

**EXPLORING BOARD FORMATION AND EVOLUTION  
OF BOARD COMPOSITION IN ACADEMIC SPIN-OFFS**

*Ekaterina S. Bjørnåli*  
*Faculty of Technology*  
*Sør-Trøndelag University College (HIST)*  
*and Dept. of Industrial Economics and Tech. Management (IØT)*  
*Norwegian University of Science and Technology (NTNU)*  
*Gunnerus gt. 1. | N-7004 Trondheim | Norway*  
*Tel. + 47 735 59505 | Fax + 47 735 59481*  
*E-mail: [ekaterina.bjornali@hist.no](mailto:ekaterina.bjornali@hist.no)*

*Magnus Gulbrandsen*  
*Centre for Advanced Study, Norwegian Academy of Science and Letters*  
*and NIFU STEP*  
*Wergelandsveien 7 | NO-0167 Oslo | Norway*  
*E-mail: [magnus.gulbrandsen@nifustep.no](mailto:magnus.gulbrandsen@nifustep.no)*

## **Abstract**

An in-depth analysis of eleven cases is used to provide insight into the neglected area of the dynamics of boards in academic spin-offs. Drawing on stage-based, resource dependence and social network theories, we explore board formation and changes in board composition occurring in Norwegian and US spin-offs. We find that these theories are important complements to earlier research on boards in technology-based new ventures. The process of board formation is mainly driven by social networks of the founders. Although we find differences in the initial board compositions in Norwegian and US spin-offs, there is convergence over time in subsequent board changes, which are mainly driven by the social networks of the board chair. Additions of key board members are associated with the progress of a spin-off developing from one stage to another. Several avenues for future research and implications are discussed.

**Keywords:** Boards of directors, Academic Spin-offs, Stages, Resources, Social Networks

## **Introduction**

Earlier board studies have mainly investigated mature firms, using samples from large US firms, agency theory and multivariate analyses of secondary data (Lynall et al., 2003; Huse 2007). Research into boards in small and entrepreneurial firms has focused on boards as a means by which new firms can manage external dependency (Selznick 1949; Pfeffer and Salancik 1978; Borch and Huse 1993; George et al. 2001). Venture capital (VC) involvement in boards of small firms has also been studied (Rosenstein 1988; Fried et al. 1998; Deakins et al. 2000; Sapienza et al. 2000). More recent research incorporates social exchange, identity, social networks, organizational justice, game and other theories to improve our understanding of corporate governance in private firms (Uhlener et al. 2007).

Still, little attention has been devoted to the board of directors in academic spin-off companies (ASOs). ASOs are usually based on technology formally transferred from the parent organization, which is a public research organization such as a university or research institute. Boards in ASOs are particularly interesting to study since ASOs are new ventures in transition, which go through a number of stages of activity and need to develop resources and capabilities (Vohora et al. 2004) and board structure and processes (Filatotchev et al. 2006) to enable their transition from a non-commercial environment to the market.

Once resource needs have been determined and a team has been selected, it will usually be necessary to obtain additional resources from outside the venture in the startup stage (Timmons and Spinelli 2004). Scientist-entrepreneurs may attract experienced and well-connected directors to their boards who can play an important role in accessing critical external resources (Lynall et al. 2003). However, finding appropriate board members is a challenge for scientist-entrepreneurs with networks limited to peers within academia (Cooper and Daily 1997; Ensley and Hmieleski 2005; Mosey and Wright 2007). In addition, to move an ASO forward to the next development stage, the new configurations of resources and capabilities should be obtained. This can be done by attracting new external directors providing access to new resources. Thus, one might expect that different board members are needed on the board in different stages. The board composition may thus change reflecting the firm's life cycle (Lynall et al. 2003).

Few studies, however, look explicitly at the boards in ASOs. Clarysse et al. (2007) have provided quantitative evidence on board composition in ASOs. They found that high-tech start-ups, with a public research organization as an external equity stakeholder, are more likely to include outside board members with complementary skills to the founding team than ASOs with venture capitalists or founders as the main stakeholders. Filatotchev et al. (2006) have provided evidence of 27 ASOs from UK universities as ventures facing a founder-manager/IPO (initial public offering) threshold, which requires access to external resources and expertise. Vanaelst et al. (2006) studied the entrepreneurial team development in ten Belgian ASOs. They showed that after legal establishment of the venture the founding team evolves into two other teams: the management team and the board. However, their focus was on the founding and management team. Showing that the boards in ASOs may change, these studies emphasize the need for more in-depth research on changes in board composition in the firm's lifecycle. Yet, the majority of board studies has taken a snapshot of the board composition at a certain point, and linked it to performance.

Responding to these calls for a closer investigation into board dynamics, the purpose of this study is, therefore, to explore how boards are formed and how boards evolve through various stages of a spin-off process. We address this research gap by investigating (1) Which board members do ASOs add, and why, in the start-up stage? (2) When, why and how do the main changes in board composition occur during subsequent stages?

Thus, our paper extends previous research and makes a number of contributions. First, it studies boards in early stage Norwegian and US spin-offs, rarely addressed by governance studies which mainly focused on mature firms employing cross-sectional data and treating the board as a static concept (Gabrielsson and Huse 2004). Given limited prior research on board evolution we use inductive logic and in-depth cases (Glaser and Strauss 1967; Eisenhardt 1989). Second, it responds to recent suggestions in governance literature to use other theories than agency theory (Huse 2007). Specifically, we combine life cycle, resource dependence and social network theories and find that these theories are important complements to research on boards in new ventures. Third, it focuses explicitly on changes in the boards of ASOs. Accordingly, the paper adds to academic entrepreneurship research by linking board changes to development stages (Vohora et al. 2004; Vanaelst et al. 2006) and dominant tasks (Kazanjan 1988) and suggesting that board changes are associated with the progress to the next stage with outside directors contributing to overcoming critical junctures.

Below, we start by outlining our framework based on stage-based, resource dependence, and social networks theories. Next, we discuss the research design and data collection methods, followed by a presentation of the findings and a development of propositions. Finally, we conclude and discuss future research directions and policy implications.

## **Theory**

To introduce a dynamic component in spin-off boards we incorporate literature on stages in new firm development. In particular, we use stage-of-growth models specifically developed for ASOs as high-tech new ventures (Kazanjian 1988; Vohora et al. 2004; Clarysse and Moray 2004; Vanaelst et al. 2006). Employing a stage-based and resource-based framework, Vohora et al. (2004) identify five stages that ASOs encounter in their development: (1) research stage, (2) opportunity framing stage, (3) pre-organization stage, (4) reorientation stage, and (5) sustainable returns stage. Furthermore, Vohora et al. (2004) argue that while the different stages are important it is the difficulties in moving from stage to stage that create critical junctures, which are the key challenges an ASO faces in its development. Critical junctures arise because the venture requires new configurations of resources, capabilities and networks if it is to progress to the next stage of development. If the critical junctures remain unresolved for a prolonged period of time, the venture will eventually fail. Four key critical junctures that spin-off companies need to overcome if they are to succeed are (1) opportunity recognition, (2) entrepreneurial commitment by a venture champion, (3) attaining credibility in the business environment, and (4) achieving sustainable returns within their respective markets.

