

USE OF ACTOR-NETWORK THEORY TO DEVELOP A HOLISTIC VIEW OF NEW TECHNOLOGY-BASED SMALL FIRM DEVELOPMENT

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ABSTRACT

Case study data on new university derived spin-off medical technology companies have been analysed using analytical processes based on actor-network theory (ANT), which introduces two new constructs to entrepreneurship research: first, network actants can include not just people but also non-personal identities such as documents and events, and secondly, these actants, whether personal or non-personal, are defined ontologically by their relationships. The paper explores the possibility of using the extended network concepts involved in ANT to develop a holistic approach to the study of the early stage development of NTSFs. This is seen as a logical development from Latour's initial focus on community impacts of new science to study of the way in which new technologies can be exploited through the generation of entrepreneurial spin-off ventures. The output of this ANT analysis has been first, a holistic graphical depiction of the actants and their relationships and how they vary between spin-off company cases from the same parent research provider. Secondly, the more detailed analysis of the actant relationships, based on the case study qualitative research data, has added to the understanding of the development of the selected spin-off ventures.

Key words: ANT, commercialisation, entrepreneurship, innovation, spin-off.

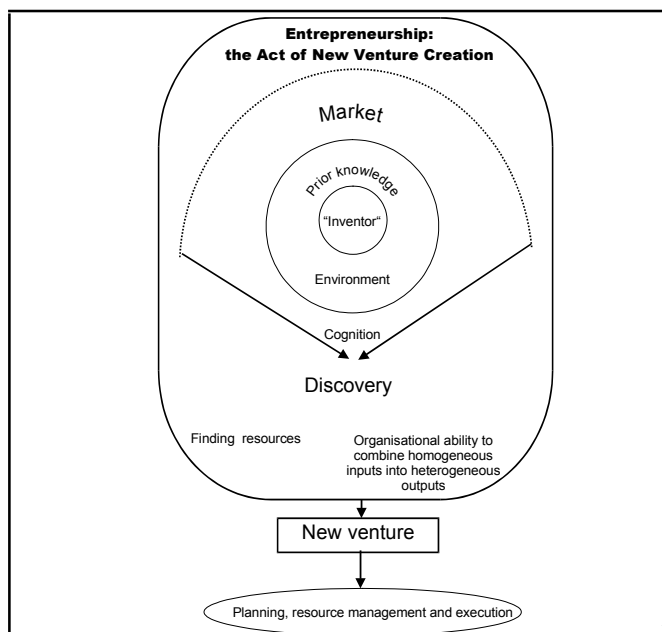
INTRODUCTION

Any study of firm development necessitates the longitudinal examination of processes (Davidsson and Wiklund, 2000). This is true for the classic studies of growth within large firms that have been the platform for current understandings of business strategy (Chandler, 1962; Penrose, 1959), but it is particularly true for the complex and idiosyncratic process of technology commercialisation by small start-up companies. Models of innovation and commercialisation have become progressively more complex and dynamic in order to capture this process (Rothwell, 1992; Dodgson, 2000; Dodgson, Gann & Salter, 2005). Despite this progress, more work is needed to integrate different perspectives on firm growth to create a more holistic view of entrepreneurship and commercialisation.

In a review of the firm growth literature, Wiklund (1998) categorised studies according to their underlying theoretical assumptions and units of analysis (Davidsson and Wiklund, 2000). One of these groupings was identified as the *resource-based perspective* where the unit of analysis is the business activity or related set of business activities rather than the entrepreneur. The second of these groupings was labelled the *strategic adaptation perspective* that focuses on governance and ownership as the main unit of analysis and is based upon theories of agency and transactions-costs. This perspective downplays the importance of individuals. However, the *motivation perspective*, with its grounding in psychological studies, uses the individual as the unit of analysis to discover what business activities expand or do not as a result of the entrepreneur's motivation. These motivations also may affect the choice of governance structures. Davidson and Wiklund (2000) classify these three perspectives as seeking factors that can explain the growth of firms. In other words, they search for antecedents of growth which is analysed as a dependent variable. In contrast to these factor studies, the *configuration perspective* deals with the process of growth itself and the organisational changes that occur as a consequence. Managerial problems will appear and structures must be put in place to address these problems. Such a perspective will focus on governance structures as a unit of analysis and is not compatible with the study of individual entrepreneurs.

More practitioner-orientated literature (eg Olson, 1985) on entrepreneurial action recognises the importance of combining the entrepreneur, the market opportunity and the organisational actions and resources required to take an idea to the market (Figure 1). However, rigorous research will need to support this new practice orientation and research based upon traditional paradigms will struggle to capture the complexity of entrepreneurship-in-action (Whittington et al., 2003). A holistic approach to entrepreneurial firm growth needs to make bridges across the traditional perspectives. Clearly, a total synthesis of all theories of firm growth that results in a 'grand unified theory' of entrepreneurship is overly ambitious. However, theories and research approaches that can make some links between Davidsson and Wiklund's (2000) categories have been explored in the broader literature on organisations. One theoretical bridge is the conceptual separation of structures and agents (Gioia and Pitre, 1990, Lewis and Grimes 1999). Focussing on agents (individuals) will result in motivational-type studies of entrepreneurial growth whilst the attention to structures (resources, organisation and governance) will direct research into the resource-based and strategic adaptation

