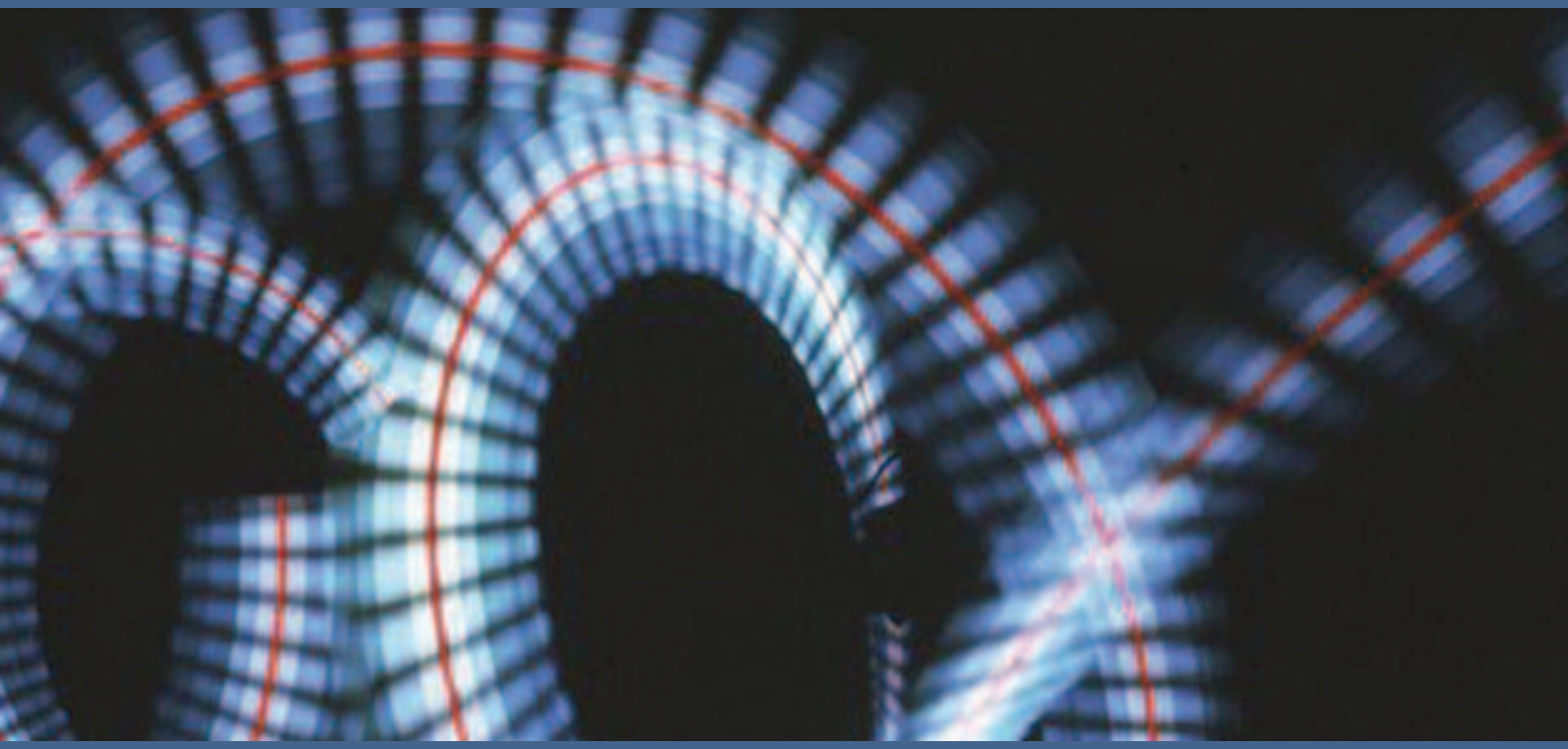
BVCA *investing in enterprise*



Creating Success from University Spin-outs

A Review conducted by Library House on behalf of the BVCA

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Foreword

The UK private equity and venture capital industry is by far the largest in Europe, accounting for some 52% of the whole market, and second only in size in the world to the US. The UK industry is invested in every sector of the economy across all regions of the country. The BVCA (British Venture Capital Association) represents the overwhelming number of UK-based private equity and venture capital firms (VCs).

The successful development of university research is one of the most important factors to a successful modern economy. In commissioning this research the BVCA was interested in discovering further information in the following areas:

- An important source of world-leading research, and products at an early phase of development.
- The pool from which a number of successful companies have been formed in the last ten years.
- A significant wealth creator for the UK economy.

We are aware that with the support of the Regional Development Funds this has been an area of real success over the last five years, but there are improvements that could be made to make it an area of true excellence. We wanted to establish positive and constructive ways in which we could take these achievements forward.

This research has shown that there is evidence that university spin-outs are at a disadvantage to their corporate counterparts. We judge therefore that there is a need to level the playing field. The research also suggests that research or products spun out at a later stage – post market validation – have the best chance of success.

A significant conclusion of this work is our call for the Government to continue to support Technology Transfer Offices (TTOs) and universities with the Higher Education Innovation Fund (HEIF) 3 funding, and if anything target funds more specifically to those projects which are most likely to succeed.

At the same time it is recognised that it is important that the venture capital (VC) community continues to invest time and resource in helping TTOs and universities overcome some of the obstacles highlighted in the report. Initially this would be helping them to identify and access high quality managers for their spin-out companies. The BVCA will be doing further work in this area over the coming months.

I would like to thank my colleagues on the BVCA's Technology Committee for their work and support in bringing this project to a successful conclusion. This is a substantial contribution to the knowledge and understanding in this important area of our national life. The UK has an outstanding network of universities and research centres which with the right support can help fuel the growth in the UK economy and further our understanding and knowledge over the next decade to the benefit of all.

Jo Taylor
Chairman, BVCA Technology Committee
November 2005

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Contents

Highlights

The following highlights emerged from discussions and analysis conducted for this Review:

- The foundations for development of more successful spin-outs are in place.
- Introduction of Government funding in 1999 for knowledge transfer/exploitation including University Challenge Funds (UCFs) stimulated an expansion in TTOs and spin-outs.
- There are now 126 TTOs in the UK.
- New spin-outs from the UK's 36 leading research universities (ranked by research income), peaked at 89 in 2001 before falling back to 30 in 2003, partly as a result of a tax change affecting university staff which has since been rectified.
- 12 university spin-outs went public in 2004.
- TTOs welcome the involvement of VCs and value their advice.
- VCs evidence improving standards and relationships in their dealings with TTOs.

Issues and recommendations

Questionnaire responses and interviews with TTOs, spin-outs and VCs drew attention to a number of key issues for which the following recommendations are proposed.

Issue: Recruiting experienced entrepreneurs and managers into spin-outs.
Recommendation: TTOs to share recruiting experiences and compensation information.

Issue: Securing grant funding for proof of market and technology qualification for spin-out candidates.
Recommendation: Universities and TTOs to request HEIF 3 funding in the form of grants for the proof of market and technology stage of the spin-out journey.

Issue: Engaging with potential customers to validate their needs and the market opportunity.
Recommendation: Universities and TTOs to build relationships with experienced businesspeople from established companies, VCs, business angels, mentors and entrepreneurs to assist spin-outs.

Issue: Understanding what it really takes to secure business angel or VC investment.
Recommendation: Agenda item for BVCA hosted workshops with TTOs, VCs, business angels and entrepreneurs.

Issue: Aligning the aims, objectives and incentives across a university, its individual departments, researchers and the TTO.
Recommendation: Universities to take action to ensure alignment.