Other researchers (e.g. Kazanjan 1998; Clarysse and Moray, 2004; Vanaelst et al. 2006) came to a similar classification of stages: a research stage, during which the project prepares itself to formally turn into a spin-off, and a post-startup stage, during which external capitalization takes place. Each venture must pass through the previous stage in order to progress to the next one, but each stage involves an iterative, nonlinear process of development in which there may be a need to revisit some of the earlier decisions and activities. In addition, ventures face different problems that dominate during different stages. Kazanjan (1998) examined the relationship between stages of growth and the dominant tasks and found that in earlier stages

the dominant tasks are product and technology development, securing finance and strategic positioning in a new product-market segment. In later stages acquisition of additional resources, sales and marketing, and organization and administration are the dominant tasks.

The legal incorporation of the company is an important entrepreneurial event marking that the company moves from the pre-startup to the post-startup era (Clarysse and Moray 2004). At this point in time the founding team evolves into the management team and a board of directors (Vanaelst et al. 2006). As shown in the study by Vanaelst et al. (2006) both the management team and the board may evolve. However, their focus was on examining changes in the founding and management team. We address this gap by focusing on changes in board accommodating stage-based aspects while seeking to understand when, why and how the changes in board composition occur in the trajectory of an ASO's development.

ASOs aim at finding appropriate board members to fill the gaps discovered in the process of forming the management team in the start-up stage (Timmons and Spinelli 2004; Ucbasaran et al. 2003). During subsequent growth stages the gaps are discovered when difficulties arise and ASOs face critical junctures. Such gaps can represent the absence of relevant experience, know-how, networks, and other current needs that can be provided by outsiders. We thus draw on the resource dependence perspective (Pfeffer 1972; Johnson et al. 1996; Pfeffer and Salancik 1978). In this view, the evolution of the board is a response to the changing resource needs in the firms. New board members are seen as resource providers playing value-adding roles in the ASO's development (Selznick 1949; Boeker and Goodstein 1991; Deakins et al. 2000; Pfeffer and Salancik 1978). Given the limited resource base of a start-up, a board of directors is an excellent vehicle for accessing scarce and/or strategic resources (Lynall et al. 2003). Following the logic of resource dependency, new members will be selected so that they bring necessary complementary resources to the firm. The resource dependence theory is concerned with reducing uncertainty regarding the flow of capital, information and other resources at the lowest cost. Hence, the scientist-entrepreneurs who have best access to critical resources that will move the firm forward will not attract new members to the board of directors. Instead, they take a place on the board themselves.

In addition, most ventures typically look to personal acquaintances of the lead entrepreneur or team for their first outside directors (Timmons and Spinelli 2004). Scientist-entrepreneurs, considering starting their own businesses, were shown to develop social networks with TTOs

and more experienced academic entrepreneurs (Mosey and Wright 2007). Social network literature is thus also relevant to our study (e.g. Granovetter 1985; Gulati and Gargiulo 1999), dealing with the influence of social networks on board formation and composition. In this view, the member addition process is driven by the actors' social relations and interpersonal attraction (Forbes et al., 2006). The implication of social network theory for new member addition is that scientist-entrepreneurs are likely to recruit board members from their existing social networks (Birley 1985; Larson 1992; Westphal 1999) so that the likelihood of adding an outside director similar to the lead entrepreneur or the team is high (McPherson et al. 2001; Zahra and Pearce 1989; Ruef et al. 2003). New members will reflect the original founders' social networks with ascribed and achieved characteristics similar to the founders.

Our integrated theoretical framework is depicted in Figure 1.

---

Insert Figure 1 about here

---

We expect that during the legal incorporation of the company the board members will reflect the existing personal networks of the founding team with characteristics similar to those of the founders, but bringing in resources that the founding team does not have. After legal incorporation the board may undergo changes as the venture needs to acquire outside resources to overcome critical junctures, solving various problems that arise in different development stages. The new members recruited in the post-startup stage will to a greater extent reflect the social networks of the existing members on board. That is, if the company has external stakeholders on the board, the composition of the board will also reflect the social networks of the principal stakeholders, such as the CEO and external financiers (Lynall et al. 2003). These new members are expected to bring critical resources that the top management team lacks, helping ASO to solve current dominant tasks and move it forward.

### **Methods and empirical context**

Given limited prior research on the evolution of boards, especially for young ASOs, our research design is a multiple case, inductive study (Glaser and Strauss 1967; Eisenhardt 1989). Multiple cases allow replication. In contrast to pooled logic where each observation is part of a larger sample, replication logic views multiple cases as a series of experiments, with each case confirming or not confirming the inferences drawn from the others (Yin 1994).

Single-case studies offer insight into one particular example; multiple cases provide us with empirical richness and may also generate generalizable and accurate theoretical insights (Eisenhardt 1989).

Following Eisenhardt (1989), our sample of ASOs was selected to give a substantial degree of variance regarding the stage of development, technological focus and institutional environments like university origin and VC industry support. This degree of variance is important to obtain insights into the process of how board composition changes over time and facilitates the investigation of replication across cases.

We have sampled eleven academic spin-off companies that were created to commercialize intellectual property (IP) initially generated within parent institutions. In all these companies at least one board change occurred. In all cases at least one of the scientist-entrepreneurs was still involved as a top manager (CEO, CTO, R&D director, board chair or member) – a person who had taken the venture through the founding process and who was aware of the current operations of the company. The ASOs come from five different Norwegian research institutions and three US universities. All institutions are actively pursuing technology transfer through licensing and ASOs. However, these institutions are located in different areas, and have a different orientation towards the commercialization of research. This is reflected in their cultures, values and institutional norms, seen not least in varying levels of public and VC support.

Norway has had a long history of ASOs for over a century. In international investigations, Norwegian universities and research institutes report a high number of spin-offs compared to many other countries (OECD 2003). However, until recently research results were the property of the individual professors. A substantial publicly funded support structure of technology transfer offices (TTOs), seed capital funds etc. has been built up following legislation in 2003 which was closely modelled after the US Bayh-Dole Act of 1980. Many earlier spin-offs have become support companies for large national industries like oil, gas and metal processing, while the VC industry has traditionally been weak. The recent legislative changes and strong public role in the commercialization of research may make Norway representative of smaller western European countries.



