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Academic intrapreneurship for health care innovation: the importance of influence, perception, and time management in knowledge commercialization at a University's Medical Centre

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Abstract
Academic intrapreneurship refers to the individual behaviours of scientists who depart from their customary research and education initiatives and become involved in knowledge commercialization without leaving academia. This paper aims to examine how academic intrapreneurs perceive and respond to organizational factors set by departments, faculties, schools, and university boards that influence knowledge transfer, the initiation of an internal project, and the collaboration with societal stakeholders. We employ an embedded case study approach to examine the role of perceived control and influence within the internal work environment of a knowledge commercialization process within the DiabetesStation, a healthcare innovation at the Erasmus Medical Center (MC), a university hospital in Rotterdam, the Netherlands. We used a semi-structured interview strategy and analyzed 12 individual respondent interviews. The results show that the relationship between academics and the Knowledge Commercialization Process within the DS at Erasmus MC was influenced by six factors (i.e., external collaboration, product quality, time availability, external financing, internal financing, and rewards and reinforcement). Our study highlights that the perception of- the academic intrapreneur's control and influence seems to impact effectively transferring academic knowledge from academic institutions to the private sector for economic and societal benefit. The research results highlight three controllable areas of an academic institution's internal work environment that can enhance the relationship between knowledge valorization and academic intrapreneurship—time availability, rewards and reinforcement, and internal financing.

Keywords Academic entrepreneurship · Perceived control · Perceived influence · Time management · Diabetes · Technology transfer

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1 Introduction

Alongside their traditional emphasis on research and education, universities have added knowledge commercialization and academic engagement as a third mandate for their activities (Etzkowitz & Peters, 1991; Perkmann et al., 2013, 2021; Siegel & Wright, 2015b). These can be achieved by fundraising for research, external consulting, university-industry-government collaboration, patenting and licensing research results, launching new technology-based firms, and establishing incubators and science parks. Policymakers are motivating academics to commercialize their findings, become (more) entrepreneurial, and create new ventures. However, this is no easy matter, and tensions may occur. Traditionally, academic entrepreneurs and their research universities and research centers searched for truth and peer recognition. Now, they must increasingly consider the commercialization of their inventions and innovations and need to identify the potential benefits of increasing individual or institutional profits, influence, and prestige (Louis et al., 1989; Siegel & Wright, 2015b).

Most of the literature on academic entrepreneurship focuses on the involvement of academic scientists and their institutions in commercializing knowledge and technology with new and established organizations, next to their primary research and teaching activities (Shane, 2004; Siegel & Wright, 2015a; Wright et al., 2007). Examples include faculty consulting, patenting and licensing, startup and spinoff formation, and public–private research partnerships (Clarysse et al., 2011; Etzkowitz, 2004). Programs to promote and support academic entrepreneurship, consisting of dedicated agencies for education and training, incubators, and science parks, have been extensively studied (Klofsten & Jones-Evans, 2000; Link & Scott, 2015; Mian & Hulsink, 2009; Mian et al., 2012; Nelson & Byers, 2015; Siegel & Wright, 2015b). Only a few studies have examined the internal initiatives and processes of entrepreneurial researchers instigating new research projects, business innovation, or institutional renewal (e.g. forming internal research centers and focused research groups within that organization) (Etzkowitz 1992, 2003; Siegel et al., 2003a).

The phenomenon of academic intrapreneurship, defined as the entrepreneurial behavior of the faculty members of universities and research centers aimed at corporate innovation and renewal, is still in its infancy (Shattock, 2003, 2008). The field of academic entrepreneurship, with its present focus on externalizing technology and people and engaging with its task environment, can be enriched by studying the intraorganizational processes and structures of universities and research centers and the innovative behavior of individuals and teams within them (Balven et al., 2018; Siegel & Wright, 2015a). This is the world of corporate entrepreneurship or intrapreneurship, where individuals or groups of individuals, in association with existing organizations, create new ventures or instigate renewal or innovation within those organizations (Sharma & Chrisman, 1999). The academic entrepreneurship literature has mainly focused on the macro-level of organizational actors, emphasizing the university or the research organization, the startup or spinoff firms, and established corporations involved in licensing and partnering. Phenomena occur at the individual level of faculty members, and their actual behavior in internal innovation and venturing processes has largely been overlooked (Siegel & Wright, 2015a). This paper aims to understand how academic intrapreneurs and other individual actors perceive and react to organizational factors set by departments, faculties, schools, and university boards

that influence knowledge transfer, the initiation of an internal project, and the collaboration with societal stakeholders.

We examine how intrapreneurs in a university medical school navigate academic and commercial discourses and take initiatives in achieving personal and organizational knowledge transfer objectives. We assess and evaluate the internal work environment of a knowledge commercialization process in ways that affect the internal organizational behavior of academics and their stakeholders. Central to this paper is the DiabetesStation^{R} (DS), a healthcare innovation at the Erasmus Medical Center (MC), a university hospital in Rotterdam, the Netherlands. Since many diabetes patients in the Netherlands hardly speak Dutch, Eric Sijbrands, a professor of internal medicine at Erasmus MC, decided to develop a *virtual diabetes doctor*. The device can converse in eight languages with diabetes patients and includes a touch screen for those who are illiterate. Patients interact with the screen as if talking to a real doctor in their own language and can perform a physical examination and blood tests themselves. Professor Sijbrands hopes that the DS will eventually be able to help the majority of the patients, allowing the diabetes professionals to have more time to deal with their patients' problems and significantly reducing many administrative tasks and bureaucratic procedures.

Our case study emphasizes the importance of the behavior of academic employees or faculty members and the relevance of internal organizational factors for promoting and creating a supportive environment for bottom-up initiatives and innovation. Our central research question is: *How do academic intrapreneurs perceive their ability to control and influence the knowledge commercialization processes in university medical hospitals?*

We employ an embedded case study approach to examine the role of perceived control and influence over external collaboration and product quality of one academic intrapreneur actively involved in knowledge commercialization and the development of healthcare innovation. We define perceived control as the belief in one's ability to exert control over situations or events. Whereas, perceived influence is the belief in one's ability to merely affect the development of someone or something. The main difference between these concepts is the intrapreneur's perception of their own importance. Initially, 12 interviews were held about the DS project, followed by another 11 additional interviews with actors who were involved in transferring the concept to the private sector. All interviews took place in 2014 and reflect the status of the DS project at that time. The following section reviews the literature on academic entrepreneurship and provides an overview of the key concepts involved in this study, namely academic entrepreneurship, corporate entrepreneurship, and academic intrapreneurship. Section 3 describes the methods and the research design, and Sect. 4 reports our empirical findings. Section 5 discusses the results and presents future research possibilities. The final section concludes.

2 Literature review

2.1 Academic entrepreneurship

Academic institutions worldwide are becoming entrepreneurial, deepening their connection with the private sector and engaging in more activities known as knowledge commercialization. Andriessen (2005) defines knowledge commercialization as the transfer of scientific knowledge from one party to another for economic or societal utilization. This can occur in universities, dedicated research laboratories, and medical schools (housing

scientific research centers and facilities to deliver clinical care and clinical drug trials) (Stuart & Ding, 2006). The further growth in technology transfer and knowledge commercialization by the universities and research centers has also been stimulated by external factors, including government policy and favorable industry conditions (Etzkowitz, 2003).

Cantaragiu (2012) analyzed the different views on academic entrepreneurship and synthesized them into the following definition: Academic entrepreneurship is a practice performed to transfer knowledge between the university and the external environment to produce economic and social value for external actors and members of the academia, and in which at least one member of academia maintains a primary role. As academic entrepreneurs are significant drivers of economic growth and wealth creation (Shane, 2004), policymakers in many countries and regions are attempting to motivate more academics to become entrepreneurs and create new ventures.

Traditionally, the significant differences between academic and non-academic entrepreneurs operating in commercial environments are their levels of motivation and commitment. In their search for truth, academic researchers seek to obtain credit for original discoveries and advancing science and recognition within the academic community, which emanates from original publications in top-tier journals, presentations at prestigious conferences, and allocation of research grants (Merton, 1957). In their study on prevalent motives of academic entrepreneurs to engage in new venture creation Hossinger et al. (2021) find support for the drive to transfer one's research outcome and/or technology, inner self-realization, necessity, and increased financial income. Work-life balance motivations and the challenge to acquire entrepreneurial knowledge and develop new professional skills act as a barrier new venture creation. Siegel et al. (2003a) found that the appropriation of additional returns to their knowledge was only a secondary motive for academic researchers turned entrepreneurs. Financial gain considerations were primarily due to the desire to demonstrate the value of their research and to secure additional research funding to hire graduate students and purchase laboratory equipment. This motivation conflicts with the entrepreneurship literature, which has found a positive relationship between entrepreneurs whose prime motivation is to increase the wealth of their products and ventures (Cassar, 2007). However, academic entrepreneurs in the biomedical and pharmaceutical industries may have to spend more than 10 years before their first product enters the market, which makes the formation of business-oriented goals problematic, especially in the short term (DiMasi et al., 2003).

Entrepreneurially minded scientists and administrators at universities and research laboratories have been actively involved in changing the internal organization of their academic institutions. They have set up centers and formed focused research groups acting as semi-autonomous firms (Etzkowitz 1992, 2003) to make them more responsive to internal and external demands. The formation of these centers was triggered by the desire to obtain equipment that cannot be acquired with limited funds and the usefulness of establishing long-term collaboration on specific scientific projects or mission-oriented research programs. According to Etzkowitz (1992: p. 33), the wide-scale introduction of team research at universities and research institutes has given rise to quasi-firms, acting like private companies, except for the ownership situation and the profit motive. "Scientific quasi-firms are small and they are more collegial than hierarchical in organization. They have a division of labor, with each research worker carrying out tasks that fit into a consistent pattern. They are committed to continuity since their strategy calls for a series of projects" (p. 33). However, despite governmental support through financing and policy, academic entrepreneurs face several challenges in creating and sustaining new ventures (Vohora et al., 2004). Academic entrepreneurs

require further commitment and motivation (Vohora et al., 2004), skills and knowledge necessary to exploit market opportunities (Franklin et al., 2001), and social capital to enable the move from a non-commercial university environment to commercial markets (Lockett & Wright, 2005).

Academic entrepreneurs are also less growth-oriented than their counterparts outside academia (Meyer, 2003). Even if their ventures have substantial development opportunities, academic entrepreneurs are often not motivated to raise funds, speak with potential customers and investors, and show the commitment necessary to achieve high performance. Since growing their ventures is not their first and foremost aim, founders of academic ventures often scale back their research position but stay committed to their university with a part-time affiliation (Meyer, 2003). Otto (1999) found that university-based firms tend to focus on the technical aspects of a venture to the detriment of the business side. To create and sustain their ventures, academic entrepreneurs must manage the resources and capabilities available to outperform commercial firms in the marketplace and generate above-average returns (Hitt et al., 2001), thus requiring technical expertise and significant business acumen.