Issue: Simplifying access to and managing the rights to intellectual property (IP).
Recommendation: Agenda item for BVCA hosted workshops with TTOs, VCs, business angels and entrepreneurs.

Issue: Demonstrating university support for and departmental commitment to entrepreneurship.
Recommendation: UK Government and universities to introduce mechanisms to support academics in comparable fashion to the use of citings in academic publications or the Research Assessment Exercise (RAE).

Issue: Measuring quality of outcome, not simply quantity of activity.
Recommendation: The UK Government and universities to balance metrics focusing on quantity of output with those that address the quality of outcome.

Executive summary

The UK has an enviable reputation for the quality of its science. What would it take to improve the conversion of this world-leading science into world-beating companies? In essence that is what this Review sets out to address.

University spin-outs are an emerging success story

Following the introduction of UCFs in 1999 as part of the UK Government's HEIF I initiative, 40 new TTOs were created taking the total to 126. In parallel there was a sharp increase in the number of spin-outs from the 36 leading research universities (ranked by research income) to a peak of 89 in 2001. New spin-outs fell to 30 in 2003, in part as a result of an unintended (and subsequently corrected) tax liability affecting university staff.

The 2004 Library House Spin-out Monitor identified 435 technology spin-outs from the 36[1] leading research universities in the UK. Of these, 46% were from the Life Science sector and 38% Information Technology. Of the 435 spin-outs, 65% were at the seed funding stage, 15% had received series A funding, 8% series B and 5% series C or later while 7% have gone public, been acquired or merged. In 2004, 12 of these spin-out companies went public.

Based on responses to the Review questionnaire, there is clear evidence of positive progress in the relationship between VCs and TTOs with 60% of VC respondents reporting a noticeable improvement in TTO skills. From the perspective of the TTOs, all 25 respondents reported that they value the advice they receive from VCs with 68% reporting improvements in their dealings with VCs.

The spin-out journey

Research to concept

This first step involves review and selection or rejection of a concept proposed by a research team. Introduction of panels comprising experienced businesspeople with relevant backgrounds from established companies, business angels, entrepreneurs and VCs would assist TTOs in the process of selecting promising ideas for further development. This step depends on academic researchers having the confidence to take the initiative and promote their ideas for exploitation. For this to be successful, alignment between all stakeholders is required. Disappointingly, 76% of TTO respondents highlighted poorly aligned incentives and inconsistencies between the aims and objectives of a university, individual departments and TTOs. Absence of recognition in the RAE for technology transfer initiatives, or mechanisms to reward academics similar to the use of citings in academic publications, act as disincentives to entrepreneurial behaviour by academic departments and their researchers.

Market & technology validation

This step is designed to validate the concept with potential customers and prove the technology will work. It also marks the beginning of the separation of the founding team from the university. Not surprisingly, the team's thoughts turn to the need to secure funding. There was agreement among all stakeholders that in the future, this essential validation work should be funded by grants rather than equity. However, where grants have not been available, nascent spin-outs have been obliged to raise seed funding to support continuation of their work. To do this requires them to set up a company. This sequence of events explains why it has been necessary for them to do this but also fuels the assertion that potential spin-outs are formed into companies too soon.

When surveyed, 60% of spin-outs and 80% of TTOs commented that the founders need all the practical help they can get throughout this critical validation stage, ideally from an experienced entrepreneur with prior knowledge of relevant customers and market sectors and an interest to get involved.

Once the validation work has been completed, which typically takes three to nine months, the majority of TTO respondents undertake a formal concept assessment with the team to determine the next step – spin-out; selling or licensing the IP to another company; partnering; retaining

[1]Within the total of 435 spin-outs, there are four instances where IP has also been contributed by another university or research institute, namely Cancer Research UK, the University of Hertfordshire, The Wellcome Trust, or The School of Pharmacy.

ownership, but making the IP freely available to use by others; or shelving further work. Help with the assessment from panels of experienced business angels, entrepreneurs, VCs or mentors would be welcomed.

Market & technology development

The next step for a spin-out is market and technology development leading to a product demonstrator, or pre-clinical trials in the life sciences world. Responses to interviews revealed that TTOs need no convincing of the value that an experienced entrepreneur can bring to a spin-out, not least in relation to their enhancement of its investment prospects and their contribution to attracting key managers and employees. This market and technology development step may take from a few months to several years and typically is funded through equity investment by founders, friends, family, business angels, potentially the university and, where the opportunity is sufficiently compelling, by VCs or industrial partners. In the future, this step could be supported as part of a Small Business Innovation Research (SBIR) like project.

Pre-cursor requirements for receiving funding are company formation and clarity on IP ownership. Of the spin-outs surveyed, 89% commented that securing access to IP rights and negotiating contracts with the university is a lengthy process. Not only does this apply to the licensing or assignment of IP at the time of company formation, but also to the ability of spin-outs to secure options on future rights to new scientific discoveries that complement and strengthen an existing IP portfolio. Other than where the university invests in the spin-out at this stage, this marks the end of the active involvement of the university and the TTO.

Product & business development

Assuming that progress through the previous step meets expectations, the spin-out company is poised to direct its energies into scaling the business through product, sales, marketing, organisation development and in some cases production. Generally, funding for this stage is provided by VCs or industrial partners.

Exit

This is the final step on the journey, where investors secure their returns via an initial public offering (IPO) or trade sale.

Ingredients of success from the venture capital perspective

VCs focus on four main areas when considering an investment proposition: the Innovation; Team; Market; and Investment case. From the outset, the most important factor VCs look for is evidence that a customer need can be met with applications of the technology. The next most important factors are early consideration by the spin-out team of the likelihood of achieving an exit, the level of motivation and commitment of the founding team, understanding of potential user benefits from the technology or innovation, size of potential market opportunity and clarity over IP ownership. For TTOs and spin-outs, understanding the way that VCs or business angels approach investment opportunities and being in a position to provide compelling answers to their questions are key to the development of more successful spin-outs.

Challenges to success from the TTO and spin-out perspective

TTOs and spin-outs place recruiting experienced entrepreneurs and managers at the top of their wish-list and highlight the difficulties involved in achieving this. Other challenges include establishing proof of market and technology, understanding what it takes to secure angel or venture investment, and simplifying access to IP. At a structural level, responses by TTOs at three-quarters of the participating universities and research institutes identified inconsistencies between their own missions and objectives and those of their universities.

The corporate spin-out advantage

From interviews with respondents including multinational corporations, it is clear that there are significant differences between corporate and university spin-outs. Typically, a corporate spin-out is founded with the explicit aim of satisfying a known customer need. Frequently, the technology is already proven, customer needs have been established and team members with a mix of technical and commercial experience can be identified, recruited and incentivised. Effectively, corporate spin-outs are launched at the equivalent of the cusp between market & technology development and product & business development as described above.

Development of a university spin-out, on the other hand, is more challenging. Understanding a customer's perspective and validating their needs, assessing market demand, proving the technology, hiring team members and raising money are all areas for which academic inventors have not been equipped by their prior experiences. But all need to be undertaken just to arrive at the same point from which a typical corporate spin-out is launched. The time, effort, funding and risk involved are obvious. And so too is the need for education and support.

Other comparisons

Analysis of VC funding data for the past five years shows that university spin-outs received between £0.35 million and £1.3 million in early stage VC funding, approximately 50% of the £0.8 million to £2.4 million invested in other early stage technology investments. Currently, 87% of VCs and 100% of TTOs view the typical university spin-out as a relatively immature prospect for VC which is reflected in the lower levels of investment. Equipping spin-outs with more of the attributes of other early stage innovation companies clearly would be beneficial for all concerned. The ability to attract experienced entrepreneurs would be an important step in this direction.