Silicon Valley, where four US cases in our sample come from, has had a strong VC industry and close informal networks between entrepreneurs (e.g. Saxenian 1994). The difference in venture capital between Silicon Valley and Michigan, where two other US cases come from, is that over a billion dollars of investments happens in the former region and about 10-20 millions in Michigan (McCorquodale 2007). Some studies have found that US TTOs are relatively more oriented toward patenting and licensing than spin-offs when compared to other countries (Arundel & Bordoy 2007; OECD 2003). Thus, ASOs may be seen as fairly common in the US and Norway, but the surrounding networks and support structure vary widely.

The cases represent different technology platforms covering engineering, biology, chemistry, physics, and computer sciences. Each of the ASOs' core technology (or medicine, drug) is characterized as internationally new. All ASOs except spin-off Software have patented their core technology in and outside their country. There has been a steady growth in employees in all cases. Finally, each case is at a different stage of development, allowing greater insights into the evolutionary aspects of board composition. Table 1 gives an overview of the sample used in our study.

---

Insert Table 1 about here

---

Biotech spin-offs tend to develop both a board of directors and a scientific advisory board (SAB) which is beyond the focus of this study. Only one Norwegian case in our sample had a SAB, the four others did not (including another biotech company). All US cases, even the four semiconductor companies, had a scientific or technical advisory board. We asked whether members of these advisory boards had contributed by helping to find and select new board members, and this was not the case.

Data were collected through in-depth face-to-face interviews, followed by telephone interviews with representatives from the eleven ASOs from March 2006 to December 2006 in Norway and from January 2007 to May 2007 in the US. We collected background material on each of the institutions about how they organized their technology transfer activities. From this, a list of interviewees was compiled. In most cases we interviewed the current CEO who was usually one of the founders, a scientist-entrepreneur or an externally introduced

“surrogate” entrepreneur (Franklin et al. 2001). In two cases we interviewed two members of the founding team on different occasions. As for Norwegian cases we could trace all board changes through the database. This limitation is thus addressed by checking the responses against the database and, if needed, asking additional questions after interviews. The original founder was an important respondent who knew the inside story of the venture throughout its entire life. The founders were targeted because they possessed the most comprehensive knowledge about the venture’s history, strategy, processes, and performance (Carter et al., 1994). Our interviews focused on different founding team and board members, their background and expertise, how they got involved in the venture etc. Additional data on the venture’s resources, strategies, and industry environment were also gathered during the semi-structured interviews and follow-up calls.

The eleven companies were between two and nine years old when the interviews were conducted. The young age of the companies and the involvement of the original founder in strategic decisions like board changes improve the likelihood of informants accurately recalling events. All interviews lasted from one to two hours and were recorded and transcribed.

Besides interviews, we used several databases that contain accounting data and information on the board and top management. For the Norwegian cases we used the national registers, Brønnøysundregistrene, the official export and trade directory Nortrade, and the business search engine Purehelp. For the US cases we used the Link Silicon Valley directory supplemented by other sources, e.g. The San Jose Mercury News and extensive web searches. Such triangulation of data improved reliability by providing a check against the inaccuracy of informant responses (Yin 1994; Jick 1979). Triangulation was especially helpful in the cases where the informants in the older ASOs had difficulties recalling the date of events or names. In addition, we assured anonymity for companies and informants. Collectively, this combination improved the likelihood that the methods yield rich, detailed, and accurate accounts.

Responses from the interviews and additional information were used to develop a case study database, which included table shells to record data (Miles and Huberman 1994). These table outlines ensured that data collection focused on the research questions and verified that the same information was collected for all cases. The individual case histories ranged between 10

and 20 pages, including interview quotes, summary tables, and charts of key facts. For each case we also used a retrospective reconstruction of the early growth stage. Within-case analysis concentrated on developing generalizable and unique patterns that emerged for each firm, and proceeded in an iterative fashion with data collection to provide better grounding and improve the conceptual insights. Once the individual case studies were complete, we used cross-case analysis, relying on methods suggested by Miles and Huberman (1994) and Eisenhardt (1989) to develop common and differential factors. Conceptual insights concerning boards in ASOs were drawn out and refined during an iterative process as the case studies progressed. This iteration between theory and data helped to sharpen constructs, strengthen the internal validity of findings, and raise the generalizability of results.

### **Findings and development of propositions**

As suggested by Vanaelst et al. (2006) pre-startup teams (before legal incorporation) differ from post-startup teams. This difference may have consequences for who is added to the board of directors. Pre-startup founding teams choose their first top management team (TMT) and board members during legal incorporation relying on their personal networks and estimates of additional resources they need to obtain from outside members. After legal incorporation, both post-startup team and board of directors may be involved in decisions about board additions. Hence, in the discussion we differentiate between initial board composition, which is the result of board formation process in the start-up stage, and changes in board composition in the post-startup stages (depicted in Figure 1). A detailed description of the initial board composition, first change in board and other findings can be found in Table 2.

---

Insert Table 2 about here

---

#### *Who is added and why in the start-up stage*

During the legal startup of the companies the founding teams consisted either solely of scientists or scientists and “privileged witnesses” (Vanaelst et al. 2006). Privileged witnesses are the advisors that guide the researchers in the pre-startup stages and with whom the researchers develop close relationships (ibid.). In our sample most of the privileged witnesses were part of the university community, e.g. TTO and incubator representatives, current and

former MBA students, and industrial partners who carried out the research together with scientist-entrepreneurs. Our small data set indicates a difference between the US and the Norwegian cases. In the latter, the privileged witnesses came mainly from the TTOs, while in the US cases the privileged witnesses represented local seed funds at the university incubators and small VCs. Similar to the findings of Vanaelst et al. (2006) for Belgium, our results seem to confirm the universities' active role as stakeholders in the development of ASOs in Norway. For the US, our data support other studies (e.g. Arundel & Bordoy 2007; OECD 2003) indicating that TTO assistance seems to be concentrated on developing patenting and licence agreements. However, further investigations are needed to compare countries, a task, which is complicated further by large differences between universities.

The advisory role of the privileged witnesses became formalized with the establishment of the board. Privileged witnesses took a seat on the board and together with scientist-entrepreneurs formally committed to the spin-off in almost all cases. In the case of Nutriment the TTO director appointed two members from his personal network, instead of taking a seat on the board himself. Only one ASO SemiCon1 formed a board which included outside members with whom the founders neither had previous relationships nor knew through personal acquaintances. This may be due to winning the first prize in the business plan competition at Stanford. As the founder stated, "After we won the business plan competition there we a lot of interest from the investors... we could pick those with experience in semiconductors...and network relevant to what we were trying to do".

