

Oliver Gassmann and Barbara Becker (2006)

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The final version of this manuscript is published in *R&D Management*, 36(1): 1-16.

The final publication is available at www.onlinelibrary.wiley.com:

<http://onlinelibrary.wiley.com/doi/10.1111/j.1467-9310.2005.00411.x/pdf>

DOI: 10.1111/j.1467-9310.2005.00411.x

<http://dx.doi.org/10.1111/j.1467-9310.2005.00411.x>

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Gaining leveraged effects in knowledge modes by corporate incubators

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Gaining leveraged effects in knowledge modes by corporate incubators

This paper analyzes the kind of knowledge that facilitates hatching and leveraging of technologies through the incubation process. For large technology-driven companies four corporate incubator types can be distinguished: fast-profit-incubators, market-incubators, leveraging-incubators and insourcing-incubators according to source and type of technology. Applying the knowledge-based view of the firm, four modes of mainly tacit knowledge were identified accordingly for the different incubator types: (1) entrepreneurial knowledge, (2) organizational knowledge, (3) technological knowledge, and (4) complementary market knowledge. Knowledge strategies include on one hand leveraging internal knowledge and on the other hand insourcing external knowledge to the firm through the corporate incubator. The research is based on the analysis of a European Commission's dataset from a benchmarking survey of 77 incubators as well as 52 interviews in 25 large technology-driven corporations in Europe and U.S.

1. Introduction

1.1 Trends in R&D and business innovation

Increasing competition and globalization of industries, markets and technologies have raised the demand for outside-in innovation and acquisition of technology through integrated R&D networks, which Chesbrough, (2003) calls a new paradigm of "open innovation". At the same time, corporations concentrating on core competencies have tried to increase their internal technology utilization via commercializing unused knowledge through licensing, selling or spinning-off (OECD, 2001).

Traditionally, research and development units (R&D) have been the source of future innovation for technology-driven corporations and thus enabling the firm to sustain a competitive advantage (Porter, 1985). Recently, the traditional role of R&D has been questioned due to several barriers arising. R&D units often act as an ivory tower with minimal problem-orientation while reduced R&D budgets create people and time constraints (Teece, 1986). This specialized functional knowledge island limit its leveraging potential due to a high 'not-invented-here' syndrome causing negative reaction against borrowing or using knowledge sources outside other departments in the firm or from the outside (Leonard-Barton, 1995). An increasing share of total R&D expenditure is spent externally to tap outside innovation sources (suppliers, customers, universities, research institutes).

Corporate incubators have emerged as a prominent organizational form of R&D management only recently in the face of new challenges. On the contrary non-profit incubators have collected experience to support

the development of new ventures since the 1960s by furthering social and community purposes. Corporate incubators are specialized corporate units that hatch new businesses by providing physical resources and support (Hansen et al., 2000, Seidel, 2001, Colombo and Delmastro, 2002). These can be either external start-ups or internal intrapreneurs with a promising business idea or technology, which will henceforth be referred to as technology ventures.

However, current research has not distinguished between non-profit and for-profit incubators (Achtleitner and Engel, 2001). For-profit incubators can also be differentiated as to whether they are linked to a corporation (which we will call 'corporate incubators', the focus of this paper) or organized as an independent organization (independent for-profit incubators).

So what do Nokia, Siemens, Panasonic and Novartis - large corporations from different industries have in common? All have successfully established a corporate incubator that continues to operate despite reduced incubation activities from a downward economy after the bubble burst. The corporate incubator can act as a knowledge hub of business building expertise where good ideas have a place to go as well as from which knowledge is transferred to other units in the corporation. Researchers have not yet constructed a typology of these corporate incubators nor identified the different knowledge modes.

1.2 Research context and methodology

Since the phenomenon of corporate incubators is relatively new, a combination of quantitative and qualitative research methods was used (Flick, 1999, Keller and Erzberger, 1999). Following Eisenhardt's process of inducing theory and developing strategic implications using case studies (Eisenhardt, 1989), the

research generated constructs through case studies, case examples and standardized firm profiles (Dyer et al., 1991, Tsoukas, 1994, Yin, 1994).

The aim of this paper is to enhance the understanding how tacit corporate knowledge can be leveraged through corporate incubators within a firm. The analysis focus on the business process facilitating the knowledge enhancement. It does not contribute to input factors such as resources or output performance of value creation of these knowledge modes.

The research was carried out in two phases: In phase 1 (2001) a quantitative analysis was performed on data based on a questionnaire of 77 incubator managers in the EU. This benchmarking study on incubators increased understanding of the knowledge leveraging incubation process. Phase 2 (2001-2002) used a case study approach and methodological triangulation to identify organizational archetypes and relevant factors of efficiency and effectiveness in corporate incubators. Of the 25 researched European and American corporate incubators, two-thirds were US-based, while one-third European based technology-driven corporations with operations in high-tech industries such as computers, electronics, and communications equipment manufacturing. Findings are based on 52 semi-structured-structured interviews with managers of corporate incubators. While corporate incubators use different names such as incubator, accelerator, business innovation or venture fund, they were included in the study if their strategic mission dealt with supporting young enterprises for technology development through the provision of physical resources.

