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For Long Range Planning, 22 November 2010

RESOLVING THE TENSIONS BETWEEN MONITORING, RESOURCING AND STRATEGIZING: STRUCTURES AND PROCESSES IN HIGH TECHNOLOGY VENTURE BOARDS

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Vitae

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Abstract

There are central tensions between the two sides of the board's institutional role or function: that of controlling and monitoring *versus* that of resource gathering and strategizing. Drawing upon a field study lasting 38 months involving 8 new ventures in the UK high technology sector, we took a close look at the structural composition, knowledge base and behaviours of the board of directors in the early stage high technology ventures. Our findings suggest that the early venture board, when consists of part-time members with diverse knowledge background, can be seen as an extension of the full time internal top management team. As "collective entrepreneurs", they play a vital role in the venturing process; pointing to a collaborative model between inside top management team and outside board directors, which goes beyond the principal-agency model. We discuss the wider implications of our work for the field generally.

Resolving the Tensions between Monitoring, Resourcing and Strategizing: Structures and Processes in High Technology Venture Boards

Quis custodiet ipsos custodes?

"Bolt her in, constrain her!" But who can watch the watchmen?" Juvenile: Satires

Parable of the Talents

"For it will be like a man going on a journey, who called his servants and entrusted to them his property. To one he gave five talents, to another two, to another one, to each according to his ability. Then he went away. He who had received the five talents went at once and traded with them, and he made five talents more. So also he who had the two talents made two talents more. But he who had received the one talent went and dug in the ground and hid his master's money. ..." Mathew 25:14-30

Introduction

The literature on boards and their contribution to firm strategy and firm development has traditionally focused on the larger public company with a diverse set of shareholders, and explored in detail how boards can act as monitors as well as builders of value. More recently there has been a theoretical and empirical augmentation by extending the literature to the study of smaller, often private companies with typically a more limited number of outside shareholders. This newer literature has noted that the role of the board may differ with a greater emphasis placed on establishing legitimacy and in assisting the firm in overcoming the liability of newness and small scale, yet retaining the monitoring role¹.

However, as Stiles (2001:631) points out, in this newer literature there is a paucity of evidence, particularly of board processes, and as a result much theorising has taken place without building on carefully grounded observation. And as Pettigrew notes, to understand the nature of board in operation, we need to pay greater attention to behaviour dynamics in and around

boardroom². This paper seeks to fill that gap. Here we report the study of some 8 firms that are in an early stage of development, sometimes labelled entrepreneurial “threshold” firms as they are beyond start up but before maturity³. In particular, we adopt an approach of direct observation, interview and examination of relevant documents, a process that has uncovered dimensions others may have missed, or misunderstood.

Our process work shows both support and contradictions with this newly emerging literature. We certainly find support for the propositions that the board can add significant value in the early stage high-technology ventures (entrepreneurial “threshold” firm) by performing value-adding services, in particular gathering resources and providing strategic advice⁴. But, our research raises questions about how this value is created. In particular, our work suggests that an active board in a young firm, when it consists of a majority of part-time members, seems at first sight to be structured in a manner that signals an institutional role of independence. But, in practice the board does not seem to operate separately from top management, but rather as an extension of the top-management team. This observation draws attention to the potential incompatibility of the institutional role of control/monitoring on the one hand and resourcing and strategizing on the other.

As we will explain, if the board is an extension of the top management team, then we need to adjust our theorising and our understanding of practice. For instance, when thinking about these entrepreneurial “threshold” firms, we should be cautious in applying concepts such as of “absorptive capacity” and “strategy making” differentially to the board and the management of the company⁵. Indeed, our work suggests that in many instances shareholders seem to choose a talented independent board but charges them with adding value; it seems that the shareholders deliberately place less emphasis on the board’s role as monitors concerned with “guarding the money”.. That is why the heading to this paper contests Juvenal’s concern of “Quis custodiet

ipsos custodes?” by the words of Mathew in the Bible who reminds us that scarce resources (good board members) are there to be put to work.

We begin our paper by reminding the reader of the extant and recent literature; highlighting areas where we see tensions to be uncovered in a process study. We then explain our sample, data collection and methods by which we metric events. We describe in some detail the actions of our sample of directors, indicating that this activity is not widely appreciated or understood, that leads us to the discussion section where we explain and confront prior theorising with our observations, and why we conclude that notions of strategy making, resource acquisition, and board accountability need to be reshaped to recognise some fundamental inconsistencies in prior thinking.

Literature review and research questions

To achieve the twin objectives of corporate governance, wealth protection and wealth creation, the extant board literature has identified three main functions or roles for the board—control/monitoring, resource gathering and strategizing⁶.

First there is the corporate governance literature that has traditionally emphasized the board’s primary function as controlling and monitoring managers on behalf of shareholders. Originated from Berle and Means’ seminal work on the separation between ownership and control, agency theorists have emphasised that, the agency costs may arise due to the misappropriation of firm resources by managers (“agents”) due to their different interests from those of owners (“principals”). To reduce such agency costs, an “independent” board of directors is put in place to monitor and control the managers of the company in general and the CEO in particular⁷. Independence in this context usually refers to a balance of executive and non-executive directors (NEDs), and the separation of Chairman and CEO, and it is believed that such structural

compositions brings objectivity and detachment from daily operations to permit members to see things differently and exercise independent judgement⁸.

On the other hand, resource dependence and institutional theorists depict the board as a mechanism that uses external ties and linkages to secure critical resources such as including advice, legitimacy, access to support from outside the firm and so on. As such, this stream puts much emphasis on direct and indirect social ties⁹. In addition to this resourcing role, management scholars and policy makers have paid increasing attention to boards of directors' direct contribution to strategizing. Drawing upon cognition and decision-making theory, scholars in this stream have argued that to be effective in shaping strategy, the board needs to have functional expertise as well as appropriate broad strategic knowledge base¹⁰.

In the entrepreneurial context most would expect the resource and strategizing role of the board to be important. Growing successful high tech ventures demands accessing and acquiring a wide array of managerial skills and expertise within a short span of time. Original founders rarely have the full range of skills required to make the business a success: many are scientists with little serious commercial experience, and even in those cases where the CEOs are not scientists, they rarely have the necessary science and technology knowledge critical to make the business a success. In addition, young ventures can rarely afford to buy in the knowledge and skills through recruiting full time professional managers. Prior work noted above suggests that part-time non-executive board members, consisting professional advisors and venture capitalists, may be more experienced and knowledgeable than the full time executive team. Therefore, it is important to ask whether the board has a knowledge base that is effective for monitoring, i.e. board's knowledge on ratifying and monitoring management decision, e.g. to hire and fire top managers, and set compensation for top managers¹¹; or whether it is more geared towards promoting resource and strategy role, i.e. "deep knowledge" of issues that are closely relevant to the "threshold firm"? Of

course, it is possible that the knowledge base of the directors would extend in both directions, but this would suggest a rather narrow set of possible directors. Therefore, in our work, we ask:

RQ1: Does the structure and knowledge composition of the early venture board promote the role and function of monitoring, or does it favour resourcing and strategizing, or does it promote both?