These findings spur reflections on social networks and resource dependency. Entrepreneurs do look to personal acquaintances of the lead entrepreneur or team for their first board members. The process of board formation is mainly driven by the social networks of the founders. Putting it another way, during the pre-startup stages the founders have developed professional relationships with privileged witnesses who guided the founders from the research stage until the venture was legally incorporated. Interaction with privileged witnesses turned them into "trusted informants" (Gulati and Gargiulo 1999). These social relations between the scientists and privileged witnesses were thus primary predictors of initial board composition, as social network theory implies. Hence,

**Proposition 1:** The board at founding will most likely consist of the scientist-entrepreneurs and people from the scientist-entrepreneurs' networks.

*When do the main board changes occur during subsequent growth stages?*

Nine out of eleven cases in our sample have overcome the *credibility threshold* around and during *first change* in the board thus reaching the next Re-orientation or Proof of Viability stage. Following Vanaelst et al. (2006) *Proof of Viability* post-startup stage was characterized by proving the viability of the newly established venture and by the team bringing together necessary resources to develop it. Entrepreneurs in this stage had gained access to and acquired an initial stock of financial, human and physical resources, which were required for the business to begin to function. The credibility threshold refers to a lack of credibility that constrains the entrepreneur's ability to access and acquire key resources: seed finance and human capital to form the entrepreneurial team (Vohora et al. 2004). Two cases that did not overcome the credibility threshold during first change were the ones that had experienced the influence of external factors - restructuring of the TTO and partner's organizations involved in these ASOs through the board. This suggests that well-advised and deliberate board changes - as opposed to externally induced changes due to outside or unforeseen events - contribute to overcoming the threshold of credibility and taking the venture to the next stage.

The only spin-off that seemed to have become *sustainable* and reached Sustainable returns or *Maturity stage* during the second change in board composition was Biotech1. This is most probably due to extremely large investments since the firm's inception. Maturity stage means that the venture had proven viability, and founders had built up credibility outside the scientific community and attracted additional resources. SemiCon2 seems to have reached the Maturity stage around the third change in board composition after the second round of fund raising and selection of a manufacturing partner. Biomedical and Biotech2, the oldest cases in the sample, seem to have reached Maturity stage during the fourth change in board. For them overcoming the sustainability threshold meant going public.

SemiCon1, SemiCon3 and SemiCon4 reported to be in the *transition* stage of overcoming the sustainability threshold and reaching the Maturity stage. These respondents emphasized the iterative, nonlinear nature of the development process. For instance, the founders in SemiCon1 were close to reaching the Maturity stage, but realized that the deficiency in management hindered them "to raise revenues and develop technology as fast as we [founders] could". So, SemiCon1 decided to replace the old CEO with a new one.

An interesting aspect of development stages in our cases is that many of the Norwegian ASOs mentioned that the first change in board was associated with “the actual start-up” of the company and overcoming the credibility threshold. Before this critical point, the companies had spent more time than planned on attracting investors, and the interviewees were disappointed with the TTOs in not being able to speed up the process. “Actual start-up” was in all cases related to finding “the right individual with the right [investor] contacts and large [industrial] networks”. None of the US spinoffs described the first change in board composition in terms of an actual start-up.

It may be added that we have observed nine founder and four outside member departures from the board during the first three changes compared to 20 outside member additions during just the first change. The effect of these departures on ASO development was unclear. The scientist-entrepreneurs left their firms for several reasons: they saw a better opportunity to pursue or they wanted to return to university. The reason for founder departure was often related to board representation when venture capitalists or independent outsiders came on board. In this case, the scientist-entrepreneur took a senior management position on the TMT or moved to the SAB.

Overall, our findings indicate that after legal incorporation the additions of the key board members (e.g. board chair, investor) are associated with the progress of a spin-off from one stage to another or at least they make the venture approach closer to the next stage. That is, the additions were associated with reaching entrepreneurial milestones, e.g. getting external capital, proving or sampling the product, finalizing deals with collaboration partners, finding new distributors, expanding to other markets, which all moved the venture forward. Hence,

**Proposition 2a:** The board composition will change as the academic spin-off grows.

**Proposition 2b:** The first change in board composition will most likely be positively related to gaining credibility and moving to the Proof of Viability stage.

**Proposition 2c:** Subsequent changes in board composition will most likely move the academic spin-off closer towards the Maturity stage.

*Why does the board change after the company's legal incorporation?*

After legal incorporation and formation of the initial TMT and board, the scientist-entrepreneurs in our cases tried to recruit key individuals outside the academic community. The initial resources of ASOs were limited to intangible resources, comprising of mainly technological assets and related know-how within a set of patents. The first boards had a limited set of complementary resources they could provide. However, the further ASO development required some initial financial investments or the co-optation of resources (Starr and MacMillan 1990) through existing relationships and external networks (Aldrich and Zimmer 1986). Hence, ASOs searched for new board members who would procure critical resources like seed or VC finance, market and industry knowledge, and management skills. Achieving this commitment relied heavily upon the level of social capital the scientist-entrepreneurs were able to leverage through their personal contacts or those of initial board members.

For all cases raising sufficient seed or venture capital was a key activity along with technology/drug development, like as in earlier investigations (Kazanjian 1988; Vohora et al. 2004; Vanaelst et al. 2006). This was critical for acquiring other necessary resources to develop an embryonic ASO venture into a fully operational business to be able to engage in productive activities. Hence, finance was the main resource obtained through new board members who were all outsiders and mostly investors (see Table 2 column 6). Prior industry experience, including networks and specific knowledge, were the second most reported resources obtained through new members. Finally, the competence “around the company” such as IP issues, legal advice and executive experience, which does not reside in the post-startup TMT was the third main resource obtained.

TTOs in Norway emphasize the importance of having people with start-up experience on the board. Surprisingly, prior start-up experience of board members was not among the first resources the board members were valued for, although several new members had started companies before. This may be due to VC funding being more likely for high quality teams (Baum and Silverman 2004; Florin 2005). This suggests that the ability to acquire financial resources or industry-specific knowledge, developed during a previous start-up attempt, may be more valuable than the prior start-up experience itself.

During the *second* change there were fifteen member additions in nine cases. In seven cases the new members were outsiders: either VCs or from industry. During next *third change* the new members added were again outsiders: seven investors, two from industry, and two CEOs. Few, the oldest cases, have had the fourth board change. There were strategic, resource-related, considerations in the decisions to add members to the board in all cases except for spin-offs Chemical and Optical. Here, the reason for the board changes was the re-structuring of other companies that were represented on the board of Optical and Chemical. These members were simply replaced by new representatives.

Thus, the board members added in the first rounds (during first and second changes) were mostly investors and people who could contribute with industry-specific networks and knowledge. The resources and capabilities obtained through these members were complementary to those of the TMT, which concentrated on mainly solving the development of technology/product task.

