The influence of the of initial network on the timing of Turn-to-Market decisions in research-based spin-offs

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Abstract

Because of a protected situation in early life, many academic spin-offs need to make the transition from a technology-based point of view to a market-based focus. The decision that initiates the change in focus is called the Turn-to-Market.

This paper argues that the size and the diversity of the initial network of an academic spin-off have a direct influence on the Turn-to-Market decision. It is useful to not only consider the likelihood of this decision but also its timing relative to the achievement of technological success by means of a prototype. This opens up content-related and methodology-related areas of investigation that have not been looked into yet.

Keywords: Academic spin-off, Turn-to-Market, timing, initial network, prototype

Introduction

Academic spin-offs are increasingly seen as an important source of innovation and potential economic progress (Clarysse, Degroof and Heirman 2003). A growing stream of research has addressed diverse aspects of their development, ranging from survival (McGrath 1999; Nerkar and Shane 2003), learning (Liebeskind et al. 1996; Owen-Smith and Powell 2004; Powell 1996), IPO (Lerner 1992), new product development (Rothaermel and Deeds 2004; Schoonhoven, Eisenhardt and Lyman 1990), patenting and innovation performance (Hagedoorn and Cloodt 2003), and growth (Zucker, Darby and Armstrong 2002).

All of those dimensions are important and relevant in evaluating a company's evolution, but they capture only partially the relevant factors.

Given that academic spin-offs originate in non-commercial settings, we claim a complementary aspect of development is whether they manage to turn to the outside world and focus on market-related issues as well as technical ones. A crucial role in this turn-to-market is played by the network a spin-off has at start-up (Nicolau and Birley 2003; Oliver 2004). Therefore this paper will look in detail into the role initial networks play in the turn-to-market. More precisely, the influence on the timing of the first decision to open up to the market is investigated.

This paper proceeds as follows. First we will outline the specific situation of academic spin-offs and how this calls for more market-oriented performance measures. We then proceed to outline the concept of turn-to-market and present a simple framework to discuss timing issues. The third section covers the role of networks and links them to the turn-to-market. In the fourth section a brief case study illustrates a number of items that emanate from the discussion.

1. The specific situation of academic spin-offs

We consciously limit the reach of this study to companies set up to commercialize results from research funded by public money. This includes universities and research centres, but not corporate R&D departments. As such our focus is on academic spin-offs (Shane and Stuart 2002). In the remainder of this text we will often refer to them as ACSOs

On the one hand, those spin-offs are just a subcategory of all high-tech new ventures and develop along similar evolutionary paths from conception of an initial idea to stability (Erikson 2002; Kazanjian 1988; Kazanjian and Drazin 1989). On the other hand, an ACSO's origins in a strictly non-commercial setting make it different in the environment it faces during its early life (Liebeskind. et al. 1996). Those differences show up in issues of legitimacy, ambiguous boundary definition and commercial shielding.

Gaining legitimacy is often a major issue for an academic spin-off. They are built on fundamental scientific findings and aim to develop technologies and products that are very new to existing markets. This implies that market education is necessary and that new industries may be created in the process. In such a new context, firms need to gain cognitive and socio-political legitimacy to establish themselves (Aldrich and Fiol 1994; Delmar and Shane 2004).

In a new and developing environment boundaries are often not clear (Munir and Philips 2002). The field or sector-in-development is a vague and flexible notion that is continuously adjusted as the companies in them evolve.

Finally, and most importantly, the environment faced by ACSOs provides to some extent protection from full-blown competition. In almost all cases, the spin-off is embedded in a web of relationships that offer resources that do not – or only to a limited extent – depend on market conditions (Oliver 2004; Powell 1998). Examples of such relations are venture capitalists, research institutions or large corporate organizations. The protection provides a grace period or honeymoon during which the young firm can fully focus on its own development without being affected too much by adverse external events (Venkataraman and Van de Ven 1998).

The protective situation offered by the environment is, however, of limited duration. After a period of time, the length of which can vary from company to company, the spin-off emerges from it and faces the competitive arena. Whereas performance during the honeymoon period can be adequately measured by focusing on technological or company-internal elements, this is no longer the case in a full-blown competitive setting. Success may now depend to an important extent on whether the ACSO has been able to shift its focus from a technology push to a market pull. In other words, the transition from a technology-driven vision to a market-driven one is key.

2. Turn-to-Market and development

This section analyses the shift from a technology to a market orientation in high-tech spin-offs. We start by exploring the meaning of a market orientation and how it impacts on the whole company. Attention then shifts to the turning point, the decision or event that marks the start of the shift towards a market orientation. Finally the third paragraph outlines that the timing of this decision, rather than just its occurrence, is of importance.