Location	Industry of corporate incubators			
	Communication Equipment Manufacturing	Computers & Electronics	Information Management	Others
USA	AT&T Ventures Ericsson Business Innovation Nokia Ventures Organization	Cisco New Ventures IBM Dotcom Incubator Intel Capital Lucent New Ventures Group Motorola Ventures Panasonic Internet Incubator Siemens Technology-to-Business Center Sun Microsystems Incubator Xerox Technology Ventures	CIA Intelligence Incubator Eastman (Digital) Company Reuters Incubators	Shell Internet Works Incubator UPS Strategic Enterprise Fund
Europe	BT Brightstar Siemens Mobile Acceleration	Business-Incubator.com	Bertelsmann Capital Ventures	Siemens Technology Accelerator Novartis Venture Fund Sulzer Innotec

Figure 1: Research sample of corporate incubators

The paper proceeds as follows. After a literature review on the knowledge-based view, the enhancement of knowledge process through corporate incubators is examined. This includes quantitative findings as well as different knowledge modes by incubator type. The following section describes the corporate incubator's role as innovation promoter through increased connectivity and interface management. The paper concludes with a discussion of corporate incubators as knowledge islands and future trends.

2. Knowledge-based view as framework

Knowledge is one of the most strategically important organizational resources. Different streams of literature comprise the knowledge-based view, such as its link to the resource-based view and the firm's strategic capabilities, definitions and modes of knowledge, knowledge epistemology, knowledge creation and sources of knowledge. Furthermore, knowledge strategies, the role of promoters, and interface management between corporate incubator and corporation are also discussed.

The knowledge-based view of the firm is an *extension of the resource-based view* as part of the dynamic theory of the firm in creating competitive advantages (Hoskisson et al., 1999, Porter, 1985). Being part of the pre-eminent school of strategic management, the knowledge based view is often process-oriented and focuses on learning and innovation (Grant, 1995, Grant, 1996, Grant, 1997). Its emphasis on learning in an organization stresses the creation of new knowledge, sharing through codifying tacit knowledge and transferring knowledge and applying it to a specific situation (Nonaka, 1994, Spender, 1996).

Based on Polanyi's assertion "We can know more than we can tell"; which points to tacit knowledge, knowledge can be distinguished between explicit (formal, structured and codified) and tacit (informal, unstructured and uncoded) (Polanyi, 1967, Polanyi, 1962). Explicit knowledge can be easily transferred and imitated at low cost, since it is articulated in language and therefore has the characteristics of a public good. Tacit knowledge, on the other hand, is by definition uncoded, and thus is harder to transfer beyond arm's length (von Krogh et al., 2000).

Understanding the nature of a *knowledge epistemology* includes the concept of autopoiesis with the three characteristics of (a) available relationships, (b) self-description of the one's organization and (c) self-referential system to past as well as future knowledge of the organization (von Krogh et al., 1994, von Krogh and Roos, 1995). The "epistemology of possession" describes the order of kinds of knowledge. It finds that explicit is preferred over tacit knowledge while individual knowledge is preferred over knowledge possessed by group (Cook and Brown, 1999).

(Nonaka, 1994) defines a spiral of organizational *knowledge creation* through combination, sozialization, externalization and internalization based on two concepts (Nonaka and Takeuchi, 1995). Conceptualization requires a mutual trust be built to enable sharing of knowledge in a 'field' of a self-organizing team with a common implicit perspective. Crystallization shares external knowledge and creates concrete forms such as products or systems with quality standards for justification.

Knowledge creation combines and involves different *sources of knowledge* (i.e., internal research, market units, external customers, competitors/innovation partners). Thus the locus of knowledge can be found internally within organizational boundaries or externally through intra-firm collaboration.

Traditionally, acquisition, joint ventures and hiring of new people have been identified as external knowledge sources of learning (Kogut and Zander, 1992). The afore mentioned process-orientation is reflected in the concept of organizational absorptive capacity, as a firm's ability to acquire external knowledge and utilize it internally (Cohen and Levinthal, 1990).

The knowledge-based view as part of the resource-based view is also used to explain the *existence of the firm* (Conner, 1991, Conner and Prahalad, 1996). Asymmetries of knowledge lead to two modes of why firms are formed based on contract-thoughts. The firm is organized through employment contracts that increase flexibility, communication and learning as well as creating shared identities in contrast to autonomous contracting in the market. Advantages to the firm exist through 'the knowledge-substitution effect' of employee's knowledge being substituted through the manager's knowledge (Demsetz, 1988, Knight, 1921). However, the argument of the firm's existence based on employment contracts must be enhanced with economic concepts such as incentives, opportunism, property rights, and moral hazard (Foss, 1996b, Foss, 1996a).