During the third and subsequent board changes the new members were investors, professional executives and those who “knew the markets” in which customers and potential collaboration partners operated. However, people responsible for the company’s financial system and sales and marketing were appointed to the TMT indicating a shift in the TMT’s focus from product/technology development to internal efficiencies (Kazanjan 1988). Thus, new board members helped the TMT with such tasks as acquisition of other resources, organization and administration, and sales and marketing. In eight cases the CEO was replaced by a new one with much executive experience indicating the need for more formalized organizational and administrative skills and routines. In seven of these cases the external professional CEO was hired to replace scientist-entrepreneurs, TTO and university seed fund representatives who were functioning as CEOs in the firm. Hence, as the resource dependence theory predicts, the boards increasingly consisted of members who could add value to the firm by bringing in different resources that the TMT needed depending on the current dominant task the ASO worked on. Thus,

**Proposition 3a:** New board members will most likely bring critical resources that the top management team lacks, depending on the current dominant tasks.



**Proposition 3b:** New board members' resources will most likely range from finance and industry experience in earlier stages to executive and market/sales experience in later stages.

*How are board members added?*

While attempting reaching the Proof of Viability stage the new board members were brought to the board through personal contacts of privileged witnesses, scientist-entrepreneurs and board chair in eight cases and of new CEO and investors in three cases (see Table 2 column 6 and 8). Surprisingly, in seven cases an outsider who entered during first board change became chair and stayed with the ASO until the time we finished all our interviews (Table 2 column 7). This had consequences for subsequent changes: the common denominator for these cases was that the new members were added to the board primarily through the networks of this *board chair*. As the new chair was an investor and/or person with 15 to 40 years of working experience in industry, the new members attracted to the board in subsequent rounds had similar backgrounds, comprising finance, executive and/or industry experience. Hence, the board composition from the second change reflected to a greater extent the social networks of the board chair as social network theory predicts.

During the *second* change in six out of seven cases the new members were also added through the new chair. Nine cases in our sample had experienced a *third change* in board with the same pattern in terms of social networks as previous change. Again, outsiders were added through the chair's network in eight cases. Few of our cases have experienced a *fourth change* so it is hard to infer firm conclusions from this; but the pattern was similar to the second and third board changes in terms of social networks.

Besides, we expected that if the company had external stakeholders on the board, the composition of the board after legal start-up would also reflect the social networks of the principal stakeholders, such as the public research organization and external financiers (see Figure 1). These new members were expected to bring critical external resources. Our findings show mixed results. The initial boards in all Norwegian spin-off cases included a TTO member who represented the public research organization as the main external stakeholder. In half of the US cases the initial board included early stage VCs as external stakeholders. Contrary to our expectations, there seems to be a convergence over time in the sense that later board members are mainly selected from the network of the professional board chair. This board chair came from outside the venture during the first change in board

composition and tended to remain in the company during all stages of growth influencing subsequent board additions. Therefore, we separate the first change in board from the subsequent changes, termed board evolution process. In five cases the chair is indeed the largest external stakeholder and financier: either VC or industrial partner. In the remaining six cases the board chair is not the largest stakeholder. The process of board evolution can thus be characterized as driven mainly by the social networks of the board chair. Hence,

**Proposition 4:** In the post-startup stages the new board members will most likely be recruited from the board chair's network.

### **Discussion and conclusions**

This paper has sought to explore the process of board formation and board evolution in young academic spin-off companies (ASOs) in Norway and the US drawing on stage-based, resource dependence and social network theories. Our research questions are: (1) Which board members do ASOs add and why in the start-up stage? (2) When, why and how do changes in board composition occur in the subsequent stages of growth?

Due to the limited number of cases, the conclusions and policy implications should be treated with care. However, since little is known about board dynamics in ASOs, our investigation represents a useful addition to the governance and spin-off literature and may provide a foundation for later empirical studies. We contribute by providing greater insight into dynamic aspects of board formation and evolution in new technology-based entrepreneurial firms (Vanaelst et al. 2006; Filatotchev et al. 2006; Clarysse et al. 2007), a relatively unstudied area in entrepreneurship and governance research (Huse 2007; Uhlaner et al. 2007). Overall, our findings indicate that stage-based, resource dependence and social network theories are important complements, which all provide partial explanations for board change processes, but have to be employed in combination to better understand the phenomenon.

We have shown that the process of board formation is mainly driven by the social networks of the founders as social network theory predicts. During the pre-startup stages the founders develop professional relationships with “privileged witnesses” (Vanaelst et al. 2006), i.e. coaches and trusted informants, who guide the founders from the research stage to legal

incorporation. As a result, the board at founding consists of the scientist-entrepreneurs and people from the scientist-entrepreneurs' networks.

Furthermore, our study has shown that the board undergoes changes as the ASO grows, and that these changes are closely related to overcoming critical junctures and reaching the next development stage. Particularly, the first change in board composition is positively related to gaining credibility and moving to the Proof of Viability stage, while subsequent changes most likely move the ASO closer to the next, Maturity stage. New outside directors bring critical resources that the top management team lacks. They may thus be considered to play a value-adding role as resource dependence theory predicts.

The very first board members were found mainly through the networks of founders, privileged witnesses, but also the chair and investors. Contrary to our expectations, the new board members in post-startup stages were not recruited from the social networks of the largest stakeholders such as universities and venture capitalists. There seemed to be a convergence over time in the sense that later board members were mainly selected from the network of the professional board chair. This chair came from outside the venture during the first board change and tended to remain in the company during all stages of growth influencing subsequent board additions. In less than half of the cases the chair represented the largest external stakeholder: VC or industry partner. Thus, regardless of whether the chair represented a principal stakeholder or not, the process of board evolution was mainly driven by the social networks of the chair. The role of the board chair in ASO development may, therefore, be more central than what is commonly assumed and requires further investigation, e.g. a large-scale quantitative study that tests the generalizability of this proposition.

Our study adds to academic entrepreneurship research by relating changes in boards to stages and dominant tasks in spin-off development (Vohora et al. 2004; Vanaelst et al. 2006; Kazanjian 1988). We suggest that changes in board composition reflect the changing resource needs of the company during stages of growth. In each stage the top management team works on certain dominant tasks and acquires necessary additional resources through new board members. The members added in the first rounds are mostly investors and industry representatives helping to solve tasks related to securing financing and strategic positioning. The members added in later rounds are investors, professional executives and those with

market-specific knowledge aiding with the acquisition of other resources, organization and administration, and sales and marketing.

Finally, we contribute to research on boards by showing that the board is a dynamic concept (Uhlener et al. 2007). As mentioned, board member additions seem to be associated with the venture's progress from one stage to another. This may imply that tenure heterogeneity which arises from additions to the board may be beneficial to the firm. Borrowing a categorization of stages of development from earlier ASO studies (Vohora et al. 2004; Vanaelst et al. 2006), we find that board member additions are closely related to events such as external capital increase. Future research may attempt to use a more refined categorization of stages and milestones borrowing e.g. from finance and governance literature. For example, one could trace to what extent and how the changes in board composition are related to achieving important entrepreneurial milestones like going public (Shane and Stuart 2002; Filatotchev et al. 2006). More research remains to be done examining in detail to what extent and how board member departures influence the firm's development.

