Corporate Incubators: Industrial R&D and What Universities Can Learn from Them

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ABSTRACT. The explosive growth of incubation has seen a concurrent and significant increase in research on and knowledge of the incubation phenomenon. However, instead of comprehensively differentiating between non-profit and for-profit incubators, research has described a whole array of partly overlapping archetypes, thus missing out on important aspects. This article first offers two arguments validating a framework of what non-profit university incubators can learn from for-profit corporate incubators before presenting the framework itself. While corporate incubators are for-profit organizations with which to enhance a corporation's technology development, university incubators try to leverage technological insights from the university in a similar manner. In accordance with their respective missions, organizational structures, incubator processes and resource flows, it is possible to transfer lessons learned from two corporate incubator archetypes—the fast-profit incubator and leveraging incubator—to the world of university incubator. Our empirical findings are based on in-depth case studies of 25 companies through 52 semi-structured interviews with managers of corporate incubators of large technology-intensive corporations in Europe and the U.S., two EU incubator benchmarking surveys and five interviews with the heads of technology transfer offices of two top technology universities.

Keywords: American and European Incubators, industrial R & D, industry spin-offs, venturing, innovation

JEL Classification: O31, O32

1. Introduction

Utilization of university research technology

In the face of budget constraints and the growing competition from private universities, the utilization of technology developed at universities is of

increasing importance. Universities are large-scale Research & Development (R&D) departments and institutes driving technology push by conducting cutting-edge research and producing numerous patents. Through joint projects they have profound relationships with a broad range of research partners such as other universities, public or private institutes and major corporations' R&D departments. However, their technological insights are often not linked to a strategic long-term agenda nor a structured process of fast market customization of research. In recent years different paths, such as research scholarships and business plan competitions, were therefore established with which escape from the ivory tower were aimed to become possible. Subsequently the questions arise of how to identify and leverage untapped commercial opportunities produced by university research and how to improve the time-to-market of the technology developed.

Traditionally research has shown that the commercialization of technology developed in the academic world measured as return on investment (ROI) of academic research have occurred through two major vehicles: (a) technology transfer (by means of spin-off companies that leverage university research) (Niosi, 2004) and the (b) management of intellectual property (by means of royalty payments through licensing agreements).

On the whole, the commercialization rate of patents developed by academics alone is low, with the exception being the commercialization of break-through technology based on a technology push paradigm. In this regard leading American research universities' different patent and licensing approaches have been specifically studied. Some universities, such as MIT, first patent their research and then look for parties interested in

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licensing agreements. Other universities only patent selectively interesting research if an interested party has already been identified and if the future licensee undertakes the reimbursement of the patenting costs. This method is followed by the University of California. Biotechnology (such as Genentech) and information technology software (e.g., Inktomi from the University of California, Lycos from Carnegie Mellon University, Akamai Technologies, Google) are two specific academic fields that have led to successful licensing.

Altered economic and social structures go hand in hand with recent trends and benefits for universities:

(1) Public budget constraints and the quest for change at universities call for a closer link between universities and industry. Louis *et al.* (1989) have identified five ways in which academics and scientists can transfer proprietary advanced technology with marketable products or services to the commercial sector: consultancy, funded research, development companies, patenting as well as licensing and venture spin-offs.

The university incubator can support the latter by providing a mentor, seed financing, networks and business training. This can strengthen the tie between basic research and science and development. Universities can provide access to laboratories, high tech equipment and highly educated specialists in order to commercialize academic research by developing products or licensing the technology (Roberts, 1991; Scott, 2000). Other researchers found a lower level of technology transfer and commercialization of research than expected through university incubators, which they attributed to conflicts of interest policies and various legal structures (Philipps, 2002).

(2) Traditionally, universities are involved in education and public service, but have recently become engaged in supporting business development activities. To increase entrepreneurial talent and support outstanding ideas, they have undertaken curriculum development for courses on entrepreneurship, coordinated business plan competitions as well as provided entrepreneurial scholarships. University incubators can support entrepreneurs through library access, state-of-the-art technology, use of laboratories and access to faculty, staff and student labor as well as access to a creative environment (Smilor and Gill, 1986).

(3) With public universities being incorporated, there is an increasing demand for the evaluation of university systems. Limited public funding raises the question of resource allocation across time and educational institutions. The output measures of universities include instruction, reflected in the quality of the teaching, as well as research in the form of the number of publications cited in academic journals (James, 1978).