Even when we consider that academic entrepreneurs may be heterogeneous in their business acumen and ability to identify opportunities, their embeddedness within the academic environment raises questions about whether they can effectively traverse from academia to commercial markets. Siegel et al. (2003a) found that academic entrepreneurs continue to remain attached to their networks of academics and scientists and rely on the shared norms of this network to exchange information. Mowery et al. (2001) noted a great cultural divide between how academic entrepreneurs and commercial firms perceive the role of knowledge. In general, commercial firms do not share academic values regarding knowledge, such as publishing results and information for public benefit. Instead, commercial technology is kept proprietary and used for strategic advantage in the pursuit of profits. However, this directly conflicts with what Merton (1957) found to be the academic researchers' core motivation of exchanging knowledge and recognition within the academic community.

Currently, the stream of academic entrepreneurship research is centered around three domains: technology transfer, university incubation, and engagement (outreach and extension). Technology transfer refers to patenting and licensing by academic researchers and includes organizational creation such as renewal or innovation, which occurs either within or outside the university through research commercialization (Philpott et al., 2011). University incubation includes new businesses created based on intellectual property generated by faculty in universities and research centers (Hayter, 2011), university spinoffs founded by academic researchers (Shane, 2004), and academic startup firms using venture capital (Zhang, 2007). Academic engagement (outreach and value-based commercialization) is the involvement of academics in societal benefit initiatives (Winfield, 2004) and partnerships with industry (D'Este & Perkmann, 2011). An example is a university faculty operating as entrepreneurial thinkers and tinkerers seeking new ways to engage with the community to create value (Kingma, 2011).

With universities becoming more entrepreneurial and knowledge commercialization gaining practical and academic importance, the productivities of their Technology Transfer Offices (TTOs) have been the focus of a large stream of research over the last three decades. This stream focuses on TTOs' commercial output such as licensing, equity positions, and patents (Chapple et al., 2005; Siegel et al., 2003a; Thursby et al., 2001). Studies investigating the productivity of TTOs, including the stage of technology (Markman et al., 2005) and the resources from the university and locality (Chapple et al., 2005;

Jones-Evans & Klofsten, 1999) suggest that TTO productivity is linked to tangible and intangible resources from the university, such as research support and a sustained focus on R&D activities.

Alongside the factors that promote TTO productivity, some inhibit knowledge commercialization. As previously discussed, universities are challenged to balance their traditional mandates with a new focus on entrepreneurship, often leading to an identity crisis. Difficulties arise when TTOs are forced to convince academic researchers and faculty to disclose and 'let go' of their inventions (Chapple et al., 2005). However, they are also challenged to continue the liaison and strategic collaboration with industry partners as these inventions are further developed (Siegel, et al., 2003a). A lack of financial and human resources has also been found to plague TTOs in their objective to valorize scientific knowledge (Jones-Evans & Klofsten, 1999). Finally, legal decisions on intellectual property and transfer arrangements further complicate and impact TTO's performance and productivity (Siegel et al., 2003b).

The second area of study in academic entrepreneurship is university incubation (Mian, 2011; Mian et al., 2021). Universities and research centers seek to transfer their knowledge and technologies to new startups (also known as new-technology-based firms), either spun-off from the parent organization or newly created with the support of the university or research center's incubator (Clarysse et al., 2005). Incubators can provide access to technology, funding, mentoring, and business advice networks to accelerate the establishment and growth of these new technology-based firms. They can also offer shared facilities (e.g., office, laboratory, workshop space, and testing equipment) and establish contacts with future partners, distributors, and customers. Together, the incubators, their incubates, the sponsoring university or research center, and all their supportive stakeholders (e.g., regional authorities, investors, technology brokers) act as a catalyst for regional economic growth. The processes of knowledge spillovers, network building, and clustering may be facilitated by creating a science, research, or technology park, further contributing to the turnaround or innovativeness of a particular region (Link & Scott, 2015; Mian & Hulsink, 2009).

The third domain of academic entrepreneurship research is engagement. There are various reasons why academic researchers reach out to non-academic organizations and social groups (e.g. industry, consumers, users, patient collectives, and civil society) for collaborative projects and applications, contract research, consulting, and informal activities such as providing ad hoc advice and networking with practitioners. Motivations for this academic engagement include commercialization (exploitation of technology and knowledge, faculty entrepreneurship), learning (informing academic research, gaining new insights, receiving feedback on research and accessing new knowledge through engagement with industry), access to funding (complementing public research monies), and access to in-kind resources (equipment, materials and data for research). Most are research-related (seeking to further and cross-fertilize their research). Only one is related to an intention to be entrepreneurial and commercialize their knowledge (D'Este & Perkmann, 2011). Instead of encouraging faculty members to become independent and commercial entrepreneurs, most are keen to retain their autonomy by ensuring that collaborating with industry is beneficial or well-matched with their research activity, in the words of D'Este and Perkmann (2011: 330): "Most academics engage with industry in order to further their own research, either through learning or through access to funds and other resources." There is an inherent tension between knowledge commercialization through patenting, incubation, and spinoff development on the one hand and research-related motivations, which are more

curiosity-driven and collaborative while adhering to the Mertonian science-specific values and norms (D'Este & Perkmann, 2011; Perkmann et al., 2013, 2021).

To continue the shift towards entrepreneurship and fully adopt knowledge commercialization as their third mandate, universities and research centers need to adopt a more business-style management strategy by incentivizing faculties and rewarding them for successful technology transfer (Friedman & Silberman, 2003; Henrekson & Rosenberg, 2001; Jensen & Thursby, 2001). However, Jacob et al. (2003) posit that transforming a university to be more entrepreneurial requires changing its organizational structure and adapting its culture and mission. A third opinion has emerged in which academic entrepreneurship is seen as a multilevel and context-dependent phenomenon (D'Este & Perkmann, 2011; Link et al., 2007; Perkmann et al., 2021), with a special emphasis on the governance of the university and the manifestation of the academic enterprise (Crow et al., 2020). The core mission of universities today is to balance its traditional roles (i.e., research and education) with its engagement and entrepreneurial activities (Etzkowitz et al., 2000; Siegel et al., 2003a). Their dominant institutional logics of the academy, the bureaucracy for higher education and research and the market are now merging into a combined logic of the academic enterprise where entrepreneurial universities seek to complement knowledge generation, instruction and societal engagement and reinforce each other.

2.2 Corporate entrepreneurship and intrapreneurship

Analytically different from individual entrepreneurship, corporate entrepreneurship is conceptualized as firm behavior and organizational renewal through risk-taking, innovation, and pioneering, shaped by corporate leadership, responsive internal structural and cultural factors, and proactive and integrated product-market strategies (Miller, 1983). Besides emphasizing the organizational factors that foster and impede corporate entrepreneurship, the processes of corporate entrepreneurship and the distinctive entrepreneurial activities of firms unfolding over time are important. Attention has been given to market and customer-driven behavior for firms engaged in corporate (re)positioning and organizational renewal (Miller, 1983) and to the internal organizational factors and processes within the corporate hierarchy. An example of the latter is the role of small groups of employees, supported by their managers and top management teams to develop and launch novel products and services, create new ventures, or instigate renewal within their existing organization.

Although much research has focused on corporate entrepreneurship, the concept lacks a strong foundation and a clear definition. Corporate entrepreneurship is an organizational phenomenon, whereas independent entrepreneurship is driven by individuals who establish a startup and commercialize their own idea. The corporation is the entrepreneurial entity, owning the business concepts and intellectual rights surrounding these concepts and assuming the risks of a venture or project. According to Covin and Miles (1999), "Corporate entrepreneurship revitalises, reinvigorates, and reinvents. It is the spark and catalyst intended to place firms on the path to competitive superiority or keep them in competitively advantageous positions" (p. 50). Further research extended this concept and analyzed the corporate entrepreneurial strategy at an individual, management, and organizational level, highlighting its antecedents, elements, and consequences (Kuratko et al., 2004, 2005a, 2005b).

Subsequently, organizational entrepreneurship was operationalized with constructs such as entrepreneurial posturing (Covin & Slevin, 1991) and entrepreneurial orientation (manifested by innovativeness, risk-taking, proactiveness, autonomy, and competitive

aggressiveness) (Lumkin & Dess, 1996; Miller, 1983). Entrepreneurial firms have internal cultures, structures, and practices to support innovation, learning, change, and strategies and processes that shape and push for the regular and continuous introduction of new products or services or the entry into new markets. Top-level managers and a strategic vision and market/customer orientation drive internal innovation and external entrepreneurial processes (Hornsby et al., 2009).

Corporate entrepreneurship is a means of accumulating, converting, and leveraging resources within firms for competitive purposes (Floyd & Wooldridge, 1999). It assumes opportunity-driven and proactive behavior that fosters innovation processes, organizational change, and strategic renewal within an established corporation, constrained by the internal structure and culture of the organization. From a process orientation, corporate entrepreneurship creates new business through market-oriented developments or by undertaking product, process, technological, and administrative innovations within existing organizations (Sharma & Chrisman, 1999; Zahra, 1993). From a knowledge- and capabilities-based perspective, entrepreneurship is essential for high-performing firms.

By combining different views on corporate entrepreneurship (Barringer & Bluedorn, 1999; Echols & Neck, 1998), McFadzean et al. (2005) defined corporate entrepreneurship as the effort of promoting innovation from an internal organizational perspective, through the assessment of potential new opportunities, alignment of resources, exploitation, and the commercialization of opportunities. Entrepreneurial employees, also known as corporate entrepreneurs, promote their business idea within the organization and seek to align themselves with relevant colleagues and mid-level management to get the project approved and eventually developed. They are fully aware that the proposed innovation may diverge from the organization's goals, fail to get organizational support, and may be abandoned or shelved.

Burgelman (1983) stated that corporate entrepreneurship is an autonomous bottom-up process where managers at an operational level play the most vital role in promoting innovation by supporting proactive and risk-taking employees. The whole selection process of projects and concepts developed by internal business developers, product managers, and other entrepreneurial employees involves senior managers and higher-level executives calling the shots. In this respect, the organization's culture, strategy, and structure matter as antecedents for corporate entrepreneurial activity by making it easier for projects to be accepted or not. Whether projects will get the green light and launch and making resources and staff available for further development is a top-level decision, often involving the company's CEO. The differences between independent and corporate entrepreneurship are clear. Stevenson and Gumpert (1985) observed that an entrepreneur may be rejected 99 times but gets the go-ahead if one crucial respondent (e.g., customer, investor) approves the proposal. A corporate entrepreneur may be supported by 99 people in the organization for a project but is opposed by just one rejection (i.e., the CEO or president).