2.1 Developing a market orientation

The transition from a technology oriented to a market-oriented vision is a gradual process that may take a long time and engages the whole of the start-up. Researchers have extensively studied the construct of "market orientation" before (Han 1998; Jaworski and Kohli 1993; Kohli, Jaworski and Kumar 1993; Slater and Narver 1994, 1995; Workman 1998). Although their main focus was on larger and/or established companies, the core tenets are applicable to start-ups and ACSOs as well.

First of all the market orientation mandates certain behavioural and decision-making components in the organization (Narver and Slater 1990). The former include a customer orientation, a competitior orientation and interfunctional coordination. The latter consist of a long-term focus and profitability as the overriding objective.

A different perspective on market orientation zooms in on the processes that need to be present (Kohli and Jaworski 1990). In this view the core issues are market intelligence generation, dissemination of this intelligence throughout the organization and responsiveness that causes the firm to react to the intelligence.

The perspectives on market orientation presented here both stress a major point: they require a transformation of the whole ACSO. Behaviour and decision criteria imply that the strategy needs to change and that the ACSO must align all its operations and processes to it (Porter 1996). If it is done properly it may pave the way for the spin-off to become very successful, even to the point where it outmatches its previously dominant competitors (Bower and Christensen 1995). The crux of the matter, however, is that this transformation can be long, difficult to achieve and complex.

The development of a market orientation needs to be put into perspective. It is an additional dimension of performance that supplements the more traditional ones, but definitely not a replacement for it. There are two reasons for this.

The first one is that not all ACSOs need to transform into market-oriented companies. Anecdotal evidence suggests It is not uncommon for start-ups to develop a technology platform far enough to turn themselves into a takeover target for large companies[1]. Those spin-offs do not feel the same urge to get out of their protective environment and take on a market focus. In such cases a market orientation based performance assessment has little – if any – relevance.

Another thing to bear in mind is that technological achievements are a necessary – but not sufficient – condition for success in the marketplace (Gans and Stern 2003). This means there is a dependence of market related success on technology related achievements. The latter do not tell the whole story, but they have to be taken into account when discussing the former.

2.2 Turn-to-Market as the critical point

As mentioned above, the process of developing a market orientation is long, difficult and multifaceted. Researching it requires reliance on longitudinal studies, most often of qualitative nature, to capture and understand all aspects and variables involved (Miles and Huberman 1994).

Another approach, which is the one taken by this study, is to turn attention towards a key decision that can be considered to initiate a transformation process. Although this method does not allow to completely grasp the phenomenon of market orientation, it does help to investigate the role of factors influencing it by offering an analytical point of reference. We will refer to this point as the "Turn-to-Market".

The decision to be focused on necessarily fulfils two conditions.

First of all it should mark the beginning of the change. This is important to avoid issues of causality (Cook and Campbell 1979) as the decision initiates the transformation of the organization and not vice versa.

Secondly the effects need to be sufficiently profound and engage the whole start-up. The discussion

1 This is especially common in sectors like biopharmacy where fundamental and applied research are very closely connected. Start-ups carry out research and development and are often bought by a large pharma concern they had partnered with from the beginning. See Ernst&Young (2002).

above showed that market orientation needs to be engrained in the fabric of the spin-off. The Turn-to-Market is an event that has sufficient impact to alter the ACSO's course.

There are three types of events that can be considered to represent a Turn-to-Market.
The first and most dramatic possibility is a change in the organizational structure. Scholars from population ecology (Hannan and Freeman 1977) have pointed out that most organizations suffer from inertia. Mintzberg (1979), in his seminal work, showed how organizational structures determine this rigidity to a very high extent. Therefore a change in the structure signals an important alteration of a company's orientation. In many cases the organization chart will not be redrawn completely; rather new positions will be created and will assume a more central role over the course of time. The positions we are most interested in for our research include – but are by no means limited to – marketing managers, product managers or business development functions.
A second type of event is the attraction of key people whose functional and/or educational background are not technology-oriented. They will be part of the management team or sit on the board from where they can exert influence on the overall course of the spin-off. This argument is akin to the hypothesis advanced by Hambrick and Mason (1984). They see strategic choices and performance as the reflection of top management preferences and values. As they depend at least partially on a person's background, bringing in people with a more market-oriented track record is likely to initiate a shift in the start-up's focus.
Finally the ACSO may enter into a relationship with a clear market motivation. Contacts with external consultants or service providers indicate that the firm recognises both the need for a market orientation and the fact that it does not (yet) possess the necessary skills to realize it (Kazanjian 1988; Vohora, Wright and Lockett 2004). At first sight, the commencement of such a relationship does not appear to be fundamental for the organization. It is however a clear indication of a shift when a technology-based company acts to embrace market-related contacts.