Figure 1 The Act of New Entry



Source: Yencken, 2005:80

perspectives. Recognising that agents and structures are inextricably interdependent creates a bridge between perspectives that shows how entrepreneurial action and motivation is both constrained and enabled by governance and resources (Whittington, 1992; Hung, 2004; Chiasson and Saunders, 2005). In addition, a dynamic view of the tension between structure and agency can also bring in issues of configuration as agents form new structures to manage problems and exploit opportunities during the growth process. One promising avenue for research in this respect has been structuration theory, which endeavours to reconcile the action-structure dichotomy (Giddens, 1984; Whittington, 1992; Gorton, 2000; Chiasson and Saunders, 2005). Another literature that is also capable of bridging the structure agency dichotomy is actor-network theory that has its origins in the field of science and technology studies (Latour 1987; Law 1992; McClean and Hassard 2004). Given the similarity between structuration and actor-network theory and the fact that actor-network theory was specifically developed to deal with technological development, its introduction to technological entrepreneurship is probably long overdue. In this paper we review actor-network as a theory and a research methodology and then show how it can be deployed in cases studies to understand the growth processes of technology-based small firms. Discussion and conclusions follow.

Actor Network Theory

Actor-network theory confronts the structure/agency dichotomy within management theory (Pozzebon, 2004) by proposing that agents (actors) are simultaneously structures (networks). If entrepreneurs are able to undertake the activity of new venture creation it is because they are able to build heterogeneous networks of people and materials that allow them to act as centres of action and control. The degree to which agency or structure will appear to dominate action depends on the length and the strength of these networks. Although Giddens' (1984) theory of structuration has been previously applied within entrepreneurship research to examine the interplay between structure and action within entrepreneurial action (Pozzebon, 2004), there is a very strong case for favouring an actor-network approach to the study of entrepreneurship in action. The main reason for adopting actor-network theory over structuration theory is that actor-network theory closely shadows the Penrosian (Penrose, 1959) view of the firm as a bundle of heterogeneous resources that includes interactions between material and human resources. In her theory of firm growth, Penrose (1959) recognised that not only do managers coordinate resources but also that these resources both constrain and enable the actions of management (Garnsey, 1995; Best & Garnsey, 1999). These interactions also shape the way that managers see external opportunities and threats. Something that is rarely appreciated within the resource-based view that draws upon Penrose is that Penrose herself incorporated theories of social construction such as Boulding's (1956) notion of 'the image' to explain the way that managers perceive external opportunities (Foss, 1999). In this way, actor-network theory forms a bridge between the resource-based and motivation perspectives on entrepreneurship. However, actor network theory also addresses issues of control and power within organisations. When actors successfully create networks of human and material agents that are consolidated and rendered reliable and stabilised with the aid of documents and technologies, then these networks extend control through the organisation. In this way actor-network theory is also concerned with issues of governance. Law (1992: 385) explicitly discusses the connection between punctualised (stabilised) actor-network packages and organisational resources:

(punctualised) network packages-routines...can, if precariously, be more or less taken for granted... In other words they can be counted as resources, resources which may come in a variety of forms: agents, devices, texts, relatively standardised sets of organisational relations, social technologies, boundary protocols, organisational forms – any or all of these.

The essence of actor-network studies of organisation is to follow the building and creation of these networks. This is a longitudinal process that examines the way that agents (both human and material) are created from networks of other heterogeneous elements as well as how they affect the creation of new actor-networks (Law 1992; Lowe, 2001; McLean and Hassard 2004). A key part in applying this to the study of new ventures is to follow the strengthening of actor-networks as they consolidate technologies and formalise contractual relationships to create resources, which in turn further influence the development of the venture (Latour 1987; Law and Callon, 1994).

CASE STUDY DATA ANALYSIS

The sample of companies

The research findings reported here draw on research for a doctoral thesis (Yencken, 2005) involving case studies of twenty two spin-off companies in an early stage of development established in Australia and Scotland, most of which were incorporated in the period FY 1995-2000. The parent research provider organisations included both large (research expenditure greater than A\$100million per annum) and small/medium research profile universities, CSIRO (the Australian national public research agency), and Cooperative Research Centres (CRCs). CRCs are an Australian Commonwealth Government initiative to bring together in the one organisational structure universities and other research providers with industry and other users of research (See www.crc.gov.au). The unit of analysis was the spin-off company. The population was theoretically sampled to ensure inclusion of a wide range of technologies and parent research providers, with wherever possible two spin-off companies from each research provider (Yencken, 2005). The case studies were based on well established qualitative research principles (Yin, 1994; Miles and Huberman, 1994; Eisenhardt, 1989).

Two of these case studies from the same university have been selected for analysis based on Actor Network Theory (ANT) concepts. Both companies involved the development of medical technology. The analysis for each company has been developed as two phases: in the spin-off company's development

- Phase 1: Invention disclosure and opportunity assessment
- Phase 2: Finding and combining resources.

The objective in the presentation of these selected case study data has been to illustrate the application of ANT concepts to the analysis of the early phases of development of New Technology-based Small Firms (NTSF). The case study data have been used firstly to create a diagram showing the various actants and the connections between them. The personal actants are shown as circles, the organisations are shown as ovals and the non-personal actants as rectangles. Actants that were seen as negative or constraints have been shown shaded. This holistic illustration

of the development of the new spin-off firm has been supported with text focussing on the nature of the interactions in the particular network illustrated.

The subsequent discussion involved two sets of comparisons involving these case studies as follows.

1. between the *invention disclosure and opportunity assessment* phase of the two different companies
2. between the two separate phases of development of one of the companies.