University incubators' potential

University incubators are another potential vehicle with which the commercialization of research can be supported. The term 'incubator' was derived from the fundamental meaning of the term: the artificial nurturing of a chicken egg in order to hatch them faster in a sheltered environment. The same hatching concept is applied to the incubating of companies; it speeds up new ventures' establishment and increases their chances of success (Hansen *et al.*, 2000). An incubator thus hatches new ideas by providing new ventures with physical and intangible resources (Allen and Bazan, 1990).

The origin of incubators can be found in the non-profit world as community and university incubators. Incubators have been operated by community development efforts or municipal organizations to fuel economic growth and job creation through government funding since the 1960s. During the 'rust belt' recession in the 1960s and mid-1970s, several states in the United States, including Pennsylvania and North Carolina, sponsored community incubators to foster economic development. In the 1980s university incubators were developed to commercialize technology developed at U.S. universities in government-sponsored university laboratories. This raise was supported by the Bayh-Dole Act of 1980 which granted U.S. universities the right to patent federally financed inventions (Van der Werf and Blumenstyk, 2001).

Examples of the commercialization of such university research are the founding of the Advanced Technology Development Center located at the Georgia Institute of Technology in Atlanta, GA, the Rensselaer Polytech Institute Incubator Center in Troy, New York State in 1980, and in 1983 of the Science Park near Yale

University in New Haven, CT (for a detailed overview of U.S. incubators see Mian, 1994, p. 528). University incubators were, in fact, established at most major universities in the United States, for example, Berkeley Business Incubator, Austin Technology Incubator, USC Columbia Technology Incubator, Maryland College Park's Technology Advanced Program and Boston University Photonics Center, to name only a few. In Europe, early incubator programs were also established at the University of Cambridge in the UK in 1978. In Nordic countries the Temporary Entrepreneurial Placement Program at the University of Twente in Holland, and the Entrepreneurship and New Business Development Program at the University of Linköping in Sweden were set up. The ETH Technology Transfer Center and EPFL Parc Scientific Incubation Team were founded in Switzerland. Successful examples were also established in Eastern European countries, for example, at Innotech, an innovation park in Hungary that was founded right next to the Budapest University of Technology and Economics in mid 1980s. Besides United States and Europe University incubators were also founded by Chinese Universities recently, such as the Tsinghua Science Park Incubator.

Despite an initial decline in the total number of incubators due to U.S. state and federal government cutbacks, the recession of the late 1980s and early 1990s spurred an exponential growth. In the 1990s a new phenomenon arose with the development of for-profit business incubators that were usually set up without government funding as independent or corporate incubators inside a corporation. Fueled by new opportunities during the Internet boom from 1998 to 2000, independent for-profit incubators, also called accelerators, hatcheries or greenhouses, were quite successful with their potential for fast profits through Initial Public Offerings in a bullish financial market. Privately run and funded business incubators were founded parallel with the Internet and venture capital boom, but often shrank, or even disappeared after 2000.

However, corporate for-profit incubators are still a prominent organizational form of R&D management for technology-intensive corporations. Corporate incubators are specialized corporate units that hatch new businesses and

enhance a corporation's technology base. The object of their support can be either external start-ups or internal entrepreneurs with a promising business idea or technology, henceforth referred to as technology ventures. As part of a larger corporation, corporate incubators have to consider long-term strategic goals and their fit with the parent corporation, but are also able to leverage the parent's resources for overall development and growth. They have learned from the rise and fall of independent incubators and have taken over some of their processes, structures and instruments as well as incorporated insights obtained from long-term corporate venturing programs.

Since corporate incubators have to survive harsher market conditions and have shorter time frames for success, the question arises: Which of the lessons learned from the for-profit corporate incubator world are transferable to universities?

2. A brief literature review

Literature on incubation has concentrated on different types of incubation and their possible effects on the environment. Previous research provided differing classifications of incubators, depending on the author and his perspective. Publications mention business and technology incubators, university technology business incubators, high technology incubators, networked and virtual incubators, to name only a few of the different expressions used. For example, max von Zedtwitz (2002) distinguishes between regional business incubators, university incubators, independent commercial incubators, company-internal incubators and virtual incubators.

Even studies of incubators in the same country reflect differing connotations and perspectives. For example, Colombo and Delmastro (2002) focuses on new-technology-based firms receiving incubation services in Italian science parks and business incubators.

Despite the number of incubator typologies, there is still no real description of non-profit and for-profit incubators—the two fundamental business models. Non-profit and for-profit incubators' development, the change they underwent regarding their actual organizational configurations as well as the different strategic focus of each, all

deserve more attention (see Figure 1). While *for-profit incubators* focus on financial returns for their owners, non-profit incubators nurture a social purpose, such as supporting community development as part of an overall economic policy, often supported by government subsidies (Nielsen *et al.*, 1985). Most *non-profit incubators*, such as technology and science parks and university incubators, are funded by the government. Private or business initiatives fund non-profit development incubators.