It should be stressed once more that the Turn-to-Market events serve as indications or symptoms of the technology-to-market shift. They are not the core of it, but a sign that marks the beginning of the transition.

2.3 Timing of the Turn-to-Market decision

An interesting question pertains not only to whether the Turn-to-Market takes place or not, but to when exactly the event happens. This indicates how long it takes for an ACSO to evolve from its inward-looking technology orientation to a outward-looking market orientation.

Taking timing into account is highly relevant from both a content and a methodology viewpoint.
As far as the content is involved, the explicit attention paid to the factor time offers important insights in the context of high technology, high velocity environments (Eisenhardt and Brown 1997; Schoonhoven, Eisenhardt and Lyman 1990). ACSOs typically operate in such environments where the timing of actions is often as important as the action itself. But timing's impact need not be limited to research in high-tech settings. Organization and management studies in general can benefit from it as it promises refinement and enrichment of existing theories (Ancona et al. 2001).
Setting up research that gives time due consideration, also presents methodological opportunities. Capturing lags pleads for longitudinal research designs instead of cross-sectional studies (Mitchell and James 2001). The latter are easier to accomplish and often a convenient way of data gathering. The added complexity of longitudinal data is, however, more than offset by the increased validity of the ensuing analysis as questions of causality are more convincingly answered.

A first approach to incorporate this timing aspect into our study is to simply calculate the time lag between a baseline reference and the Turn-to-market moment as defined above. An obvious choice for a baseline in this case is the spin-off's foundation or incorporation date. This does not imply that there is no activity before this date (cf. Shane 2001), but it marks the beginning of the spin-off as an independent entity and unit of analysis. The point in time where Turn-to-Market takes place can be established by using the dates on which the events described above are announced.
The main advantage of this way of working is clearly the straightforward operationalization. The main drawback is that two aspects of Turn-to-Market we discussed before are not accounted for. Developing a market orientation, to begin with, is not a necessity for all start-up companies. Such firms would be classified as unsuccessful by this measure as they never experience a Turn-to-Market. Even if they fulfil their – technological – goals and live up to or even exceed expectations they will still be seen as failed. Secondly, the Turn-to-Market is contingent upon technological success. A number of firms may

never switch their attention to market-related issues or will do so very late as compared to competitors because they struggle with fundamental technological issues. In such cases the timing does not necessarily reveal anything about the start-up's orientation but rather reflects an external factor (technological problems).

A more refined approach consists of modelling technological achievement and subsequent market orientation. This way the technology influence, which is the major disturbance factor in the previous design, is controlled for.
Technology development is not a straightforward or a linear process (Pisano 1996). Its success can only be established post-hoc, i.e. when it is finished or certain targets have been achieved. One such target, which is widely viewed as a crucial milestone, is a working prototype (Carter, Gartner and Reynolds 1996; D'Adderio 2001). The prototype does not only prove the underlying scientific principle, but also indicates that the implementation of it into a product is possible. Therefore we will take prototype development as the indication of a technological achievement.
Instead of measuring the time lag from foundation, it is now possible to focus on the time lag between prototype development and the Turn-to-Market. This is shown in Illustration 1.[2]