As Forbes and Milliken point out, sometimes the board is capable of performing all of the possible institutional roles, but does not actually behave in the manner expected¹². In our particular case, it can be because there is a paradoxical tension between the two sides of board's function: that of control/monitoring versus that of resource gathering and strategizing, arising from divergent assumptions of human nature and company needs. On one hand, the underlying assumption of the principal-agent model is individual opportunism, extrinsic motivation and a distrusting owner-manager relationship; hence, board's control role or function calls for discipline. On the other hand, board's resource and strategy function calls for a board-management collaboration model, which assumes collectivist tendencies, intrinsic motivations, and trusting owner-manager relationship. While scholars have proposed a simultaneous need for control and collaboration, there is little empirical evidence on how boards may solve this tension¹³.

To understand how the tension is resolved, we need to observe the behaviour of the board and its members. While the monitoring function calls for a balance of insider and outsiders on board; being an outsider does not necessarily imply being independent. Similarly, the presence of expertise does not equate to the usage of them¹⁴. Roberts, McNulty and Stiles (2005) have shown that, to keep their independence and enforce monitoring function, corporate board members engage with the executive team but without seeking to assume an executive role, i.e. stay "detached" from firm's daily operation. At the same time, others have argued that, to create value for the firm, the board need to actively involved in the resource gathering and strategizing process.

For example, much stress is placed on the social networks and the capacity of boards to facilitate the access and acquisition of resources through their social ties¹⁵. And although the discussion in the resource dependency and social network literature tends to emphasise the presence of such resources, rather than the use of them, the implication of the theorizing is that boards should be active in finding and capturing resources. In a similar vein, strategy scholars have suggested that the board needs to be actively engaged with management in the whole strategic decision making process¹⁶. So the key question remains, does the board appear to resolve the tensions between monitoring and resource and strategy function? So, we ask,

RQ2: Is the early venture board's behaviour consistent with their monitoring, resource and strategy role and function?

Context, Data and Methods

To explore our research questions, we took a close look at the board of director's involvement in 8 early stage high tech ventures in the UK from the initial idea generation to forming a fuller scaled business. As shown in Table 1, all our sample firms were in the high-tech sectors—life science, medical devices, diagnostics and software engineering; and they adopted a variety of business models. All of them were incorporated between 2001 and 2005 with the exception of AUV, which was incorporated in 1996; and the pre-founding stage of most of them can be traced back before 2000. 2 companies in our sample do not involve academic founders. By December 2006, 2 companies (ID and PHY) went public, 1 company (AUV) was acquired by a listed company, and all other 5 companies were active. Whilst all our sample firms seemed variably successful by the end of the data collection period in the sense that they had not failed, their success was not always proven¹⁷. In 2009, one of them (ID) had been liquidated in 2008 but restarted with the same technology following a small IPO, another was dormant, and the rest varied in the degree of “liveliness”. We deliberately did not sample ventures funded by “full service venture capital firms”, i.e. those who provide continuous funding along with management

expertise. As noted earlier, there are few full-service VCs existing in the UK, and they back very few ventures. We also note that our sample is biased (deliberately) towards life science sector, where new ventures face the extremely demanding task of gathering the necessary knowledge and funding, as this was the focus of our questioning. There is much recent literature that talks about these challenges in the UK context¹⁸.

INSERT TABLE 1 ABOUT HERE

We followed the sample firms over a 38 month period from October 2003 to December 2006. Such a real time data collection approach has been suggested as promising as it maximizes the probability of discovering short-lived factors that exert important influence and is unlikely to bias researchers before the ultimate outcomes become apparent¹⁹. To explore our research questions, we examine board's structure, knowledge composition and their behaviour systematically across all cases. We track changes in board's structure over time. To identify the knowledge structure of the board and its composition, we collected detailed curriculum vitae and interviewed board members about their background. With regard to the issue of the early venture board's behaviour and how they performed monitoring, resourcing and strategizing roles, we conducted repeated interviews with key informants as well as repeatedly attended board meetings and client meeting of some of our sample firms during this period. Please see appendix 1 for more details on methods, data collection and analytical procedures.

Findings

We do not pretend that all UK high-tech firms have boards that are structured like the ones we studied, but we do claim that our sample is characteristic of many ambitious UK high-tech ventures (as evidenced by many informal conversations with directors of other companies held at conferences we have organised). For our firms, we found that the boards were structured in a manner to encourage “independent monitoring”. But paradoxically they deliberately chose not to follow this institutional role; rather the board saw themselves as an extension of management,

responsible for building successful ventures. That the board is capable of acting independently is made clear by our analysis of the board structure and knowledge composition. That the board actually does not take on this role, but instead gets involved in the business of running the firm is clear from our process analysis, i.e. the commitment of the board of directors to roles of providing managerial skills and expertise, fund raising and designing business model. But this does not mean that the boards did not engage in monitoring activity in the same way that all senior managers are concerned with monitoring, rather we found that the board's position was not one of "independence" and so "institutionally" their role was not that of being monitors.

1. Our sample of high-tech early ventures had a large "outsider" dominated board with diversified knowledge background

We delay the analysis of how boards operate for a few pages on purpose, to show the unusual structure and knowledge base of our boards that contain many very sophisticated professional advisors. These structures lend themselves to our boards being very well qualified to independently monitor management; quite unlike the typical board of say a small family private firm that is not involved in high-technology. This examination of the structure of the boards is necessary to build a proper appreciation of the importance of our findings about board behaviour.

First we show how our sample of early stage ventures had large size working boards. We note that our focus of observation is the working board that includes some who are not legal board members at the time. We term these individuals as "informal" board members---they are often present at board meetings and involved in the decision making process and they typically include: 1) past and prospective legal directors, i.e. some people may stay on board when they are no longer serve as legal board of directors, or they may start to participate in the venturing process before they become legal directors; 2) key professional advisors such as solicitor, accountant, scientist, financial PR, management consultant and etc, whose expertise are instrumental at certain

stage of the venturing process; 3) board members from its company subsidiaries after they have gone public (PHY and ID); or from its holding company after it was acquired (AUV); 4) representatives of institutional shareholders such as representatives from government funding agencies and university as well as major individual shareholders, not necessarily appointed as legal board members.

Triangulated from both primary and secondary data sources, we coded the legal and “informal” board members of each company year by year from incorporation to Dec 2006. As shown in table 2, there is a significant portion of “informal” board members involved in the early stage venturing process. And an early venture’s working board size at any given year from founding varies, whilst the largest size could reach 12 in the case of PHY, all of them have a working board size larger than 3. On average the board size increases as firm grows²⁰. The average size of the working board of our sample companies is 7.25 (s.d. 1.67) with a range from 5 to 10.

We also examine two key aspects of board structural characteristics as mentioned in the literature review, i.e. the proportion of outsider or non-executive directors on board; and the separation of Chairman and CEO. As mentioned earlier, there is a significant portion of “informal” board members, who are outsiders. And typically the only insider on the legal board is the founder/CEO, and the duality of CEO and Chairman is very rare among our sample. Although from time to time, board members may act as interim CEO, CFO and executive chairperson when there is a crisis such as shortage of funding, or sudden departure of key members of the management team. In another word, our data suggests that these early venture boards tend to be dominated by outsiders, a structure that fosters monitoring in the traditional sense. However, being an outsider does not necessarily equate to “independence”; we need to pay attention to their behaviour as explored later.