CASE STUDY NO.6: EARLY STAGE GLAUCOMA DETECTION INSTRUMENT

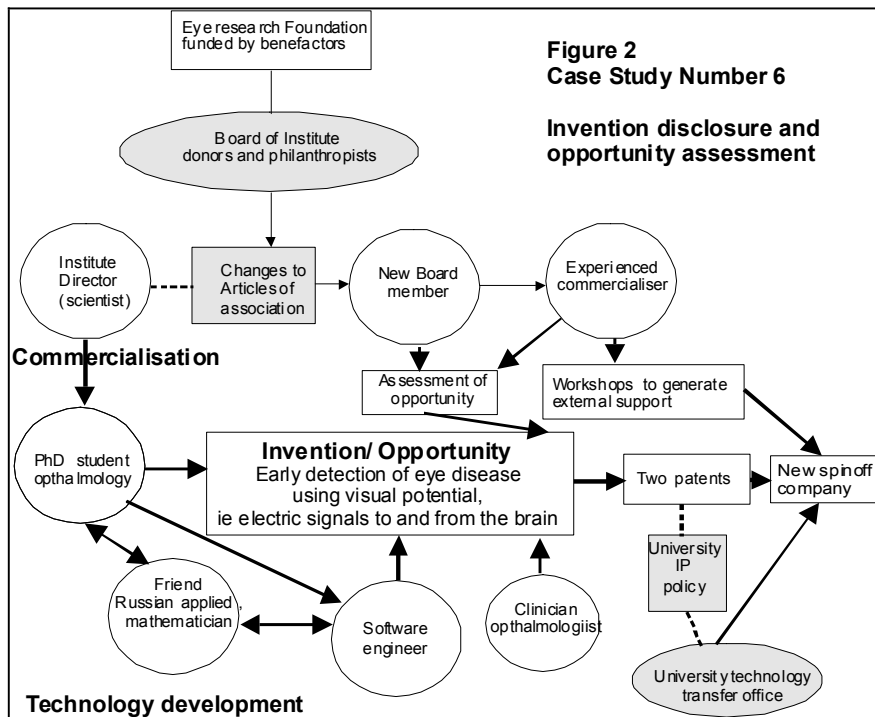
Case No.6: Invention disclosure and opportunity assessment phase

The actants and network connections in this first phase of this company’s development are shown in Figure 2.

Idea

“I was formally a clinician and I had been working with visual potential for the last ten years.” (Inventor)

Visual potential is about post-visual stimulation and the reporting of electric signals from the visual part of the brain the inventor’s the inventor’s previous clinical work was important in



seeing that this field of research had some commercial opportunity. An early recruit to the project was a clinical ophthalmologist with a strong interest in research. After a year they managed to show that the electrical signals involved in visual potential could be used in clinical practice. The outcome was the possibility of early detection of eye diseases like glaucoma using these electric signals. They decided that their research had commercial potential. This network was soon expanded to put in place a scientific network with strong personal connections in parallel with the Institute's developing commercialisation network.

“To develop our own system, I found a couple of friends. One of them was a mathematician and the other one was a software engineer and I asked them if they can do something for us for free because we did not have any money at that stage. The mathematician, luckily for us, had been working in the same area back in Russia, it took him six months to develop a completely new operating system and send it back to us. The software engineer developed software for us and again for free in six months time.”

Then a patent was registered through the University's technology transfer office (TTO). They also established a company, basically outside the University and without its formal approval, initially. This was technically in breach of the University intellectual property policy. This non-personal actant was a network barrier to be overcome or bypassed.

Assessment and commercialisation channel choice

At this University, there were a number of specialised medical research institutes with parent philanthropic Foundations with strong community outreach connections. The Director at the eye research institute at the University thought that there might be something of commercial value in the research there, but he did not know how to harness it. At the time, the Constitution of the Institute did not allow for experts to be on the Board just on merit. “It was all about people who gave money.” The Director at the Institute had recognised that he needed a different type of expertise at the Board level and he had spent as much as two years actually trying to negotiate with the University to change the Articles of the Constitution of the Institute which was a Foundation within the University. A new Board Director was then able to be introduced onto the Board of the Institute as a *subject matter* expert. In this way the commercialisation network was considerably strengthened and the blockage created by a non-personal actant, the Institute's Articles of Association, was removed. The network connections were further developed by running a series of workshops to identify commercialisation projects.

“We said well guys we need to run a workshop, so that's what we did... In December 1998, we had our first cut at it and we had another go at it in January, it was the Christmas period. So by January 1999 we had almost got a project up and we signed up some external sources.”

There was an initial quite formal opportunity assessment by the new Institute Board Director. This led to the selection of this opportunity as the first new venture project. The University technology transfer office (TTO) did not do any assessment as to whether a new start-up venture was the right channel. At that time the University's technology transfer office was seen as simply a bureaucracy.

Alternatives to the creation of a new spin-off incorporated entity were considered. A colleague who had experience in start up companies himself was brought in. It was his advice that what was needed was a separate corporate entity in which the University of course would have a significant shareholding through the Institute. This was a rather unusual case: the Institute was not a separately incorporated body and was a Foundation within the Department. The business people on that Foundation, or one of them in particular, worked with the inventors—in fact unknown to the University's TTO at that time—to develop a business plan and they formed a company outside of the University. The technology transfer office was consulted during the business planning process; but the company was formed by these people on their own.. The shareholders were a group of individuals both from within and without the University, some of them were business people including one of the business people on the Foundation Board, who had developed the business plan. They included the Head of Department, two inventors and some other outside investors.

“We managed to pull together a draft Shareholders Agreement and we agreed to incorporate the business at that time with equal shareholdings essentially for the six Founders and we also agreed to make the Institute a beneficiary.”