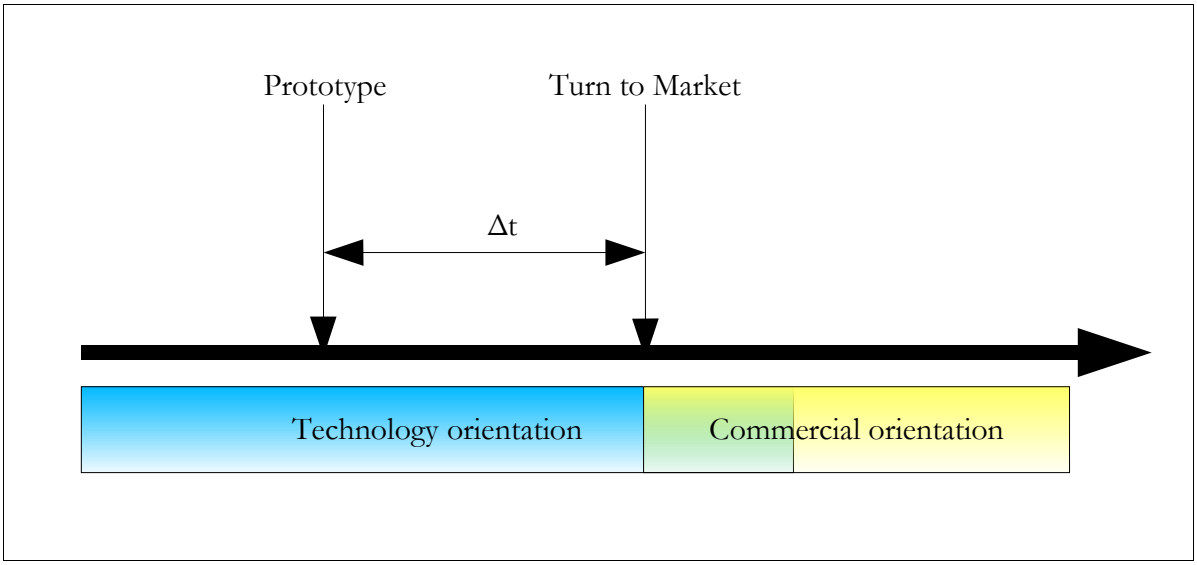

Illustration 1: Timing of the Turn-to-Market decision

Including a working prototype in an ACSO's evolution presents at first sight little difference from our initial approach. Nonetheless it solves the issue of technological problems' influence on the timing of the Turn-To-Market. Only the interval starting from the prototype development is measured. Technology is supposedly summarized in the period prior to that and hence does not play a major role anymore in determining when the Turn-to-Market takes place. Additionally the problem of spin-offs not aiming to become market-oriented is partially sidestepped. They tend to stay in the technology-development phase, often by refining their technology platform. Such spin-offs are eliminated from Turn-To-Market analysis as they do not develop prototypes. This elimination is not perfect, though, as spin-offs who fail during their technology phase land in the same group.

3. Networks and the decision to turn to the market

We posit that the timing of the Turn-to-Market is influenced by the networks the spin-off has at its foundation. Support for this argument can be found in Shane and Stuart's (2002) work on the performance of university start-ups. They find that the social capital of the founder, which is a considerable endowment for the young firm, is an important determinant of early success. The role of the founder's social capital can be expanded to include the network of an ACSO at foundation (Baum, Calabrese and Silverman 2000; Baum and Oliver 1991; Stuart, Hoang and Hybels 1999). Such networks provide start-ups with resources that are normally only acquired at a more advanced age and

2 Note that we make the implicit assumption of prototype development happening before the Turn-to-Market. Although this is intuitively the most acceptable case, further analysis may loosen this restriction and consider cases where the order is reversed.

therefore have a considerable impact on early performance.

We will first pay more attention to the specific network properties than can be investigated in the context of this research. Secondly a number of propositions will be formulated regarding the relationships between initial networks and Turn-to-Market.

3.1 Network parameters in entrepreneurship

Scholars have discussed networks and their parameters at length (see Powell and Grodal 2005 for a review). Their studies have shown that the three core dimensions are structure, content and governance (Hoang and Antoncic 2003).

The structure of the network refers to the pattern and the strength of relationships between actors. Those ties can be closely knit, involving frequent contacts or rather loose without frequent communication (Granovetter 1973). In the first case the network will be closed with few links to the outside world, whereas the second case presents far more structural holes and strategically important positions (Burt 1997; Hite and Hesterly 2001; Walker, Kogut and Shan 1997).

The content of the exchanges concerns the type of resources that flow through networks. They are often intangibles like emotional or psychological support. Another major type of content is signalling, where the fact that a start-up has some relationships to respectable organizations helps to gain legitimacy (Shane and Cable 2002; Stuart, Hoang and Hybels 1999).

The governance issue has been hotly debated in economics and agency theory where it is stated that formal contracts, coupled with appropriate incentives, should govern relationships (Jensen and Meckling 1976). From a more sociological perspective researchers plead for trust and reciprocity as mechanisms to steer exchanges (Larson 1992). Others have suggested that a balance between both is advisable (Shane and Cable 2002).

In this study we focus on the parameters of network size and network diversity. Network size simply refers to the number of direct contacts the focal firm has. Network diversity is concerned with the different types of relationships. Connections to universities or research institutions, for example, are clearly different from links to venture capitalists or corporate partners (Powell, Koput and Smith-Doerr 1996).

Size and diversity together capture elements from each of the dimensions discussed above.

Network structure is captured to some extent as small and undiversified networks are more likely to be homogeneous and closed than a wide array of different contacts. There are far more opportunities for structural holes and strategic relationships in the latter case.

The content and the governance of the exchanges are connected to diversity. Scientific links, such as collaboration and co-publication, very often involve the transfer of intangible and tacit knowledge (Liebeskind et al. 1996; Oliver 2004). Moreover, the strong social norms among scientists ensure an open relationship that limits cheating and free riding behaviour (Liebeskind ibid.). Contacts to corporate partners, while also offering forms of resource-transfer, are mainly seen as signals that the spin-off is credible. Those relations almost always start very formally (Hite and Hesterly 2001) and are therefore governed by contractual obligations.