Knowledge enables us to identify technological and organizational complementarities (Kogut and Zander, 1996). Thus knowledge is contingent on the organizational structure which can be characterized by observability and system embeddedness of knowledge function in the system (Birkinshaw et al., 2002). Knowledge strategies are linked to practical managerial implications including offering the right space which Nonaka calls 'ba' (Nonaka and Konno, 1998). As well as decisions regarding knowledge source (internal vs. external), scope of knowledge base (narrow versus broad) and speed of learning (fast versus slow) to name only a few variables (Gupta and Govindarajan, 1991, von Krogh et al., 2000).

In summary, previous research has covered the knowledge creation process in R&D as well as the knowledge transfer mechanism itself. However, applications of knowledge modes on the incubation process have not been developed. A special focus on roles of knowledge modes in different types of corporate incubators has not yet been researched.

3. Empirical findings on incubation process

The knowledge process through corporate incubators is a reciprocal learning process for all three actors involved – the corporate incubator itself with the incubator manager, the parent corporation, and the technology venture. Involvement of the incubator manager with their technology ventures is one of the most important phases in the incubation process since it influences the scope and quality of value-adding for the technology venture (Figure 2). The incubator manager and their staff support the growth of the technology venture through providing management assistance via an extensive flow of resources. Involvement also

includes the interaction between the incubator manager and technology ventures regarding ease of access, allocated time and intensity of exchange, passive or pro-active nature of support, formal or informal performance reviews of technology ventures and the long-term link to graduates (i.e., former technology ventures hatching incubated companies).

The interaction between incubator manager and technology ventures should not happen randomly, but should happen regularly through mutual feedback, similar to employee performance reviews. Surprisingly, 52.9% of for-profit incubator managers said that they do not have clear monitoring arrangements, monitoring only half of the time compared to non-profits. However, they are more likely to receive feedback from their technology ventures informally (88.2%), through periodical meetings (58.8%) or via surveys (58.8%). For-profit incubators also communicate with their stakeholders through informal methods and periodical meetings. This is important, since incubator performance is correlated to the feedback of stakeholders, measured by the number of methods of feedback received (.476)^a. A better feedback system also increases incubator performance.

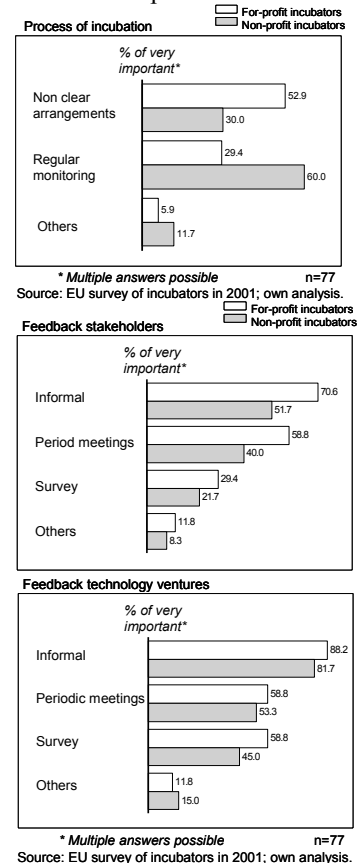


Figure 2: Incubator's enhancement of knowledge process through involvement

The length of time that a technology venture remains in the incubator is correlated to:

- The number of its employees ranging between 10 to 20 (.532)^a. Thus, the longer technology venture stays in the incubator and grows through incubation support, the more people it will employ.
- The total physical space of the incubator itself

(.499)^a. An incubator with large physical space can house a growing technology venture longer.

- Other rental income of the incubator (.488)^a. Income from rentals depends on how long a technology venture remains in the incubator. In the case that an incubator earns profits mainly from service fees, the incubator might have an interest that technology ventures stay longer in the incubator. In contrast, for an incubator that holds high equity stakes in technology ventures, a fast exit through the sale of the start-up might be the main focus.
- The technology ventures originated in branches of existing companies (.438)^a. This could mean that technology ventures from existing companies stay in the incubator for a shorter time because they have more experience to leverage.

One important measure of involvement is the quality and quantity of advice provided by the incubator manager to the technology ventures. Since the quality of advice is hard to determine, depending on the subjective perception of the individuals in the technology venture, the amount of time spent on giving advice can be assumed to give insights into the quality of the advice. About fifty-six percent of incubator managers of for-profit incubators spend 20-50 minutes with their incubating companies, while 37.5% spend no more than 20 minutes. Surprisingly, for-profit incubators spend less time per week giving advice to their technology ventures than do non-profit incubators. Only 6.3% of for-profit managers advise for more than 50% of their working week, compared to 23.2% of non-profit incubator managers. One could argue that for-profit incubator managers are more efficient at providing management assistance or that they concentrate their time more on the selection and exit processes. Another explanation may be that start-ups in non-profit incubators need more advice because of the higher tendency of a technical or university non-business background.