Institutional incubator sponsors are consequently non-profit or for-profit organizations, thus determining the incubator's tone. Non-profit incubators can be either community or university incubators focusing on social returns. There is a fine line between community incubators, technology and science parks and university incubators, since science parks can belong to a university with close cooperation occurring between the two. Usually university incubators are public institutions, although at private U.S. universities they can be funded privately too. Mian (1994) found no difference between the two types of university incubators as far as structure and performance are concerned, thus university incubators are henceforth presumed to be publicly funded.

For-profit incubators achieve positive gains through service fees and equity stakes in new ventures in the medium to long-term (Hansen *et al.*, 2000; Achtleitner and Engel, 2001). For-profit incubators include independent incubators that aim to gain fast profits from successful start-ups, or corporate incubators that look to extract value from their portfolio of technologies, or explore new technology for their core businesses. Independent for-profit incubators are often part of a holding, or are sponsored by venture capitalists.

Another major research stream focuses on whether or to what degree the incubator can have a positive impact on its environment. This research therefore focuses on the entrepreneur and incubated start-up firms as well as on economic spill-over effects.

Some researchers could not find any evidence of incubation having a positive impact. When compared with firms outside the incubator, the direct impact measured through the R&D intensity of start-ups located in an incubator is the same, with negligible higher innovative output as measured by the number of patents (Colombo and Delmastro, 2002). Westhead (1997) could not support his hypothesis regarding the higher innovative activity (as measured by the number of patents and new products) in start-ups located in a technology park

Figure 1. Typology of incubators.

when compared to the ones outside. Other researchers too have called the positive effects of incubators on economic development into question (Autio and Klofsten, 1998; Sherman, 1999).

However, the number of researchers finding positive impacts for incubators far outweighs those that find negative impacts, since positive impacts include also secondary positive spill-over effects. Public university incubators can have a positive effect on incubated firms (Stenberg, 1990; Felsenstein, 1994; Mian, 1996; Scott, 2000). They increase the survival rate of new ventures by reducing the entrepreneurs' resource constraints in their pursuit of opportunities (Mian, 1997; Stevenson and Jarillo, 1990; Timmons, 1999). Incubators can also accelerate the time-to-market and likelihood of success (Allen and McCluskey, 1990). Indirect, positive impacts on the new venture in an incubator include a higher likelihood of it adopting technology innovations, participation in international R&D collaborations and increased access to the research center's R&D output (Colombo and Delmastro, 2002). Analyzing the positive effects of publicly-traded biotech firms' linkages to universities, George *et al.* (2002) support their hypothesis of lower R&D costs and a higher innovation output. This does not, however, necessarily result in increased financial performance (as measured by the net sales to assets ratio).

Studies on non-profit community- and university-sponsored incubators have examined the positive microeconomic impact of incubators on a region as measured by factors such as direct job creation, cost per job, the survival rate of incubated firms and taxes raised (Cooper 1985; McMullan *et al.*, 1986; Allen and McCluskey, 1990). Secondary benefits can also be derived from the multiplier effect of jobs created and income available as well as from an increasing demand for products and services by the new ventures themselves (Markley and McNamara, 1995; Nijkamp and van der Alsters, 1988; Rice and Matthews, 1995).

Non-profit incubators can also serve as "change agents" in economic development (Campbell *et al.*, 1985), reducing information costs, overcoming difficulties in obtaining business services and increasing access to resources such as capital and know-how. University incubators are an

important source of entrepreneurship as they support the development of business plans and spot entrepreneurial talents (Roberts, 1991). University incubators can revitalize an economy and support regional economic development and job creation, they are often part of economic policy alternatives for regional development (Crampton and Evans, 1993; Davelaar and Nijkamp, 1988; Plosila and Allen, 1988; Birch, 1987).

The above economic analysis explains why university incubators are established in some regions, but offers little insight into how the university incubator can be managed. Since universities are increasingly forced to incorporate financial considerations as well as adopt corporate methods of efficiency and output orientation in pursuit of their educational purpose, the lessons learned from corporate incubators that survived the recent economic downturn can be valuable for the development of their incubators. A practical, guiding incubation framework needs to include the dialog between the provider of incubation services and the receiver of these services as well as the kind of services that will be exchanged between the two.