3.2 The influence of networks on the turn to market

Our discussion up until now has outlined that academic spin-offs experience the turn to a market focus at different times relative to their technological achievements. This time lag is influenced by the size and the diversity of a spin-off's initial network. This is shown in figure Y.

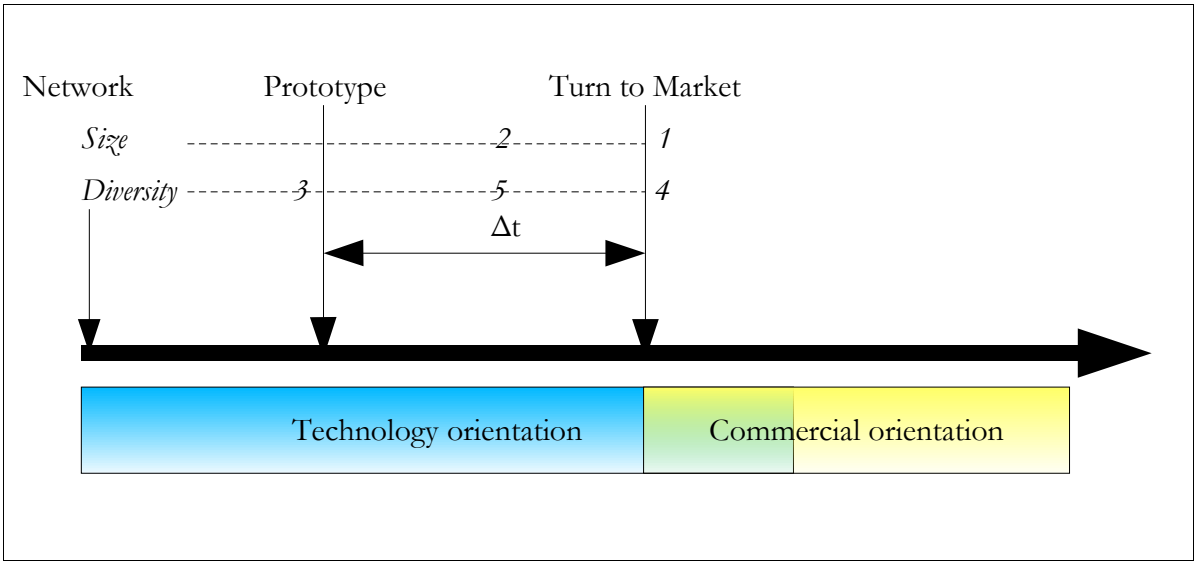

Illustration 2: Five propositions summarized. The numbers refer to the propositions.

Illustration 2 wraps up the arguments presented before and offers a number of propositions for further research. Rival hypotheses have been grouped for reasons of clarity.
We will offer a brief rationale for each proposition.

1) The size of the initial network positively influences the likelihood of a Turn-to-Market
A large network is more likely to contain structural holes and links to more remote actors. Such relationships are often more formal and may push for market-based relationships instead of socially governed bonds. This can increase the readiness of the spin-off to develop a market orientation. Moreover, having a large networks at start-up may signal a belief by external parties that the venture is worthwhile and thus may go all the way to the market

2) The size of the initial network reduces the time lag between prototype and Turn-to-Market
A large network potentially connects the spin-off to more resource bases, which can speed up its development.

3a) *A higher percentage of non-scientific links increases the likelihood of achieving a prototype*
Non-scientific partners have an interest in the results of a technology, not in the technology itself. Therefore they push the scientists in the company to come up with concrete products or samples, the best example of which is the prototype.
3b) *A higher percentage of scientific links increases the likelihood of achieving a prototype*
A prototype is a major milestone in technology development and signals the success of it. A broad set of scientific links opens up collaboration possibilities and helps the development advance.

4a) *A higher percentage of non-scientific links increases the likelihood of Turn-to-Market*
Non-scientific contacts are more commercially oriented and will encourage the ACSO to become market-oriented.
4b) *A higher percentage of scientific links increases the likelihood of Turn-To-Market*
Although this hypothesis is less clear intuitively, it is included as a control measure. If Turn-to-Market is dependent on technological success and proposition 3b (scientific links promote technological success) turns out to be correct, then this proposition may also turn out to be correct.

5) A higher percentage of non-scientific links reduces the time lag between prototype and TTM
Using the same reasoning as for proposition 4a, non-scientific contacts pushing for market orientation not only increase the likelihood of reaching it but will also make sure it happens earlier.