INSERT TABLE 2 ABOUT HERE

Our data also shows that most directors have experience of directorships of other firms, something that is consistent with them being monitors. We examine this issue carefully using the total directorship per director as a proxy for board's level of knowledge on monitoring, including both their current and past directorship. We include all the current and past board directors from founding to December 2006 as a proxy for a working board since they account for the majority of the working board members according to our observations. As shown in table 3, the average number is 24.35 with a range from 15.5 to 33.8. That is, each director has involved in more than 24 outside firms on average. This indicates a substantial level of experience for early venture board; indeed it is much higher than that found in many IPOs and corporate boards. For instance, in a study of 251 UK "IPO company" boards (with an average firm age of 5.4 years and s.d. 13.83), Filatotchev and Bishop report that the average number of outside directorship per non executive directors (NED) is 8.42 (s.d. 6.82); while on average NED jointly have almost 18 directorships (s.d. 16.92).

If the board was present to undertake guidance and resource gathering, one would expect directors to have "deep knowledge" of issues that are closely relevant to the "threshold firm", and we find this also to be the case. To gauge such "deep knowledge", we took a close look at each member's prior experience, and we coded their specialist expertise into two types---functional and entrepreneurial knowledge. According to Collins and Evans, human expertise can be generally categorized into two levels---ubiquitous and specialist expertise.

Ubiquitous expertise ...involves learning or reading rather than immersion in the culture of those who have the knowledge, 'enculturation' is the only way to master an (specialist) expertise which is deeply tacit knowledge-laden because it is only through common practice with others that the rules that cannot be written down can come to be understood²¹ (2007:24).

This echoes our key informants' view that, although many board members have ubiquitous knowledge across the function domains, they typically contribute their specialist expertise in one primary knowledge domain. We code functional knowledge, which often co-incident with industry knowledge, into three types of primary specialist knowledge domain—technology development, business development, and corporate finance. We refer entrepreneurial knowledge to an in-depth understanding of the process of setting up and building a venture from scratch, e.g. when to integrate what kind of knowledge and how. We only code those individuals who had been involved in successfully setting up more than one venture before joining the start-up in question as having entrepreneurial knowledge, i.e. they were either successful serial entrepreneurs or having a wealth of experience of helping young firms to grow.

As shown in table 3, on average there are about 2 directors in technology development, business development and corporate finance knowledge domains, whereas 1 director contributes to entrepreneurial knowledge (PHY is an exception). This indicates that building successful high-tech high growth ventures requires a diversified array of knowledge. What is not shown in the table is the level of expertise that individual board members have. For those who hold entrepreneurial knowledge, they are typically successful serial entrepreneurs themselves, or had helped to build more than 3 start-ups. Some individuals had been involved in more than 50 start-ups. For those who hold technological, business and finance expertise, many of them used to hold senior positions in large corporations, or partner positions in renowned professional services firms. Typically, they have more than 20 years professional working experience in their respected field, covering a wide spectrum of specialized expertise such as clinical research and development, marketing and sales, business development, legal advice, corporate finance and so on.

In summary, the structure of the knowledge of the board of directors that we observed and the extent of their outside involvement is consistent with BOTH the view that the board members could be monitors and the view that they could be builders of value. We stress that we make no

claim that all UK high-technology firms have boards like those we studied, but we pay particular attention to the issue of structure and knowledge composition because we believe it does represent the practices of a group of firms that are interesting and have hitherto not been fully documented.

INSERT TABLE 3 ABOUT HERE

2. *Process Revealed: How our sample of early stage high-tech venture boards helped young firms to access managerial expertise and funding*

While Tables 2 and 3 indicate the potential pool of knowledge that these new ventures can access, the presence of knowledge does not equate to the usage of them. We therefore explored whether the early venture board's behaviour is consistent with their monitoring, resource and strategy function.

Our observations confirm that boards provide access to managerial skills and expertise both directly and indirectly. For instance, we note boards appear to use their webs of social contacts to validate or search information and expert knowledge when needed, including identifying target market customer needs, potential partners and so on. Boards also help to identify and recruit management talents. They may know someone personally who fits the criteria through their prior working experience, or they have used a particular head-hunter who has proved to be efficient in finding a particular type of talents for early stage ventures. In addition, they also help to screen and interview candidates. We also note, from time to time, board members may plug in knowledge gap directly by acting as interim CEO, CFO, and executive chairperson. In another words, early venture boards may complement as well as substitute internal top management teams.

Further, we observed that these young ventures have frequent, often monthly formal board meetings where members read the meeting agenda and documents beforehand; and digest and correct board minutes afterwards. At the same time, informal meetings among board members

(daily or weekly) are also common. It is this intensive interaction among a tightly connected group that supplies a repertoire of managerial skills and knowledge to the young ventures.

One particular area of resource gathering dominated the agenda of all of our boards, and that was fund raising. We found our early venture boards to be heavily involved in fundraising both strategically and operationally. To explore the role of board in fundraising, we gauge the amount of time and efforts each venture board spent on fundraising during our observation period, drawing upon our observations and field notes initially. We then conducted follow-up interviews with key members of the board to confirm our estimations. As confirmed by key actors, the amount of time and effort involved from incorporation to achieving the first round major commercial funding increases rather diminishes as funding size increases; management time and expenditures occurred during consistent.

As shown in table 4, ***inside the boardroom***, a significant amount of time (41-64% on average) was spent on formulating fundraising strategy and related issues. Our findings echo the view that the fragmented vertical funding market structures in the UK presents a formidable challenge for early stage high tech ventures. And boards play a key role in devising a viable fundraising strategy, i.e. identifying initial funders, subsequent routes of funding and exit strategy for existing investors, as well as adapting to the funding environment as required. Without a carefully designed “funding map” to orchestrate the funding process as the venture evolves, fundraising tends to be costly. Multiple rounds of fund raising tend to increase the direct funding cost such as the advisory fees and in-direct costs of pitching and negotiating with potential funds providers. Also additional cost may occur when these ventures encounter liquidity problems. Another key strategic issue is to determine when to raise funds, how much to raise and at what valuation. Raising enough funds at each round at an appropriate valuation requires an accurate projection of future cash outflow before reaching the inflection point. Often for high tech ventures, meeting each milestone tends to

inflate company valuation. Hence, timing is key; raising funds shortly before meeting a critical milestone tends to leave money on the table. Our research indicates that boards are crucial in the decision making process.

Outside the boardroom, a high proportion of board directors (38-63% on average) are directly involved in fundraising; and on average, these directors spent 38-61% of their time on fundraising.

Typical activities include:

1) Seeking and validating funding related information. It is vital to identify and update information about the potential fund providers at different venture development phases and their funding criteria. For instance, government backed funding schemes are often lifelines at idea generation and proof of concept stage in the UK. And it is reported that there are more than 100 different kinds of “hybrid” funding schemes in the UK. Each of them varies in its vintage, funding criteria, the amount invested and the way of funding is structured²². While often a great deal of the information is available in the public domain, an in-depth understanding of how funding agencies work requires more than desk research. We note that many board members sit on the advisory board of various funding schemes.