It is important to recognise, despite the prevailing perception, that there is no single 'best practice' technology transfer model in the US which could be imported here. In fact, just like the UK, there are models in operation covering the spectrum from the 'hands-off' approach where the TTO only addresses IP licensing and contracts to the more 'hands-on' approach where there is active practical and financial proof of market and technology support for spin-outs.

Looking to the future

The HEIF 3 funding round presents an opportunity to support the proof of market and technology step in the spin-out journey through grant funding.

All TTOs responding to the Review identified the value they receive from links with VC, with 68% reporting that interactions with VCs had improved in the previous two years. In some cases, VC firms manage a UCF and are closely engaged with the TTO. In others, VCs provide access to an informal view of the investability of a particular opportunity or identify actions that would improve the investment proposition. The opportunity exists to formalise these relationships by establishing specialist advisory panels, which could also include participants from the corporate community and business angels.

The BVCA plans to host workshops to further relationships and understanding between VCs, TTOs, business angels and entrepreneurs.

The Gauntlet, an on-line service developed by Library House in partnership with the London School of Economics and Political Science and with the support of the BBC, is designed to provide entrepreneurs with a detailed understanding of how investors think and what it takes to get them to invest. Its application by TTOs will contribute to better informed and prepared spin-outs.

Implementation of the UK equivalent of the US SBIR programme by the UK Government could open the way for university spin-outs to capture some of the customer interaction and team building benefits that their corporate spin-out counterparts enjoy.

1. Background

In a knowledge-based economy, capturing and leveraging the value of IP is generally held to be the path to sustainable wealth creation and societal benefits. Economic prosperity is expected to result from exploiting innovation capacity, improving competitiveness, and enhancing productivity. In the UK, more public money is being committed to R&D as a stimulus for innovation and its subsequent commercialisation.

The UK Government recognises the important role universities can play in helping to produce social and economic returns from the nation's investment in science and has established a number of initiatives over the past five years in order to promote knowledge and technology transfer activities. For example, HEIF funding for the commercialisation of university scientific research commenced in 2001 and now totals approximately £265 million (HEIF I and HEIF 2). Universities have responded by becoming more commercially oriented – adding entrepreneurship courses to the curriculum; setting up UCFs, developing TTOs to facilitate business-university interaction and encouraging licensing and the creation of spin-out companies to exploit their science and related IP.

For their part, the founders of these innovation-based companies are seeking to meet, partner and engage with providers of expertise and capital. Entrepreneurs are attracted to universities to find opportunities to build exciting young companies. An increasing number of corporates value their engagements with universities – a key input to supporting the emerging trend of 'open innovation'. The business angel and VC communities are looking to invest in companies that offer them the potential to build world-leading companies delivering attractive returns on capital invested. With so many capable and committed parties, so many resources being invested and so much at stake for the nation, it is not surprising that the process is being scrutinised. Is all this investment of resources paying off?

There are positive signs: technology spin-outs have become an increasingly popular vehicle in universities for commercial exploitation of potentially valuable scientific discoveries; there are the success stories such as Wolfson Microelectronics, Ark Therapeutics, Celoxica, Transitive Technologies, Ceres Power, Synairgen, Vectura, Vastox. But the fundamental question remains – what could be done to increase the quality and success of university spin-outs?

1.1 Key findings from prior research into technology spin-outs

Everyone involved in commercialising scientific inventions agrees there are challenges to making the process work more effectively. The formation and development of technology spin-outs has been a keenly debated topic between Government, publicly funded research organisations, investors, industry, academic scientists and entrepreneurs. The debate has resulted in a number of studies aimed at understanding technology spin-outs and providing evidence and insight to shape policy and strategy. There is a degree of commonality from the key findings from these studies.

University technology transfer strategy and capabilities

Since 1999, fuelled by a range of Government initiatives, universities and research institutes have been through a period of 'experimentation' in the mechanisms, processes and strategies employed to commercialise scientific research. Pump-priming the sector in this way has lead to a great deal of learning on the part of all stakeholders. The Lambert Review[2], conducted by a team at HM Treasury, recognised that variability in the quality of TTOs was in part due to a lack of training and experience amongst TTO staff. Recruiting experienced individuals into TTOs who brought specialist commercial skills or an industry background was found to be difficult. Previously, the Bank of England[3] found that constraints on the resources of TTOs and the complexity of processes within universities when conducting commercial negotiations were barriers to creating quality spin-outs and accessing equity funding.

In 2004, previously disparate funding streams for universities and research institutes were rationalised under the HEIF – providing a long-term commitment from Government to support technology transfer activities and university-business interaction. At the same time, universities were encouraged to formulate strategies to build a balanced portfolio of technology transfer activities appropriate to their distinctive academic strengths and to their particular regional context. Technology transfer continues to evolve with progress being made by universities, business and Government in the drive to achieve more success.

Quantity and quality of spin-outs

The Lambert Review found the quality of technology spin-outs varied widely among different universities, with some spin-outs of low quality. In addition, it argued that TTOs had engaged in too little licensing of university IP and were creating too many unsustainable spin-outs, going so far as to recommend a rebalancing of activities away from creating spin-outs and towards licensing technologies. In January 2005, a little more than a year later, a report entitled 'University spin-out companies: Starting to fill the evidence gap' funded by The Gatsby Charitable Foundation[4] (The Gatsby Report) commented that universities have a more balanced view of the potential direct and indirect benefits from supporting spin-out activity. TTOs were found to have a realistic understanding of how difficult it can be to generate sustainable direct returns from spin-outs. The Gatsby Report also recognised that the majority of TTOs fully appreciated that life science and complex physical science technologies can take several years to develop into revenue generating companies and in certain fields are expected to have a very long payback time.

Metrics for commercialisation activities

The Gatsby Report also observed that Government metrics used to measure the activity and outputs from third stream funding activities may not be appropriate indicators for effectiveness or quality. Counting the number of spin-outs created and license deals executed per unit of research expenditure overlooks the importance of quality. Narrowly defined metrics may have encouraged universities to become overly aggressive in negotiating licensing deals with industry or entrepreneurs, and may have artificially increased the number of spin-out ventures. This narrow view can lead to universities channelling resources into inappropriate activities. Worse still, promising ideas may have been prematurely packaged into spin-outs that have little chance of attracting venture funding and hence growing to make a positive contribution to the economy. Encouragingly, The Gatsby Report found that TTOs had developed a firm understanding that attempting to capture value from spin-outs 'upstream' i.e. by TTOs being commercially aggressive in negotiating transfer of IP, can severely hinder the development of these nascent businesses.

Access to funding

'The Financing of University Spin-outs' a report undertaken by The Bank of England[5] (the Bank) reported

[2] Lambert Review of Business-University Collaboration, (2003). HM Treasury.
[3] Quarmby, L., (2002) The Financing of University Spin-outs, Domestic Finance Division, Bank of England.
[4] Minshall, T. and Wicksteed, W, (2005) University spin-out companies: Starting to fill the evidence gap. The Gatsby Charitable Foundation, UK.
[5] Quarmby, L., (2002) The Financing of University Spin-outs, Domestic Finance Division, Bank of England.

that despite the introduction of UCFs in 1999, universities and research institutes found it difficult to access funding for proof of concept stage projects, whereas access to VC funding was found to be less problematic. In the same study, the Bank also concluded that access to private finance was less important than non-financial factors in commercialisation of IPR. The Bank's research also found that investors were restricting themselves to working with a small group of universities that had developed a professional TTO interface.