3. Research methodology

Given our research focus on the insights into corporate incubators' structure and operations that can be transferred to university incubators, we chose the incubator organization as our unit of analysis. Since the phenomenon of university and corporate incubators is relatively young, we used a combination of quantitative and qualitative research methods in three phases of research (Flick, 1999; Keller and Erzberger, 1999). While some researchers questioned this methodological mix due to the different aims and purposes of each method (Dey, 1993; Leininger, 1994), a combination of qualitative and quantitative research methods is deemed feasible and can offer valuable insights.

(1) To enhance the basic understanding of how *corporate incubators* function, explorative interviews were carried out between 2001 and 2002 in a *first phase* that enhanced the basic understanding of how corporate incubators function. This qualitative approach included the identification and selection of corporate incubators, data gathering

and an analysis of the relationship between and the interaction of corporate incubator and the parent corporation (Yin, 1994). We thus followed Eisenhardt's process of inducing theory and developing strategic implications by means of case studies (Eisenhardt, 1989).

The criteria for selecting specific corporate incubators, included their

- high degree of R&D intensity and of sales generated from products no older than three years;
- business-to-business focus with headquarter in Europe or United States;
- focus on high tech industries such as computers, electronics, and communications equipment manufacturing; and
- importance in supporting young enterprises or start-up ideas through special programs, including the provision of physical resource.

In 52 semi-structured interviews with corporate incubator managers of 25 large European and American technology-intensive corporations we focused specifically on the management and organization of corporate incubators and their impact on the corporation over time. Incubator managers in particular were key informants and interviews with them lasted between one and two hours on average, while phone interviews averaged half an hour. To increase the validity of the case studies, data were collected and analyzed through multiple sources of evidence, such as archival records, company profiles, company records, company presentations, annual reports, press releases and articles, as well as our own observations and explorative interviews (Dyer *et al.*, 1991; Miles and Huberman, 1994; Tsoukas, 1994). Case study protocol and company profiles increase the reliability of the data (Eisenhardt, 1989). 72% of the case studies are on U.S.-based, technology-intensive companies such as Reuters Incubator, Xerox Technology Ventures or Sun Microsystems Incubator, with 28% from European-based companies such as Siemens Technology Accelerator, BT Brightstar or Sulzer Innotec.

(2) In a *second phase* we analyzed the quantitative database of 950 *European incubators*, developed by the European Commission in 2001 and synthesized findings from two benchmarking

surveys conducted by the European Commission in 2001 for both sides of the dyadic relationship, the European incubator managers ($n = 77$) as well as start-up companies in the incubator ($n = 71$) (European Commission 2002).

(3) We furthermore conducted five interviews with researchers and heads of technology transfer offices of two top 10 universities in engineering to deepen our understanding of *university incubators* and the lessons learned from corporate incubators that could be transferred.

The order of the paper is the following: After an analysis of the differences of university and corporate incubators, four types of corporate incubators found in our research are described and lessons learned for university incubators are developed.

4. Mapping the difference between university and corporate incubators

Common traits and differences between non-profit university incubators and for-profit corporate incubators need to be examined. While the goal of corporate and university incubators in utilizing their technology base is similar, they achieve it through different means, as our research shows.

The analysis of the common and differing traits between the two types of incubators follows a comprehensive framework with three levels of analysis: (See Figure 2)

- (a) The provider of the incubation services i.e. its mission, structure, process and resources;
- (b) The types of incubation services provided, e.g., infrastructure, financing, consulting, networking and branding;
- (c) The receiver of incubation experiencing the impact of the services—this can be the entrepreneur himself, the region or the company.

Mission

The strategic intentions and goals of the incubator are defined in the mission, which needs to be linked to the overall strategy of the institution. In a corporate incubator the intentions and goals are aligned to the corporation's technology

Figure 2. Framework for incubator analysis.

focus and time frame, meanwhile in university incubators these should be linked to how the university positions itself and what role the incubator plays within the university. Similar to corporate incubators, university incubators support the organization's mission by offering a successful vehicle for the commercialization of research as reflected by the number of spin-offs, for example, and the creation of a funding source. The educational opportunity and incentive system offered to would-be-entrepreneurs, whether faculty or students, provides training in entrepreneurial skills that have become increasingly important in recent years: in-house entrepreneurs can serve as additional faculty members or researchers and incubators may even employ a number of university entrepreneurs as well as students or graduates. Overall, there has been a positive 'contribution to the sponsoring university's mission' (Mian, 1997), but university incubators still have a long way to go towards clearly defined technology strategies that are similar to the ones in the corporate world.