The time that incubator managers dedicate to advising and assisting the technology venture is correlated to:

- The number of marketing services (.434)^a. Incubators that do more advertising and marketing might have more resources that they can provide to their technology ventures.
- Total operational subsidies (.423)^a. The more subsidies an incubator manages to attract, the more resources that can be utilized to advise technology ventures.

The process of incubation describes how the management of the incubator and technology ventures interact to increase the success rate of the start-up. The engagement of the incubator with a single technology venture can change over time due to changing needs of the technology venture in its life-cycle as was analyzed in detail in the interaction between venture capitalists with start-up (MacMillan et al., 1989, Sapienza et al., 1996, Sapienza and Timmons, 1989). The four-stage process of incubation (selection, structuring, involvement and exit) as it was derived from venture capitalists (Gompers and Lerner, 1999, Lerner, 2000)

can be enhanced with several variables listed in Figure 3. These are variables that incubator managers have to focus on during their exchange with the technology ventures.

In the selection phase, for-profit incubators decide what kind of technology ventures they want to attract and select their incubator. They look for innovative projects that already have a developed business plan and promising high growth potentials of either start-ups or spin-offs of existing companies. The high number of enquiries is matched by the high number of initial screenings, leading to a small rate of admission. Once the technology venture is selected, structuring determines how the technology venture will pay for the services it will receive, usually through medium equity stakes (of about 20% compared to 5.5% of non-profit incubators) or services charges.

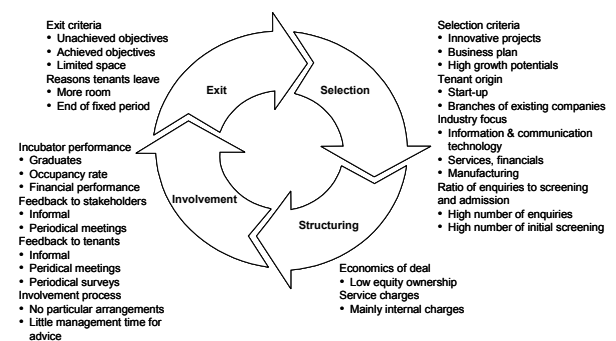


Figure 3: Process variables of corporate incubators

The longest phase of the incubation process is involvement. For-profit incubators have no particular arrangement of exchange with their technology ventures and allocate only a little management time for direct advice. However, they are good at collecting comprehensive feedback from their technology ventures as well as stakeholders in order to understand their interest. For-profit incubators measure their performance usually with three variables of decreasing importance with financial performance not being a top priority: number of graduates, occupancy rate (i.e., the number of technology ventures per size of the incubator), and financial performance.

During the final incubation stage of exit from the technology venture, the for-profit incubator follows developed exit criteria in case of unachieved objectives or milestones. Achieved objectives can halt the incubation time at the end of a fixed incubation period or limit the room in the incubator itself.

4. Different knowledge modes by incubator type

Based on our exploratory research of 25 corporate incubators we identified four different types of corporate incubators in large technology-driven corporations: fast-profit-incubator, leveraging-incubator, insourcing-incubator, and market-incubator.

The typology of corporate incubators is derived from distinguishing the mission of the corporate incubator by its source of technology, from within or outside the corporation, and by its type of technology as core- or non-core technology. Different incubator types build upon diverse knowledge bases.

4.1 Entrepreneurial knowledge by fast-profit-incubator

The fast-profit-incubator commercializes non-core technology for later spin-off. It utilizes internally developed technologies such as unused patents through setting up and funding technology ventures with the end goal of exiting from these involvements through spin-off and making a profit. Examples of fast-profit-incubators are BT Brightstar, Nokia Ventures Organization and Siemens Technology Accelerator.

Siemens Technology Accelerator commercializes non-core technologies from Siemens' patent portfolio. Since most of its ideas are sourced in the central research unit Siemens Corporate Technology, the incubator is located at the central headquarters in Munich. It identifies unused patents and transfers their connected intellectual property rights to the newly founded start-up to prepare its later spin-off. In contrast, the other incubator from Siemens, Siemens Mobile Acceleration as a market-incubator supports the business unit Information and Communication Mobile, not the central R&D identifying complementary knowledge. Another example launched later in February 2000 is BT Brightstar Incubator that tries to utilize patents in communication technologies filed by engineers and researchers of British Telecom. In the beginning they relied on internal sources to find great technologies or patents and create business plans that were financed through external partnerships with institutional venture capitalists.

The fast-profit-incubator taps *entrepreneurial knowledge* on how to start a company, builds skills and capacity in the technology venture, and also defines and targets a market and transfer patents out of the parent corporation to the technology venture. Expanding its horizon of possible solutions and alternatives, it supports the matchmaking with external markets. In the end, the impact of a successful spin-off is profit and a focus on core competencies for the parent corporation.