2) Reaching and persuading potential investors. In the UK, as the funding range of government initiatives is typically between GBP 20K and 250k²³, “informal” venture capital funds from business angel (BA) and high net worth individuals (HNIs) plays significant role in plugging in this equity gap for early stage ventures. In our research, we note that, while on average BA and HNIs typically invest under £100,000 per deal individually, there are individuals who invest up to £0.5 million per deal. To connect and persuade these investors is not a trivial task. BA/HNI network, where they share information, knowledge and may jointly invest in a deal, tends to be local and rather enclosed (e.g. Cambridge, London, Scotland angel networks). We note that board members connect to this community either through a direct membership (i.e. many of them are

active BA themselves), or through personal ties with the gatekeepers—often local accountancy, tax or legal advisors who provide services to BA or HNIs on their personal matters.

Yet, being aware of an investment opportunity is a different matter from making an investment decision. While most government funding are provided in the form of grants, BAs and HNIs who invest in early stage ventures seek risk adjusted financial returns. Apart from skills, persuasion also needs to tailor to individual investment flavor. Some investors may have a special interest for a specific type of technology, or a specific type of technological application area; others may view early stage ventures as an alternative investment asset class which enjoys tax breaks in the UK. We also note that many individual investors have strong faith in a particular board member such that they tend to invest in the companies that he or she is involved repeatedly. This seems to suggest that these investors are betting on the board. Further, we note that very often board members also plug in the equity gaps themselves when needed.

3) Coaching and assisting members of the internal top management team to pitch to potential funders. The perception of the internal top management team's ability to articulate the strategic plan convincingly in front of potential investors is key in successful fundraising. We noted that a lot of effort and time went into coaching. Some board members may spend a whole afternoon going through presentations, some may travel with the internal management and attend presentations to boost the internal top management team's confidence and enhance the perceptions of potential resource providers as it signals board commitment to the venture. After meetings, feedback and skill training would be given.

Furthermore, board cohesiveness is critical to successful fundraising. As shown in table 4, out of the 4 life science businesses, three of them are low in board cohesion. In the case of AOX, although the board has spent a lot of time discussing fundraising inside boardroom, there is little action taken outside boardroom. In the case of AUV and PHY, the success rate is still low despite

a significant amount of time and effort spent inside and outside boardroom. Only NOVA exhibits a high level of cohesiveness. Generally speaking, we observe that board cohesiveness is manifested in following ways:

1) In the case of high level of cohesiveness, board members recognize and respect each other's expertise area. This tends to reflect good match between expertise and task delegation. This tends to reduce cognitive conflicts, and ease the decision making process as more knowledgeable member's opinion will have more influence on the actual outcome; and board will have more influence on internal top management team. In low cohesiveness, the opposite tends to happen. For instance, one board member of PHY comments, *"Although the business has good potential, there is a total lack of focus in strategy. The management team was looking for funding sources and potential drug candidates as the CEO and some key executives see fit; they don't listen to the board"*.

2) There is extensive communication within the group both formally and informally. We observe many board members often socialize outside boardroom, and informal discussion takes place frequently. One key issue in causing communication difficulties is jargons and language used in different knowledge domain. In many cases, we observe effective board tends to use layman's language in discussion to ensure everyone is involved. Any reference to professional jargon is explained clearly.

3) Board members seem to have good faith and trust in each other, and highly motivated when cohesive is high. For instance, the NOVA board member showed strong faith in both the business idea and company management. When the company's future is most uncertain due to unfavorable capital market, board members plug in their funds to close the equity gap. In contrast, we observe that board members of PHY are less motivated in raising funds for the company.

This is in consistent with the board research drawing upon cognition and group dynamics literature. Research has suggested that whilst the increase in board size and diversity promotes creativity and cognitive capacity to solve complex and unpredictable problems that firms may face, it may also create “collective action” problems such as “free riders”, cognitive conflicts and in-fighting. This may lead to low level of cohesiveness, which in turn moderates the relationship between board resources and effectiveness²⁴. Our data provide empirical evidence to support this view.

Another factor influencing fundraising outcome is the nature of business, as indicated by the last column in table 4, initial target market. Ventures involved in toolkits, diagnostic and software engineering business (ID, AIR, CYTO, BLUE) have low capital needs and it is easier to raise money for these companies. In the case of BLUE, the main cost is the salary of one researcher who is partially funded by a University. At the same time, investors are more likely to invest in those prototypes that they are able to “touch and feel”. In contrast, raising funds for life science ventures are more difficult. Not only because they require a significant amount of funding, but also involves expertise to envision the prospects of the business which is highly intangible.

INSERT TABLE 4 ABOUT HERE

3. Early venture board as architect of business model design

The key strategic issue in early stage venturing process is business model design. High-technology ventures often start with a new scientific or technological idea, and it requires a good business model to turn an idea into a sustainable business. According to Teece, business model design involves determining (1) the benefit the enterprise will deliver to the customer; 2) the technologies and features that are to be embedded in the product and service; 3) the identity of market segments to be targeted; (4) how the revenue and cost structure of a business is to be ‘designed’ (or if necessary ‘redesigned’) to meet customer needs; (5) the way in which technologies are to be

assembled and offered to the customer; and (6) the mechanisms and manner by which value is to be captured. The first three points reflect how to create value whereas the latter three points reflect how to capture value. Moreover, business model design needs to morph over time; and this is likely to involve iterative processes²⁵.

To explore the issue of board's involvement in strategy, we took a close look at whether business model design change at each company from its incorporation to December 2006; and, if so, how changes take place. Following the existing literature on business model, we code the change of business model design along two dimensions—value creation and value capturing features. As shown in table 5, we note that all firms' business model design has been modified to some extent. And these changes were typically occurred in the boardroom, i.e. key issues regarding the business model were typically brought up, debated, decided and revised during board meetings. We explore each box in turn.

Along the dimension of **value creation**, a *high degree of change* implies that board may refine or re-define the initial and final target market, and hence re-design the sequence of product pipelines to reach the final target market. It is key to identify and distinguish first customers from scaling customers. Not only because these customers have different needs, but also early stage ventures rarely have the required resources and capacity to fulfil scaling customer needs initially. (In contrast, a *low degree of change* implies that board may only modify the sequence of product pipelines within the initial design of the target market, such as cases of AIR, AUV, AOX and CYTO.)

In the case of NOVA, the scientific founder was an immunologist by training with over a decade's experience in the field of natural antimicrobials. The venture was incorporated in 2004 aiming to commercialise the scientific founder's breakthrough idea of an innovative anti-infective platform technology which prohibits the development of acquired or transmitted pathogen

resistance as often occurred in conventional anti-infection treatment. The initial business plan was to target the market of antifungal and antibacterial therapeutics. The initial funding application was denied by a funding agency on the basis that the business model was “too ambitious”. Before long, the start-up was joined by an experienced Chairman with extensive expertise in the commercial life sciences arena. Subsequently, the board was restructured with added expertise in the corporate finance and life science areas. The board suggested breaking down the overall target market into a number of more specific target markets. They identified the fungus nail infection treatment as an initial target market, and designed the sequence of product pipeline within the original broad target market of antifungal and antibacterial therapeutics. Over time the product pipeline would grow to include compounds targeting areas such as systemic fungal infections, respiratory infections, acne/dermal infections and etc.