Structure

Structure describes the institutional and organizational premises according to which the incubator operates, such as the sources initially provided by the institutional sponsor, the incubator's degree of

autonomy respect of the sponsor, and the location. Structure concerns the incubator's set-up, such as its size, the number and background of employees, the source and scope of funding, and the industry focus. The incubator's governance raises issues as to whom the incubator manager reports, the composition and meeting schedule of the incubator's advisory board as well as the advisor's professional and experiential background. Corporate incubators' board is often made up by senior executives from other departments or internal technology experts. A board dominated by the private sector and regional policymakers should oversee university incubators. The structure sets the stage and creates a framework of interests and incentives within which the different actors drive the incubation process.

University and corporate incubators are usually set up outside the organization. In the case of corporate incubators, a complete new venture unit is started besides existing functions and business groups. The separate environment supports an entrepreneurial culture, while maintaining a close link with enabling capabilities (e.g., independence and coordination) is crucial.

As part of their organizational design incubators can be organized as independent units as cost center or profit center with secured own funding. The first decision that has to be made regarding the organizational design is whether to keep the incubators within the existing organizational or

business units, or whether to keep them separate and thus outside the core of the university. For example the Technology Advancement Program of the University of Maryland belongs to the university's Engineering Research Center, the Advanced Technology Development Center at Georgia Tech is not part of the university.

Process

The process of incubation is about the engagement of the incubator with the new venture and the possibility to change over time due to the new venture's current life cycle's needs. Corporate incubators usually follow a formal process of value-adding activities similar to that of the venture capital model (MacMillan *et al.*, 1989; Gompers and Lerner, 1999): after a due diligence the new venture is selected and a term agreement is signed which structures the financial terms. The involvement phase is crucial for the incubator manager's interaction with his portfolio companies by means of coaching, feedback and management assistance. While the exit of the new venture ends the direct engagement, long-term links with previously incubated companies will be nurtured. University incubators usually have a less structured incubation process, focusing mainly on the incubator manager's direct involvement. Increased participation incentives tap faculty members' commitment and therefore enhances involvement (Mian, 1994).

Resources

Tangible and intangible resources flow from the incubator to the new venture. Resources include tangibles, such as financing, physical space and infrastructure. For university incubators these resources include the initial university funding, and in-kind support such as providing staff salaries, room maintenance and utilities. Harder to measure intangible resources such as the management of know-how, branding and the enhancement of networks with potential customers. One of the major differences between university and corporate incubators is the availability of a "know-how network" in corporate incubators (Smilor and Gill, 1986), which includes technical and market-

ing experts, intellectual property lawyers, accountants, potential debt or equity investors and other service specialists. For university incubators, Mian (1996) stresses specific value-added university-related services such as the university's image, and the use of the laboratories and students.

Another important difference identified is the role of the entrepreneur; in university incubators the researchers and academic entrepreneurs usually have a less proactive role. This was determined in a study evaluating the effect of scholarships at a Norwegian university incubator found positive effects through providing would-be entrepreneurs with scholarships for the acquisition of skills (Reitan, 1997). Government support led to a quantitative success regarding the survival and 'commercial utilization' rate, but in qualitative terms the impact was rather limited as far as the entrepreneurs' contribution to employment, turnover and net income before tax was concerned. Besides direct financial support, indirect incentives can include a supportive infrastructure, distribution, and value-added services.

5. Four types of corporate incubators

Based on our exploratory research on 25 corporate incubators, we identified four different types of corporate incubators in large technology-driven corporations: (1) fast-profit incubators, (2) leveraging incubators, (3) insourcing incubators, and (4) market incubators, all of which have mutual, but differing, features (see Table I) (Becker, 2003).

Our research revealed differences in the *mission* of the various corporate incubators, distinctions that are reflected in structural and operational differences as well as in the way in which resources are utilized. Fast-profit incubators gain financial returns by spinning out internal non-core technology units or, to a lesser extent, through growing external start-ups. Leveraging incubators create breakthrough technology by acting as match-makers between central R&D and marketing units. Insourcing incubators, on the other hand, scan the environment for windows on emerging technologies and invest in start-ups' disruptive technologies for potential later spin-in, while market incubators support the development of complementary technology to increase the demand for the parent company's product.

Table I
Classification of corporate incubators

Four types of corporate incubators (n = 25)	
1. Fast-profit incubator	Mission: incubation for profit, Matchmaking with external market, Exit: fast spin-off for making profit
2. Leveraging incubator	Mission: incubation for growth, Matchmaking internal with business units, Exit: integration into core business
3. Market incubator	Mission: incubation for market development, Matchmaking with new market, Exit: spin-off
4. Insourcing incubator	Mission: incubation for evaluation, Matchmaking with acquisition potential, Exit: integration into corporation

These various types of corporate incubators can also be distinguished according to whether their *technology source* is from within or outside the company. Technology sourcing can occur through either internal development of mainly internal ideas, or through external acquisition. Leveraging and fast-profit-incubator both focus on leveraging internal technology of different types. On the other hand, market and insourcing incubators concentrate on external sources of technology.