Nokia Ventures Organization was established in 1998 to source ideas throughout the organisation with most leads coming from Nokia Research itself. Its structured approach reflects the utilization of entrepreneurial knowledge by supporting ideas conceived within the parent corporation outside the current businesses in form of new technologies or new markets for a longer time horizon.

4.2 Organizational knowledge by leveraging-incubator

The leveraging-incubator leverages internal developed technology to the market (inside-out innovation) thereby supporting the growth of the corporation. It strives to increase the utilization of internally developed technologies. Through matchmaking central R&D with market units it increases the commercialization of current or future core technologies to be integrated into core businesses in the future. Lucent New Ventures Group, Reuters Incubator and Siemens Business Accelerators demonstrate examples of the leveraging-incubator.

When Lucent was spun-off from AT&T, the incubator *Lucent New Ventures* was set-up in late 1996. Its goal was to create ventures exclusively from Bell Labs Lucent Technologies' research center in order to utilize technologies that were not a good strategic fit to their core business. Another motivation included to tap technologies that were not commercially exploited because of lack of financial capacity.

This type of incubator leverages *organizational knowledge* of how to activate the whole organization, build internal effective partnerships and good working relationships with other corporate departments and communicate within corporate organizational boundaries. Its successful matchmaking within the corporation aligns the company's core competencies.

The information distributor Reuters, along with its major customers, banks and media companies realized early the potential of leveraging technological ideas through incubation. Founded already in 1995, *Reuters Incubator* later called Reuters Venture Capital connects different pockets of knowledge within the organization.

4.3 Technological knowledge by insourcing-incubator

The insourcing-incubator sources emerging external technologies that might be of interest to the corporation for potential spin-in (outside-in-innovation). It exits from the technology ventures through integration into the corporation, either through an existing business unit or through the formation of a new business unit. Insourcing-incubators can be found at several corporations including Bertelsmann Corporate Ventures, Cisco New Ventures, Ericsson Business Innovation, Motorola Ventures, Panasonic Internet Incubator and UPS Strategic Enterprise Fund.

Panasonic Digital Concepts Center was established in October 1998 to give its Japanese parent company Matsushita visibility and access to technologies and players in the Silicon Valley. Access to core technologies is important to reaching goals of, of differentiation and partnership building purposes, as one of their principals explains. Panasonic's strategy of basically outsourcing R&D is unusual Japanese corporation, which tend to develop their core technologies. Thereby it moves away from traditional focus on international corporate R&D center or investing in venture capital funds. Another example, *Ericsson Business Innovation*, founded rather late in July 2000, discovered mainly external technologies for

integration into the parent corporation.

It utilizes *technological knowledge* of screening external markets for promising ideas and high-potential start-ups (its radar function) and build bridges from the start-up to the corporation and back. By screening the local scientific community for emerging technologies, it analyses how the start-up might fit within the corporation. Matchmaking successfully with acquisition potentials, the insourcing-incubator develops and expands core competencies.

UPS Strategic Enterprise Fund gives an account of how incubators can support being at the forefront of technology. Operating since 1997 it increases the United Parcel Services' knowledge about emerging technologies that can be helpful to the company and its customers. The insourcing-incubator got involved in start-ups such as Air2Web, a wireless technology enabled tracking packaging using wireless devices such as PDAs and phones. Another technological solution was offered to track packages with no labels, using RFID technology developed by Savi Technology, which may have enormous future strategic value to the firm and its customers. Technology scanning can be initiated from the incubator itself but also from the business units in a bottom-up approach to strategically closely align it to its business units. Motorola's business units identify holes in their product roadmaps or long range plans and give the incubator *Motorola Ventures* a list of things they think Motorola should have in two or three years time. Motorola Ventures confirms these opportunities through discussion with its partners and seeks to match the identified potentials with external start-up technology. Thereby the incubator acts as a strategic investor to invest in technologies that will support Motorola's existing and emerging platforms and products. They emphasize long-range relationships with their portfolio companies to transfer knowledge in and out of those technology ventures. Joint Development Agreements motivate both parties to integrate their technologies through the same core design.

4.4 Complementary market knowledge by market-incubator

The market-incubator develops a market for a complementary non-core technology to increase demand for its own technology and products. It takes a unique position in supporting the development of complementary technologies without potential acquisition goals. Examples of the market-incubator are Business-Incubator.com, IBM Dotcom Incubator, Novartis Venture Fund and Siemens Mobile Acceleration to name only a few.

An example that has followed this path is *Business-Incubator.com* offering a comprehensive technology package for newly founded technology ventures. The incubator was set up through partnering of Sun Microsystems, Oracle, Cisco Systems, and Exodus as part of client development or marketing effort to build promising Internet companies long-term.

This type of incubator uses *complementary market knowledge* of how to segment customer demand, finds satisfying solutions to customer problems in proximity and determines how to be sensitive to markets' and customers' needs. Analyzing current and future technology standards can define its complementary technology position. The successful matchmaking with external markets can enhance core competencies.