While the board may play a critical role in streamlining the sequence of product pipeline just as in the case of NOVA, they may also refine the business model to broaden the product scope. For instance, in the case of ID, the company’s first application was for the detection and monitoring of dental caries (tooth decay) based on their proprietary technology (ACIST). As the firm grew, the board helped to shape the strategy by broadening their product scope of a medium term plan to develop additional applications for the clinical ACIST technology in the area of caries management, including 3D imaging. In the longer term, the board also planned to develop further its clinical ACIST technology platform to address other applications such as lesion detection and imaging in oncology.

We also observe that some boards may change their target market frequently during the business model design process. In the case of PHY, their business model design was based on identifying target markets and drug candidates from proven Chinese botanical drug treatments which meet unmet medical needs in the West; as well as undertaking the purification, characterisation, clinical trials and formulation required to make them acceptable to regulatory

authorities in the West. And we observed that the company's strategy frequently shifted among various identified target markets of their drug candidates including liver disease, obesity, Hepatitis C, Oncology, Respiratory infections and antibiotic resistance.

In other cases, the board may also abandon the initial target market and re-focus. For instance, in the case of BLUE, the company was founded to commercialise a novel data mining technology. The initial target market aimed at the financial investment sector; and the board helped to introduce the initial user, a large financial institution in the City of London. However, it has proven to be difficult to break into this specific market. Hence, the board searched for other potential opportunities for commercialising the technology, from the bioinformatics area to the on-line data analysis areas, such as textual, web data such as blogs and discussion threads, condition monitoring.

Along the dimension of *value capturing*, a high degree of change implies designing (as some of them have no clear revenue model initially) or re-designing the revenue model and related features. In the case of NOVA, we note that as the board streamlined the sequence of target markets, it also helped to specify the revenue model, i.e. to take its lead compound through Phase IIa trial before seeking an application-specific licence agreement and strategic alliance with a suitable pharmaceutical partner. Whereas in the case of AUV, while the initial revenue model design was the same as above, the execution was so poor that the company essentially became a contract research organization. When a new Chairman joined the board in 2004, the strategy was re-focused to becoming a drug development company. In order to achieve that, the board decided to merge with a listed company in order to obtain sufficient funding to take its lead compound through Phase IIa trial in the area of Oncology and the deal was successfully executed in 2005.

In the case of PHY, although it followed similar revenue model as that of NOVA, we note that the partnering strategy was again changed frequently. The rationale behind the business model

design was that, by identifying drug candidates from proven Chinese botanical drug treatments, they would be able to shorten the R&D process that it takes to develop new drugs from 12-15 years, to 5-7 years. As a result, it would significantly reduce development costs and produce an earlier financial return. Hence, their business model hinges on finding the right partners in both the West and Far East. Yet, it seems that they lack focus. We note that, at many board meetings, new names of potential collaborators were frequently suggested by the CEO and other executive team members. It often resulted in heated debate within the boardroom as some board members strongly opposed the lack of focus in their partnering strategy. This is also reflected in table 4, where the success rate of fundraising is rather low in the case of PHY whilst the great amount of time and effort were consumed. In the case of BLUE, as the target market shifted from financial sector to on-line data analysis areas, the board redesigned the revenue model from tailor-made consulting business to providing services to SMEs and other individuals such as students, sole traders and etc.

A low degree of change implies that the board helps to refine certain features of revenue model as well as searching and identifying potential collaborators including initial users, partners for research development, licensing, marketing, distribution and sales. For instance, in the case of ID, the board modified certain features of the “razor and blade” revenue model (i.e. commercialise the system through one-off sales of the base station and recurrent sales of the disposable sensors and software upgrades), such as the price range. The board also helped to refine the distribution strategy from partnering with one global distributor to using multiple local distributors in order to diversify risk. AIR, AOX and CYTO share similar features in this regard. We summarize the change in business model in table 6.

INSERT TABLES 5 ABOUT HERE

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This finding suggests that, all strategic decisions involved in designing a good business model require in-depth knowledge about market, technology, finance as well as the linkage among them.

As original founders rarely have the range and depth of necessary knowledge, the early venture board together with the internal top management team often acts together as the architects of business model design. This is in sharp contrast with established firms, where TMTs typically are professional managers with a wealth of experience and in-depth knowledge about the daily management issues of the organisation; and thus more likely to initiate the substantive content of strategy and implementing strategic changes.

Discussion and contributions

We started the paper by highlighting the tensions between the two sides of the board's functions: that of controlling and monitoring versus that of resourcing and strategizing in the context of entrepreneurial "threshold" firms. To explore this issue, we examined early venture board's structural composition, knowledge base and whether their behaviours are consistent with their functions. Our approach differs from previous work on boards in two ways: we looked closely at early venture boards; and we conducted our work not at one remove from the boardroom (such as by questionnaire), but by direct observation, interview and examination of relevant documents, a process that has uncovered dimensions others have been missed, or misunderstood²⁶.

Our findings suggest that when the early venture board consists of a majority of part-time members with diverse knowledge backgrounds, it can be seen as an extension of the full time internal top management team. As "collective entrepreneurs", they play a vital role in the early venturing process in a collaborative mode that beyond the traditional principal-agent mode²⁷. This finding supports the propositions that the board can add significant value in the early high-technology venture firms or threshold firms by gathering resources and providing strategic advices²⁸. At the same time, our research raises questions about how this value is created.

Our companies were unusual, because the boards were carefully structured so as to appear to be capable of acting “independently” because they had an unusually large number of independent highly qualified outsiders. Yet, despite this seemingly favourable structure we show that the early venture board cannot remain “independent” whilst performing resource and strategy role effectively. Early venture boards are not monitoring in the traditional sense. They are not detached from the firm’s operations; quite the opposite, they are typically actively engaged in venture’s resource gathering and strategizing activities.

Secondly, our early venture board did appear to add considerable value to these young firms by their use of knowledge and social networks in various ways exploiting both the depth and breadth of their personal knowledge and of their networks. One particular area where the board plays a key role is in obtaining finance. Most studies of high technology ventures look at those funded by the US styled full service VCs, few look at other firms and fewer still study board behaviors of European and UK firms. Our work shows that at least in the UK, boards may spend more than 50% of their time in the board room strategizing about fund raising and more than 50% of their time outside the board room putting these plans into practice. This finding helps us understand why so many policy makers (e.g Nightingale et al in the recent NESTA report) complain that the structure of the UK funds market being inefficient: boards are disproportionately concerned with fund raising, even when companies face excellent prospects. It also has implications for potential directors regarding their expected duties, such as “expected time commitment” (The Combined Code of Corporate Governance, 2008).