The corporate incubator can source external technology from start-ups or university labs, reducing the scope of corporate R&D and thus time as well as investment risk. Rather than developing technology themselves, corporations focus on business building and commercialization of external technology in the form of outside-in innovation.

The *type of technology* is connected to the overall strategy of the parent corporation. Core technologies are technologies that are strategically important for the corporation from the perspective of substitution technologies, customers, or competitors. Since core technology is closely linked to corporate strategy, it can change over time due to a new strategic focus, restructuring or consolidation. An example of core technology would be a car manufacturer's design and production of a vehicle's steel frame, or new genomics technology for a biotechnology company.

All corporate incubator types manage corporate technology assets in order to enhance company growth by leveraging or acquiring new technologies. Leveraging incubators and insourcing incubators both focus on core technologies with the leveraging incubator pushing internally developed technology to the market. The insourcing incubator sources external technology from the market. Although fast-profit incubators and market incubators concentrate on non-core technology, they can

be equally important to a corporation. The fast-profit incubator introduces non-core technology to the market for later corporate spin-off. Market incubators indirectly support the demand for their corporation's product by increasing the demand for complementary products.

In grouping the 25 corporate incubators into the described classification scheme according to source and type of technology, a general distribution pattern emerges. One of the most common incubators is the insourcing incubator that scans technologies from innovative start-ups, thus sourcing future technology externally. The work of the insourcing incubator is used as an intermediate phase before a potential spin-in. The market incubator reveals the second highest distribution in the research sample, but seems most likely to go out of business due to changing market demands. Leveraging and fast-profit-incubators occur with approximately the same frequency, with fast-profit-incubators being on the decline due to fewer opportunities in a bearish financial market. However, corporate incubators have only recently emerged, and continue to evolve by changing their names, mission or even their long-term commitment.

The corporate incubator's classification of source and type of technology is helpful in setting up or reposition existing university incubators. The classification of the four types can be transferred to some degree, particularly that of fast-profit and leveraging incubators. University incubators will mostly leverage internal technology derived from their research labs by using the leveraging incubator. The fast-profit incubator might be used for fast exits through spin-offs, if the technology developed is not part of the university's future research program, but is a mere by-product of the research process.

At first the concept of external sources of technology for universities is rather strange. Under external technology we understand technological innovation not derived from university laboratories, but developed by outside entrepreneurs. This scenario is rather odd for universities and might have been applicable in the case of some Internet technology in the beginning of the 1990s. While insourcing incubators play a minor role in universities, they are crucial for corporations searching the market for outside-in innovation. Similarly, market incubator to support complementary technology might only be very rarely applicable to universities. Thus, in the following, we describe the fast profit and leveraging incubator archetypes in detail.

Fast-profit incubator

The fast-profit incubator supports financially internal business opportunities to leverage intellectual property. Businesses that do not fit with the company's strategic direction are spun out. Fast-profit incubators gain financial returns by separating internal non-core technology units (See Figure 3). This incubator type operates under the assumption that parts of the corporation's developed technologies are underutilized and do not get to the marketplace, and can thus be better exploited in an external spin-off. The fast-profit incubator is often organized as part of a corporate R&D unit because it needs to access the central R&D department for its technological opportunities and has to transfer patents from the parent company to the spin-off start-up.

The German electronics company Siemens has an example of the fast-profit incubator type. With about 28 patent application filed every day and more than 120,000 patent rights around the world, Siemens has a large intellectual property pool to tap. Founded in February 2001, Siemens Technology Accelerator utilizes Siemens' large intellectual property pool. It is closely linked to the Siemens Corporate Technology department—the Siemens central research unit—from which it receives the majority of its screened ideas in such industries as information and communications, microsystems, sensors, medical and health care. Because the inventor will further improve the idea

at his laboratory in the central R&D unit, a new venture is not co-located in the incubator, while the corporate legal unit transfers relevant corporate patents to the new venture. A contractual agreement defines the scope of the support that the new venture will receive from the incubator, such as advice given by the Siemens personnel coach and access to Siemens' comprehensive network of internal and external partners.

Involvement in the spin-off of non-core technology could be a low-risk venture for the parent company since it could track the development of technology closely. This requires only a low investment in terms of personnel (by having employees on the board of the start-up) and money (by holding minority equity stakes). In a continuing relationship, the corporation supports the start-up by providing advice, network and marketing support and also R&D laboratory facilities and pilot production facilities are shared. Patents are transferred non-exclusively from the parent to the start-up, providing the parent with the option to re-enter the field.