The Lambert Review argued that too much UCF money had been allocated towards early stage investments in spin-out companies and not enough towards proof of concept as originally intended. The Lambert Review recommended an increase in the availability of proof of concept funding to be used, in order to establish if a new technology is technically and commercially viable or not.

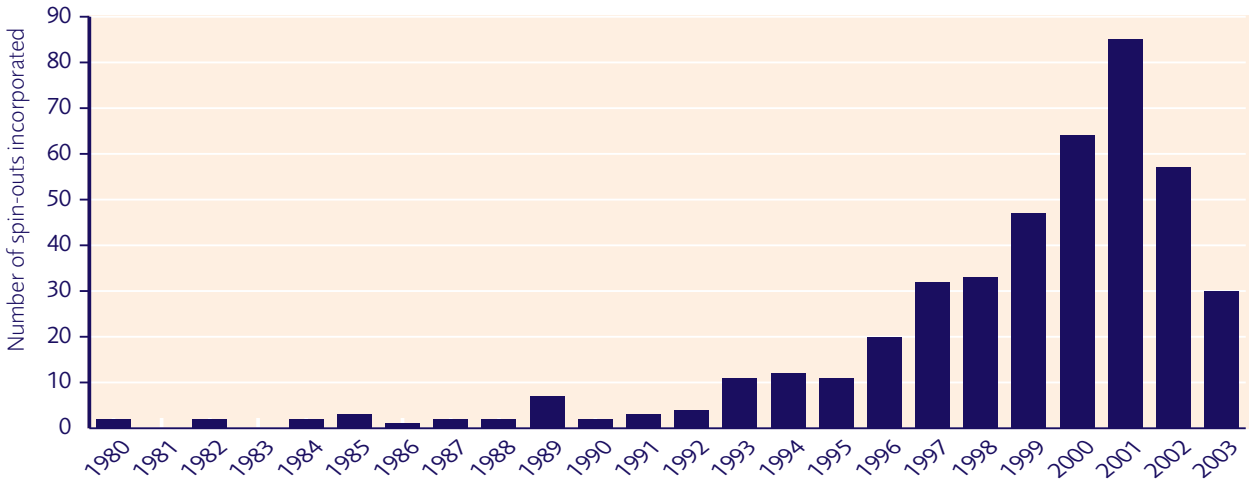
Attracting high quality entrepreneurial management

The Bank study found that when accessing equity funding, "a lack of appropriate quality of management" was the single most important inhibitor. In fact, finding and recruiting talented entrepreneurs with experience of having built successful technology companies was reported to be a more significant problem than any particular financing issue. Academic scientists do not always want to play a direct role in the commercialisation of their research. In the majority of cases, the inventor might not have the appropriate skills, the desire, or experience to develop commercial applications and products or to run a company. Given the importance of this issue, little has been done to resolve the problem of bringing entrepreneurial talent to bear on developing innovations from university science.

The same themes consistently appear in these studies – as well as others carried out in the UK, Europe, the US, Canada and Australia. What is surprising is that with the exception of a few studies, most of this research has evaluated and reported on the phenomenon of technology spin-outs without conducting detailed analysis on the companies themselves. This Review is the first to present quantitative data based on technology spin-outs from the leading UK universities and research universities and institutes.

2. Technology spin-outs

Figure 1: UK university spin-out company formation activity



Source: Spin-out Monitor, Library House, 2005

2.1 Technology spin-out definition

A technology spin-out is defined as a company engaged in business that is dependent upon licensing or assignment of technology for initiation from a public research institute (e.g. university, Government laboratory, etc.)[6]. Technology spin-outs are a sub-set of new technology-based firms which commonly have the following characteristics[7]:

- Their value is linked primarily to the longer-term growth potential, derived from scientific knowledge and IP.
- In early stages the companies lack tangible assets.
- Their products initially have little or no track record and are largely untested in markets.

While not the subject of this Review, there are numerous examples of successful start-up companies that were founded by (or involve) alumni, months or years after they left a university. The genesis of many of these companies can be traced back to ideas that were prompted by university research and/or by networks established at that time. In many respects, this category of start-up can be considered as an indirect spin-out.

2.2 The importance of technology spin-outs

This Review is based in part on information from the 2004 Library House Spin-out Monitor (Spin-out Monitor) which examined technology spin-outs from the UK's 36 leading research universities (ranked by research income). As shown in Figure 1, technology spin-outs started to increase in number as a mechanism for commercialising research in the early 1990s. Numbers increased sharply during the late 1990s, fuelled by several drivers including exuberant conditions in technology markets, increased availability of seed and early stage private capital, the introduction of UCFs in 1999, as well as the pressure of implicit, and in some cases, explicit targets for TTOs to create new companies.

Spin-out formation peaked in 2001, when 85 companies were created. This number fell by over a third in 2002. A number of additional factors contributed to the continued decline (of around 50%) during 2003, not least of which was a tax barrier created by Schedule 22 of the Finance

[6] This definition of a technology spin-out is consistent with the definition applied by Quarmby (2002) to the context of university spin-outs.
[7] Bank of England, (2001) Financing of Technology-Based Small Firms.

Act 2003. This legislation inadvertently hindered the transfer of knowledge from universities to technology spin-outs, before it was remedied in December 2004[8].

The Spin-out Monitor identified 435 technology spin-outs from the 36 leading research universities in the UK. Of these, 46% were from the life science sector and 38% information technology. 39% of the total were either at the proof of market and technology step, or market and technology development stage. A further 9% were at the beta product stage or had a compound in clinical trials. 26% were shipping product but unprofitable and 25% were profitable. An overview of companies by industry sector is shown in Figure 2.

According to the Spin-out Monitor, 65% of the 435 spin-outs were at the seed funding stage, 15% had received series A funding, 8% series B and 5% series C or later while 7% have gone public, been acquired or merged. Details can be found in Figure 3. In 2004, 12 of these spin-out companies went public, including Ardana and Ceres Power while trade sales included Blaze Photonics and Molecular Skincare.

The 435 companies included in the Spin-out Monitor exclude technology consulting and service spin-outs on the basis that these companies generally are not candidates for VC funding.

The term spin-out includes companies which are at the proof of market and technology concept stage or are market and technology development projects. These entities have been incorporated at an early stage for a number of reasons which are explored in the next section.

As shown in Figure 4, 7% of spin-outs in the Spin-out Monitor were at the proof of market and technology concept stage.

The largest category of spin-outs (41%) can be classified as 'market and technology development projects' where the spin-out team may have achieved proof of market and technology and be engaged in further technology (as distinct from product) development or pre-clinical development. Based on questionnaire responses, many of these technology development spin-outs have yet to produce a persuasive demonstration or sufficient scientific data to show how the technology could be commercialised. Demonstrating this is fundamental to attracting potential industry partners, licensees for the technology or where appropriate, business angels or other early stage investors.

All TTOs interviewed recognised this important transition from a project aiming to demonstrate proof of market and technology to a business which focuses on product and business development. This is a stage in the journey of the spin-out company, when technology development needs to take place before a sustainable company can be created. The vast majority of stakeholders, including corporations with R&D labs, agreed that this technology development stage can in some cases take up to five years or more, before the technology created in the research laboratory has been proven to the point where it can be productised and the emerging business opportunity displays the characteristics to attract VC funding.

Over a quarter (26%) of technology spin-outs from universities and research institutes were companies that are shipping product but were unprofitable, whilst 25% were shipping product profitably, signifying that more than 100 spin-outs have successfully made the transition from research laboratories to profitability.