The University initially became an equity holder through the Institute. It was not initially a direct shareholder.

A patent had been filed quite early in the joint research effort. When they had their first business plan, the founders started to negotiate with the University technology transfer office (TTO) to license their technology from the University to make something of it. They indicated their need for finance for the next six to twelve months but the TTO said that they had no funds for seed finance and were unable to help. However the TTO provided a draft of a licensing agreement:

“Oh it was interesting because it was just an ugly process. There was not a lot of empathy there for what we were trying to do and it was pretty much a lot of tell and not much listening involved. But be that as it may, we got our CEO on board and we tried to finalise a licensing agreement. The TTO Director now had reasonable understanding that this was an opportunity, but two weeks after we had reached an *In Principle* Agreement for Licensing, the response came back: “sorry, we're not going to license this to you unless we are a shareholder”.

That created an enormous amount of bad blood. A dialogue had been running with the University by then for about nine months and at no point had it ever flagged any interest in being a shareholder in the company and neither did it ever behave like a shareholder. Any good faith that could have existed between the parties was completely extinguished at that point. The TTO had drafted a written agreement which the might have been prepared to complete but then there was a disconnect between their expectations and maybe those of the University's senior management or governing body.

“The University had set expectations with us back in April that they did not want to capitalise the venture in any way, they were not prepared to contribute anything, including any costs to do with registering patents...They provided nothing.. In fact the only thing that the University did to acquire its share was to actually just to put up the money for the first of the patents. This was subsequently repaid. So they have not been out of pocket one cent...”

The attitude of the University TTO ultimately changed and it now sees the company being brought in so that in the end it was exactly in line with policy.

“Oh it’s a fantastic company; I have to say that the involvement of the inventors and their advisors did put it on a very good path.”

Case summary

The actants (personal, organisational and non-personal) and the relevant network connections have as indicated earlier been illustrated in Figure 2. It has been possible in this one diagram to show in a holistic mode the important actants and networks involved in the establishment of this spin-off company. The text has been used to enrich the reader’s understanding of the various network elements and their connections with each other. The diagram well illustrated the quite large number of actants, mostly positive but some negative or constraining in their effects, involved in the formation of a new technology-based spin-off company

Case No. 6: Finding and combining resources

The actants in this second phase of the development of this university spin-off company are illustrated in Figure 3. By the start of this phase a company had been incorporated with a business plan. A CEO and an exclusive licence to exploit the university owned patents concerning visual potential and the measurement of electric signals from the eye to the brain that might be used for the early stage detection of glaucoma. The Institute was there to fund research and did not have the resources needed to develop the prototype instrument. The early resources came *pro bono*: some people agreed to commit their time in exchange for a then-unidentified future benefit. The Institute had recruited a Board member with considerable start-up experience. He was the driver in the early stages of venture assessment and commercialisation. The newly recruited CEO had had no previous small company start-up experience. The Board Chair was a pharmacist originally and he sold his company to a major pharmacology multinational and because he made it such a big success for them they just promoted and promoted him. So he completely understood the entrepreneurial process, but he had also been a Senior Executive in a firm with which the company was trying to develop a close working relationship.

“I’ll tell you what is also vitally important – that is getting the right people on the Board. I was able to through my contacts get the President of the Asia Pacific Board of a major pharmacology multinational as the Chairman of our Board and the contacts that he brings are just unbelievable, so you have to have networks.”

“We met [the man who was to be our new Chair] essentially because one of the things that I’d identified was that we needed some big friends to make this thing work... so we need to find a company that we’ve got a line of interest with”.

The initial commercialisation network was small and closely connected.

The initial finance came from the team of individuals directly involved and their *pro bono* support. The IP was reviewed and sorted out. They knew that they had formed something that was going to work if they could raise capital on an equitable basis. They identified about a dozen

different sources for funds. They sought expressions of interest from six. The Board analysed four and basically short listed down to two. They decided to negotiate a non-refundable deposit with a Perth based venture capital firm. It was headed by a stable board with well respected corporate citizens. This was the first additional network connection in this phase. These comments confirm the importance of Board network connections in the early phase of a new venture.

Market opportunity and business model

Glaucoma is the world's leading cause of preventable blindness. Once you know that you have glaucoma you can actually medicate just to keep that condition under reasonable control, but it is a very insidious disease, it starts attacking your field of vision from the outside until you are really just left with a couple of tunnels.

“We believe that this device, because of its accuracy and sensitivity will probably pick up disease maybe a year or a year and a half in advance of the current subjective standards. But it's a hard road and we're just fortunate I think that we're starting this product up in a small trial market like Australia. It is going to be *hard yards* to actually start attacking the competition in their own market place of the United States and Europe...”

The Company has gone through a fairly structured marketing exercise involving an advisory panel of Australian and New Zealand's *best practice* ophthalmologists. Their expertise was used to help guide the product development. The Board and CEO wanted to make sure that this product is absolutely bedded down in Australia first – every little wrinkle taken out of it, and just fully understand any little glitches that appear in the supply chain. “We do not want to prematurely go into the international market before we know that we've actually got things really bedded down here.”

As a deliberate policy, the company had been looking for strategic alliances.

“We are such a small player...Our main competitor is almost in a monopoly position in the market that we are going in to. We just felt that; even if we raised the capital to commercialise our technology, if they decided to get very litigative with us, it would be pretty tough for us...We have skirted with the idea of licensing technology to them and in fact have entered into a MOU with them which has since closed out with no net result.”

The company moved quickly and early to develop its marketing related network connections.