The field of corporate entrepreneurship includes various approaches and concepts. Some, like entrepreneurial posture and orientation and strategic renewal, are located at the firm level and are top-down, involving top management's active and facilitating role. Others, like entrepreneurial employee behavior and championing, are individual-level and bottom-up phenomena where creative people are the locus of initiatives and innovation (Bosma et al., 2010; Parker, 2011). This individual-level and bottom-up view on corporate entrepreneurship focusing on pro-active work-related initiatives of individual employees to develop new concepts, products, ventures, and business models for their employer is often called intrapreneurship (Antoncic & Hisrich, 2003; Bosma et al., 2010; Fry, 1987; Hisrich,

1990; Kuratko et al., 1990; Menzel et al., 2007). Pinchot (1987) coined the term *intrapreneurship* (short for intracorporate entrepreneurship) and *intraprise*, referring to an enterprise inside a company. Intrapreneurs have strong intrinsic motivation and commitment to develop an idea and turn it into reality: "Intrapreneurs are the self-appointed general managers of a new idea. They are responsible for moving the idea forward (Pinchot & Pellman, 1999, p.: 22). They rely on the crucial input provided by other idea generators and intrapreneurs, fellow venture team members, other supporters of innovation within the organization like sponsors and climate makers and are supported by mid-level and higher-level management. They are team players and are creative and proactive within the organization.

Some researchers view corporate entrepreneurship and intrapreneurship to be the same. However, we see intrapreneurship as a subsection of corporate entrepreneurship. It refers to creating new business ventures within existing organizations and developing new concepts, products, services, and technologies (Antoncic & Hisrich, 2003). It includes establishing an effective environment to advance intra-corporate entrepreneurship, actively promoting idea generation and experimentation, creating opportunities for free problem solving, and implementing multidisciplinary team approaches and other support structures (e.g., availability of time and other resources) (Fry, 1987; Hisrich, 1990).

It also refers to the entrepreneurial behavior of employees, highlighting personal initiative, actively searching for information and support, bottom-up team formation, and management backing, all aimed at innovation and new product and business development. Antoncic and Hisrich (2003) define intrapreneurship as entrepreneurship within an existing organization, referring to its employees' emergent intentions and behaviors related to departures from the customary. So any employee with an entrepreneurial spirit in an existing organization at any level and in any position can be defined as an intrapreneur (Menzel et al., 2007).

Five roles have been acknowledged in the intrapreneurial process (Pinchot & Pellman, 1999): the idea generator, the intrapreneur, the team (members), the sponsor, and the innovation climate maker. These roles can change with the idea generator becoming the intrapreneur and the innovation climate maker becoming an active sponsor of new business development.

An intrapreneur has a lot in common with an innovation champion (Greene et al., 1999). Champions keep ideas alive and move projects along within their organization. They do this by quickly recognizing the potential of new products and seizing market opportunities, committing themselves personally to these ideas and projects, advocating them projects internally, and generating support from other people throughout the organization to make these projects and products work (Markham & Aiman-Smith, 2001). Both intrapreneurs and champions have a long-term experience within the organization, in-depth knowledge, and a broad vision of the relevant sector(s) that launch new products and internal ventures. Both are willing to put themselves on the line for an idea of doubtful success, first within the organization and then in the market. Schon (1963: 84) argued almost five decades ago that innovation success is closely linked with the presence of a champion: 'the new idea either finds a champion or dies.' Champions are active innovators who take creative ideas (which they may or may not have generated). They bring these ideas to life by promoting them, generating enthusiasm and excitement, building support and commitment, overcoming resistance, and ensuring that these innovations are implemented (Howell & Higgins, 1990, 1991).

The literature distinguishes between four innovation champion roles: the organizational maverick, the network facilitator, the transformational leader, and the organizational buffer (Burgelman, 1983; Howell & Higgins, 1990, 1991; Shane, 1995). In the maverick role, the

champion offers autonomy from the organization's rules, procedures, and systems, thereby creating the necessary space for innovation. As a network facilitator, the champion seeks to develop cross-functional coalitions of managers across different functional areas of the organization, all aimed at promoting innovation. In the transformational leader role, the champion persuades other members of the organization to provide support for innovation. In the buffer role, the champion creates a loose monitoring system, ensuring that innovators can use the organizational resources and are free to act creatively. Like the intrapreneur, the champion is both loyal to the organization and committed to corporate innovation and renewal. The champion actively mobilizes creative co-workers, establishes multidisciplinary teams, and ensures the backing and support of mid-level and top-level managers.

Some authors have adopted a more narrow definition of a champion (Maidique, 1980; Sim et al., 2007). While intrapreneurs or innovators are active over the whole chain of product and project development and throughout all three phases of invention, opportunity identification and implementation, champions basically sell awareness and acceptance of new projects or products into their organizations. The champion model has had some successes with winning projects and products but in most cases it has failed with intrapreneurs leaving the company or cynicism popping up among those that remain (O'Connor et al., 2018). Companies should move beyond this champion model and implement a portfolio approach that develops multiple options of new business platforms and innovations. In addition, such a portfolio approach requires a full complement of different roles and distinct competency sets for their innovation professionals. In order to institutionalize innovation through people effectively, a company-wide innovation management system is also needed (O'Connor et al., 2018).

2.3 Academic intrapreneurship

In their overview of the state of the art of research in academic entrepreneurship, Siegel and Wright (2015a) mention that most studies are on the research/extension-outreach nexus, and only a few on the research-informed education/extension-outreach mission nexus. They mention the need "to embrace greater variety in the extent and nature of academic entrepreneurship in the context of the changing role and purpose of universities" (p. 593). Most analyses of academic entrepreneurship are based on a macro (institutional or firm) perspective. Micro-level perspectives on organizational commitment, organizational culture, and organizational justice within universities and research centers are lacking (Siegel & Wright, 2015a).

One of the few exceptions is the study by Siegel et al. (2003a), who identified that the key impediment to effective technology transfer tended to be organizational. More specifically, the most critical organizational factors in academic entrepreneurship and technology transfer were the informational barriers and cultural mismatch between universities and research centers and the private sector of small and large firms, the incentive structures for faculty involvement (e.g., pecuniary and nonpecuniary rewards (e.g., opportunities for tenure and promotion), and the promotion, staffing and compensation practices of the TTO itself. Unfortunately, the rewards for faculty involvement were often insufficient, and the actions taken by administrators to break down informational and cultural barriers between universities and firms were not very successful.

Another was the study of Bercovitz and Feldman (2008) into the adoption of technology transfer and organizational change at the individual level. This was only successful if the faculty member was well prepared and trained and peer groups supported it. A symbolic

reason to comply with entrepreneurial behavior was pressure from department chairs. Similarly, Baldini (2009) also studied the involvement of faculty in research commercialization and identified the following key potential obstacles: the lack of support from the university administration (including insufficient rewards, lack of a TTO, and patent fund), problems in the commercialization of the inventions (e.g., excessive bureaucracy), heavy teaching loads and administrative duties, and problems related to the knowledge of the university-level patent regulation.

Balven et al. (2018) suggested going even deeper than organizational factors making or breaking academic entrepreneurship and technology transfer, and shifting attention to its key protagonists: faculty members with their cognition, motivation, and behavior. Zucker and Darby (1996) were among the first to study the micro-micro level in detail by investigating star scientists, who were extraordinarily productive and played a key role in forming new industries and transforming existing ones. These excellent scientists were a link between universities and firms by moving back and forth from university to firm or collaborating at the bench-science level with fellow scientists at firms. Their boundary-spanning activities between academia and industry ensured that these star scientists generated significant scientific and financial results. Relevant in understanding the micro-foundations of academic entrepreneurship is the tension between TTO commercialization and education, role identity transition (open dissemination of research versus direct commercial sensitivity (secrecy), hybrid role identity (strains between a focal academic self and a secondary commercial person), and work-life balance issues (Jain et al., 2009).

Besides the limited investigation of the micro-processes in academic entrepreneurship, informal technology transfer has also been overlooked in research (Balven et al., 2018). Most research has examined the structured and formal process of technology transfer and patenting, licensing, and other contractual ways of academics engaging with industry. Informal transfer includes non-formalized contacts, talks, and meetings, the professor's privilege of engaging in industry and patenting, serving as a formally paid consultant to an industrial firm, direct collaboration of academics with industry personnel, and joint publications of faculty members with industry personnel (Grimpe & Fier, 2010). Research into phenomena such as faculty intentionally bypassing the TTO in transferring the technology or unintentionally side-stepping formal technology transfer processes is lacking (Balven et al., 2018; Huyghe et al., 2016).

The literature review on the concept of academic intrapreneurs reveals only two scientific articles that briefly touch on the concept while discussing entrepreneurial research universities (Shattock, 2003, 2008). A deeper focus on the phenomenon of academic intrapreneurship and a concrete definition is needed to accurately conceptualize academics as intrapreneurs. Intrapreneurship refers to creating new ventures and developing products, services, and technologies. Academic entrepreneurs do not often create new ventures but work alongside the private sector to transfer technology (Rothaermel et al., 2007). Academic intrapreneurs often remain inside the university environment (Meyer, 2003). They exhibit behavioral intentions that depart from their customary job descriptions, just as academic entrepreneurs leave their primary research and education roles to work alongside their respective TTOs and valorize their innovations. Champions are also internal leaders and entrepreneurs who take on creative ideas and bring them to life. Thus, academic intrapreneurship refers to the individual behavior of scientists who depart from their customary research and education initiatives and become involved in knowledge commercialization and product/service development without leaving academia.

2.4 Academic intrapreneurship in the context of academic medical centers

In the field of academic entrepreneurship, university medical hospitals are often overlooked as an object of study of knowledge commercialization, corporate venturing, and societal and economic impact (Bercovitz & Feldman, 2008; Louis et al., 1989; Silva & Ramos, 2018). Hospitals are in the words of Thune and Mina (2016: 1550)—hidden research and innovation systems. In their critical literature review on the role of hospitals in the generation of innovations, Thune and Mina (2016) have identified three streams—or better levels—of research: the micro-context of operation of innovative health care practitioners and their contribution to innovation, the meso-perspective conceptualizing the innovativeness of hospital organizations, the macro-roles of hospitals in innovations in health care value chains and in socio-technical systems of medical technologies. While universities and academic institutions have three missions (i.e., education, research, and engagement/outreach), university medical hospitals have a fourth, a less strategic but more operational mission, providing high-quality healthcare to patients (like any other hospital would do). Their primary processes and strategic orientations may support each other, but these different operations may be extremely complex to manage (Silva & Ramos, 2018). For example, they include offering daily clinical care, generating new knowledge from the findings of clinical trials and through basic and applied research, involving highly skilled staff educated and trained internally at its teaching facility, engaging with patient organizations and government agencies, and forming strategic collaborations to support advanced research, and new clinical trials with biomedical corporations. In running their primary processes and businesses, university medical hospitals face challenging issues (e.g., whether to invest additional funds in equipment, staff, patient care, or teaching/vocational training) and conflicting expectations of diverse internal and external constituencies.