The Genomics Novartis Fund works with technology ventures to refine their derived technology platforms in the field of functional genomics that might become future technology standards. In exchange for Novartis development support through supporting operation and refinement; the firm can continue to use the technology platform in the future.

4.5 Survival of the fittest incubator types

Once the analyzed corporate incubators are grouped according to the described classification scheme by source and type of technology; an interesting distribution pattern emerges. Instead of an even distribution most incubators are either insourcing- or market-incubators pointing to the highest potential for external sourcing of technology. However one third of the corporate incubators have been eliminated (as marked in Figure 4 with italics and a cross-sign) or have changed to a pure corporate venture capital model.

Based on our limited sample of 25 corporate incubators we have indicators that *insourcing-incubators* are the most promising type of corporate activities also for the future. Reduced R&D budgets along with people and time constraints call for outside orientation towards 'open innovation' and external knowledge sourcing (Chesbrough, 2003, Teece, 1986). Particularly, knowledge creation and core tasks of R&D management are increasingly sourced through start-ups or re-delegated to academic institutions or other corporations. For example, in the biotechnology industry established corporations cooperate with start-ups for radical innovation to reduce time-to-market compared to central R&D (Pisano, 1990). Collaborative research arrangements are beneficial for both sides, start-ups can develop new products more effectively and large corporations can provide market testing and marketing for the developed products. Insourcing-incubators can be an intermediate phase to determine interfaces between corporation and start-up to increase the likelihood of a later acquisition (spin-in) of the technology venture.

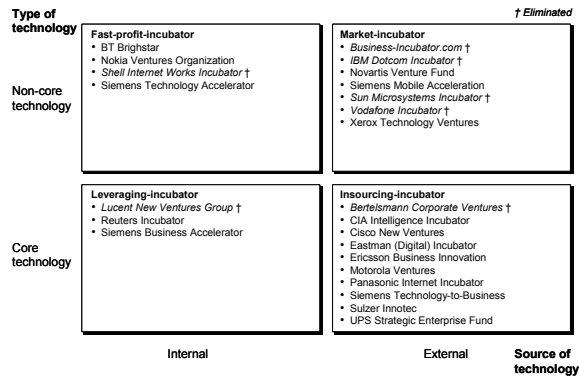


Figure 4: Different survival rates by incubator type

The second highest distribution of corporate incubators can be found for *market-incubators* reflecting their high potential and importance of insights into complementary market knowledge. However, market-incubators are highly volatile to changing market demands such as changing economic conditions or technical standards. The burst of the Internet bubble triggered the highest elimination rates of market-incubators proportional to the other types. On one hand complementary market knowledge may be re-delegated to the classical market function away from R&D management. At the same time knowledge access of local markets and realized productivity gains are often high-risk bets on the potential extraction of market capitalization. Built on the expectation that a new technology standard or platform such as the Internet or mobile communication materializes, these types of incubators can dissolve easily. The two other types of incubators, fast-profit and leveraging-incubator, which optimize internal sourcing of technology and thereby overcome organizational inertia, occur at about the same frequency of distribution.

5. Discussion

Fast-profit-incubator and insourcing-incubator leverage either internal or external knowledge for later spin-in. Since entrepreneurial and technological knowledge stay in the corporation, knowledge sharing is of major importance. The corporate incubator can support *knowledge-sharing* between R&D and different business units, making knowledge available for absorption and use (Davenport and Prusak, 1998). Emphasis on learning in an organization stresses the creation of new knowledge, through sharing codifying tacit knowledge and transferring knowledge and applying it to a specific situation (Nonaka, 1994, Spender, 1996). Besides sourcing knowledge internally from other departments (e.g. R&D or business units) or externally from start-ups, the corporate incubator can support knowledge transfer of experience and application of technology between research and market units. Knowledge is rich if it has high informational quality and is relevant to potential users. This decreases venturing costs and realizes economies of scale.

However, there is the traditional trade-off between reach (connectivity) and breadth (customization, bandwidth) (Teece, 2000). Its informal organic structure, with little formalization and extensive contact with knowledgeable experts throughout the corporation, behaves like a 'spider's web' supporting the knowledge transfer (Miles and Snow, 1986). Mainly tacit knowledge is shared between the incubator and other business units. The process skills of selecting and supporting technology ventures through ongoing advice or occasionally ad hoc consulting on a needed basis (e.g. "from experience with other start-ups we did..", best practice comparisons) can be transferred through people working beside incubator staff.

An example of supporting knowledge-sharing is *Nokia Ventures Organization*. It grants managers mobility in order to encourage a steady flow of information within the corporation. Employees from the business units can move into the incubator for a limited time to support their idea to its realization. Following Nonaka and Takeuchi's distinction of knowledge transformation, a corporate incubator can support socialization, the transfer from explicit to implicit knowledge through co-location and experience transfer from the incubator manager, as well as internalization of transfer from explicit to implicit knowledge through learning-by-doing in joint projects (Nonaka and Takeuchi, 1995).