Leveraging incubator

The leveraging incubator creates breakthrough technology by acting as a matchmaker between central R&D and marketing units, while simultaneously managing the interface between R&D and marketing (Gupta *et al.*, 1985; Souder, 1988; Brockhoff, 1989; Koehler and Goergen, 1991). The leveraging-incubator assumes there is an underutilization of core technology since newly developed technology needs support to be introduced to a new market or to new customers. Large, diversified companies with complex structures and interdisciplinary technology projects typically use leveraging incubators to commercialize core technology by bridging business units that understand customer needs and marketing.

The incubator's staff members, such as personnel coaches, act as process promoters. They identify the potential, develop a business plan, support access to inside and venture capital funding and manage the transfer of relevant corporate patents to the new venture. The incubator's staff also needs to understand and evaluate the technological potential of research carried out by the corporate R&D unit (see Figure 4).

Figure 3. Summary of fast-profit incubator.

Simultaneously they have to be very communicative within the corporation as a whole and act as knowledge brokers to improve the information flow, since they possess organizational knowledge of who might know what a gatekeeper function (Allen and Cooney, 1971; Tushman and Scanlan, 1981; Hauschildt and Chakrabarti, 1988). Thus the leveraging incubator's competencies are mainly organizational rather than technological. For instance, knowing what part of the organization might be interested in the technology and how to use internal networks to gain political support (see the promoter role by Witte (1973)).

The world-leading Finnish telecommunications company Nokia has such a leveraging incubator. Nokia Ventures Organization has a structured approach to the development of new technology for new markets (its mission statement is "the

renewal of Nokia") by building future core businesses and reporting directly to the president. Technology screening to identify disruptive technologies and new business models is done mainly inside Nokia. The technology venture can be part of a business unit, or totally separate, with a higher risk but also higher potential reward for the members of the new ventures in the latter case. Nokia focuses on cultivating a close link between the new venture and its business lines as reflected in preferred exits, such as spin-ins to existing business units, the formation of new Nokia business units, or sale to external buyers.

Survival potential

To ensure innovation in the long-term, large corporations need to act and perform entrepreneur-

Figure 4. Summary of leveraging incubator.

ially. Corporate incubators can support the realization of entrepreneurial ideas in line with the corporation's technology focus. The empirical results of the case studies could be summarized in a typology of the four corporate incubators, namely the fast-profit, leveraging, insourcing, and market incubators. These archetypes can be distinguished according to whether the corporate incubator adopts core- or non-core technology and whether the source of technology is to be found internally or from outside the company. Each type has certain strengths and weaknesses, depending on the incubator's mission.

Since they can enhance business results, budgets are available to support innovation and growth during a strong economy rather than during restructuring in a recession. In a weak economy, money-losing activities such as corporate incubators are often the first to be shut down.

About one third of the corporate incubators analyzed have closed down or have been changed to a pure corporate Venture Capital model. However, the chance of survival differs substantially by types of incubators. One of the most recession-proof incubators seems to be the insourcing incubator since reduced R&D budgets call for more outside-in innovation. Market incubators are most cyclical, depending on the major technology leaps that cause old technology to become outdated. For example, if WAP technology does not materialize as a new communication standard, then incubators in the mobile telecommunication industry supporting its software will also become obsolete.

6. Lessons learned for university incubators

First, a clear *differentiation* is needed between *non-profit* and *for-profit* incubators according to their goal and institutional sponsor. University incubators are usually non-profit incubators that nurture a social purpose with public funded money. For-profit incubators, such as corporate incubators, stress financial returns. However, with the rise of established private and corporate universities this equation might change in the future. The increased private funding of university research may furthermore allow even public universities to establish private incubators.

Second, four elements, similar to those developed in this article's comparison of corporate and university incubators, should be defined to increase the efficiency and effectiveness of university incubators: A clear *mission* classifies the source and type of technology. A *structure* defines the outside advisory board that consists of different industry and public representatives, who can provide valuable strategic advice as well as leverage their network. Defining a *process* of entrepreneurial activities to support the new venture helps to structure the different value-adding activities. And, finally, thinking about *resources* and how to make the best use of them is of major importance. This includes defining the physical resources as well as developing a know-how network (Becker and Gassmann 2006).