Doctors and specialists have to combine different roles at the micro-level, creating tension, stress, and conflicts of interest. Their roles include managing the care of the patients, lecturing and training the new generation of medical specialists, carrying out path-breaking research and running clinical trials, and engaging with external stakeholders, such as government agencies, biomedical firms and patient groups. Confronted with these sometimes difficult to combine activities and overall unhappiness with regard to hospital management of because of their own entrepreneurial mindset, some physicians vote with their feet. They leave the hospital and become an entrepreneur by starting group practice formations and specialty clinics for themselves (e.g. radiology, plastic surgery, orthopedics, ophthalmology) or (co-)owning private hospitals (Wilson, 2008; Koelewijn et al., 2014). In this study the emphasis is not on spin-off entrepreneurship but on academic intrapreneurship by investigating the contribution of the university's medical researchers and clinical staff to the development of their novel technologies, tools and practices. In this organizational effort to promote and support innovation, the university's medical center seeks to guide and facilitate this process intendedly and occasionally and unintendedly may constrain it.

3 Methodology

To explore the relationship between the knowledge commercialization process and academic intrapreneurs, we must assess which important factors affect this relationship. We first empirically test whether the determinants of an environment conducive to

intrapreneurial behavior are transferable to an academic setting, while remaining attentive to inductively arising factors. Our theoretical contribution is to examine how academic intrapreneurs perceive the knowledge commercialization processes, how they affect their personal and organizational goals, and what factors affect them. We aim to decipher the level of involvement, influence, or control an academic intrapreneur has within the different stages of the knowledge commercialization process. We analyze the actors (academic intrapreneur, technology transfer officers, strategic partners), their organizations, and the context (university system and external environment) to examine the perception of internal control from the perspective of the academic intrapreneur and the university medical hospital.

3.1 The setting of the study

Like most university medical centres, Erasmus University Medical Centre (EMC), created in 2003 as a merger of the Academic Hospital Rotterdam and Erasmus University's Faculty of Medicine & Health, has four missions: patient care, education (training), research and valorization (service and engagement). The DS is an example of Erasmus MC's academic intrapreneurship and knowledge commercialization effort.[1] The idea for the DS was generated by Eric Sijbrands, a professor of internal medicine at Erasmus MC. He discovered that the number of diabetes patients in Rotterdam had rapidly increased and was afraid that he could no longer guarantee high-quality diabetes care to all patients in the future. Sijbrands can vividly remember how he came up with the idea: "In 2009, following an evaluation at our diabetes outpatient clinic, we found that nearly three-quarters of our patients barely spoke any Dutch. Because of this language barrier, we could not always help them as we wanted to (Interview with Erasmus Magazine, 14/02/20)." This challenge triggered a process of thinking about an ICT application that could solve the language issue and eventually resulted in the DS, with 24-h care, a telemedicine company, and its director Joop Wallenburg.

Initially, Sijbrands thought about developing a device that patients could use at their homes, but sensed that this would probably result in unreliable measurements. The DS is mobile and can be driven around the country in a small van, allowing doctors to get it close to their patients, such as older people living in the countryside. The examination and the discussion of the results can then take place in their own village, preventing them from the hassle of traveling to the hospital.

The DS operates as a virtual physician for diabetes patients. It allows diabetes patients to measure values, such as weight, blood pressure, and blood sugar levels, and assess their eyes and feet without the assistance of physicians or nurses. All data is assessed based on the threshold values the patient has entered in advance. If these are exceeded, the system will immediately provide information about the dangers involved. If necessary, patients are referred to their physician for early consultation. The physician receives this information via e-mail. If implemented, the DS can benefit society by allowing diabetes patients to play a more active role in treating their disease and allowing Erasmus MC to save operating expenses and reap the profits by licensing the technology to other hospitals and care facilities.

As a professor of internal medicine, Sijbrands is the academic intrapreneur behind the DS. The head of Erasmus MC's TTO, Rob Posthumus, and strategic partners in the

[1] The research for this case was conducted in 2014 and reflects the status of the DS at that time.

industry formed the Diabetes Steering Group to valorize the innovation. We first interviewed Professor Sijbrands. We used snowball sampling and conducted twelve individual respondent interviews. Respondents were selected based on their involvement in the development and/or validation of the DS knowledge commercialization project. Our questioning was tailored to each respondent to maximize the usability of our data. Three respondents were members of the DS steering group, two were employees at the University Medical Center's TTO, three were strategic partners at EMC, two were employees of the university's medical center, and two were diabetes patients embedded in the external environment.

3.2 Research design

This study relied on qualitative research methods and employed a semi-structured interview strategy. We developed a list of general questions and themes to be covered but allowed the interviews to be exploratory, allowing further questioning and probing when relevant themes arose. The general questions and themes list were developed based on The Corporate Entrepreneurship Climate Instrument (Kuratko et al., 1990). This diagnostic tool to assess, evaluate, and manage the firm's internal work environment to support entrepreneurial behavior and implement corporate entrepreneurship strategy (Ireland et al., 2006).

3.2.1 Corporate entrepreneurship climate instrument

The Corporate Entrepreneurship Climate Instrument highlights areas of the internal work environment that should be the focus of ongoing design and development efforts. Through the use of the Corporate Entrepreneurship Climate Instrument, many studies have consistently identified five specific factors, which are important determinants of an environment conducive to intrapreneurial behavior (Adonisi & Van Wyk, 2012; Hornsby et al., 1999, 2002, 2009; Kuratko et al., 2005a, 2005b; Rutherford & Holt, 2007).

Management support of corporate entrepreneurship involves how employees perceive the manager's willingness to facilitate and enhance entrepreneurial activities with an organization (Hornsby et al., 2002). *Work discretion* refers to the commitment of top managers to tolerate failure, provide decision-making latitude and freedom from excessive oversight, and delegate authority (Ireland et al., 2006). *Rewards and reinforcement* involve developing and using systems that reinforce entrepreneurial behavior, highlight significant achievements, and encourage the pursuit of challenging work (Ireland et al., 2006). *Time availability* refers to evaluating workloads to ensure that individuals and groups have the time needed to pursue innovation and that their positions are structured in ways that support efforts to achieve short and long-term organizational goals (Ireland et al., 2006). *Organizational boundaries* relate to the organizational structure, in which innovative ideas are evaluated, chosen, and deployed (Hornsby et al., 2002).

We created a questionnaire for our respondents based on the main themes of the Corporate Entrepreneurship Climate Instrument – (1) management support of corporate entrepreneurship, (2) work discretion, (3) rewards and reinforcement (4) time availability, (5) organizational boundaries, and (6) specific climate variables which organically originated from the interviews with participants in this study. We incorporated several questions for each theme to ensure that the Corporate Entrepreneurship Climate Instrument was applied to our questionnaire, and we could deduct results based on a wider study.

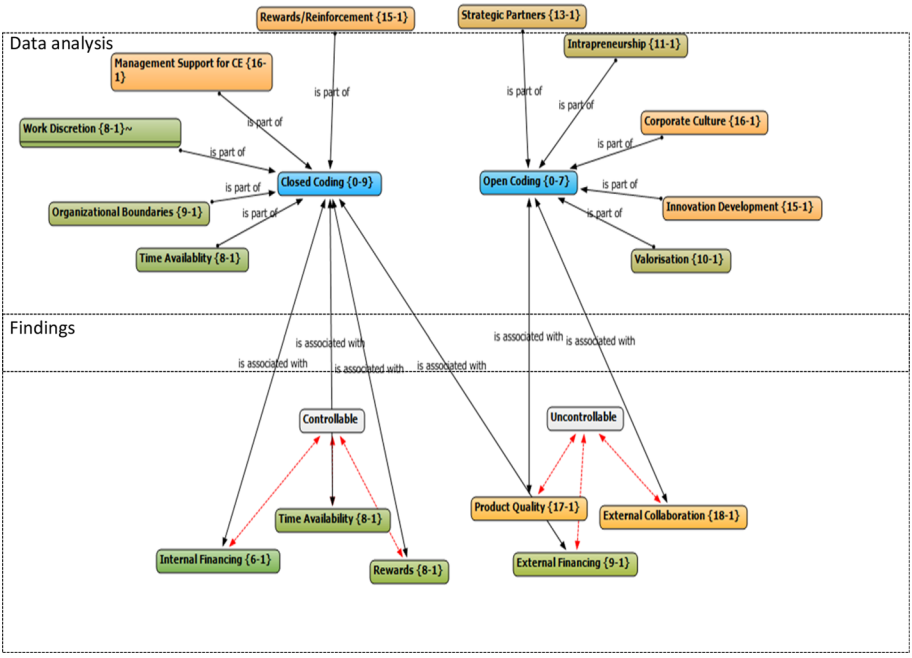

Fig. 1 Coding network

3.2.2 Evaluation and interviews

Each participant received a Participation Information Sheet which contained information about the nature of the research, respondent requirements, respondent rights, and whom to contact if any issues arose. Through this document, we gained the full consent of our respondents, who understood that the research was entirely voluntary and that they had the right to withdraw partially or completely from the process. Respondents were also informed about the Corporate Entrepreneurship Climate Instrument themes, which were the basis for the interviews.

To further triangulate our data, we used secondary data, including strategic press releases of the Erasmus MC referring to strategic planning on knowledge commercialization and press releases on the DS. Interviews ranged from 30 to 90 min. Ten interviews took place in the respective offices of the respondents. The two interviews with the diabetes patients were conducted via telephone to maintain anonymity and reduce inconvenience.

3.2.3 Analysis and coding process

After employing our qualitative research approach, we completed 12 audio-recorded, semi-structured interviews, which were subsequently transcribed. When analyzing our transcripts, we balanced the use of deductive coding, derived from the theoretical framework and inductive coding from themes emerging from respondent interviews. This combination

Table 1 Main findings

	Factors of perceived control	Factors of perceived influence
Theoretical confirmations	Time availability	External financing
	Internal financing	
	Rewards and reinforcement	
Theoretical implications		External collaboration
		Product quality

of deductive and inductive analysis is significant as it bridges the gap between theory and practice (Short et al., 2009). Fereday and Muir-Cochrane (2006) state that a deductive and inductive hybrid approach demonstrates rigor within a qualitative research study. In analyzing the interview transcripts and two triangulating documents, we used a combination of closed and open coding and performed a visual network analysis of our data. This process allowed us to identify how our codes were generated from the raw data to uncover themes, relationships, and analysis. One individual coder used the software tool Atlas.ti to interpret the data from our 12 interviews (Hwang, 2008).