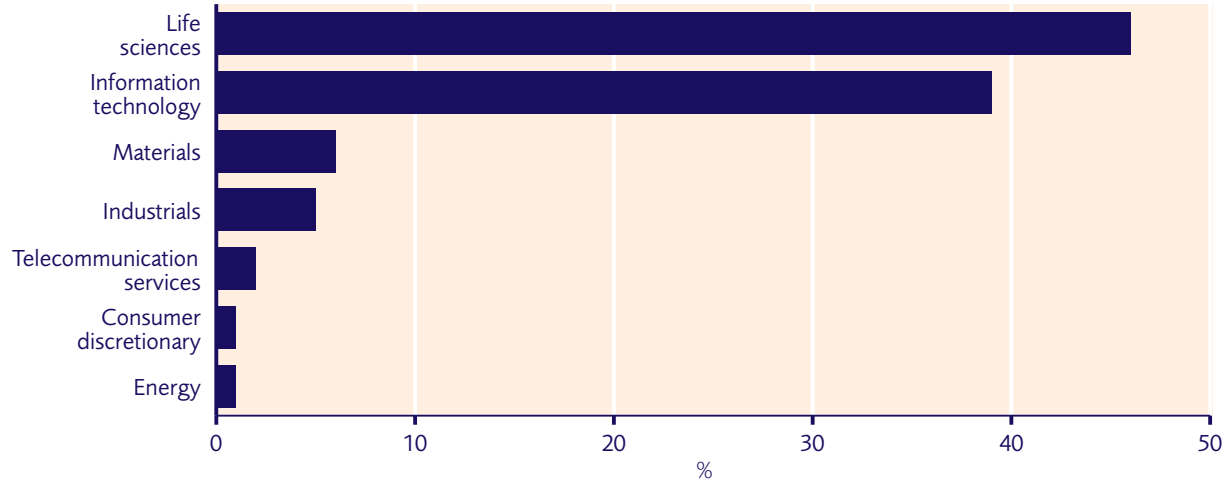
2.3 What is the motivation for early formation of a company?

Commercialisation of scientific research by a university invariably involves licensing technology, whether to a spin-out, or to an industrial partner. TTOs at the UK's leading research universities are experienced in exploring the various options for the commercialisation of technologies and selecting the appropriate route, and this Review found no evidence to the contrary. In other words, these leading universities neither see spin-outs as a panacea nor the sole route for creating and capturing value from intellectual property rights (IPR). Further, they actively consider other routes to commercialisation including licensing and joint-ventures with industry.

That being said, it is difficult to escape the observation that some technology spin-outs have been formed into companies prematurely. What are the reasons for this?

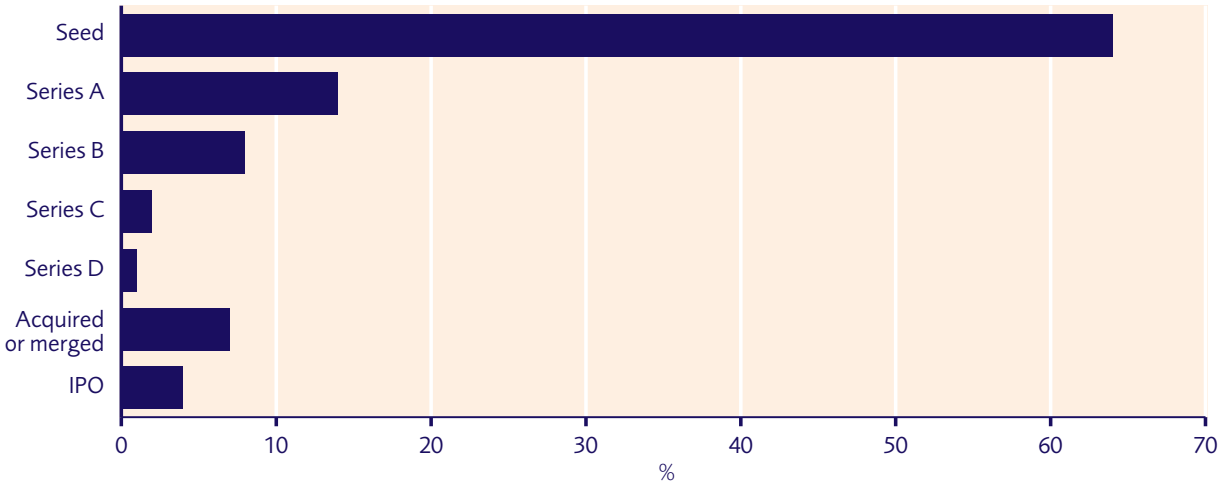
[8] Schedule 22 of the Finance Act, 2003, sought to ensure that those who are awarded shares as part of their remuneration package are liable for income tax and national insurance on such payments. An unintentional consequence of this legislation was a discouragement to academic entrepreneurs to form technology spin-outs, given the additional cost to academic members of universities from taking equity shares in technology spin-outs. As a result, a number of universities held back the number of spin-outs formed during 2004, until HM Treasury amended this legislation.

Figure 2: UK university spin-outs by technology sector



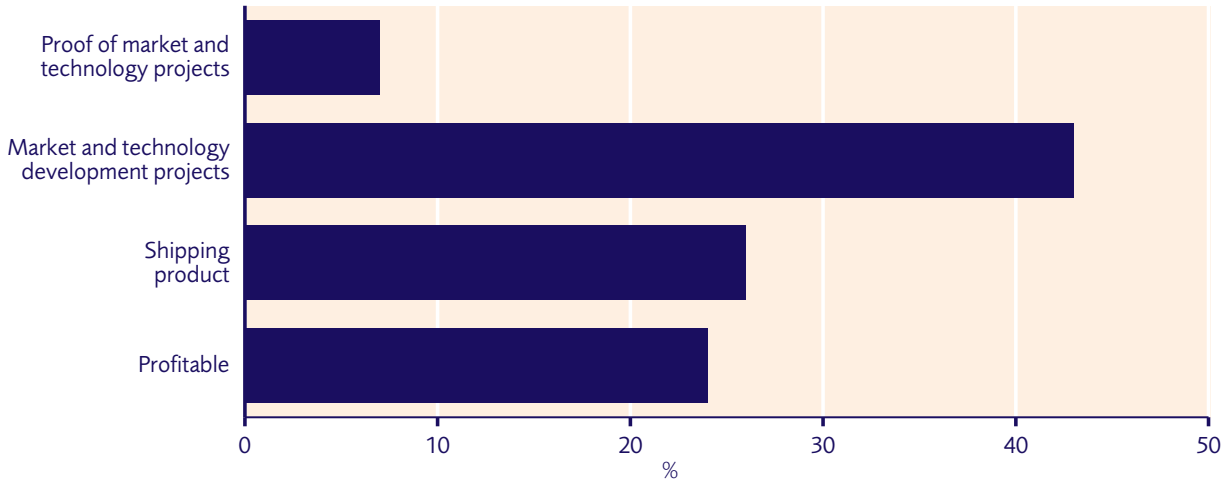
Source: Spin-out Monitor, Library House, 2005

Figure 3: UK spin-outs by stage of funding



Source: Spin-out Monitor, Library House, 2005

Figure 4: UK university spin-outs by stage of development



Source: Spin-out Monitor, Library House, 2005

The following reasons have been advanced by the various interested parties, to explain why technology spin-outs have been incorporated.