Early venture board also appeared to engage in building management team’s capability through coaching and mentoring. As mentioned, there is intensive interaction between internal top management team and external directors both inside and outside the boardroom, where more knowledgeable directors would mentoring less experienced top management team through various forms such as storytelling, debating, giving feedbacks on their performance and etc. Through these

activities, it seems that early venture board augment the top management team's managerial ability. For instance, we observe that, over a short period of time, many founders become more confident and competent in dealing with external affairs such as pitching investors and partners, as well as internal day-to-day management issues.

Thirdly, our finding provides some evidence on alternative strategists in early stage ventures. The existing organization and strategy literature tends to portray founders, CEOs or the internal top management team (TMT) as the main strategists, taking command during the strategizing process. For instance, in a study of high tech startups in Silicon Valley, Hannan, Burton and Baron report that initial strategy tends to be strongly influenced by founders' prior experience; and is costly to change. Gavetti and Rivkin show that re-designing new venture strategy requires a change in the internal TMT²⁹. These studies seem to assume that founder and TMT have the necessary knowledge and experience required to design and refine a "good" strategy. However, in the context of early stage high tech ventures, original founders often lack such kind of experience and skills. The few existing studies on governance in entrepreneurial firms seem to suggest that, whilst board's involvement in strategy tends to be limited in conventional small firms, US venture capital backed high-tech ventures' board tends to have high power relative to management, and their involvement in both strategy formulation and evaluation tends to be high³⁰. Differing from the above studies, our finding suggests that board often act as business model architects, initiating and developing strategy at early stage ventures.

Putting the above together, our findings suggest that in these entrepreneurial "threshold" firms, boards and TMT can be seen as the same group; and this has some profound implications for future researchers. Firstly, it is not enough to study the internal top management team of the early stage high-technology firm, nor is it wise to ascribe everything to the founder's conditions, as is some commonly discussed. Rather, in thinking about the firm, researchers need to cast their net

wider, and look at the boards of directors, past and present to see the complete picture of possible influences on the firm. This brings a new dimension to the “plural” form of entrepreneur³¹. Further, we should be cautious in applying concepts such as of “absorptive capacity” and “strategy making” differentially to the board and the management of the company³². Rather, the notion of absorptive capacity seems to be something that occurs collectively among the top management team alongside the board. Likewise, strategizing cannot be separated either because the board is highly connected with making the company’s direction. Indeed, our work suggests that outside shareholders would do better to choose a good board and let them add value, rather than try to worry about finding people to “guard their money”, as suggested by Juvenal’s concern of “Quis custodiet ipsos custodes?” by the words of Mathew in the Bible.

Furthermore, our findings echo the view that we need to pay attention to board behaviour in gaining a better understanding of how board resolves the tension among multiple functions³³. Our findings show how process research can complement that which studies structures. Here we showed that structural analysis alone could lead the researcher down the wrong path, perhaps over-emphasising the role of the board as monitors. And it is only when the processes are unpicked is it transparent what is happening.

Our findings signal some differences and similarities between the literature and work on “high technology firm” where ownership is also closely held and other closely held small firms such as the family firm studied in a different arena. In both cases as firms move through development stage in their life cycle, they face challenges and opportunities, e.g. task environment, resource needs, complexity of system and structures etc. Yet their responses are very different; the high-technology young firm uses the board as a mechanism to solve this problem where as the family firm solves this problem outside of the board room. But there are similarities between the two kinds of firms: the board’s controlling/monitoring role is marginal. In both cases, owners often assume key management positions or/and sit on board. This means that the board

cannot be “independent” monitors, even though in the case of high tech early venture boards they seem to be rather “disciplined”. Future studies may probe these similarities and differences further³⁴.

Our findings are almost certainly influenced by our context: we are examining “threshold” firms in a state of transition between founding and maturity where the environment is fast moving and complex (as in high technology), where the demands on the board is different from those in established corporations. Conceiving of the board as a group of monitors that has a minor role in supporting top management is naïve in these contexts. Rather, we suggest that, the emergent firm is so resource constrained that it is better to think of the board in a completely different way namely as the key additional resource that helps management by providing talent and effort to solve highly complex problems. This construct may also help boards in other contexts (such as organisational crisis) frame their roles and ways they can add value.

Conclusions

The early stage venturing process is a crucial period in a start-up’s life because many key features formed during this early stage including initial strategy and structure tend to have long lasting effect on firm’s subsequent quality of life. Our research seems to suggest that such “imprinting effect” may occur through the interaction among the “collective entrepreneurs”, i.e. the early venture board and the internal top management team. And that in this process, the structure, total knowledge base and experience of the wider group is critical to understanding what happens to the young high-tech firm.

Appendix 1 METHODOLOGY

As suggested by Eisenhardt and Grabner (2007), our sample selection was theoretically driven: we followed in real time 8 high-technology companies that we thought ex-ante would see interesting management challenges³⁵. During our preliminary research, we compiled a list of UK early stage high tech ventures through various sources including FAME database, UNICO survey database as well as networking events and conferences. In the end, 8 firms agreed to participate in our research.

The bulk of data was collected over a 38 month period from Oct 2003 to Dec 2006. And follow up interviews were conducted in 2009. The 1st author followed all 8 firms over 38 month period (Oct 2003 to Dec 2006) intensively, including board meeting and other formal and informal meeting observations, repeated interview. The 1st author started by conducting semi-structured interviews with founders/CEOs first and asked them “who are the key individuals that have helped or helping you during early stage venturing process, and how do they help you?” Using a snowballing strategy, the 1st author then interviewed these key individuals as mentioned by CEO/Founders, including representatives of government funding agencies, business angels, University technology transfer officers (TTOs), independent advisors and professional advisors. Most of these individuals were part of the working board at certain points. The 1st author also attended many board meetings, management and client meetings at 5 of these firms. In total, she conducted 52 formal interviews and meeting observations, 85 hours tape-recorded. The 1st author remained an “outsider” throughout this research in order to keep a neutral status. ***At the same time***, the 2nd author was involved directly in one of the case companies whilst the 3rd author was involved directly in all these case companies at a certain point. They as “insider” add valuable insights to the board’s involvement in the venturing process.

Primary data were supplemented by company confidential documents, including board agenda and minutes, business plan drafts, financing rounds and etc. Other secondary data includes information available from company websites, FAME, Perfect Filing database, including press release, financial accounts, IPO prospectus and etc. In particular, we collect information on each board member, including their CVs, past and current directorships. Furthermore, we conducted additional interviews with key informants between July and August 2009.

Our data analysis was undertaken in a highly iterative manner. Broadly speaking, it involved two stages of analysis. Firstly, drawing upon multiple data sources, the 1st author constructed a detailed account of each firm along timeline and verified the main storyline with each firm. The second stage of analysis involved multiple rounds of coding. Coding followed the

principles of grounded theory. We go back and forward between data and theory. The three authors not only debated about the results from each rounds of data analysis among themselves, but also drew upon feedback from presenting the tentative findings at workshops involving a wide community of practitioners and academics. The two stage of analysis is equivalent to the ethnographic approach of first order and second order analysis³⁶.