4 Results

Figure 1 visually represents our research findings and data analysis, complete with density and groundedness. The results show that the relationship between academic intrapreneurs and the knowledge commercialization process within the DS at Erasmus MC was influenced by six factors (i.e., external collaboration, product quality, time availability, external financing, internal financing, and rewards and reinforcement). Four factors (i.e., external financing, internal financing, rewards and reinforcement, and time availability) were derived from the sum of unique quotations in our deductive closed codes. Two factors (i.e., external collaboration and product quality) were derived from the sum of unique quotations in our inductive open codes.

From an internal individual and organizational perspective, the academic intrapreneur and other individual-level actors involved in the commercialization of the DS at Erasmus MC found perceived time availability, rewards and reinforcement, and internal financing to be factors of within their control. External Collaboration, Product Quality, and External Financing were perceived to be factors of which they could merely influence (see Table 1).

To present our analysis in full detail, we will now discuss each of these factors in descending prominence from highly controllable and important to slightly influenced and of lesser importance (see Table 2).

4.1 Factors of perceived control

4.1.1 Time availability

The research findings indicate a great difference between Erasmus MC and their partnering organizations concerning the availability of time to pursue intrapreneurial initiatives and

Table 2 Factors of perceived control and influence at EMC

	Definition	Factors	Erasmus MC is perceived to have:
Perceived control	Perceived control is defined as the belief in one's ability to exert control over situations or events	Time availability	Control to recognize intraprenuerial initiatives and commercialization directly on employees' time schedules
		Rewards and reinforcement	Control to establish group-based rewards and recognition programmes for commercialization and intraprenuership
		Internal Financing	Control to allocate internal funding to intrapreneurial initiatives and commercialization
Perceived influence	Perceived influence can be defined as the belief in one's capacity to affect the character, development, or behavior of someone or something	External collaboration	Only a degree of influence over the collaboration with GPs and partnering organizations
		Product quality	Only a degree of influence over the product quality of the DS, which is more in the domain of the partnering organizations
		External financing	Only a degree of influence over the funding decisions of external organizations

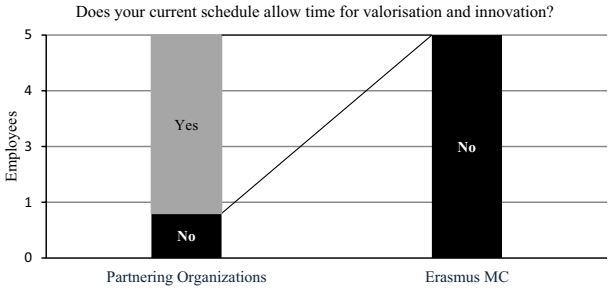

Fig. 2 Time availability chart

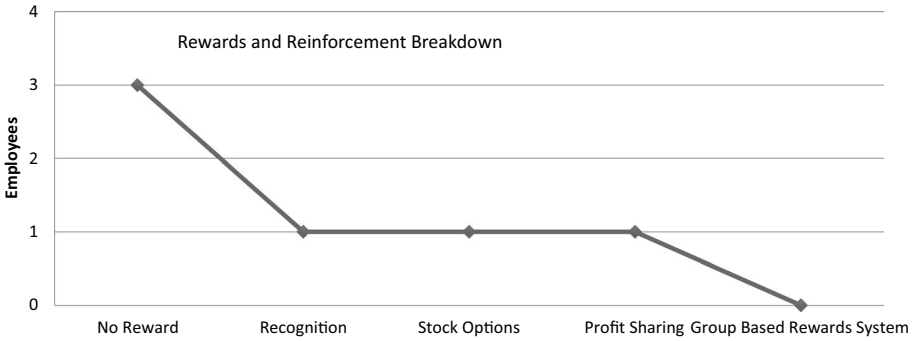

Fig. 3 Reward and reinforcement chart

commercialization. While commercialization is a mandate of Erasmus MC, it is not recognized as such in employees' time schedules. Thus, an entirely controllable factor affecting knowledge commercialization at Erasmus MC is time availability for commercialization (see Fig. 2). In an optimal environment, workloads are optimized to ensure that individuals and groups have time to achieve short- and long-term organizational goals. The academic intrapreneur generated the idea and the initial development of the DS in his own personal time: "*I invented this in my own time; there was no time included in my schedule for this*" (Intrapreneur Sijbrands).

He also collaborated with the technical company and sought the advice of an external diabetologist in his own free time. This suggests a commercialization 'time squeeze' at Erasmus MC. Although the intrapreneur and his department showed tremendous intrinsic motivation, other commercial initiatives suffered from these time constraints *"Some departments report a lack of time to do general tasks, so we just don't have time to invest in commercialization"* (Internal stakeholder at the university). Erasmus MC does not seem to ensure that employees have scheduled time to pursue commercialization, which is perceived as a controllable factor that affects intrapreneurial initiatives and commercialization.

4.2 Rewards and reinforcement systems

The research results suggest an imbalance in the rewards and reinforcement system for commercialization at Erasmus MC. While the current rewards and reinforcement system in place does reward profitable academic intrapreneurs both intrinsically and extrinsically,

these rewards are confined to the individual and their department (see Fig. 3). *"The policy is that part of the profits you generate with your invention goes to the inventors. 40% is for Erasmus MC, 40% is for the researcher's department, and 20% is for the researcher. That's the system we use. Some researchers have become very rich because of their inventions. So that's a stimulus"(*University administrator*).*

The DS was a group-based project, which extended outside the academic intrapreneur's department. Those who championed, sponsored, and advised the project aided its development entirely from their own intrinsic motivation. Most were not rewarded for their contributions to the project. The incompatible rewards and reinforcement system is a controllable factor, which inhibits commercialization and intrapreneurship at Erasmus MC. *"Rewarded? If you mean by money or anything. No."* (Member of the DS steering group). The intrapreneur inspired others to share his vision. He was motivated and enthusiastic, and his approach stimulated two key champions of the project to provide crucial support. One of the managers of the outpatient clinic at Erasmus MC) remarked: "*I tried to support it and generate enthusiasm with the doctors and their assistants at the outpatient clinic. At first, they didn't want to use it and preferred the old way of doing things.* " The second key champion was a director at a primary care organization, who was influential in generating vital support from the general practitioners: "I encouraged the doctors and tried to show them what I was thinking, but it was very difficult to get them along." Although one Erasmus MC employee working at the TTO office was rewarded with stock options in the venture, he also cited that intrinsic motivation was his central source of incentive: *"There was no money to pay me, so I got some shares, which are well virtually worthless, but that's part of the game. I got 2%, which is not much, but it was the idea, and I liked it."* These findings suggest that although Erasmus MC had a rewards and reinforcement system for profitable knowledge commercialization, it does not directly reflect group-based initiatives that span departmental boundaries. Therefore, due to the lack of incentives for champions, sponsors, and advisors of innovation, the rewards and reinforcement system of Erasmus MC is perceived as a controllable factor, that negatively affects knowledge commercialization within this institution.

4.3 Internal financing

Due to the skepticism and lack of financial commitment from external sources, some respondents wondered whether Erasmus MC could finance the DS internally. *"Erasmus could fund it because it's a minor amount, and then we could start and produce the data. Once we start producing data, it's much more difficult to stop this innovation, and we can just start implementing it"* (Intrapreneur Sijbrands). Although the steering group acknowledges the costs of constructing a new hospital, they are deeply passionate about their innovation and wary of external reproduction. "*I think people are afraid of investing in Erasmus MC and in the Netherlands. Nobody invests in anything, and I think that's completely wrong. We can never make a profit if we continue like this"* (Intrapreneur Sijbrands). Although this was the view of respondents closest to the DS, others raised the issue of budget availability in Erasmus MC's pillars of research, healthcare, and education. They argue that Erasmus MC's budget has decreased while the demand for healthcare is increasing. *"Budget availability is no longer a matter of course! While demand for healthcare is on the rise the available budget is declining"* (A university administrator). Investments in healthcare innovations are complex because of the long-time lags between idea generation

and value extraction. Due to the reluctance of external sources and the fear of external reproduction, internal financing is perceived as a controllable factor affecting the commercialization of the DS.

4.4 Factors of perceived influence

4.4.1 External collaboration

Diabetes care in the Netherlands is highly fragmented, with many organizations playing different roles. The DS's commercialization depends on the success of Erasmus MC's external collaboration, notably with general practitioners and partnering organizations within the project. *"In diabetes care, you can get a budget, and you have to stick to it. That's very difficult because you're organized in clusters or regions. You have to work with 40 or 50 organizations to decide how to spend the money to have the best care for diabetic patients in the region. It's very difficult and very complicated"* (TTO employee).

4.4.2 General practitioners as key stakeholders

One stakeholder group, which significantly impedes the knowledge commercialization of the DS, is the general practitioners (GPs) group. This group currently receives an amount of money per patient. Their income would be negatively affected if they were to recommend their patients to the DS. One of the strategic partners stated: *"Most GPs only think of the money they're going to lose"* (Strategic partner). The DS requires a general practitioner's referral, but it simultaneously decreases their earnings. The concerns of general practitioners are not purely financial. Contact between diabetes patients and their general practitioner is intensive, personal, and long-term, allowing general practitioners to monitor improvement and develop relationships with their patients. Their close connection and the lack of trust some general practitioners have in their patients' proposed self-management practices directly lead to their reluctance to participate in the DS project. *"The risk is that the GPs don't refer their patients to the DS and won't receive any income"* (TTO employee). *"There are 6000 GPs in the Netherlands—you can't do without them"* (Member of the Steering Committee).

However, Erasmus MC has some influence over the collaboration with GPs, due to its position as a university medical center and the medical expertise of Professor Sijbrands. "*The medical specialist made a good impression on me and many others. He explained the growing trend of diabetes patients very well. And it's very clear that if we don't take action, we'll end up with lots of problems in our diabetes care. And none of us are thinking about this. We're just so short-sighted (*Strategic partner). Erasmus MC can stimulate general practitioners and primary care organizations to join the DS project through the academic intrapreneur's enthusiasm, knowledge, and forward-thinking. "*Don't underestimate him! He's passionate about his work and attracts the attention of healthcare professionals. They're interested and intrigued. You get the entrance because he provides it and the rest you will have to cope with; their demands, their needs, and their expertise,* etc., *to make it into a neutral project, but at least he brings them to the table"* (TTO employee).