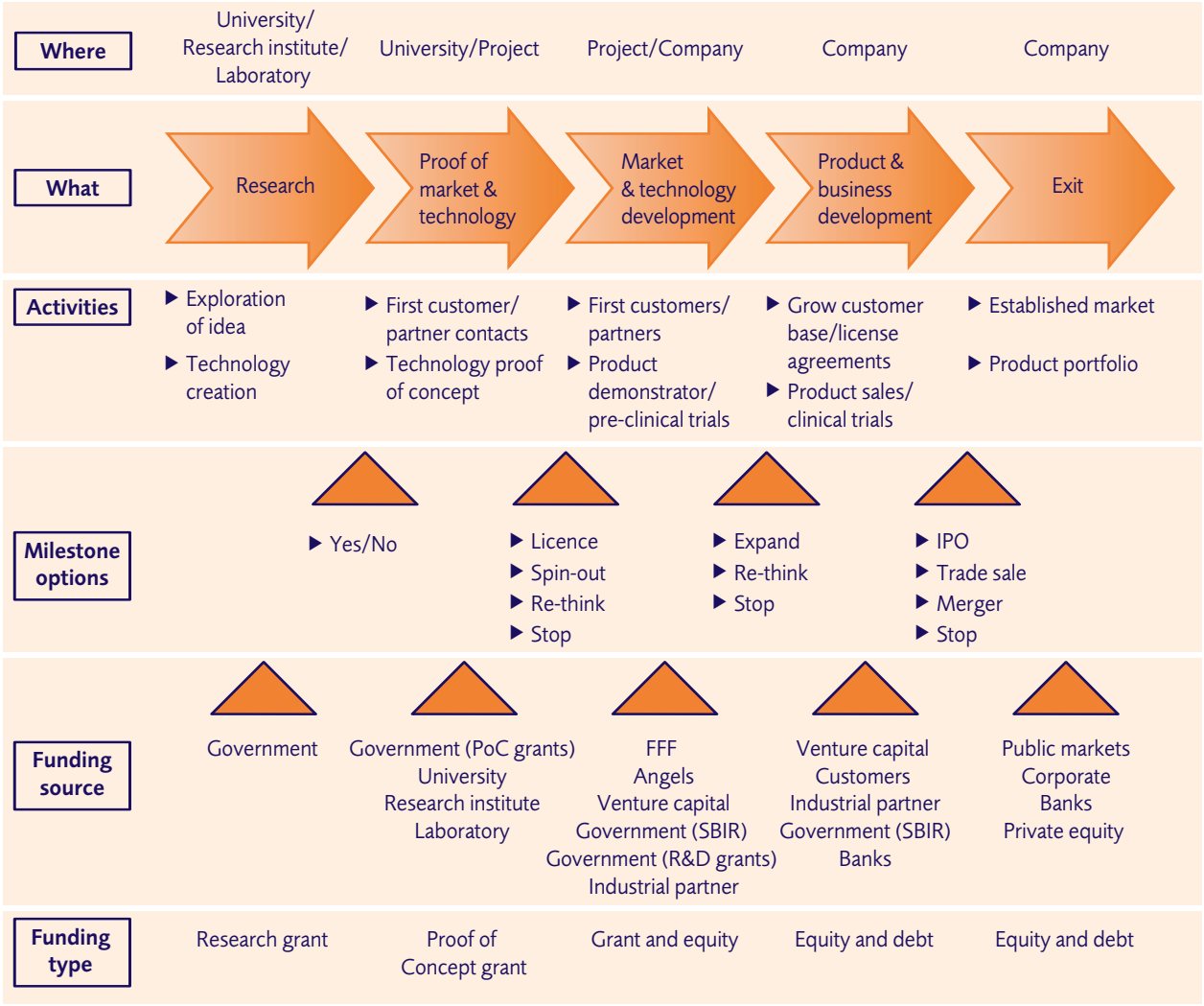
- Secure equity funding for proof of market and technology concept work.
- Attract funding for applied research to develop a pipeline of patented IP.
- Provide a legal entity into which IP can be transferred to be developed or used in some way.
- Establish a legal entity which can attract equity investment.
- Signal separation from the university and any constraints that may be perceived from that relationship by potential investors and/or partners.
- Enable universities and their TTOs to meet implicit (or in some cases explicit) targets for setting up new innovation-based companies.

Recognising these motivations to form companies at a very early stage is important to understanding and addressing some of the challenges faced by technology spin-outs, TTOs, entrepreneurs and investors.

As argued later, early stage proof of market and technology concept studies are more appropriately supported by grants, not equity finance.

3. The spin-out journey

Figure 5: The spin-out journey



In an article entitled 'The Eureka Myth'[9], Harold Evans captures the romance and the grind involved in the journey from invention to successful company: "The eureka moment is a hugely attractive idea, full of drama. But the act of inventing and improving is far more often a long, hard slog. And the act of capitalising on invention – of managing the transition from a brain wave to the bustle of the marketplace – is the really hard part."

The spin-out journey, summarised in Figure 5, describes the five steps through which an idea or concept arising from scientific research is transformed into a successful business. In many respects it provides an idealised view of the process, but provides a reference for terms used in this Review.

Research to concept

This first step takes place within a university and involves review and selection or rejection of a concept proposed by a research team. Arriving quickly to a

[9] Evans, Harold, (2005) The Eureka Myth, Harvard Business Review, June 2005

yes/no decision, as to whether the basic concept is likely to be commercially viable and whether the technology is likely to work is important for researchers and their department.

Market & technology validation

This step is designed to validate the concept with potential customers and prove the technology will work. Following review and decision that there are sufficient grounds to take the concept forward, the 'project' enters a new phase. Here, the opportunity's market potential is explored through direct customer contact. In addition, a technology proof of concept is carried out. Given the unproven nature of the opportunity and the inherent difficulty in accessing equity funding for such work, this step lends itself to grant funding. Once the validation has been completed, which typically takes three to nine months, the majority of TTOs undertake a formal concept assessment with the team to determine the next step – spin-out; selling or licensing the IP to another company; partnering; retaining ownership, but making the IP freely available to use by others (e.g. hospitals, schools, researchers); or shelving further work.

Market & technology development

The next step for a spin-out is market and technology development leading to a product demonstrator, or pre-clinical trials in the life sciences world. Here, customer engagement intensifies; development partners for the technology may be signed up and the technology is further developed to what can be called a prototype or 'product demonstrator' or pre-clinical trials in the case of a biotechnology company. This step may take from a few months to several years and typically is funded through equity investment by founders, friends, family (FFF), business angels, potentially the university and where the opportunity is sufficiently compelling by VCs or industrial partners. Pre-cursor requirements for receiving funding are company formation and clarity on IP ownership. Other than where the university invests in the spin-out at this stage, this marks the end of the active involvement of the university and the TTO.

The next decision on the spin-out journey is significant: take the project/company forward to the next level of full commercialisation; change direction or close down. If at this point, addressing an unmet need does not provide a profitable route to commercialising the research, social returns may be realised by utilizing the technology in a non-profit way – allowing hospitals, schools, or other universities and institutes to benefit.