Third, non-profit organizations, such as university incubators, can learn from those sophisticated incubation systems in the private industry which survived the harsh conditions of a declining economy. Of the four identified types of corporate incubators (see Gassmann and Becker, 2006, 2004), two can be transferred to university incubators. The *fast-profit incubator* focuses on short-term support and high financial returns through the fast exits of spin-offs after transferring patents to the start-up or the signing of licensing agreements. The technology supported in the incubator is not core to the university but is a by-product of research or newly developed in students' projects or business plan competitions (such as software or new Internet business models). There is no long-term connection through equity stakes in the new venture. On the other hand, the *leveraging incubator* drives core technology developed in university labs (e.g., biotechnology) to the market for long-term support and connection with the industry. Return on investment is in the form of licensing, but more importantly through equity stakes, with university researchers on the management board of the start-up.

Evaluation of university incubators

Our research on lessons for university incubators from corporate incubators established the following advantages:

- University incubators can enhance the scope of university research's *technology utilization*.

This applies particularly to breakthrough technology that the university created and initiated by enriching technology insights with the evaluation of market opportunities leading to a reduced time-to-market and risk of technology adoption. Conversely, there is a high barrier to industry-university cooperation in incremental technology, since industry itself can leverage their market insights through customer contacts.

- Accordingly, the higher commercialization rate of technology leads to *increased economic returns* through licensing agreements and sale. This is of allowing importance in times of public budget constraints and the quest for benefits from research.
- University incubators can increase the *quantity as well as quality of entrepreneurial activities* at universities. University research is often not taken to market because scientists may not know how to start a company, cannot excite or recruit others to implement an idea or do not obtain funding. A university incubator can serve as a focal point of entrepreneurial activities to encourage both, faculty and students to tackle venturing activities in brown-bag lunches and in a series of formal discussions.
- Incubation can increase the *success rate of start-ups* for business implementation. A structured incubation process supports new venture creation by reducing market insecurities through insights from experts (e.g., the incubator's board) and learning from peers in other start-ups. University incubators also substantially enhance the resources available to the entrepreneur.
- University incubators can overcome 'failures' in the technology market and *reduce transaction problems*, such as adverse selection, moral hazard and holds up. Sophisticated selection criteria, such as pitches to a funding plenary, or business plan competitions as well as an improved interaction through a structured incubation process, increases the quality of supported ventures.

On the other hand, the disadvantages of university incubators also need to be considered:

- Good entrepreneurs might not need incubators to support their start-up due to their own business skills and resources such as their individual network and access to funds. *Adverse selection* might not support the best entrepreneur but the needy one.
- The university incubators' protected environment may even set the wrong focus and incentive structure for entrepreneurial researchers and thereby increases an "*ivory tower*" mentality.
- The university incubator's staff might come from the university with knowledge of technology but to a lesser degree of business management. Having less experience than, for example, a venture capitalists with twenty-years' experience of venturing, building and testing business models, raising funds and obtaining initial customers, *their ability to add high value* to the new enterprise might be limited.

Further research needed

This paper has only provided a first look at the complexity of what the university incubators can learn from corporate research. Longitudinal research needs to analyze the changes within incubators and undertake a comparison of public versus privately funded university incubators. This research should be grouped around the development of three types: incubated start-ups, non-incubated start-ups and established firms. These incubators should be examined (a) regarding economic returns through licensing fees and royalties, (b) success rate measured as commercialized university inventions (e.g., first sale of product, although some start-ups are acquired by established firms before first sale) and (c) time to termination as the end of the licensing contract. The incubators should furthermore be studied in respect of required capabilities and how they differ in various industries, with Information Technology and electronics being particularly important.

The link between the recent increase in entrepreneurial curricula (such as courses on entrepreneurship and business plan contests) and the number of implemented ideas in start-ups should be analyzed comparing stand-alone

start-ups with start-ups in the university incubator. This study should include primary effect, such as the survival rate of incubated start-ups and number of patents and new products as well as secondary effects of job creation in the region and taxes raised.

Furthermore, output measures for comparison of universities need to be established to increase the transparency and net benefit of higher education. Examples could be the number of technologies developed and the commercialized patents, or the number of entrepreneurs serving as adjunct faculty or researchers, the scope of entrepreneurial skill training provided by the corporate incubator to faculty and students, the number of entrepreneurs at the university and the number of students or graduates hired by new ventures. Formal social networks of occupational communities and the affiliation with a research university are encouraged by a cyclical exchange through use of libraries, and laboratories. Questions on the strength of formal and informal ties for mutual benefit between academic researchers in laboratories and teaching and the university incubators need to be further evaluated (Macdonald, 1987).

While additional research is needed to further explore the effectiveness of the different incubator types, it appears that university incubators have become necessary to encourage technology development and utilization.

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