4.4.3 Partnering organizations

Due to the collaborative development of the DS, Erasmus MC must also effectively work alongside other partnering organizations, which provide the technical capabilities and the site location. These partnering organizations had various opinions about the collaborative competencies of Erasmus MC. *"They're a good partner. They keep us up to date, and we can always contact them if we have any questions. I don't really have any real complaints about them"* (Strategic partner). Others disagreed and mentioned that Erasmus MC inhibited the knowledge commercialization of the DS through bureaucratic reporting and excessive consultation requirements. *"Eric Sijbrands is a good partner, but the organization is too bureaucratic, and that's a real problem when you want to innovate. You have an idea, you ignore the company's rules, and make it successful. But that's not how it works at Erasmus. The entire organization is involved, which means you're spending more time on meetings and reporting than on the product. The fragmented diabetes care policy in the Netherlands and the strong connection between diabetes patients and their primary healthcare organizations are forcing Erasmus MC to manage its relationship with the general practitioners.*" (Strategic Partner) It must successfully manage the development of the DS in cooperation with a partnering organization. The relationships between Erasmus MC and the general practitioners affect the development of the DS but are not perceived to be entirely controllable by Erasmus MC but collectively influenced by several stakeholders.

4.4.4 Product quality

Compared to standard diabetes care in the Netherlands, the overall quality of the DS is a factor affecting its commercialization. The DS must immediately improve the quality of diabetes care before it can be included in the Dutch Medicine Reimbursement System. However, the DS steering group has no concerns about product quality: *"ES compared the measurements performed in the system with measurements performed in the standard practice. And there came writing out of it, a paper, saying that this was better. So there was the quality assessment" (Steering group member). "We've evaluated the quality and safety of the different parts but also demonstrated the predictability of the outcome. And that has been safeguarded."* (TTO employee). However, advisors and patients of the DS have a different perspective about the quality of the station. Although the DS can conduct most of the measurements necessary for an annual check-up for patients with type two diabetes, it does not substitute the current level of care. Currently, during a typical appointment, diabetes patients can ask their questions and answer questions about their lifestyle choices (smoking, eating, and exercise), after which a tailored treatment plan is developed. Therefore, the current version of the DS would have to be in operation alongside standard care. This raises concerns about its business practicality. *"If it increases care costs but doesn't improve the care, I don't see any chance of it being included in the Medicine* Reimbursement*"* (Strategic partner). Besides, although many components of the DS, such as the eye camera, are well developed, other components lack sufficient quality standards compared to current diabetes care. *"There's no substitute for a diabetes patient's feet in your hands checking the arterial pulsations! A machine cannot reproduce that"* (Strategic partner).

Besides the product quality concerns of the DS advisors, patients have also suggested the need to further improve the system. *"The DS doesn't interpret the information. I think it would be really helpful if the system could explain the information."* (Patient). Another patient was also critical: *"The DS is supposed to send our information directly to our file,*

but sometimes we don't receive it. It really needs to be improved. The same teething problems occur time after time" (Patient). The product quality of the DS seems to be a factor that can be influenced but not controlled internally. Its components, notably the foot scanner and its business practicality, need to be improved. To change the negative perception of some respondents, the steering group must continue to validate and incrementally improve the quality of the DS.

4.4.5 External financing

There is a strong relationship between financing and the commercialization of the DS. Healthcare innovations are characteristically long-term investments that require substantial funding to reach the market. The DS had financial problems from the beginning. KPN, a Dutch telecom company, was the initial financier of the DS, but a year and a half into the 3-year contract, they withdrew from the project. Following KPN's withdrawal, the DS returned to Erasmus MC, and a new version (v. 3.0) was developed, which is currently waiting for financial support from a Dutch social insurance company. Professor Sijbrands is optimistic: *"We finished the project more than a year ago and we're still waiting for the green light from one of our insurance companies. They talk a lot about innovations, especially these kinds of innovations, but they hardly ever fund them."*

The DS steering group thinks the insurance company is promoting the 'valley of death', a phrase used in venture capital to refer to the period from when an innovation receives initial capital to when it begins generating revenues (Auerswald & Branscomb, 2003). During this period, additional financing is typically scarce, leaving the innovation vulnerable to cash flow requirements. *"Our insurance companies are promoting the valley of death because they promise you all kinds of things, by saying—this is the best invention, the best business case ever—and then they do not respond anymore."* (Academic Intrapreneur) All members of the DS steering group and others involved in the project share resentment towards the insurers' lack of funding and transparency. In the case of the DS, the perception was that the academic intrapreneur did not have control of external financing. This perception is highly situational, stemming from a controversial debate whether finance is the result of human decision (and therefore controllable), or must be viewed in a wider economic context (and therefore merely influenced). The actors in Erasmus MC felt they could only influence external financing opportunities through incrementally improving the quality of the station.

5 Discussion

As we conceptualize it, academic intrapreneurship can be defined as entrepreneurship within academic institutions. It refers to academic researchers' emergent intentions and behaviors who depart from their customary research and education initiatives and instigate innovative activities and orientations such as transferring academic knowledge technology. Our empirical research findings confirm three factors: management support of academic intrapreneurship, time availability, and rewards and reinforcement are transferable to academic commercialization processes such as the DS. Due to the significant effect of a lack of financial resources (from internal and external sources) for the DS, we divided the factor management support of corporate entrepreneurship into internal and external financing. Using these two factors, we move away from Hornsby et al. (2002), who viewed

management support as championing innovation, providing resources, and institutionalizing entrepreneurial activities within an organization's processes. Instead, we focused entirely on the provision of resources. This is justified as a lack of funding was the most inhibiting managerial support factor within the knowledge commercialization process of the DS. As an intrapreneur himself, Fry (1987) first identified resource acquisition and availability as a factor correlated to corporate entrepreneurship. Kuratko et al. (1990) also found that resource availability is important for organizations introducing an academic intrapreneurship strategy. Like Kuratko et al. (1990), we found that the availability of funds and options for financial support was directly linked to corporate entrepreneurship strategy.

Time availability and rewards and reinforcement factors are directly transferable from the corporate entrepreneurship literature to our empirical research on the DS. Time Availability refers to the continuous evaluation of workloads to ensure that individuals and groups have the time to pursue innovation and that their positions are structured to support efforts to achieve short and long-term organizational goals (Ireland et al., 2006). Rewards and Reinforcement involve developing and using systems that reinforce entrepreneurial behavior, highlight significant achievements and encourage the pursuit of challenging work (Ireland et al., 2006), including targets, feedback, incentives based on results, and a continued focus on the responsibility of the individual employee (Hornsby et al., 2002). At an organizational level, the research findings suggest that although Erasmus MC has a rewards and reinforcement system in place for profitable commercialization, it does not directly reflect group-based initiatives that span departmental boundaries. Due to the lack of incentives for champions, sponsors, and advisors of innovation, the rewards and reinforcement system negatively affected the knowledge commercialization process of the DS. Organizationally, Erasmus MC does not ensure that their employees have available, scheduled time to pursue commercialization. This impacts effective knowledge commercialization and academic intrapreneurship.

As our research followed the development and validation of a specific product, one of our findings was that product quality greatly differed from our other six factors, which were more focused on the overall knowledge commercialization process. The factor, product quality, originated in our inductive coding due to significant reference to the DS's product design and detail engineering. Product quality has received significant attention in commercial practice and academic research due to its critical relevance for delivering customer value and competitive advantage. However, as product quality intersects the disciplines of philosophy, economics, marketing, and operations management, the academic result is a multitude of findings and competing perspectives. Garvin (1984) identified eight dimensions of product quality: performance features, reliability, conformance, durability, serviceability, aesthetics, and perceived quality.

From a user-based approach, the DS lacks reliability, conformance, and aesthetics compared to standard diabetes care in the Netherlands. This perspective was also highlighted by a diabetologist, who cited problems with the features and performance of the DS. Academic research has found that organizations can successfully pursue a competitive advantage if they focus on an as yet untapped dimension of quality. Thus, product quality should be the focus of the academic intrapreneur, TTO, and the strategic partners at an individual and organizational level as the knowledge commercialization process moves from realization to evaluation. A more effective balance of technical expertise and business acumen is required within this process to raise the quality of the end product. Otto (1999) found that university-based firms tend to focus on technical aspects of a venture to the detriment of the business side. Thus, to create significant and sustainable market demand for their

products, academic entrepreneurs must manage the resources and capabilities available so that their product outperforms others with respect to Garvin's (1984) eight elements of quality.

The inductive factor, external collaboration, originated in our open coding due to the continued reference to Erasmus MC's strategic partners. While historically, organizations have only relied on external outsourcing for simple functions and products (Mowery et al., 1996), there has been unprecedented and sustainable growth in corporate partnering and reliance on various forms of external collaboration (Hergert & Morris, 1988). The need to combine complementary assets played a prominent role in developing the DS. Erasmus MC developed the idea internally, one strategic partner provided the technical knowledge, and the other strategic partner provided the future location of the station and operating personnel. Managing this external collaboration and increased awareness of communication and reputation as a partner are all dynamic factors present in the DS knowledge commercialization process.

An implication of the importance of External Collaboration on individual academic intrapreneurs is the need to proactively move outside of their networks in academia and work closely alongside their strategic partners in private industry. Academic intrapreneurs who transition from academia to commercial markets should accept that their academic values of sharing knowledge openly may need to shift towards the commercial view of proprietary information for strategic advantage. At an organizational level, the academic intuition must be aware of its corporate culture and external reputation when transferring technology to the private sector. In the case of the DS, some strategic partners believed that Erasmus MC inhibited the process through bureaucratic reporting and excessive consultation requirements. This indicates that an academic institution's shared norms may greatly differ from their strategic partners, and a sustained effort to understand and be aware of these differing views will enable stronger external collaboration.

6 Conclusion

The core objective of our research was to determine the role of academic intrapreneurs perceived control and influence in knowledge commercialization processes. We showed that the perception of- the academic intrapreneur's control and influence seems to impact effectively transferring academic knowledge from academic institutions to the private sector for economic and societal benefit. At an individual level of analysis, actors in the process perceived external financing, external collaboration, and product quality as factors that academic intrapreneurs can influence but not control entirely. As these three factors are more associated with the later stages (evaluation and commercialization) than earlier stages (idea and realization) in knowledge transfer, the academic intrapreneur perceived that his level of control decreased as the DS moved towards the market. At the organizational level, the academic intrapreneur and other individual actors perceived that university management had complete control over the factors of time availability, internal financing, and rewards and reinforcement.

Our study highlights three controllable areas of an academic institution's internal work environment that can enhance the relationship between knowledge valorization and academic intrapreneurship. The first is time availability. The workloads of internal employees should be reevaluated to ensure that individuals and groups have the time to pursue innovation and structure positions in ways that support efforts to achieve short and long-term

organizational goals. The second refers to the academic intrapreneur's rewards and reinforcements. Management should focus on the continued development of systems that reinforce intrapreneurial behavior and highlight significant achievements. The third refers to internal financing. University management should strive to create more options for financial support for high-potential innovative projects. University management will benefit from the lessons learned from the DS and make future portfolio management decisions to facilitate their academic intrapreneurs and enhance knowledge commercialization.