4. An illustration: the NanoComp case

The NanoComp case is based on interviews the authors conducted with key people at an academic spin-off in the field of nanotechnology. NanoComp's story is somewhat unusual in that it spans a long period of time. Despite its old age, it still exhibits all the properties of a start-up. This means that the early-development phase has been spread out over a 20-year period, which makes it easier to analyse.

4.1 An overview of NanoComp

The company was founded in 1985 to commercialize a new technology for semiconductor lithography. The traditional way of producing computer chips consists of etching the required connections on a piece of silicon by using light beams. Because of the explosive evolution in microelectronics, circuits needed – and still need – to become ever smaller so more of them can fit on the same surface. The existing techniques are limited in this respect as they can not make etchings smaller than the wavelength of the light used. Nanocomp's technology does not rely on light, but on charged particles to overcome this physical barrier and allow for ultra-small circuits.
Unfortunately for NanoComp, the general tendency in the semiconductor industry at that time was to focus on new light technology with ultra-short wavelengths. Despite this setback, it continued improving on and developing its technology. The unusual factor here was the steady support of from finance providers who did not seek to get out of this venture as soon as possible. The company struggled and managed to survive for an amazingly long period through doing contract research and participating in research projects until 2001.
In 2001 the lead investor brought aboard a new CEO who came from a large industrial company to bring about a turnaround. The domains in which the company was active were redefined to semiconductor production (but a different aspect of it) and the creation of very small nanostructures. This shift of priorities had huge implications for NanoComp as it no longer mirrored a technical achievement, but market niches and market problems. As the CEO explained:
"*So we really switched from being a start-up company that provides a new technology with unparalleled performance, to offering a solution with enormous cost savings*. ... *That was another reason we could manage the turn-around: we could finally identify direct applications, market niches and market segments for our technology*"

4.2 Aplication of the model

The NanoComp case illustrates a number of concepts introduced before.
To begin with, it shows how academic spin-offs are protected in early life (which spans 15 years in this exceptional case) from the market's most adverse influences. Especially the relationship with the venture capitalist turned out to be crucial here.

The Turn-to-Market is also clearly visible. The new CEO was someone with a different functional background, having spent most of his career in new business development for a large multinational. By putting such a person in a crucial position, NanoComp quickly started to change its focus. Before the arrival of the CEO it was completely immersed in developing a superior technological solution, whereas afterwards it started looking upon its task as providing solutions to the demand of the market. The transition caused the whole of the company to change and a number of new key positions were created.

Finally the Turn-to-Market and its timing were heavily influenced by a network contact (the lead investor in this case). Without this impulse the re-orientation would probably not have occurred or would have taken place even later than it did now.

5. Conclusions and future research

This paper looked more closely into the timing of the Turn-to-Market decision in academic spin-offs. We showed that the size and the diversity of the initial network influence both the probability that a Turn-to-Market takes place and the point in time at which it happens.

The paper makes three contributions to the innovation literature.
First of all the specificity of academic spin-offs (ACSO) as a unit of analysis is recognized. Their scientific origins and the environment they face in early life make them a special subcategory of all high-tech start-ups. More specifically, they face the challenge of turning an inward technology orientation into an outward market orientation.
The second point is closely related to the first one in that the research highlights the importance of non-

technological measures in addition to the – more traditional - technological ones. Ultimately success is decided upon in the market place and the extent to which a spin-off is able to adjust itself to this reality influences its own performance. Therefore we need measures to capture this dimension as well.
Thirdly we explicitly incorporate the time dimension into our work. Not only does this open up an entire domain of research with questions hitherto unanswered, but it also presents methodological opportunities. Time and timing call for longitudinal research designs and attention to causal relationships.

The framework outlined here is of course only a first step and there are many options open for further research.
The model should be further refined to include additional influencing factors that can act as control variables. Additionally the Turn-to-Market's dependence on technological success may be modelled in a more fine-grained way.
A second option is to link Turn-to-Market and its timing to performance. Our research leaves open questions on whether firms that turn to the market earlier perform better or worse than those who do so later on. This question is highly relevant for venture capital investors or technology transfer offices. They are often the parties who push most for a commercial orientation with their portfolio companies. The underlying believe of this attitude is that being focused on the market early on is beneficial for performance. This assumption has, however, never been put to rigorous testing.
Future research may also focus on the timing of other decisions than the Turn-to-Market. Both market and technology aspects of spin-offs deserve the additional timing perspective.

Bibliography

Aldrich, H. E. and C. M. Fiol (1994), "Fools Rush in - the Institutional Context of Industry Creation," *Academy of Management Review*, 19(4), 645-70.

Ancona, D. G., P. S. Goodman, B. S. Lawrence, and M. L. Tushman (2001), "Time: A new research lens," *Academy of Management Review*, 26(4), 645-63.