The leveraging-incubator acts as matchmaker between R&D and market units, building on organizational knowledge insights. However, barriers to innovation and limited knowledge flow can lead to a negative reinforcing cycle of low credibility and influence leading to low status discipline, low attractiveness, low pay and thus hesitant performance (Leonard-Barton, 1995). Barriers to innovation can be consistent to an information problem of '*not-knowing*' (knowledge gap), a motivation problem of '*not-wanting*' to know (motivation gap) and a qualification problem of '*not-being able*' (capability gap) to break through administrative barriers. These barriers can lead to either procrastination or even prevention of developing new technology or establishing a technology venture (Hauschildt, 1997).

For example the *CIA Intelligence Incubator*, called In-Q-Tel, was launched in September 1999 by the Central Intelligence Agency with support of the U.S. Congress to accelerate the acquisition and integration of new technologies for government intelligence; thereby improving the Agency's information gathering and analysis capabilities. While they can hatch an IT solution successfully in the incubator, one of the major issues is the integration and insertion into the Central Intelligence Agency itself through an established In-Q-Tel Interface Center. While the adoption of technology is high at the senior management level, middle management is more reluctant to use external technologies of the insourcing-incubator because of the not-invented here syndrome and resistance to change.

Managing *knowledge islands* of functions, hierarchies, business units and individual interest can

be connected and supported through the corporate incubator. Establishing an open knowledge flow, increased motivation and an easier approval process are all activities that can enhance innovation capabilities. A corporate incubator can provide the internal support for innovative projects through promoters or product champions (Schon, 1963, Markham, 1999, Witte, 1973, Chakrabarti, 1974, Maidique, 1980, Howell and Higgins, 1990, Hauschildt and Gemuenden, 1999). Promoters or champions can overcome ambiguity, frustrating time delays, and resistance to change by directing specific energy towards power sources or by enhancing insights from key individuals in an informal division of labor. Since true champions are deeply and personally committed to the project, they cannot be designated but rather emerge through self-identifying of a need, such as the use of their own inventions or their need for personal recognition. Thus, their authority is based on their own expertise and charisma, or contagious interest; and not on delegation. In summary, innovation requires the interplay of different promoters to overcome information, motivation and administration problems, as shown in Figure 5.

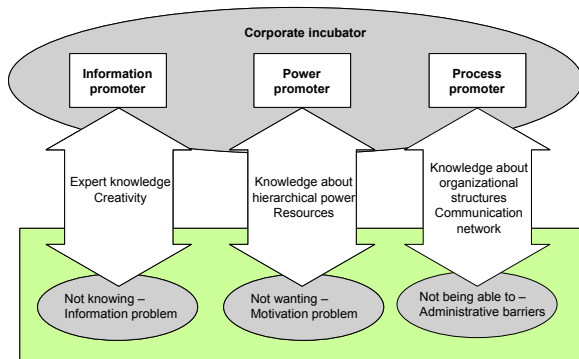


Figure 5: Corporate incubator supporting or acting as promoters

Corporate incubators can coordinate all three promoter roles or even take on some promoter roles themselves in order to realize innovative projects (Hauschildt and Chakrabarti, 1988):

- The *information promoter* (or specialist or knowledge promoter) represents expert knowledge such as technical or market perspectives.
- The *power promoter* has the hierarchical potential and resource knowledge to help overcome politics (Cabral-Cardoso, 1996). Tidd divides this role further into the organizational sponsor who must believe in the project potential and the actual project team leader who has the organizational power to make things work (Tidd et al., 1997).
- And the *process promoter* holds organizational knowledge through insights into who has what knowledge in the organization. The corporate incubator is the ideal location for knowledge brokers, also known as 'gatekeepers' or 'boundary spanning individuals', to use their connection to communication networks (Tushman and Scanlan, 1981) that improve information flow through connecting buyers with sellers of knowledge.

The nucleus of innovation comes from the information

promoter who can be sourced internally from different business units or even externally. The power promoter guarantees support and might even initiate the innovation themselves. Because the corporate incubator already received support from senior management during its set-up, these power promoters can also be leveraged for single ideas for a technology venture. The corporate incubator's specific strengths lie in the process promoter's role, which can guarantee a smooth transition of the innovation towards its commercialization. The incubator manager can act as project champion to reach up in the hierarchy for legitimization of the technology venture, get access to corporate resources, lobby throughout the organization and build helpful outside connections.

The fast-profit-incubator also uses promoters to leverage its entrepreneurial knowledge. *Siemens Technology Accelerator* provides a good example of the interaction of the three promoter roles in the innovation process, which are partly located in the incubator itself, and partly within the parent corporation. The researcher, as specialist promoter, possesses the original idea, situated in Siemens central R&D department called Corporate Technology. Staff of the incubator such as personnel coaches, act as process promoters, identifying the project's potential, developing a business plan, supporting access to internal and VC funding and managing the transfer of relevant corporate patents into the technology venture. They also leverage Siemens' wide internal network as well as provide access to customers and suppliers. Finally, senior management at the central R&D can act as power promoters to support the technology venture throughout the hierarchies.