This research has limitations. Despite our efforts, a greater understanding of the knowledge commercialization activities and strategy within university hospitals and other academic institutions is needed. The scope of our research was confined to one single knowledge commercialization process within an academic hospital. Another internal research project at Erasmus MC or another university hospital may produce different results. Although we believe that our research findings are highly reliable, we understand that case-study research has limitations and that semi-structured interviews will not allow for statistical generalizations about the entire population. We encourage other researchers to empirically test the determinants of an environment conducive to intrapreneurial behavior at academic institutions and university medical schools throughout the world. This will result in the continued expansion of our theoretical understanding of the relationship between knowledge commercialization and academic intrapreneurship.

References

Adonisi, M., & Van Wyk, R. (2012). The influence of market orientation, flexibility and job satisfaction on corporate entrepreneurship. *International Business and Economics Research Journal, 11*(5), 477–486.

Andriessen, D. G. (2005). *Value, valuation and commercialization*. Den Haag: Krie.

Antoncic, B., & Hisrich, R. D. (2003). Clarifying the intrapreneurship concept. *Journal of Small Business and Enterprise Development, 10*(1), 7–24.

Auerswald, P. E., & Branscomb, L. M. (2003). Valleys of death and Darwinian seas: Financing the invention to innovation transition in the United States. *Journal of Technology Transfer, 28*(3–4), 227–239.

Baldini, N. (2009). Implementing Bayh–Dole-like laws: Faculty problems and their impact on university patenting activity. *Research Policy, 38*(8), 1217–1224.

Balven, R., Fenters, V., Siegel, D. S., & Waldman, D. (2018). Academic entrepreneurship: The roles of identity, motivation, championing, education, work-life balance, and organizational justice. *Academy of Management Perspectives, 32*(1), 21–42.

Barringer, B. R., & Bluedorn, A. C. (1999). The relationship between corporate entrepreneurship and strategic management. *Strategic Management Journal, 20*(5), 421–444.

Bercovitz, J., & Feldman, M. (2008). Academic entrepreneurs: Organizational change at the individual level. *Organization Science, 19*(1), 69–89.

Bosma, N. S., Stam, F. C., & Wennekers, A. R. M. (2010). *Intrapreneurship: An international study*. EIM Research report.

Burgelman, R. A. (1983). A process model of internal corporate venturing in a diversified major firm. *Administrative Science Quarterly, 28*(2), 223–244.

Cantaragiu, R. (2012). Towards a conceptual delimitation of academic entrepreneurship. *Management and Marketing, 7*(4), 683–700.
Cassar, G. (2007). Money, money, money? A longitudinal investigation of entrepreneur career reasons, growth preferences, and achieved growth. *Entrepreneurship and Regional Development, 19*(1), 89–107.
Chapple, W., Lockett, A., Siegel, D. S., & Wright, M. (2005). Assessing the relative performance of U.K. university technology transfer offices: parametric and non-parametric evidence. *Research Policy, 34*(3), 369–384.
Clarysse, B., Tartari, V., & Salter, A. (2011). The impact of entrepreneurial capacity, experience and organizational support on academic entrepreneurship. *Research Policy, 40*(8), 1084–1093.
Clarysse, B., Wright, M., Lockett, A., Van de Velde, E., & Vohora, A. (2005). Spinning out new ventures: A typology of incubation strategies from European research institutions. *Journal of Business Venturing, 20*(2), 183–216.
Covin, J. G., & Miles, M. P. (1999). Corporate entrepreneurship and the pursuit of competitive advantage. *Entrepreneurship Theory and Practice, 23*(3), 47–63.
Covin, J. G., & Slevin, D. P. (1991). A conceptual model of entrepreneurship as firm behavior. *Entrepreneurship Theory and Practice, 16*(1), 7–26.
Crow, M. M., Whitman, K., & Anderson, D. M. (2020). Rethinking academic entrepreneurship: University governance and the emergence of the academic enterprise. *Public Administration Review, 80*(3), 511–515.
D'Este, P., & Perkmann, M. (2011). Why do academics engage with industry? The entrepreneurial university and individual motivations. *Journal of Technology Transfer, 36*(3), 316–339.
DiMasi, J. A., Hansen, R. W., & Grabowski, H. G. (2003). The price of innovation: New estimates of drug development costs. *Journal of Health Economics, 22*(2), 151–185.
Echols, A. E., & Neck, C. P. (1998). The impact of behaviors and structure on corporate entrepreneurial success. *Journal of Managerial Psychology, 13*(1/2), 38–46.
Etzkowitz, H. (1992). Individual investigators and their research groups. *Minerva, 30*(1), 28–50.
Etzkowitz, H. (2003). Research groups as "quasi-firms": The invention of the entrepreneurial university. *Research Policy, 32*(1), 109–121.
Etzkowitz, H. (2004). The evolution of the entrepreneurial university. *International Journal of Technology and Globalisation, 1*(1), 64–77.
Etzkowitz, H., & Peters, L. S. (1991). Profiting from knowledge: Organizational innovations and the evolution of academic norms. *Minerva, 29*, 133–166.
Etzkowitz, H., Webster, A., Gebhardt, C., & Terra, B. R. C. (2000). The future of the university and the university of the future: Evolution of ivory tower to entrepreneurial paradigm. *Research Policy, 29*(2), 313–330.
Fereday, J., & Muir-Cochrane, E. (2006). Demonstrating rigor using thematic analysis: A hybrid approach of inductive and deductive coding and theme development. *International Journal of Qualitative Methods, 5*(1), 80–92.
Floyd, S. W., & Wooldridge, B. (1999). Knowledge creation and social networks in corporate entrepreneurship: The renewal of organizational capability. *Entrepreneurship Theory and Practice, 23*(3), 123–144.
Franklin, S., Wright, M., & Lockett, A. (2001). Academic and surrogate entrepreneurs and university spinout companies. *Journal of Technology Transfer, 26*(1–2), 127–141.
Friedman, J., & Silberman, J. (2003). University technology transfer: Do incentives, management and location matter? *Journal of Technology Transfer, 28*(1), 17–30.
Fry, A. (1987). The Post-It-Note: An intrapreneurial success. *SAM Advanced Management Journal, 52*(3), 4–9.
Garvin, D. A. (1984). What does "product quality" really mean. *Sloan Management Review, 26*(1), 25–43.
Greene, P. G., Brush, C. G., & Hart, M. M. (1999). The corporate venture champion: A resource-based approach to role and process. *Entrepreneurship Theory and Practice, 23*(3), 103–122.
Grimpe, C., & Fier, H. (2010). Informal university technology transfer: A comparison between the United States and Germany. *Journal of Technology Transfer, 35*(6), 637–650.
Hayter, C. S. (2011). *What drives an academic entrepreneur: New research seeks to understand a start-up's definition of success*. New York Academy of Sciences.
Henrekson, M., & Rosenberg, N. (2001). Designing efficient institutions for science-based entrepreneurship: Lessons from the US and Sweden. *Journal of Technology Transfer, 26*(3), 207–231.
Hergert, M., & Morris, D. (1988). Trends in international collaborative agreements. In F. Contractor & P. Lorange (Eds.), *Cooperative strategies in international business* (pp. 99–109). Lexington Books.
Hisrich, R. D. (1990). Entrepreneurship/intrapreneurship. *American Psychologist, 45*(2), 209–222.

Hitt, M. A., Ireland, D. R., & Hoskisson, E. R. (2001). *Strategic management: Competitiveness and globalization*. SouthWestern.

Hornsby, J. S., Kuratko, D. F., & Montagno, R. V. (1999). Perception of internal factors for corporate entrepreneurship: A comparison of Canadian and US managers. *Entrepreneurship Theory and Practice, 24*(2), 9–24.

Hornsby, J. S., Kuratko, D. F., Shepherd, D. A., & Bott, J. P. (2009). Managers' corporate entrepreneurial actions: Examining perception and position. *Journal of Business Venturing, 24*(3), 236–247.

Hornsby, J. S., Kuratko, D., & Zahra, S. (2002). Middle managers' perception of the internal environment of corporate entrepreneurship: Assessing a measurement scale. *Journal of Business Venturing, 17*(3), 253–273.

Hossinger, S., Block, J., Chen, X., & Werner, A. (2021). Venture creation patterns in academic entrepreneurship in academic entrepreneurship: The role of founder motivations. *Journal of Technology Transfer*. https://doi.org/10.1007/s10961-021-09904-y

Howell, J. M., & Higgins, C. A. (1990). Champions of technological innovation. *Administrative Science Quarterly, 35*(2), 317–341.

Howell, J. M., & Higgins, C. A. (1991). Champions of change: Identifying, understanding, and supporting champions of technological innovations. *Organizational Dynamics, 19*(1), 40–55.

Huyghe, A., Knockaert, M., Piva, E., & Wright, M. (2016). Are researchers deliberately bypassing the technology transfer office? An analysis of TTO awareness. *Small Business Economics, 47*(3), 589–607.

Hwang, S. (2008). Utilizing qualitative data analysis software: A review of Atlas.ti. *Social Science Computer Review, 26*(4), 519–527.

Ireland, D. R., Kuratko, D. F., & Morris, M. H. (2006). A health audit for corporate entrepreneurship: Innovation at all levels. *Journal of Business Strategy, 27*(1), 10–17.

Jacob, M., Lundqvist, M., & Hellsmark, H. (2003). Entrepreneurial transformations in the Swedish university system: The case of Chalmers University of Technology. *Research Policy, 32*(9), 1555–1568.

Jain, S., George, G., & Maltarich, M. (2009). Academics or entrepreneurs? Investigating role identity modification of university scientists involved in commercialization activity. *Research Policy, 38*(6), 922–935.

Jensen, R. A., & Thursby, M. C. (2001). Proofs and prototypes for sale: The licensing of university inventions? *American Economic Review, 91*(1), 240–259.

Jones-Evans, D., & Klofsten, M. (1999). Creating a bridge between university and industry in small European Countries: The role of the industrial liaison office. *R&D Management, 29*(1), 47–56.

Kingma, B. (2011). *Academic entrepreneurship and community engagement: Scholarship in action and the syracuse miracle*. Edward Elgar Publishing.

Klofsten, M., & Jones-Evans, D. (2000). Comparing academic entrepreneurship in Europe–the case of Sweden and Ireland. *Small Business Economics, 14*(4), 299–309.

Koelewijn, W. T., de Rover, M., Ehrenhard, M. L., & van Harten, W. H. (2014). Physician' entrepreneurship explained: A case study of intra-organizational dynamics in Dutch hospitals and specialty clinics. *Human Resources for Health, 12*(1), 1–12.