Investors

The original Company business plan indicated in its cash projections that it needed about \$1.5 million as its next tranche of finance to get to a point where it would be viable.

“At the end of the day I actually upped that and asked for \$2 million, which we got as our second tranche of investment. The initial business plan had us selling 70 units of product in the first year on the basis that that was 0.01 per cent of the world market. But the business plan did not give you the faintest idea of how you would sell the first unit and showed no understanding of just how long it would actually take to get an idea into a physical product. “

One of the possible investors was rejected because they were going to want to take too much of a management role. The company that was subsequently chosen has been quite prepared basically to let them run their own race. They have provided tranches of money on the basis of agreed performance criteria, but they have not interfered to the extent that the other contender might have. These decisions show the importance of the personal actant connections and the importance of compatible values in selecting first investors. The company's key contact with the venture capitalist was by now its Board Chair. He was himself an entrepreneur.

The founders originally relied on 'outside people' who had developed a business plan. The venture capitalist then did a more detailed due diligence. In an early stage situation like this, the focus of the due diligence was basically on the science, and then on whether that science generates a major business opportunity. No formal valuation was done at this stage.

An earlier comment suggested that the investor's attitude was benign and non-interfering.

"I don't know whether it would be better if we had a more involved shareholder or not, but the truth is that they've been incredibly supportive, they have enjoyed what they've seen and they have now bought 85 per cent of the company... We keep in sufficient contact with this investor. Even if we do not have a Board meeting, every single month they are always provided with the financials... More recently, probably once a week I would be having a conversation with their Chief Operating Office, who is also a member of our Board, and I suppose those conversations will become more frequent as they have now taken this new stake [85 per cent] in the company."

The investor's director was equally explicit.

"I definitely have contact between board meetings but that's more or less been on the lines of just ensuring that there is nothing that we can do to assist... We got it right at the beginning, so we all knew what needed to be achieved and just when it needs to be achieved."

The important inputs from the venture capitalist were focussed on some business structuring. The involvement was more focussed on corporate restructuring than mentoring. The key network issue here was the interaction between Board members, new investor, assessments and business plan, a mixture of personal and non-personal actants

"They've been so excited about the company that they've actually; just in the last couple weeks they've actually acquired 85 per cent of the stock in the company. The University was the only shareholder who has not accepted the offer because in their view the valuation was far too low."

Development

The R&D had been going probably for about three or four years by the time the CEO was recruited in January of 2000. The founders were in the market for a CEO to actually take the idea forward, to get venture capital, to do the myriad of things that are actually required to get an idea into the market place.

"When I came on board in January 2000, we had a couple of little plastic sticks glued together with a few electrodes and that was the capturing of the visual *evoke potential*. In the two years

since we've actually got to the stage now where the first of our product is actually going to be sold. We have twelve customers just waiting in the line and we will actually start shipping that product next week. So it's just been a pretty hectic two years to actually get an idea into a physical product and into the market place." (CEO)

The workshops on shareholders' agreements in December and January had identified a few things that were needed to be put in place if they were going to raise capital on any sort of equitable basis.

"I knew we needed to be able to show people something. By that I mean a prototype of some sort; that seems to be important in most of the things that I have been involved with in the past, people want to see something. You can show them patents and stuff but often you can get capital on more equitable terms if they can see something, so we decided we wanted to prototype something. So we applied for and got a [*State Government*] Diffusion Grant. This was pretty small bucks, it was like \$20,000 and we worked with industrial designers to do something better than a Hicks Robinson type prototype. So that's almost pre seed finance if you like, not quite."

Scientists when uncertain want to do more research to remove the uncertainty, but to survive commercially a first new product is required.

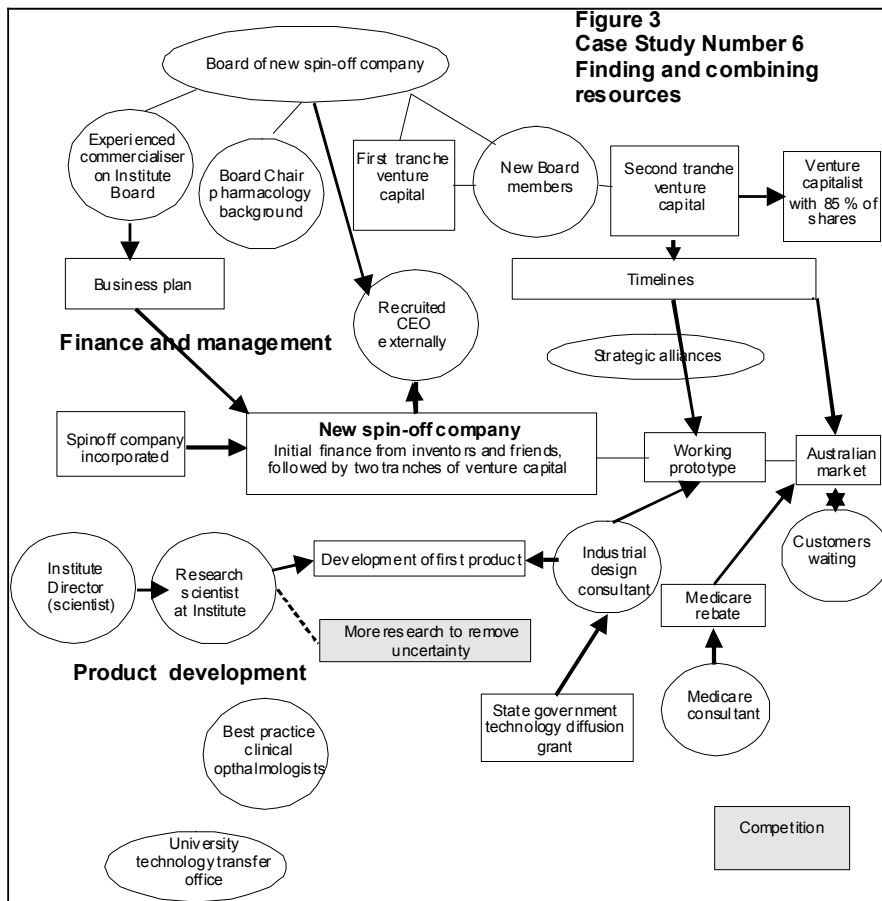
"That's been the major negative, just in handling the personalities. They just cannot quite accept the speed with which the thing is moving forward. They would like to be able to endlessly trial with things, have a unit up at the Institute for six months and do this, and do that. You just have to adopt some risk management approaches for this and say well look we have got the machine, we think it about 99 per cent right..."