Table 1 Summary of Case description

Firm	Sector	Year of Incorporation	Academic founder	Age by Dec 2006	Company status as in Dec 2006	No. of FT employee by Dec 2006	Company status as in Aug 2009
NOVA	Life science	2004	Y	3	Active	12	Active
AOX	Life science	2005	Y	2	Active	1	Active
PHY	Life science	2002	N	5	Listed in 2006	4	Active
AUV	Life science	1996	Y	11	Acquired in 2005	12	Dormant
ID	Medical device	2001	Y	6	Listed in 2004	9	Liquidated in 2008
AIR	Medical device	2001	N	6	Active	6	Active
CYTO	Diagnostics	2004	Y	3	Active	1	Active
BLUE	Software engineering	2005	Y	2	Active	0	Active

Table 2 High growth early ventures have a large “outsider” dominated working board

Firm	Size of working board	Size of “informal” board	Who are informal board members	Size of working board in Dec 2006	Size of legal board in Dec 2006
NOVA	3--9	2--5	Previous and future board directors; VC representative; representatives from University; individual shareholders; key advisors and consultants (physician, solicitor, accountant, scientist, financial PR)	9	8
AOX	3--6	1--3	Previous and future directors, advisors and consultants (solicitor, accountant, scientists), University technology transfer representative	6	6
PHY	4--12	2--4	Previous and future directors, key shareholders, directors from Ltd. management team (in-house scientists), consultants and advisors (scientist, accountant, corporate financier)	10	7
AUV	3--7	1--2	Previous and future directors, management team (research development manager), consultant (accountant, scientist), director from key partners (Eirx).	7	6
ID	4--9	2--4	University technology transfer representative, advisors and consultant (marketing specialists, lawyer, financial PR.), directors from Ltd (its subsidiary)	8	6
AIR	3--5	1--2	Previous and future directors, representative of government funding agency, advisors and consultants	5	4
CYTO	3--7	1--3	Previous and future directors, original founding scientists, key advisors and consultants (solicitor, accountant, management consultant)	7	5
BLUE	3--6	2--4	previous and future directors, University technology transfer officer, head of university department (representative of institutional owner), founding scientists, consultant (accountant, scientist)	6	4
			Mean (Standard Deviation)	7.25 (1.67)	5.75 (1.39)

Table 3 Early venture board's highly diversified knowledge composition

Firm	Board' directorship		Board's primary specialist knowledge							
	Total no. of past and current directors by Dec2006	Outside directorship per director	Functional knowledge						Entrepreneurial knowledge	
			Tech. development (count)	%	Business development (count)	%	Corporate finance (count)	%	count	%
NOVA	8	19.8	3	38%	1	13%	3	38%	1	13%
AOX	6	33.8	2	33%	1	17%	2	33%	1	17%
PHY	9	25.6	2	22%	2	22%	2	22%	3	33%
AUV	10	15.8	3	30%	3	30%	3	30%	1	10%
ID	7	31.1	2	29%	3	43%	1	14%	1	14%
AIR	4	15.5	1	25%	1	25%	1	25%	1	25%
CYTO	7	19.9	2	29%	2	29%	2	29%	1	14%
BLUE	4	33.3	1	25%	1	25%	1	25%	1	25%
Mean	6.88	24.35	2.00	29%	1.75	25%	1.88	27%	1.25	19%
S.D.	2.17	7.64	0.76	5%	0.89	9%	0.83	7%	0.71	8%

Table 4 Early venture board's involvement in fundraising

Firm	% of board's time involved in discussing funding issues INSIDE board room	% of board members involved in fundraising directly	% of board members' time (those involved in fundraising) involved in fundraising OUTSIDE board room	Initial target market	Board Cohesion	Success rate (No. success/no. of approach)
NOVA	50-70%	50-70%	50-70%	Antifungal and antibacterial therapeutics	High	30-50%
AOX	50-70%	0-30%	0-30%	Stroke and Alzheimer's disease	Low	30-50%
PHY	70-100%	70-100%	70-100%	Liver disease, obesity, Hepatitis C, Oncology, Respiratory infections and antibiotic resistance.	Low	0-10%
AUV	50-70%	70-100%	50-70%	Cancer	Low	0-10%
ID	50-70%	50-70%	50-70%	Dental caries management	High	30-50%
AIR	30-50%	30-50%	30-50%	Dedicated airway device	High	50-70%
CYTO	30-50%	30-50%	50-70%	MCM protein antibody diagnostics for cancer	High	50-70%
BLUE	0-30%	0-30%	0-30%	Data mining software for finance sector	High	50-70%
Average	41-64%	38-63%	38-61%			30-42%

Table 5 Change in business model design

Degree of change in value capturing features	High	AUV	NOVA, BLUE, PHY
	Low	AOX, CYTO, AIR,	ID
		Low	High
		Degree of change in value creation features	

Table 6 Early venture board's impact on business model design

Firm	Business model design feature--value creation	Business model design feature--value capturing
NOVA	Identifying the first application; and designing the sequence of product pipeline within a broad target market, i.e. designing and developing of antifungal and antibacterial therapeutics with first market application in nail fungus treatment.	Designing the revenue model to take its lead compound through Phase IIa trial before seeking an application-specific licence agreement and strategic alliance with a suitable pharmaceutical partner. Identify potential partners for pre-clinical and clinical research; as well as out licensing partners.
AOX	Identify commercially-exploit these proprietary platform technologies and drive forward further novel antioxidant drug design concepts with applicability to a range of conditions of significant unmet medical need. Market focus initially in neurodegeneration and in particular, stroke and Alzheimer's disease.	1) Designing the revenue model to take its lead compound through Phase IIa trial before seeking an application-specific licence agreement and strategic alliance with a suitable pharmaceutical partner. 2) Identify potential partners for pre-clinical and clinical research; as well as out licensing partners.
PHY	Identifying target market and drug candidates from proven Chinese botanical drug treatments which meets unmet medical needs in the West. And undertaking the purification, characterisation, clinical trials and formulation required to make them acceptable to regulatory authorities in the west. Identified target market of their drug candidates includes liver disease, obesity, Hepatitis C, Oncology, Respiratory infections and antibiotic resistance.	Designing the revenue model to take its lead compound through Phase IIa trial before seeking an application-specific licence agreement and strategic alliance with a suitable pharmaceutical partner. Designing R&D process to reduce the time that it takes to develop new drugs from 12-15 years, to 5-7 years, which is expected to result in significantly reduced development costs and an earlier financial return. Identify potential in-licensing and out-licensing partners in both China and the west.
AUV	Identify drug development candidates in cancer.	Identify initial revenue sources which mainly from repeated contract research. Lately, identify trade-sales target.
ID	Identifying and designing a sequence of application area based on their proprietary technology (ACIST). The company's first application is for the detection and monitoring of dental caries (tooth decay). In the medium term, the company's strategy is to develop additional applications for the clinical ACIST technology in the area of caries management, including 3D imaging. Longer term plans to develop further its clinical ACIST technology platform to address other applications such as lesion detection and imaging in oncology.	1) Design the revenue model. i.e. commercialise the system through one-off sales of the Base Station and recurrent sales of the disposable sensors and software upgrades. 2) Identify potential partners for research development, manufacturing and distribution globally (from one potential global distributor to multiple distributors risk diversification).
AIR	Identify the commercial potential for its intellectual property platform, with a primary focus in dedicated airway devices, to other miniature imaging, infection-control and clinical training.	Identify the key end-user markets from early adopters to the late majority. Identify manufacturing partners (mainly local) and distribution partners, from one global partner to multiple distribution partners).
CYTO	Identify the commercial potential for the MCM protein antibody diagnostics for cancer developed at Cambridge U. Initially for cervical cancer, then bladder cancer and prostate cancer in the field of urology. In future, continue with its development of an integrated diagnostic package based on MCM technology but also including IP-protected engineered urine collection systems and a unique urine collection protocol.	1) From contract research to obtain an exclusive global licence, with extensive patent protection, from CRT (Cancer Research Technology) in Urology field. 2) Identify research partners to commercialise its technology in screening for other types of cancer; as well as out licensing partners.
BLUE	Identify the commercial potential of the novel data mining technology originated from an university. The initial target market aims at the financial investment sector. Given the difficulties in dealing with large financial institutions, the company expand its target markets including bioinformatics, and other data analysis areas, such as textual, web data such as blogs and discussion threads, condition monitoring.	Designing and refining revenue model, from tailor made consultancy service for larger organisations to online data analysis service allowing SMEs and other individuals such as students, sole traders and etc to access to data analysis tools that are normally only accessible to large corporations due to their cost.