Product & business development

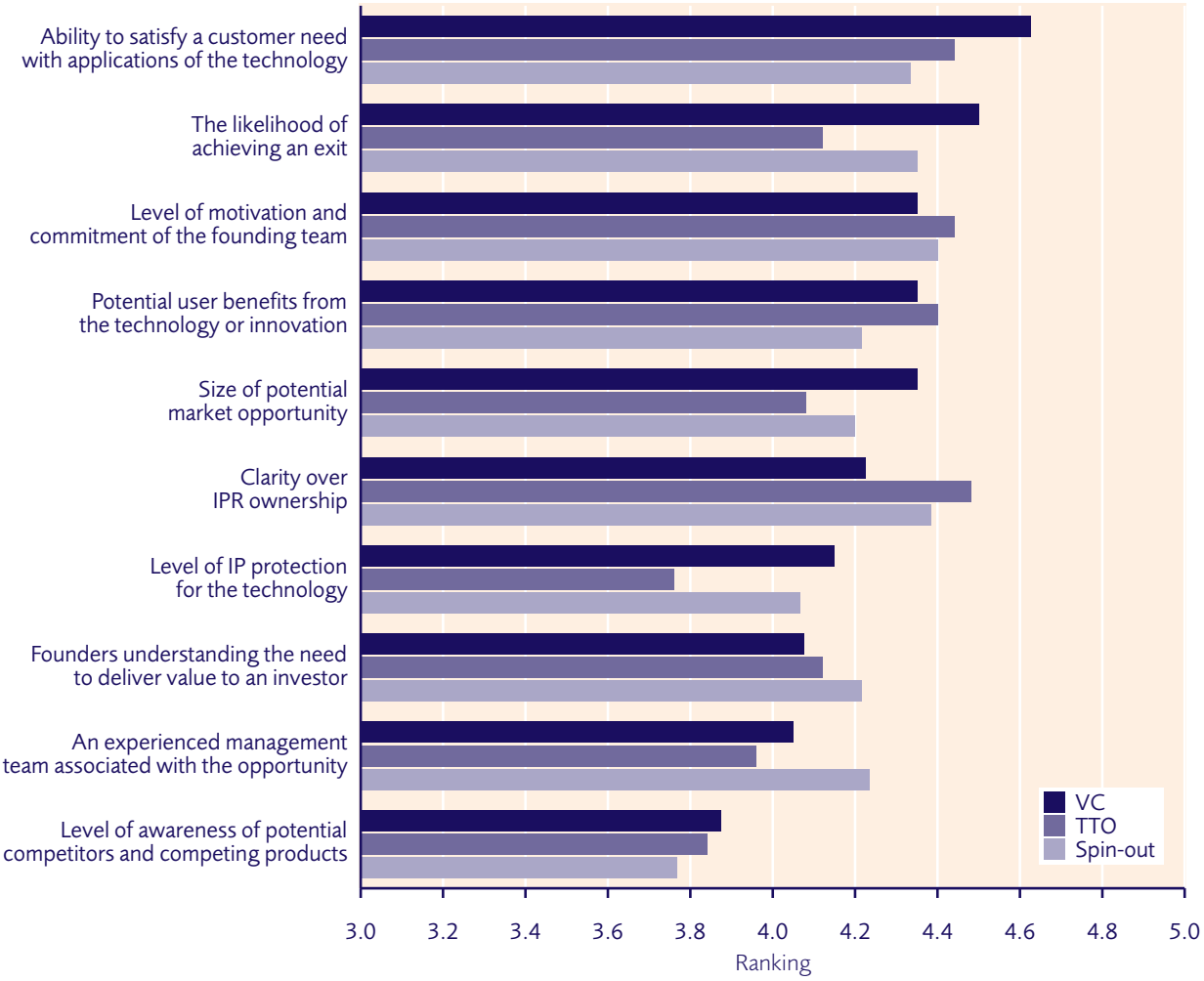
Assuming that progress through the previous step meets expectations, the spin-out company is poised to direct its energies into scaling the business through product, sales, marketing, organisation development and in some cases production. In the case of biotechnology companies, clinical trials are underway. Companies are starting to think about potential 'exit' routes, such as IPO and mergers and acquisitions, because this stage of company development is typically funded by VC investors. Other sources of funding can include business angels, Government schemes, industrial partners, customers and banks.

Exit

This is the final step on the journey, where investors secure their returns via an IPO or trade sale. This Review focuses on the role of VC investors in the process of financing early stage technology spin-outs. For VC investors, the exit is the endpoint of their engagement, but it is neither the endpoint for the company nor its new public market or acquiring company investors.

4. Ingredients for success from the venture capital perspective

Figure 6: Ranking of factors required for successful spin-out investment



Note 1: 1 = Unimportant, 2 = Not very important, 3 = Quite important, 4 = Important, 5 = Very important.

4.1 What is important?

As part of this Review, 42 VCs that had invested in high-technology ventures (including technology spin-outs) were asked to rank the factors that had influenced them to invest. From a list of 42 different factors, the ten most important to VCs are shown in Figure 6. Responses from TTOs and technology spin-outs are shown for comparison. Generally, these results indicate that TTOs and technology spin-outs have a broadly similar appreciation of the factors VCs are looking for when reviewing an investment proposal. Given this level of common understanding, where are the problems, if any? This is explored in later sections.

4.2 What differentiates successful technology spin-outs?

There are four main areas that VC investors look for in an investment proposition.

1. The innovation
   (i.e. science, technology, product, service)
2. The team
3. The market
4. The investment case

At different stages in the spin-out journey, there will be a different weighting placed on the individual elements that underlie these four main areas.

Categorising the top ten criteria that VCs look for in a successful spin-out investment case into these four main areas is revealing – it demonstrates that VCs care a lot about the innovation and the team behind it.

Area	Factor	Ranking
Innovation	Ability to satisfy a customer need with applications of the technology	1
	Potential user benefits from the technology or innovation	4
	Clarity over IP ownership	6
	Level of IP protection for the technology	7
Team	Level of motivation and commitment of the founding team	3
	Founders understanding the need to deliver value to an investor	8
	An experienced management team associated with the opportunity	9
Market	Size of potential market opportunity	5
	Level of awareness of potential competitors and competing products	10
Investment	The likelihood of achieving an exit	2

Innovation

The most important question in the mind of a VC is, "does this innovation satisfy a customer need?" This same question can be put in other ways such as, "does this innovation solve a known customer problem or help a customer realise an opportunity?" The follow-on question is, "what are the potential user benefits?" In the mind of a VC, if it solves a problem, that's good, but what is the benefit the customer derives as this will have a bearing on value and price?

The other two questions on the innovation have to do with the IP, its ownership and the steps that have been taken to protect it. It's not surprising that clarity over IP ownership is the top ranked factor for TTOs and spin-outs as this is the area where intense debate and negotiation takes place as discussed in later sections. It is surprising, however, that TTOs rank the importance of the level of IP protection for the technology lower than any other factor. Protection of IP is one of a TTO's primary objectives and as discussed in the next section, VCs need to feel confident that every effort has been exerted to ensure that the IP invested in a spin-out is clean and robust.

Team

This is a key area for VCs as they are looking for clear evidence that the founders have the commitment and energy to take the company through its early stages. However, they also understand that one of the areas of value that they bring to a young company is help in recruiting key managers and developing the management team. From the TTO and spin-out perspective, they are aware of the lack of experience of a typical academic founding team in building a company. Ideally they would like to be able to attract an experienced entrepreneur and managers as part of the team that pitches to investors as they correctly believe that this will improve their chances of securing investment.

Market

Investors are motivated by the scale of the business opportunity as this directly influences the potential financial return. Where the size of the market is also linked with fast growth, this presents an even more attractive opportunity. However, there is always competition and VCs expect spin-out founders to have an awareness of potential competitors and their products and capabilities.

Investment

There are many aspects to this area including valuation, the initial and total amount of capital that will be required prior to an exit and the expected return. At this

early stage, VCs are looking for an understanding in the spin-out team of the motivations of investors and evidence that they have analysed the business opportunity including income statement and cash flow projections. In doing this, the spin-out team will gain an appreciation of the financial elements of the business and be able to converse with investors.

Overall, there is very high consistency in the answers provided by investors and the other parties involved. If everybody is agreed on where the challenges lie, what are the challenges in developing and financing spin-outs?