Our research has a number of implications. Changes in the board may be seen both as an effect of ASOs' development and progress to a new stage, and as a driving force in this development. More longitudinal research is needed, but our data point to the latter effect and the role of key outside directors in overcoming critical junctures. An important policy message is therefore to include the perspective of board dynamics in mechanisms intended to support ASO development. For instance, certain types of public funding seeking to stimulate academic entrepreneurship could be made contingent on the ability to attract professional outside directors to the board of an ASO.

The next important policy message stems from our evidence regarding the TTOs' involvement in and contribution to ASOs. Compared to well-established US TTOs whose involvement was basically limited to developing patenting and licensing agreements, we found that young TTOs in Norway played a much more active role in ASOs. They were represented on the ASO board and in some cases the management team, picking new board members and participating in other strategic decisions. Despite this active involvement during the legal incorporation and early post-startup period, the Norwegian spin-offs seemed to have a slower rate of development in post-startup stages.

The reason for the Norwegian TTOs' active participation may be due to their aims to secure a future income for themselves and their universities and to demonstrate the legitimacy and importance of technology transfer and ASOs – following recent legislative changes that some academics did not welcome. There may thus be a conflict of interest for the TTO staff as representatives of the university (Mosey & Wright 2007), since involving outsiders may reduce their role and potential income. Public ASO support programs and seed capital funds, which exist in Norway and most other countries interested in stimulating academic entrepreneurship, should be aware of this and moderate the financial expectations to TTOs.

Until recently, the legal establishment of a spin-off company was regarded as a significant event for Norwegian TTOs, and they received extra funding for this. The pitfall here is therefore also related to premature formal establishment of an ASO before all necessary resources and capabilities have been acquired and developed. Public support mechanisms should be tailored so that they could prevent the premature formal establishment of an ASO. As shown in our data, after such early legal start-up some scientist-entrepreneurs were frustrated by a lack of progress. So, attracting the first key outside directors who were also the main resource providers was experienced as an “actual” start-up enabling the ASO to develop the business further. The challenge for TTOs is, in other words, to find a balance between acting as a representative of the university and as a wider societal institution.

For policy-makers and practitioners we suggest that there may be a need to develop policies that meet the needs of ASOs in finding outside directors. Efforts to develop networks and relationships with professional board members – investors, industrial members, and executives – may be an important additional component in general and specific assistance programs. This may imply that TTOs should recruit staff with working experience in private high-tech sectors in established companies, not only in start-ups. Such actions may help address the concerns that academic spin-offs are being created without the necessary resources to move the business forward.

Our study has a number of limitations which will hopefully be addressed by future research. One limitation is methodological. We have conducted one or two interviews per firm using a limited number of cases. Overall, we attempted to address this limitation by studying cases that are in different stages of development, to better capture the evolutionary aspects of board composition. Future research might undertake longitudinal studies of a greater number of

cases to trace the board evolution of firms through development stages. Next, additions and departures raise important governance issues in terms of how changes in the equity holdings are negotiated. We have been able to observe the effects of additions on firm development. Further research may explore departures, negotiation and tension issues, and examine whether the changes are conflict-loaded or resolved by the power that may come from the size of an individual's equity holding.

In spite of these limitations, we have attempted in this study to shed light on an unstudied topic, namely board formation and evolution of board composition in new technology-based firms, going beyond agency perspective. Our results indicate that the process of board formation is driven by the social networks of the founders, while the process of board evolution is mainly driven by social networks of the board chair with external board members adding value by bringing the additional resources that the management team lacks and, thus, contributing to the development of the venture.

## References

- Aldrich, H. E. and C. Zimmer (1986). Entrepreneurship through social networks. In: Sexton, D.L., Smilor, R.W. (Eds.), The Art and Science of Entrepreneurship. Ballinger, Cambridge, MA: pp. 3-23.
- Arundel, A. and C. Bordoy (2007). Developing internationally comparable indicators for the commercialization of publicly-funded research. Working paper, UNU-MERIT.
- Baum, J. A. C., Silverman, B.S. (2004). Picking winners or building them? Alliance, intellectual, and human capital as selection criteria in venture financing and performance of biotechnology startups. Journal of Business Venturing **19**, 411 – 436.
- Birley, S. (1985). "The Role of Networks in the Entrepreneurial Process." Journal of Business Venturing **1**(1): 107.
- Boeker, W. and J. Goodstein (1991). "Organizational Performance and Adaptation: Effects of Environment and Performance on Changes in Board Composition." Academy of Management Journal **34**(4): 805.
- Borch, O. J. and M. Huse (1993). "Informal Strategic Networks and the Board of Directors." Entrepreneurship theory and practice **18**(1).
- Carter, N.M., Stearns, T.M., Reynolds, P.D. and Miller, B.A. (1994). New venture strategies: theory development with an empirical base. Strategic Management Journal, 15, 21-41.
- Clarysse, B. & Moray, N. (2004). A process study of entrepreneurial team formation: The case of a research based spin off. Journal of Business Venturing, **19**(1), 55–79.
- Clarysse, B., M. Knockaert and A. Lockett (2007). "Outside board composition in high tech start-ups." Small Business Economics **April**.
- Cooper, A. C. and C. M. Daily (1997). Entrepreneurial Teams. In D. Sexton and R. Smilor: Entrepreneurship 2000. Chicago, III, Upstart Publishing.
- Deakins, D., E. O'Neill and P. Mileham (2000). "The role and influence of external directors in small, entrepreneurial companies: some evidence on VC and non-VC appointed external directors." Venture Capital **2**(2): 111.
- Eisenhardt, K. M. (1989). "Building Theories From Case Study Research." Academy of Management. The Academy of Management Review **14**(4): 532.
- Ensley, M. D. and K. M. Hmieleski (2005). "A comparative study of new venture top management team composition, dynamics and performance between university-based and independent start-ups." Research Policy **34**(7): 1091-1105.
- Filatotchev, I., S. Toms and M. Wright et al. (2006). "The firm's strategic dynamics and corporate governance life-cycle." International Journal of Managerial Finance **2**(4): 256-279.
- Florin, J. (2005). Is venture capital worth it? Effects on firm performance and founder returns. Journal of Business Venturing **20**, 113– 135.
- Forbes, D. P., P. S. Borchert, et al. (2006). "Entrepreneurial Team Formation: An Exploration of Member Addition." Entrepreneurship Theory and Practice March.
- Franklin, S., M. Wright and A. Lockett (2001). "Academic and surrogate entrepreneurs in university spin-out companies." Journal of Technology Transfer **26**: 127-41.
- Fried, V. H., G. D. Bruton and R. D. Hisrich (1998). "Strategy and the board of directors in venture capital-backed firms-Venture capital and high technology." Journal of business venturing **13**(6): 493.
- Gabrielsson, J. and M. Huse (2004). "Context, Behavior, and Evolution: Challenges in Research on Boards and Governance." International Studies of Management & Organization **34**(2): 11-36.
- George, G., D. Robley Wood Jr and R. Khan (2001). "Networking strategy of boards: implications for small and medium-sized enterprises." Entrepreneurship and Regional Development **13**(3): 269.
- Glaser, B. G. and A. L. Strauss (1967). The discovery of grounded theory: strategies for qualitative research. Chicago, Aldine Pub. Co.
- Granovetter, M. (1985). "Economic action and social structure: A theory of embeddedness." American Journal of Sociology (91): 481–510.
- Gulati, R. and M. Gargiulo (1999). "Where do interorganizational networks come from?" The American Journal of Sociology **104**(5): 1439-1493.