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- ¹⁰ The emphasises on the prominent strategy role of board has been reflected in recent UK public policy such as the Higgs report (2003), the Companies Act (2006), the Combined Code on Corporate Governance (2008) in the UK. For early works on this subject see Lorsch, J. and McIver, E. Pawns or Potentates: The Reality of America's Corporate Boards, HBS Press, Boston, MA. (1989). More recent work see McNulty, T. and Pettigrew, A. M. (1999) Strategists on boards, *Organization Studies*, 20: 47-74 (1999); Rindova, V. (1999) What corporate boards have to do with strategy: A cognitive perspective, *Journal of Management Studies*, 36: 953-75. Stiles, P. (2001) The impact of the board on strategy: An empirical examination, *Journal of Management Studies*, 38: 627-50. Golden, B. R. and Zajac, E. J. (2001) When will boards influence strategy? Inclination x power = strategic change, *Strategic Management Journal*, 22: 1087-111. 2001. For a detailed literature review see A. Pugliese et al Boards of Directors' Contribution to Strategy: A Literature Review and Research Agenda, *Corporate Governance: An International Review*, 17(3): 292-306 (2009). Hendry, K., Kiel, G. C. and Nicholson, G. (2010) How boards strategise: A strategy as practice view. *Long Range Planning*, 43 1: 33-56.
- ¹¹ Fama, E. and Jensen, M. (1983) Separation of ownership and control. *Journal of Law & Economics*. Vol (XXVI): 301-325.
- ¹² Forbes, D. P. and F.J. Milliken, (1999) Cognition and Corporate Governance: Understanding Boards of

Directors as Strategic Decision Making Groups, *Academy of Management Review*, 24 (3): 489-505

- ¹³ Sundaramurth, C. and Lewis, M. (2003) Control and collaboration: Paradoxes of governance. *Academy of Management Review*, 28(3):397-415. Roberts, J. McNulty, T. and Stiles, P. (2005) Beyond agency conceptions of the work of the non-executive director: creating accountability in the boardroom. *British Journal of Management*, 16: S5-S26.
- ¹⁴ Ibid ref 12.
- ¹⁵ Ibid ref 10.
- ¹⁶ Ibid ref 11&12.
- ¹⁷ In the UK, “proof of concept” funding is often provided by government agencies, aiming to plug the equity gap between founding to achieving A round funding for early stage ventures.
- ¹⁸ The context of growing high tech ventures in the UK is characterized by highly-fragmented early-stage risk-capital market. Recent studies such as those of Mason and Harrison, Dimov and Murray and Nightingale et al in the NESTA report have suggested that, the early stage risk capital market in the UK features a variety of government backed “hybrid” funding schemes (i.e. a combination of public and private funding), “informal” venture capital investment from business angel and high net-worth individuals, together with possible follow-on funding from the AIM market. As such, one critical survival threshold for early stage high tech ventures is to achieve the first round major commercial funding or so-called A round funding. Passing the funding threshold also signals the young venture’s successful access and acquisition of necessary skills and expertise to take the venture forward. Nightingale, P. et al (2009). From Funding Gaps to Thin Markets: Supporting Hybrid VC in the 21st Century, NESTA report; Dimov, D.P. & Murray, G.C. (2008), ‘An examination of the incidence and scale of seed capital investments by venture capital firms, 1962-2002’, *Small Business Economics*. 18(1-3), 13-40; Mason, C. M. Harrison, R. T. (2003) Closing the Regional Equity Gap? A Critique of the Department of Trade and Industry’s Regional Venture Capital Funds Initiative, *Regional Studies*, 1360-0591, 37, 8, 855 – 868.
- ¹⁹ Pettigrew, A. 1990. Longitudinal Field Research on Change: Theory and Practice, *Organ. Sci.* 1 267-292; Van de Ven, A. H. and Engleman R. M. 2004. Event- and outcome-driven explanations of entrepreneurship. *J. Busi. Venturing* 19 343-358.
- ²⁰ By the end of 2006, the size of the legal board members range from 4 to 8 with a mean of 5.75 (s.d. 1.39), the average age of our sample is 4.75 (s.d. 3.01). This is bigger than that of UK university spinoff as reported in Filatotchev et al’s study (2006).
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- ²² See for instance Nightingale et al., ref 18
- ²³ See for instance Nightingale et al., ref 18 .
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- ²⁶ See for instance Stiles and Pettigrew ref 2.
- ²⁷ Gartner et al. observed (1994:6), ““the entrepreneur’ in entrepreneurship is more likely to be plural, rather than singular, residing not in one person, but in many.” Gartner, W.B., Shaver, K.G., Gatewood, E., Katz, J.A.(1994), Finding the entrepreneur in entrepreneurship. *Entrepreneurship Theory and Practice* 18 (3), 5–10.
- ²⁸ Ibid ref 1.
- ²⁹ M.T. Hannan, M.D. Burton and J.N. Baron, *Inertia and Change in the Early Years: Employment Relations in Young, High Technology Firms*, *Industry and Corporate Change*, 5 (2) 501-536. (1996); Gavetti, G., and Rivkin, J. W. (2007) On the Origin of Strategy: Action and Cognition Over Time. *Organization Science*, 18: 420-439.
- ³⁰ See for instance the work of Fried et al, ref 5
- ³¹ See for instance Hannan et al, ref 28
- ³² See for instance the work of Zhara et al. ref 5
- ³³ See for instance Forbes and Milikin ref 13
- ³⁴ A discussion on family vs. non-family business boards see Lane, S., Astrachan, J., Keyt, A. and McMillan, K. 2006, Guidelines for family business boards of directors. *Family Business Review*, 19 (2):147-167.
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- ³⁶ Data analysis method refers to A. Langley 1999. Strategies for theorizing from process data. *Acad. Management Rev.* 24 691-710; Pettigrew, A. 1990. Longitudinal Field Research on Change: Theory and Practice, *Organ. Sci.* 1 267-292.