The incubator manager, as process promoter, often leverages their large informal network built from former positions in the corporation as well as common projects with other colleagues. *Cisco New Ventures* is an example of having an incubator linked to the corporation through intrafirm networks. Once an acquisition of a technology venture is decided, it manages the diffusion of their spin-in process of start-ups through a centralized cross-functional integration team (called the SWAT team). Around 15-20 people from human resources, sales, marketing and manufacturing all support the rapid assimilation of the acquired company.

Since corporate incubators are specialized units to hatch technology ventures all incubator types have to balance co-ordination needs of the parent with communication costs for knowledge-sharing in order to achieve a common objective. Self-reliant autonomous units require only low communication costs, increasing interface links, and increase coordination intensity and communication costs (Frese, 1995). Interface management needs to:

- Define the relationship between the incubator and the rest of the organization (e.g. business units, central R&D and senior management);
- Facilitate communication between different business units;

- Manage expectations of receiving operating unit; and
- Ensure continuous input of the mentoring or receiving operating business unit of the technology venture while avoiding becoming captive too early.

The corporate incubator can coordinate its formal *interface with centralized units* of the parent corporation through explicitly defined contact persons at the parent. These interface agents in corporate services such as R&D, legal and finance or market-near business units are all part of a predefined process of advice to optimize the incubation process. If the incubator manager and their staff need to tap further information or networks from the parent corporation, the defined communication channels help to reduce search time on the side of the incubator staff as well as ensuring commitment and support from the parent corporation. These interfaces also support the exit from 'graduated' technology ventures after a successful incubation process. For example, in the case of a spin-off of a technology venture, corporate finance and market business units might help to establish potential buyers for a trade sale or acquisition. Once the technology venture is incorporated back to the core businesses, pre-established contacts are even more helpful. Also, lessons learned during the incubation process with technology ventures can be transferred back to the parent, particularly in R&D or market units.

Siemens Mobile Acceleration has appointed contact persons in the corporate center and major business units to standardize the process of support, which the technology venture receives from its parent corporation. A godfather or mentoring program ensures a close link and fit with the Siemens Mobile portfolio.

Interface management with functional and business units controls the cooperation of the corporate incubator team with other functional areas such as production, marketing, and other R&D units. This reduces formal hierarchical communication paths and decrease cultural or linguistic barriers (Brockhoff, 1989). The corporate incubator can view other units as internal divisional customers and try to utilize cross-fertilization through cross-functional integration and concentration of staff at a level where integration is most crucial.

5. Conclusions

Four types of knowledge were identified for the aforementioned four types of corporate incubators: (1) entrepreneurial knowledge, (2) organizational knowledge, (3) technological knowledge, and (4) complementary market knowledge. The corporate incubator enhances the locus of innovative knowledge from internal to external idea sourcing. By combining the cognitive differences between the mindsets of entrepreneurs and managers (Busenitz and Barney, 1997), corporate incubators can enhance organizational learning. Entrepreneurs or intrapreneurs deal with higher uncertainty and are used to making decisions with limited information. Contrary to this, established

companies or successful individuals can face competency traps by not extending beyond trajectories created by past successes (Levitt and March, 1988, Levinthal and March, 1993). Established corporations might be unable to respond and adapt to the environment because of core rigidities-- the dysfunctional flip side to core capabilities-- through which embedded knowledge inhibits innovation (Leonhard-Barton, 1992). The corporate incubator can reduce the growing mobility of well-trained workers from large corporations to technology ventures. Intrapreneurs can get involved in the development of their own ideas and benefit financially from the upside potential without leaving the large corporation.

Through incubation four different knowledge modes can increase the likelihood that the most promising ideas will be selected and then realized. For example, *Sulzer Innotec* increases their quality of realized ideas through a structured selection funnel with two committees - a general innovation board and a more specialized incubator board. While the number of ideas evaluated decreases substantially with each filter, the number of employees, and thus their time spent analyzing each business idea, increases over time.

Further research is needed in several areas:

- In-depth longitudinal study on development of corporate incubators's knowledge modes in the new economy;
- Quantitative analysis of phase-dependent knowledge flow between incubator manager, corporation and technology venture (early set-up versus harvest phase);
- Survey on success factors of incubators regarding structural approach and quality measures for intangible resource flow, sophistication of management know-how, extent of networking quality and branding impact.
- Develop reference model for measuring knowledge input and output to quantify efficiency and effectiveness of the four incubation phases: selection, structuring, involvement and exit.

Our exploratory study provides a first insight into knowledge-modes of corporate incubators and invites further development and applications.

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