- Huse M. (2007). "Boards of directors in SMEs: a review and research agenda". Entrepreneurship & Regional Development, **12**:4, 271 – 290.
- Jick, T. D. (1979). "Mixing Qualitative and Quantitative Methods: Triangulation in Action." Administrative Science Quarterly **24**(4): 602.
- Johnson, J. L., C. M. Daily and A.E. Ellstrand (1996). "Boards of Directors: A Review and Research Agenda." Journal of Management **22**(3): 409.
- Kazanjian R.K. (1988). Relation of Dominant Problems to Stages of Growth in Technology-Based New Ventures. Academy of Management Journal, **31**, 2, 257-279.
- Larson, A. (1992). "Network Dyads in Entrepreneurial Settings: A Study of the Governance of Exchange Relationships." Administrative Science Quarterly **37**(1): 76.
- Lynall, M. D., B. R. Golden and A. J. Hillman (2003). "Board composition from adolescence to maturity: A multitheoretic view." Academy of Management. The Academy of Management Review **28**(3): 416-431.
- McCorquodale M. (2007). Interview with the founder of the spin-off company SemiCon4 from the University of Michigan. May.
- McPherson, M., L. Smith-Lovin and J. M. Cook (2001). "Birds of a feather: Homophily in Social Networks." Annual review of sociology **27**(1): 415.
- Miles, M. B. and A. M. Huberman (1994). Qualitative data analysis : an expanded sourcebook. Thousand Oaks, Calif., Sage.
- Mosey, S. and M. Wright (2007). "From human capital to social capital: A longitudinal study of technology-based academic entrepreneurs." Entrepreneurship Theory and Practice: 1042-2587.
- Mowery, D., R. R. Nelson, B. N. Sampat and A. A. Ziedonis (2004). Ivory tower and industrial innovation. Palo Alto, CA: Stanford University Press.
- OECD (2003). Turning science into business: patenting and licensing at public research organisations. Paris: OECD.
- Pfeffer, J. (1972). "Size and Composition of Corporate Boards of Directors: The Organization and its Environment." Administrative Science Quarterly **17**(2): 218.
- Pfeffer, J. and G. Salancik (1978). The external control of organizations : a resource dependence perspective. New York Harper & Row.
- Rosenstein, J. (1988). "The board and strategy: Venture capital and high technology." Journal of Business Venturing **3**(2): 159.
- Ruef, M., H. E. Aldrich and N. Carter (2003). "The Structure of Founding Teams: Homophily, Strong Ties, and Isolation among US Entrepreneurs." American sociological review **68**(2): 195.
- Sapienza, H. J., M. A. Korsgaard, P. K. Goulet and J. P. Hoogendam (2000). "Effects of agency risks and procedural justice on board processes in venture capital-backed firms." Entrepreneurship and Regional Development **12**(4): 331.
- Saxenian, A. (1994). Regional advantage: culture and competition in Silicon Valley and Route 128. Cambridge, MA: Harvard University Press.
- Selznick, P. (1949). TVA and the Grass Roots : a Study in the Sociology of Formal Organization. Berkeley, Calif., University of California Press.
- Shane, S., Stuart, T. (2002). Organizational endowments and the performance of university start-ups. Management Science **48**, 154– 170.
- Starr, J. A. and I. C. MacMillan (1990). "Resource Cooptation Via Social Contracting: Resource Acquisition Strategies for New Ventures." Strategic Management Journal **11**: 79.
- Timmons, J. A. and Spinelli, S. Jr. (2004). New venture creation: entrepreneurship for the 21st century. Boston, Mass.: McGraw-Hill 6th ed.
- Ucbasaran, D., Lockett, A., Wright, M., Westhead, P. (2003). Entrepreneurial founder teams: factors associated with member entry and exit. Entrepreneurship Theory and Practice **28** (2), 107– 127.
- Uhlener, L., M. Wright and M. Huse et al. (2007). "Private firms and corporate governance: An integrated economic and management perspective". Small Business Economics **April**.
- Vanaelst, I., B. Clarysse, M. Wright, A. Lockett, et al. (2006). "Entrepreneurial Team Development in Academic Spinouts: An Examination of Team Heterogeneity." Entrepreneurship Theory and Practice: 1042-2587.



- Vohora, A., M. Wright and A. Lockett (2004). "Critical junctures in the development of university high-tech spinout companies." Research Policy **33**: 147-175.
- Westphal, J. D. (1999). "Collaboration in the boardroom: Behavioral and performance consequences of CEO-board social ties." Academy of Management Journal **42**(1): 7-24.
- Wright, M., B. Clarysse, P. Mustar and A. Lockett (2007). Academic Entrepreneurship in Europe. Edward Elgar Publishing
- Yin, R. K. (1994). Case study research: design and methods. Thousand Oaks, CA Sage.
- Zahra, S. A. and J. A. Pearce, II (1989). "Boards Of Directors And Corporate Financial Performance: A Review and Integrative Model". Journal of Management **15**(2): 291.