our investors who would like to start seeing some return on there investment. You have just got to actually say well sorry fellas, but we need a product now."

The really critical issue with new technology in the spin-off was to get a product to market as soon as possible. The scientist inventors understood this, up to a point. They were important in so far as they had equity, but they were dependant upon access to cash and an objective had been agreed at board level as to what needed to be set up and when. There comes a time once a product is launched to start getting market feedback, the product development concept has to be driven into something the market demands rather than something that the scientists think it needs to be. So the research has to be market driven. The CEO at this critical stage had to manage these potential areas of conflict in the network connections to achieve the desired commercial objective.

"I think one of the reasons why we have succeeded is that we actually run a virtual company. There are only two employees; there is myself and my assistant. Everything else is done through Consultancy Agreements, collaborations and partnerships and that's the absolute key to the success of getting this product as quickly to market as it actually has been ... The strategic planner has continued to ask me who would I like to actually bring on next... The only additional resource I would be thinking of bringing on will be someone to assist with the record keeping and the finances because those are now very complicated." (CEO)

The complexity and externalities of the network connections involved are well illustrated in Figure 3



Market

Their marketing network connections were coming together well.

“We have a magnificent marketing company that we work with. We have a great consultant project manager. We probably do not need anyone full time.”

They are also in discussions with a possible distribution partner in the United States.

In an unusual extension of the marketing network the CEO used a consultant to help with getting the best Medicare rebate.

“The thing that will in fact drive our success in Australia took me 15 months of intense negotiation and lobbying and that was the acquiring of a Medicare Health Insurance rebate on

the procedure. We managed to argue for a rebate that is effectively double what our competitors have, that was the toughest one. But without a reimbursement and without a very generous reimbursement, the product would have struggled a lot harder than I now believe it will... That was the toughest challenge, and again, I had to actually find the right person to assist us through that labyrinth of bureaucrats in the Health Commission down in Canberra. Those people resist!”

Product development

The Company has one scientist at the Institute. All the engineering and product design development has been handled through Australia’s largest industrial design company.

“We were fortunate enough to have found them. They are a magnificent company and some of the people who have actually been assisting us have just been absolutely fantastic. But we also have a very, very good project manager on consultancy work with us. ..So we’ve just been fortunate in being able to align ourselves with a whole series of niche players who have just done a superb job. I think the one piece of fortune that I’ve actually had is the ability to have actually picked the right people to just fill all the little gaps in the puzzle.” (CEO)

The CEO had identified that they had an R&D bottleneck. They had this one inventing scientist up at the Institute and he was probably not capable of doing much more than just continuing to develop that one ophthalmic product.

“But for example, this will probably have application in neurology...We know that this thing can actually give early indications of things like MS and neuritis. We think it can also be probably used as a test in audiology, but these are all developments that are going to require different researchers than the ones who actually developed that machine.” (CEO)

The company was going to have to extend its scientific and technical network to be able to exploit new opportunities that are being identified.

Management

“They’ve got a good CEO, yes. And a very committed investor, so it’s very good.” (Board member)

He has used his own networks well.

Credibility

“Oh we’ve had discussions with a number of overseas companies. In fact the *gold standard* company, Humphreys, actually paid for a couple of trials in the Northern region of Sweden. So anyway we convinced them that we were possibly the new player on the block.”

Case summary

This case shows how a number of small interlinked networks were progressively developing, starting with a scientific and medical technical network, involving both research scientists and clinical ophthalmologists. This was followed progressively by the development of effective connections in a both a financial venture capital and a marketing focussed network.