Baum, J. A. C. and C. Oliver (1991), "Institutional Linkages and Organizational Mortality," *Administrative Science Quarterly*, 36(2), 187-218.

Baum, J. A. C., T. Calabrese, and B. S. Silverman (2000), "Don't go it alone: Alliance network composition and startups' performance in Canadian biotechnology," *Strategic Management Journal*, 21 (3), 267-94.

Bower,J.L. and C.M. Christensen (1995), “Disruptive Technologies - Catching the Wave” *Harvard Business Review*, 73(1), 43-53.

Brown, S. L. and K. M. Eisenhardt (1997), "The art of continuous change: Linking complexity theory and time-paced evolution in relentlessly shifting organizations," *Administrative Science Quarterly*, 42 (1), 1-34.

Burt, R. S. (1997), "The contingent value of social capital," *Administrative Science Quarterly*, 42(2), 339-65.

Carter, N. M., W. B. Gartner, and P. D. Reynolds (1996), "Exploring start-up event sequences," *Journal of Business Venturing*, 11(3), 151-66.

Clarysse, B., J. J. Degroof, and A. Heirman (2003), "Growth paths of technology-based companies in life sciences and information technology," Office for Official Publications of the European Communities.

Cook, T.D. and D.T. Campbell (1979), *Quasi-experimentation: design and analysis issues for field settings*, Boston, Houghton Mifflin

D'Adderio, L. (2001), "Crafting the virtual prototype: how firms integrate knowledge and capabilities across organisational boundaries," *Research Policy*, 30(9), 1409-24.

Delmar, F. and S. Shane (2004), "Legitimating first: organizing activities and the survival of new ventures," *Journal of Business Venturing*, 19(3), 385-410.

Erikson, T. (2002), "Entrepreneurial capital: the emerging venture's most important asset and competitive advantage," *Journal of Business Venturing*, 17(3), 275-90.

Ernst & Young (2002), “Beyond Borders: the global biotechnology report 2002”

Gans, J. S. and S. Stern (2003), "The product market and the market for "ideas": commercialization strategies for technology entrepreneurs," *Research Policy*, 32(2), 333-50.

Granovetter, M. S.(1973), "The strength of weak ties", *American Journal of Sociology*, 78(6), 1360-1380

Hagedoorn, J. and M. Cloodt (2003), "Measuring innovative performance: is there an advantage in using multiple indicators?," *Research Policy*, 32(8), 1365-79.

Hambrick, D. C. and P. A. Mason (1984), "Upper Echelons - the Organization As A Reflection of Its Top Managers," *Academy of Management Review*, 9(2), 193-206.

Han, J. K., N. Kim, and R. K. Srivastava (1998), "Market orientation and organizational performance: Is innovation a missing link?," *Journal of Marketing*, 62(4), 30-45.

Hannan, M. T. and J. Freeman (1977), "Population Ecology of Organizations," *American Journal of Sociology*, 82(5), 929-64.

Hite, J. M. and W. S. Hesterly (2001), "The evolution of firm networks: From emergence to early growth of the firm," *Strategic Management Journal*, 22(3), 275-86.

Hoang, H. and B. Antoncic (2003), "Network-based research in entrepreneurship - A critical review," *Journal of Business Venturing*, 18(2), 165-87.

Jaworski, B. J. and A. K. Kohli (1993), "Market Orientation - Antecedents and Consequences," *Journal of Marketing*, 57(3), 53-70.

Jensen, M. C. and W. H. Meckling (1976), "Theory of Firm - Managerial Behavior, Agency Costs and Ownership Structure," *Journal of Financial Economics*, 3(4), 305-60.

Kazanjian, R. K. (1988), "Relation of Dominant Problems to Stages of Growth in Technology-Based New Ventures," *Academy of Management Journal*, 31(2), 257-79.

Kazanjian, R. K. and R. Drazin (1989), "An Empirical-Test of A Stage of Growth Progression Model," *Management Science*, 35(12), 1489-503.

Kohli, A. K. and B. J. Jaworski (1990), "Market Orientation - the Construct, Research Propositions, and Managerial Implications," *Journal of Marketing*, 54(2), 1-18.

Kohli, A. K., B. J. Jaworski, and A. Kumar (1993), "Markor - A Measure of Market Orientation," *Journal of Marketing Research*, 30(4), 467-77.

Larson, A. (1992), "Network Dyads in Entrepreneurial Settings - A Study of the Governance of Exchange Relationships," *Administrative Science Quarterly*, 37(1), 76-104.

Lerner, J. (1994), "Venture Capitalists and the Decision to Go Public," *Journal of Financial Economics*, 35(3), 293-316.