Figure 1: Integrated theoretical framework

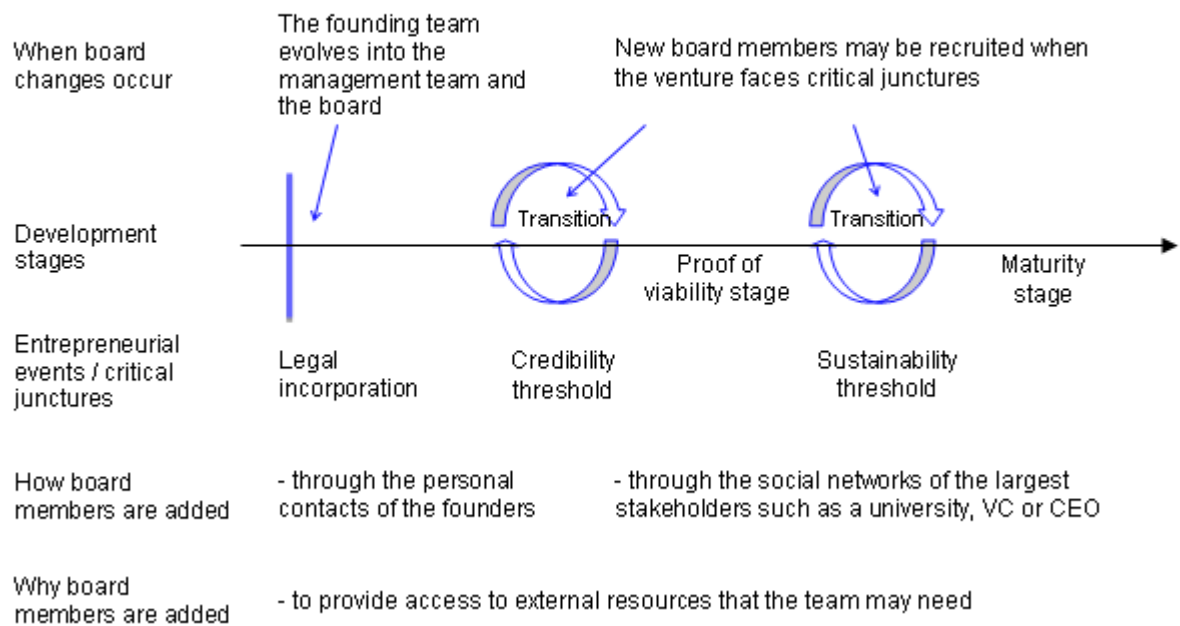


Table 1: Cases overview

Firm and Board characteristics	Academic spin-offs Norway					Academic spin-offs US					
	Biomedical	Nutrimet	Optical	Chemical	Software	Biotech 2	SemiCon 1	SemiCon 2	Biotech 1	SemiCon 3	SemiCon 4
Establishment year	1998	1999	2001	2001	2004	1998	2000	2001	2003	2004	2004
Parent organization	The Norwegian Forest and Landscape Institute	The Foundation for Scientific and Industrial Research	Norwegian Defence Research Establishment	Norwegian University of Life Sciences	Norwegian University of Science and Technology	Stanford university	Stanford university	University of Michigan	UC Berkeley	UC Berkeley	University of Michigan
Number of full-time employees in 2007	15	7 Norway, 16 abroad	5	0	3	10	25	25	69	25	20
Degree of innovation	New technology (drug, medicine), patented internationally				Not patented	New technology (drug, medicine), patented internationally					
Stage of development	Maturity	Proof of viability	Proof of viability	Proof of viability	Proof of viability	Maturity	In transition to Maturity	Maturity	Maturity	In transition to Maturity	In transition to Maturity
Founding team size*	3	3	4	5	7	3	2	3	3	4	4
Positions of academic inventors held in the company (current and previous)	Product development dir., R&D dir., CEO, board members	Short period CEO, board chairman, board members	CEO, CTO, board chairman, board members	Board chairman, board members	VP technology development, VP R&D, board members	CEO, board members	CTO, President	CTO, Chief Science Officer, R&D Director, board member	VPs R&D, President, board members	President and CTO, founder / board member	CTO, board member
Board size in 2007	6	7	4	4	4	8	9	7	8	7	6
Number of board membership changes	6	6	4	2	2	8	7	7	6	3	3

\* Founding team size is the number of founding team members during legal incorporation of the company, including academic founders (inventors) and surrogate entrepreneurs (entrepreneurs recruited from outside)

Table 2: Board composition during legal incorporation and first change in board

	<b>Initial board composition</b>	<b>Board chair</b>	<b>Theories</b>	<b>1st board change: Who added / removed</b>	<b>How and why board members were added / removed</b>	<b>Board chair</b>	<b>Theories</b>
<b>Biomedical</b>	The same as the team: 2 scientists, TTO representative	Privileged witness	Social networks (of scientists)	+ 2 outsiders	Investor through PW (TTO); industry member through new investor	New investor became chair and stayed with the company till 2007	Social networks (of PW & new investor) and RDV
<b>Chemical</b>	The same as the team: 4 scientists, TTO representative	Scientist	Social networks (of scientists)	- 2 inventors + 1 outsider	TTO representative was replaced	New TTO representative who stayed with the company till 2007	None
<b>Nutriment</b>	2 scientists, 2 TTO's acquainted	Scientist	Social networks (of PW)	+ 1 outsider	Industrial investor through new CEO	New industrial investor who stayed with the company till 2007	Social networks (of PW & new CEO) and RDV
<b>Optical</b>	Scientist, TTO member, 2 industrial partners (from the same research group)	Privileged witness	Social networks (of scientists)	+ 2 outsiders	Two privileged witnesses were replaced	The same person	None
<b>Software</b>	2 scientists, surrogate entrepreneur	Privileged witness	Social networks (of scientists)	+ 2 outsiders	Investors through PW (TTO)	New investor who stayed with the company till 2007	Social networks (of PW) and RDV
<b>Biotech 1</b>	The same as the team: 4 scientists	Scientist	Social networks (of scientists)	- 1 inventor + 1 outsider	Legal advisor through scientist	The same person	Social networks (of scientist) and RDV
<b>Biotech 2</b>	The same as the team: 2 scientists, 1 small VC	Scientist	Social networks (of scientists)	+ 3 outsiders	Investors through money raising, 1 member from industry through new investor	New member from industry who stayed with the company till 2007	Social networks (of new investor) and RDV
<b>SemiCon 1</b>	2 scientists, scientist's relative, 2 VCs, industrial outsider	Lead VC	Social networks (of scientists) and RDV	+ 3 outsiders	Investors and CEO through chair	The same person who stayed with the company till 2007	Social networks (of board chair) and RDV
<b>SemiCon 2</b>	2 scientists, 2 local seed fund members	Privileged witness	Social networks (of scientists & PW)	- privileged witness + 1 outsider	New CEO through PW	New CEO who stayed with the company till 2007	Social networks (of PW) and RDV
<b>SemiCon 3</b>	scientist and surrogate entrepreneur/PW	Scientist	Social networks (of scientists )	+ 1 outsider	From industry through privileged witness	New member from industry , stayed with the company till 2007	Social networks (of PW) and RDV
<b>SemiCon 4</b>	The same as the team: 2 scientists, 2 local seed fund members	Scientist	Social networks (of scientists & PW)	+ 3 outsiders	Investor through money raising, member from industry through PW	The same person	Social networks (of PW) and RDV

Abbreviations: "+" – addition of the member, "-" – removal of the member, PW - privileged witness, RDV – resource-dependence view