CASE NO. 11 ALLERGENIC PARTICLE ASSAY AND NASAL FILTERS

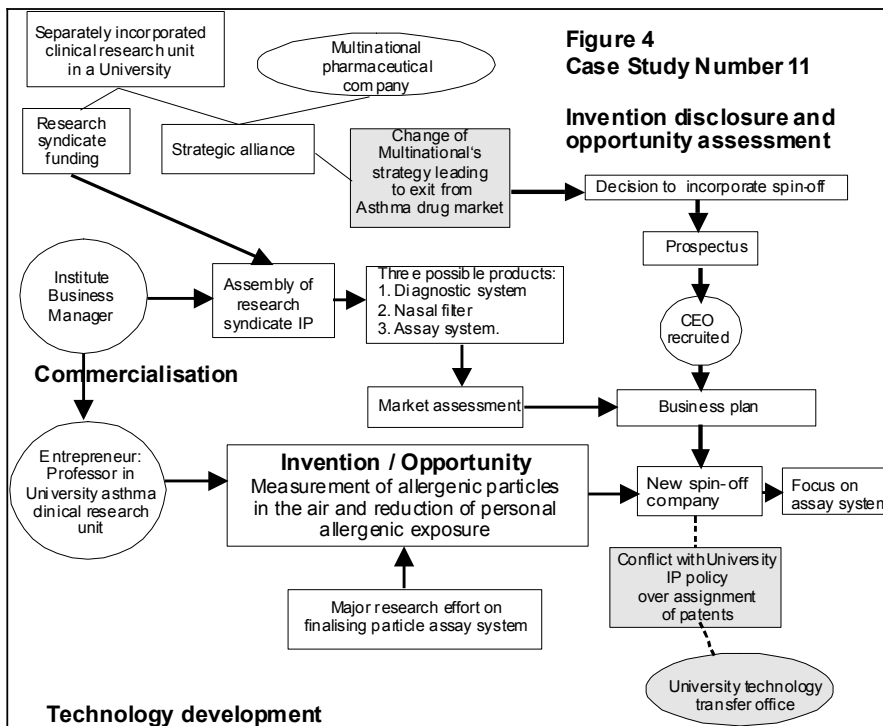
Invention disclosure and opportunity assessment

Idea

“The idea that came from a University professor in a university medical research institute was that you could put a device into your nose and capture particles and look at your environment. Now the idea of nasal collection was novel in 1995 and that is what was patented.”

The field is broadly a nasal filter device and assay kit, which can be applied to a diversity of fields in the collection and measurement of airborne particles that cause allergenic health problems. The IP covers the detection of airborne particles. The initial research had been funded by several research syndicates the participants in which included a major multinational pharmaceutical company under the then existing Australian tax-effective research syndication provisions.

“So the emphasis here has been on measuring personal allergenic exposure and trying to develop that link between exposure and trigger, and then symptoms. And that’s the underlying research interest, but from a commercial point of view that’s not necessarily where the first market is. So my role has been to try and spin out the commercially attractive stuff from this. ...So the point that I am saying is yes, there is a market there, it’s going to take a long time and you start off in the research area and move. Anyway, it was sufficient to get the research syndication together;



two provisional patents came out of it and the marketing part of the syndicate was at the time coming from the world's largest allergy diagnostic company...So that was a good syndicate, it looked really interesting.”

There were some uncertainties:

“The role of allergens in asthma continues to be unclear and in some circumstances they are obviously incredibly important and other circumstances they probably do not play an important role and we do not understand the role of allergens in asthma.”

“Well I'd worked in the field of allergy for allergy *imageology* for a number of years and this seemed to answer many of the outstanding questions (which were actually stronger at the time I think than they are now) about the role of environmental exposure. But it really seemed to provide the most significant the most significant advance in diagnosis of environmental exposure really in the last 50 years and it will work.”

“So in a sense of why did I bother: the thing that continued to strike me was that the inventors continued to get E-mail with unsolicited expressions of interest from experts in the world, globally. And so they'd go to a conference and chat about their work and people would say can I use it? I want to use this nasal capture device to look at allergens in my home, or in my lab, or with my patients? So there was this continued trickle of unsolicited interest from people who were opinion leaders saying I want to have a go. The second thing was that the trickle related not just to the capture of particles for rhinitis and asthma, which was our main area of interest, but for occupational exposure, bio safety, all sorts of bits and pieces. So there was a range of applications. Moreover you could coat these devices with a substance and you could investigate if there was a chemical reaction “

The initial focus was on identifying and measuring particulate allergens. The need was to have a system that patients could use in combination with their doctors to help them understand how much allergen and to which allergens they were exposed. It would be a piece of equipment used by a doctor rather than something that people have in their home.

“The scenario would be that you would go to your doctor as your asthma was getting worse...You would get the samplers from a chemist on a script and you would go home and do a series of samplings, probably give a blood sample depending on which test they had in mind. That would go to a service laboratory that would then provide a report to the clinician who would determine appropriate treatment.”

“Sprays are not so effective in high load situation and so we're not necessarily competing head on with those because they're complimentary of course.

Critical events

The first critical event was the withdrawal of the multinational from any further interest in the technology. The IP was owned by the syndicate but the multinational as a member of the syndicate had first access to it and had been going to take out a marketing license. However the ending of the syndicate funding then came with no ongoing marketing opportunity. The decision

to incorporate a new spin-off company arose out of this event. It was not the first choice as a commercialisation strategy.

The second critical event was the change in focus which came from new and later market research and from ongoing problems with the finalisation of the assay kit software from development of the assay kit to the nasal filter and the related effect on the investors who used the changed timelines as an excuse to avoid further contributions.

Founders

A professor in the Institute was the initial driving force.

“There are only three people in the world who are interested in these things ... So it was my context and knowledge and publication in this incredibly small field of allergens and allergen exposure and because I'd done some fairly pivotal work for the UK in the 1980's which got me the recognition in this area and is still referred to now.”

“He is quite a world authority. He is a very good inventor to work with. He is very helpful, wants to do the right thing, thinks commercially, and thinks in the best interest of the company, so he's been very, very closely involved but very realistic as well. Not over optimistic about the outcomes.”

But it was the other founder, a business manager at the Institute; working part time with the Institute, who saw the commercial opportunity. She became Chair of the Board

“I saw its potential subject to market validation and I guess I recommended to the Institute's Finance Committee that it was worth spending enough money to take a look at it, and if there appeared to be value to package it, and then to get it commercial.”

The initial network was quite small with limited external connections.