Kuratko, D. F., Hornsby, J. S., & Bishop, J. W. (2005a). Managers' corporate entrepreneurial actions and job satisfaction. *International Entrepreneurship and Management Journal, 1*(3), 275–291.

Kuratko, D. F., Hornsby, J. S., & Goldsby, M. G. (2004). Sustaining corporate entrepreneurship: Modeling perceived implementation and outcome comparisons at organizational and individual levels. *International Journal of Entrepreneurship and Innovation, 5*(2), 77–89.

Kuratko, D. F., Ireland, R. D., Covin, J. G., & Hornsby, J. S. (2005b). A model of middle-level managers' entrepreneurial behavior. *Entrepreneurship Theory and Practice, 29*(6), 699–716.

Kuratko, D., Montagno, R. V., & Hornsby, J. (1990). Developing an intrapreneurial assessment instrument for an effective corporate entrepreneurial environment. *Strategic Management Journal, 1*, 49–58.

Link, A. N., & Scott, J. T. (2015). Research, science, and technology parks. In A. N. Link, D. S. Siegel, & M. Wright (Eds.), *The Chicago handbook of university technology transfer and academic entrepreneurship* (pp. 168–187). University of Chicago Press.

Link, A. N., Siegel, D. S., & Bozeman, B. (2007). An empirical analysis of the propensity of academics to engage in informal university technology transfer. *Industrial and Corporate Change, 16*(4), 641–655.

Lockett, A., & Wright, M. (2005). Resources, capabilities, risk capital and the creation of university spin-out companies. *Research Policy, 34*(7), 1043–1057.

Louis, K. S., Blumenthal, D., Gluck, M. E., & Stoto, M. A. (1989). Entrepreneurs in academe: An exploration of behaviors among life scientists. *Administrative Science Quarterly, 34*(1), 110–131.

Lumpkin, G. T., & Dess, G. G. (1996). Clarifying the entrepreneurial orientation construct and linking it to performance. *Academy of Management Review, 21*(1), 135–172.

Maidique, M. A. (1980). Entrepreneurs, champions, and technological innovation. *Sloan Management Review, 21*(2), 59–76.
Markham, S. K., & Aiman-Smith, L. (2001). Product champions: Truths, myths and management. *Research-Technology Management, 44*(3), 44–50.
Markman, G. D., Phan, P. H., Balkin, D. B., & Gianiodis, P. T. (2005). Entrepreneurship and university-based technology transfer. *Journal of Business Venturing, 20*(2), 241–263.
McFadzean, E., O'Loughlin, A., & Shaw, E. (2005). Corporate entrepreneurship and innovation part 1: The missing link. *European Journal of Innovation Management, 8*(3), 350–372.
Menzel, H. C., Aaltio, I., & Ulijn, J. M. (2007). On the way to creativity: Engineers as intrapreneurs in organizations. *Technovation, 27*(12), 732–743.
Merton, R. K. (1957). Priorities in scientific discovery: A chapter in the sociology of science. *American Sociological Review, 22*(6), 635–659.
Meyer, M. (2003). Academic entrepreneurs or entrepreneurial academics? Research-based ventures and public support mechanisms. *R&D Management, 33*(2), 107–118.
Mian, S. A., & Hulsink, W. (2009). Building knowledge ecosystems through science and technology parks. In: *26th IASP World Conference on Science and Technology Parks proceedings, Research Triangle Park, NC*.
Mian, S. A. (2011). University's involvement in technology business incubation: What theory and practice tell us? *International Journal of Entrepreneurship and Innovation Management, 13*(2), 113–121.
Mian, S., Fayolle, A., & Lamine, W. (2012). Building sustainable regional platforms for incubating science and technology businesses. *International Journal of Entrepreneurship and Innovation, 13*(4), 279–291.
Mian, S. A., Klofsten, M., & Lamine, W. (Eds.). (2021). *Handbook of research on business and technology incubation and acceleration: A global perspective*. Edward Elgar Publishing.
Miller, D. (1983). The correlates of entrepreneurship in three types of firms. *Management Science, 29*(7), 770–791.
Mowery, D. C., Nelson, R. R., Sampat, B. N., & Ziedonis, A. A. (2001). The growth of patenting and licensing by US universities: An assessment of the effects of the Bayh-Dole Act of 1980. *Research Policy, 30*(1), 99–119.
Mowery, D. C., Oxley, J. E., & Silverman, B. S. (1996). Strategic alliances and interfirm knowledge transfer. *Strategic Management Journal, 17*(S2), 77–91.
Nelson, A. J., & Byers, T. (2015). Challenges in university technology transfer and the promising role of entrepreneurship education. In A. N. Link, D. S. Siegel, & M. Wright (Eds.), *The Chicago handbook of university technology transfer and academic entrepreneurship* (pp. 138–167). University of Chicago Press.
O'Connor, G. C., Corbett, A. C., & Peters, L. S. (2018). *Beyond the champion: Institutionalizing innovation through people*. Stanford University Press.
Otto, J. (1999). *Entrepreneurship skills for scientists and engineers: Recent European initiatives*. The IPTS Report.
Parker, S. C. (2011). Intrapreneurship or entrepreneurship? *Journal of Business Venturing, 26*(1), 19–34.
Perkmann, M., Salandra, R., et al. (2021). Academic engagement: A review of the literature 2011–2019. *Research Policy, 50*(1), 104114.
Perkmann, M., Tartari, V., et al. (2013). Academic engagement and commercialization: A review of the literature on university–industry relations. *Research Policy, 42*(2), 423–442.
Philpott, K., Dooley, L., O'Reilly, C., & Lupton, G. (2011). The entrepreneurial university: Examining the underlying academic tensions. *Technovation, 31*(4), 161–170.
Pinchot, G. (1987). Innovation through Intrapreneuring. *Research Management, 30*(2), 14–19.
Pinchot, G., & Pellman, R. (1999). *Intrapreneuring in action: A handbook for business innovation*. Berrett-Koehler Publishers.
Rothaermel, F. T., Agung, S. D., & Jiang, L. (2007). University entrepreneurship: A taxonomy of literature. *Industrial and Corporate Change, 16*(4), 691–791.
Rutherford, M. W., & Holt, D. T. (2007). Corporate entrepreneurship: An empirical look at the innovativeness dimension and its antecedents. *Journal of Organizational Change Management, 20*(3), 429–446.
Schon, D. A. (1963). Champions for radical new inventions. *Harvard Business Review, 41*, 77–86.
Shane, S. (1995). Uncertainty avoidance and the preference for innovation championing roles. *Journal of International Business Studies, 26*(1), 47–68.
Shane, S. (2004). *Academic entrepreneurship: University spinoffs and wealth creation*. Edward Elgar.
Sharma, P., & Chrisman, S. J. J. (1999). Toward a reconciliation of the definitional issues in the field of corporate entrepreneurship. *Entrepreneurship Theory & Practice, 23*(3), 83–103.
Shattock, M. L. (2003). *Managing successful universities*. Open University Press.

Shattock, M. (2008). *Entrepreneurialism in universities and the knowledge economy: Diversification and organizational change in European higher education*. Open University Press.

Short, J. C., Broberg, J. C., Cogliser, C. C., & Brigham, K. C. (2009). Construct validation using computer-aided text analysis (CATA): An illustration using entrepreneurial orientation. *Organizational Research Methods, 13*(2), 320–347.

Siegel, D. S., Waldman, D., & Link, A. N. (2003a). Toward a model of the effective transfer of scientific knowledge from academicians to practitioners: Qualitative evidence from the commercialization of university technologies. *Journal of Engineering and Technology Management, 21*(1), 115–142.

Siegel, D., Waldman, D., & Link, A. N. (2003b). Assessing the impact of organizational practices on the productivity of university technology transfer offices: An exploratory study. *Research Policy, 32*(1), 27–48.

Siegel, D. S., & Wright, M. (2015a). Academic entrepreneurship: Time for a rethink? *British Journal of Management, 26*(4), 582–595.

Siegel, D. S., & Wright, M. (2015b). University technology transfer offices, licensing, and start-ups. In A. N. Link, D. S. Siegel, & M. Wright (Eds.), *The Chicago handbook of university technology transfer and academic entrepreneurship* (pp. 84–103). University of Chicago Press.

Silva, P. J., & Ramos, K. S. (2018). Academic medical centers as innovation ecosystems: Evolution of industry partnership models beyond the Bayh-Dole Act. *Academic Medicine, 93*(8), 1135–1141.

Sim, E. W., Griffin, A., Price, R. L., & Vojak, B. A. (2007). Exploring differences between inventors, champions, implementers and innovators in creating and developing new products in large, mature firms. *Creativity and Innovation Management, 16*(4), 422–436.

Stevenson, H. H., & Gumpert, D. E. (1985). The heart of entrepreneurship. *Harvard Business Review, 85*(2), 85–94.

Stuart, T. E., & Ding, W. W. (2006). When do scientists become entrepreneurs? The social structural antecedents of commercial activity in the academic life sciences. *American Journal of Sociology, 112*(1), 97–144.

Thune, T., & Mina, A. (2016). Hospitals as innovators in the health-care system: A literature review and research agenda. *Research Policy, 45*(8), 1545–1557.

Thursby, J. G., Jensen, R. A., & Thursby, M. C. (2001). Objectives, characteristics and outcomes of university licensing: A survey of major US universities. *Journal of Technology Transfer, 26*(1–2), 109–124.

Vohora, A., Wright, M., & Lockett, A. (2004). Critical junctures in the development of university high-tech spinout companies. *Research Policy, 33*(1), 147–175.

Wilson, R. C., Carraher, S. M., Carraher, S. C., Ferris, G. R., & Carraher, C. E. (2008). When entrepreneurship and ethics collide: The case of physician-owned specialty hospitals. *Journal of Applied Management and Entrepreneurship, 13*(1), 68–83.

Winfield, I. (2004). Fostering social entrepreneurship through liberal learning in the social sciences. *Peer Review, 7*(3), 15–17.

Wright, M., Clarysse, B., Mustar, P., & Lockett, A. (2007). *Academic entrepreneurship in Europe*. Edward Elgar.

Zahra, S. A. (1993). A conceptual model of entrepreneurship as firm behavior: A critique and extension. *Entrepreneurship Theory and Practice, 17*(4), 5–21.

Zhang, J. (2007). *A study of academic entrepreneurs using venture capital data*. IZA Discussion Papers, No. 2992.

Zucker, L. G., & Darby, M. R. (1996). Star scientists and institutional transformation: Patterns of invention and innovation in the formation of the biotechnology industry. *Proceedings of the National Academy of Sciences, 93*(23), 12709–12716.