been created, raising more than USD 2 billion in external funding and creating thousands of permanent jobs. ATDC focuses in early stage companies varying from four months to three years [8].

Sid Martin Biotechnology Incubator

Sid Martin Biotechnology Incubator is a typical example of technological education synergy between the United States Department of Agriculture, the University of Florida and the State of Florida. It started in 1987 as a research park. Having one successful spin-out named RTI Biologics listed on NASDAQ was enough to accelerate the incubator itself. NBIA named Sid Martin Biotechnology Incubator as the top Incubator of the World for 2013, following another success of the *World's Best University Biotechnology Incubator* awarded from Sweden-based research group UBI. The graduated companies have attracted nearly USD 1 billion in funding and more than 1,000 people work in the incubator today [4].

Rice Alliance for Technology and Entrepreneurship

The Rice Alliance for Technology and Entrepreneurship founded in 2000 is an initiative of Rice University and it was formed as a strategic alliance between three schools: a) George R. Brown School of Engineering; b) Wiess School of Natural Sciences; and c) Jesse H. Jones Graduate School of Business.

Rice Alliance as an incubator assisted more than 250 start-ups, which raised more than USD 0.5 billion in capitalisation. More than 26,000 individuals have participated in Rice Alliance's workshops. A huge interest has risen all over the world for the *Rice University Business Plan Competition*, which offers more than USD 1.3 million in prises. Furthermore, a remarkable finding is provided by Rice University, that USD 394 million have been raised by the 133 past competitors that are in business today [9].

Stanford's StartX

StartX is a community based academic incubator established from its graduates and is considered to be non-profit as it takes no equity or fees. In just two years, the accelerator programme has received applications from over 2,400 Stanford founders, 210 of which passed to the next phase of entering the accelerator and 60 companies already graduated from the programme. 85% of the Stanford located companies fund-raised more than USD 100 million, averaging USD 1.51 million per graduated company [10].

Figure 1 below provides a graphical representation of the income generated by these incubator centres.

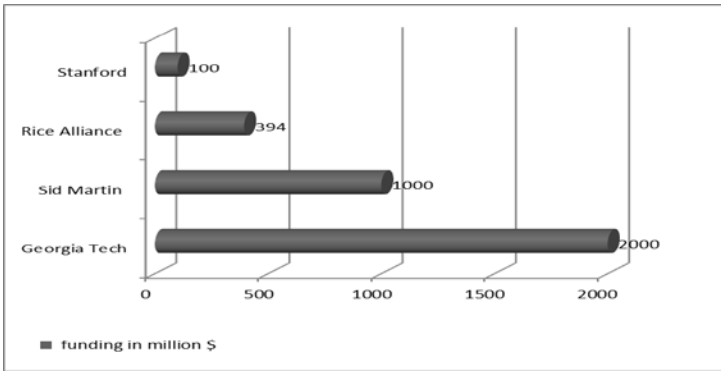

Figure1: A comparison of incubators total funding in million $.

ECONOMIC AND ACADEMIC ADVANTAGES OF UBIS

Start-up Companies

Start-ups that were founded in UBIs have the advantages of other technology business incubators, such as free office space, free cloud services, access to mentors and investors, along with the special offerings of HEIs, such as access to a library, access to expensive laboratory equipment and interns. Companies that graduated from UBIs tend to locate near university campuses in order to benefit from the best available talent without a high-priced payroll budget [11].

Universities

Universities that establish a successful incubation/acceleration programme gain numerous benefits including reputation produced through technological engineering research, profits and excellent employment rates for their students. Indicators that measure the success of the above are the following:

- Citations to university research. Start-ups that created unique products cite previous university based work to their patent applications.
- Citations to academic journals. University research is mainly measured by citations of the publishing research results in international academic journals. University professors can produce an adequate number of journal article citations that relate to the university's previous academic work by mentoring the start-up companies and their R&D departments.
- Total worth of equity percentages from the graduated companies.
- Firm size. It is used to refer to the total number of employees.
- Revenues. UBIs are measured for the total revenues produced that may be result of multiple factors including paid workshops, internal restaurant revenues, etc.
- Total funds raised. Graduated companies that raise huge funds improve the stakeholder equity position of the university, advertise indirectly the innovation of products and the successive selection of ideas from the side of the UBIs.
- Companies failed. The lower number of the indicators is a meter of successful incubation programme [9][12][13].

Local and National Authorities

Governments that try to set up incubators, which might be envisioned as an applied product of technological and engineering education encourage the development in the latest state-of-art technologies and engineering. Israel has the highest number of engineers, scientists and PhDs per capita, the largest number of start-up companies in proportion to its population and holds the highest rate of patents per capita in the world. These numbers are a large proportion of the technological business incubator programme that were launched in the early 1990s by the Israeli government. The initiative was an effort to exploit the talents of more than 750,000 scientists, engineers and physicians that arrived from the former USSR and started with six incubators.

Today, there are 24 such incubators all over the country. Local and national authorities benefit from reduced unemployment and expansion of the tax base. Firms that create economic activity also stimulate economic growth in the local area and throughout the state. Local tax fees in utility bills enhance local authorities' capitalisation [14]. Exports and internationalisation are two other key characteristics from which governments benefit indirectly. Through the improvement of the current account per GDP, they create an environment for attracting international investment, scientific personnel and the relocation of other companies to other nations [13][15].

CONCLUSIONS

Evidence of the success of incubators can be drawn from the selected study cases of UBIs. The statistical evidence from other studies and international organisations, such as the NBIA support the numerous advantages for the involved stakeholders' start-ups, universities, and local and national authorities. Local and national authorities should further focus on creating strategies and synergies following other successful international examples for the reinforcement of the creation of new companies. Universities should create clusters for the development of UBI, either alone or with other universities. The benefits referred to can provide advancement in technological and engineering education, economic sustainability to universities and improve significant economic indicators for governments.

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