Liebeskind, J. P., A. L. Oliver, L. Zucker, and M. Brewer (1996), "Social networks, learning, and flexibility: Sourcing scientific knowledge in new biotechnology firms," *Organization Science*, 7(4), 428-43.

McGrath, R. G. (1999), "Falling forward: Real options reasoning and entrepreneurial failure," *Academy of Management Review*, 24(1), 13-30.

Miles, M. B. and M. A. Huberman (1994), *Qualitative data analysis,* Thousand Oaks: Sage Publications

Mintzberg, H. (1979), *The structuring of organizations: a synthesis of the research*, Englewood Cliffs: Prentice Hall

Mitchell, T. R. and L. R. James (2001), "Building better theory: Time and the specification of when things happen," *Academy of Management Review*, 26(4), 530-47.

Munir, K. A. and N. Philips (2002), “The concept of industry and the case of radical technological change” *Journal of High Technology Management Research*, 13, 279-297

Narver, J. C. and S. F. Slater (1990), "The Effect of A Market Orientation on Business Profitability," *Journal of Marketing*, 54(4), 20-35.

Nerkar, A. and S. Shane (2003), "When do start-ups that exploit patented academic knowledge survive?," *International Journal of Industrial Organization*, 21(9), 1391-410.

Nicolaou, N. and S. Birley (2003), "Social networks in organizational emergence: The university spinout phenomenon," *Management Science*, 49(12), 1702-25.

Oliver, A. L. (2004), "Biotechnology entrepreneurial scientists and their collaborations," *Research Policy*, 33(4), 583-97.

Owen-Smith, J. and W. W. Powell (2004), "Knowledge networks as channels and conduits: The effects of spillovers in the Boston biotechnology community," *Organization Science*, 15(1), 5-21.

Pisano, G. P. (1996), "Learning-before-doing in the development of new process technology," *Research Policy*, 25(7), 1097-119.

Porter, M. E. (1996), "What is strategy?," *Harvard Business Review*, 74(6), 61-&.

Powell, W. W. (1998), "Learning from collaboration: Knowledge and networks in the biotechnology and pharmaceutical industries," *California Management Review*, 40(3), 228-+.

Powell, W. W. and S. Grodal (2005), "Networks of innovators," in *The Oxford Handbook of Innovation*, D. Mowery, ed. Oxford: 56-85.

Powell, W. W., K. W. Koput, and L. SmithDoerr (1996), "Interorganizational collaboration and the locus of innovation: Networks of learning in biotechnology," *Administrative Science Quarterly*, 41(1), 116-45.

Rothaermel, F. T. and D. L. Deeds (2004), "Exploration and exploitation alliances in biotechnology: A system of new product development," *Strategic Management Journal*, 25(3), 201-21.

Schoonhoven, C. B., K. M. Eisenhardt, and K. Lyman (1990), "Speeding Products to Market - Waiting Time to 1St Product Introduction in New Firms," *Administrative Science Quarterly*, 35(1), 177-207.

Shane, S. (2001), "Technological opportunities and new firm creation," *Management Science*, 47(2), 205-20.

Shane, S. and D. Cable (2002), "Network ties, reputation, and the financing of new ventures," *Management Science*, 48(3), 364-81.

Shane, S. and T. Stuart (2002), "Organizational endowments and the performance of university start-ups," *Management Science*, 48(1), 154-70.

Slater, S. F. and J. C. Narver (1994), "Does Competitive Environment Moderate the Market Orientation-Performance Relationship," *Journal of Marketing*, 58(1), 46-55.

Slater, S. F. and J. C. Narver (1995), "Market Orientation and the Learning Organization," *Journal of Marketing*, 59(3), 63-74.

Stuart, T. E., H. Hoang, and R. C. Hybels (1999), "Interorganizational endorsements and the performance of entrepreneurial ventures," *Administrative Science Quarterly*, 44(2), 315-49.

Venkataraman, S. and A. H. Van de Ven (1998), "Hostile environmental jolts, transaction set, and new business," *Journal of Business Venturing*, 13(3), 231-55.

Vohora, A., M. Wright, and A. Lockett (2004), "Critical junctures in the development of university high-tech spinout companies," *Research Policy*, 33(1), 147-75.

Walker, G., B. Kogut, and W. J. Shan (1997), "Social capital, structural holes and the formation of an industry network," *Organization Science*, 8(2), 109-25.

Workman, J. P., C. Homburg, and K. Gruner (1998), "Marketing organization: An integrative framework of dimensions and determinants," *Journal of Marketing*, 62(3), 21-41.

Zucker, L. G., M. R. Darby, and J. S. Armstrong (2002), "Commercializing knowledge: University science, knowledge capture, and firm performance in biotechnology," *Management Science*, 48(1), 138-53.