The initial business plan was based on the professor's ideas and the input from their Californian consultant in terms of assumptions about the market. These were validated by a respiratory clinician to confirm that this level of penetration of these technologies in these markets could be assumed.

“And then I ran the numbers and came up with a business case that said on a nasal sampler for allergens, on a rapid sampler, and using a nasal device and a filter collectively you can value this company at whatever the number was. At that point with the Finance Committee of the Institute we agreed that we would go to market and try and raise venture finance, having put all the IP into the new spin-off company. There was a hell of a lot of legal negotiation to make sure the IP was clean. Then we had to plan how we went to market. We raised money on the basis of that plan and valuation.”

Incorporation

The original funding was through a research syndicate. This came to an end in 1998. Suddenly there was no more money and the multinational was no longer interested. Staff numbers working

on the research had plummeted. The company was actually incorporated at the end 1998 but it did not actually have anyone on its payroll.

“And I guess she was the driver in terms of spinning a company out from the Institute. What happened then; the prospectus did not actually say that the diagnostic system, which was the nasal sampler and the assay would be the first product. It nominated three products, the diagnostic system, the filter and an assay system for measuring the allergens. These were the three potential products of which we had knowledge and IP protection. Part of that process was that we had to get a CEO before we got funded. The CEO rewrote the business plan...and we went ahead into the assay system.”

The initial Directors were given a very small number of options only, no cash under the venture capital shareholding agreement and that was really their only remuneration.

The critical network connections in this initial work on incorporation were the syndicate investors and the IP as a non-personal actant.

Intellectual property and its protection

The first key thing was to extract the IP and make sure that the IP, all the rights and everything, were owned by the company. The Institute business development manager put an enormous amount of effort into including IP from each part of the syndication scheme, which had different investors who had certain licensing rights. The original IP was the University's. The patents were then licensed completely to the Institute for the syndicate project.

“In 1995 the Institute...licensed from the University some core patents, some core technology that had been developed by a University scientist. He had through the University technology transfer office lodged a couple of patents.”

There were from the University's technology transfer office's point of view some unusual aspects of the IP arrangements in this case.

“The base intellectual property was based on a professor who was a University employee. But the first patents dated back many years ago when there was an R&D Syndicate within the Institute involved... So for some reason, some obvious reason, some valid reason; apparently because it was signed off by the University long ago; instead of the University solely owning the IP under the University's IP policy, there was an arrangement where it seemed to be owned by the inventor and the University; there were other IP ownership issues. More inventions had been made during the time that the Institute funded the inventor's work through the Syndicate. So there was a mixture of rights and ownership of IP and so it was decided to assign the intellectual property a company formed by the Institute, a separately incorporated body.”

The patents were to be assigned rather than licensed and the University was initially not happy with that.

“We did not assign, agree to assign until they had an investor and a business plan that gave us some indication that they could do the commercialisation. But the argument was made to

the University that because the ownership was so messy, and there were so many owners it was better to put it all into this one vehicle... The University had a very good relationship with this separately incorporated Institute....”

“Yes I think the University have been consistently good, I have no problems with the University.”

Tidying up the IP ownership was an important driver for the creation of just one incorporated entity to hold the licence for all the IP involved. This has been identified in the literature as a frequent justification for spinning off a company, but not one that necessarily presages commercial success.

Market opportunity and business model

Basically it became clear that there was a platform and the inventor could have tried to develop 56 different applications at once. Progressive market research and some ongoing technical problems with the assay kit resulted in a change of development focus from nasal sampling and assay to nasal filtration. In defining a market, three market research studies were carried out. Two were done in Sydney and one was done in the US. Based upon these studies, which were not large studies, they then defined what they saw as their target market.

“So we said there is a platform of capability for nasal sampling and filtration, the first applications of which will be in the asthma and rhinitis area and that could be either nasal sampling or filtration. Later on, only last year through some direct market investigation where we ran a series of consumer focus groups, it became clear that the preference initially is for filter products because the strength and support (and hence market) for a sampler is much weaker. So in the last twelve months we have focused nearly entirely in a commercial sense on nasal filters even though the inventor has continued to maintain his research interest in broad sampling technology.”

The company had a Comet grant. It came in just before the venture capital money came in.

Case summary

The personal networks were much smaller for the first phase of this case and it was the non-personal actants and events that were not under the control of the key personal actants that determined the establishment and led to the eventual failure of this venture.

DISCUSSION AND CONCLUSIONS

In this study of new venture creation we have demonstrated the value of using actor-network based research methods. Fundamentally speaking, and to use Law's (1992) terminology, commercialisation of technology through new ventures is about the creation of resources through 'punctualisations' of semi-stable actor-networks so that they can be consolidated and rendered reliable platforms for future growth. While informal and weaker social actor-networks tend to dominate the early phase of firm development- possibly due to their flexibility, the venture must be stabilised by bundling these weak social relations into more robust forms in the shape of legally

formalised relationships and standardised and proven technologies. If these non-human actants cannot be folded into the entrepreneur's initial network of weaker informal relations with other people and technologies, then it is unlikely that the venture will proceed. In essence, resources must be created through growth and stabilisation of the actor-network.

This form of analysis is significant because it ties together several disparate strands in the entrepreneurship research literature. The creation of organisational resources is central to the analysis but it also brings in elements of governance and entrepreneurial agency. This research is therefore a step in the direction of bridging these literatures in an effort to obtain a more holistic view of the process of new venture creation. The value of this approach lies in the groundedness of the actor-network research project that will allow us to generate new insights into why new ventures succeed or fail.

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