4.3 The corporate spin-out advantage

From interviews with respondents including multinational corporations, it is clear that there are significant differences between corporate and university spin-outs. Typically, a corporate spin-out is founded with the explicit aim of satisfying a known customer need. This can arise in a variety of ways. In some large industrial companies, an innovation area on which a group has been working, is no longer perceived to be central to the organisation's strategic direction and the decision is taken to spin it out. In others where the underlying purpose of the company is contract research, teams can be working on technology solutions for clients when the opportunity is spotted to leverage that experience to meet a new customer requirement. In both cases, the spin-out starts life with clear advantages over a university spin-out.

- Frequently, the technology has already been proven.
- Customer needs have been established.
- Customers may have been closely involved with specifying and testing the solution and will place orders.
- Teams with a mix of technical and commercial experience may well have been working together for some time and additional known people can be identified, recruited and incentivised.
- Team members are more experienced technically and commercially.
- The concept has been sheltered, developed and funded in a commercial environment.
- Significant time and funding may have been invested by the corporate parent, inevitably de-risking the proposition.

Effectively, corporate spin-outs hit the ground running and can offer attractive investment opportunities for VC firms.

Development of a university spin-out, on the other hand, is more challenging and risky for everyone involved. From the spin-out team's perspective, understanding what problem their innovation might solve, validating a customer's needs, assessing market demand, proving the technology, hiring team members and raising money are all areas for which academic inventors have not been equipped by their prior experiences. But all need to be undertaken just to arrive at the same point from which a typical corporate spin-out is launched. The time, effort, funding and risk involved are obvious. And so too is the need for education and support.

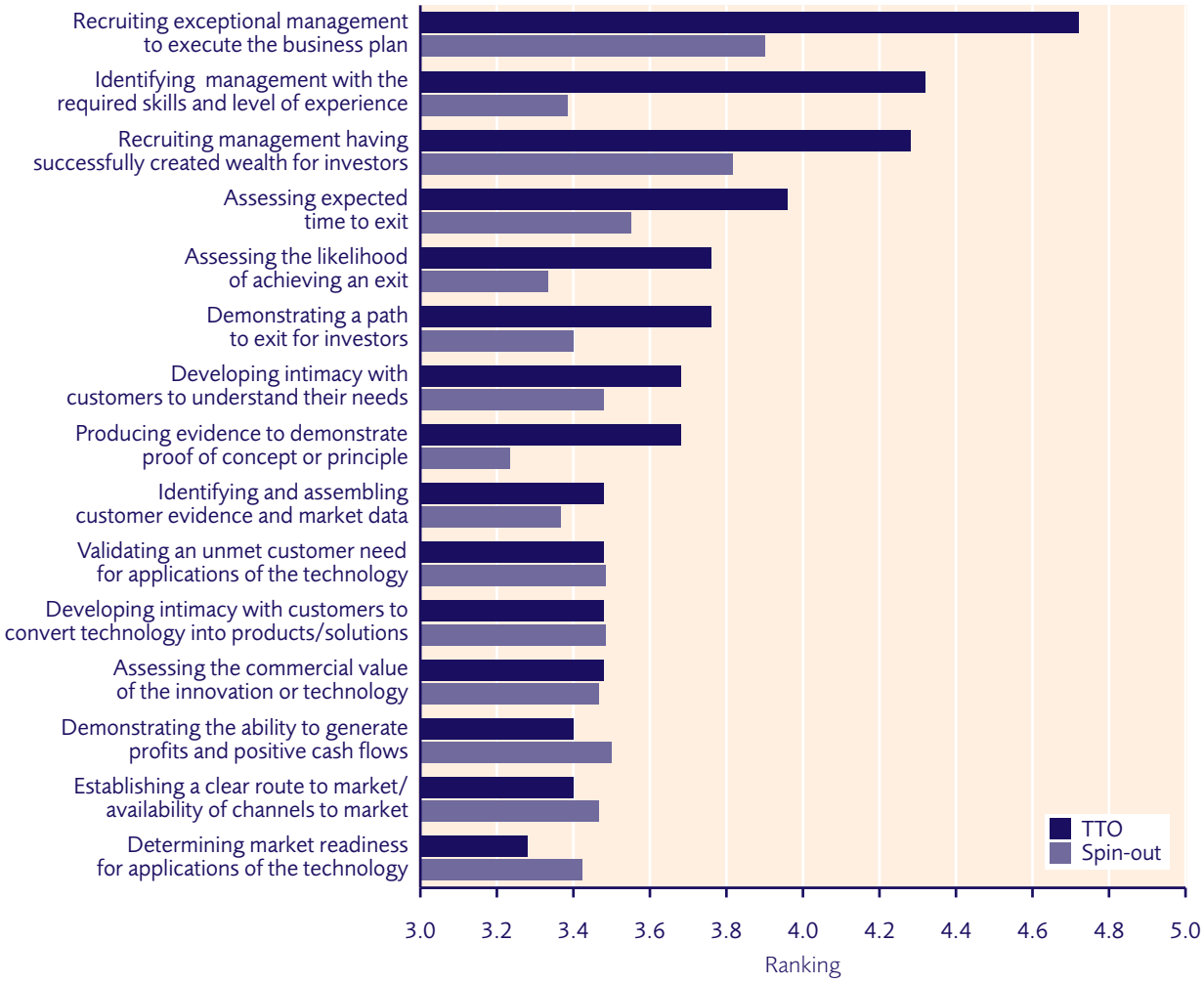
Cambridge Consultants: Growing successful corporate spin-outs

Cambridge Consultants is a leading technology and innovation company, renowned for its ability to solve technical problems and provide creative, practical solutions to business issues. From its foundation in 1960, Cambridge Consultants has built a worldwide reputation for the quality of its novel design and development work for clients. In parallel, it has pioneered technologies that have grown into businesses in their own right. Printing machinery (Domino, Elmjet and Inca) and semiconductor design (Alphamosaic, CSR, Cyan) exemplify how its client work over several years stimulated internal developments resulting in the spin-out of successful companies. In their experience, an important determinant of success has been the inclusion of at least one world-class individual in the team.

Cambridge Silicon Radio (CSR) which was spun out in 1999 is one such example. Over a number of years, Cambridge Consultants had undertaken client assignments in short-range radio focusing on CMOS semiconductor solutions. The founding team had worked together on various of these projects with involvement in the marketing of Cambridge Consultant's capabilities, meeting clients and selling these capabilities to solve their specific needs, generating contracts, undertaking and managing the technology and product development, testing the results and documenting their work, all to a budget. With the emergence in April 1998 of the Bluetooth initiative, the founding team recognised the opportunity to invest their talents to create a spin-out venture that capitalised on the prior experiences of the founding team in short-range radio and semiconductor design. Over a six-month period, the team campaigned for and secured internal support for the concept. Engagements with VCs proceeded in parallel and following board approval for the spin-out, a term sheet was secured. The promise was that CSR would be the first company to offer a fully-integrated, 2.4GHz radio, baseband and microcontroller solution all on one CMOS chip, offering wireless communication between a plethora of products including mobile 'phones, PDAs and PCs. In the Spring of 1999, CSR received initial VC investment of $10 million, but the relationship with Cambridge Consultants did not end there. To accelerate the progress of the company, a Bluetooth software stack and microprocessor core were developed by Cambridge Consultants enabling CSR to focus on their single chip RF solution. Over the following five years, CSR delivered on its promise and built a company that floated on the London Stock Exchange in February 2004. In mid-2005, CSR became the largest fabless semiconductor company in Europe and employs 600 people.

5. Challenges to success from the TTO and spin-out perspective

Figure 7: Factors that TTOs and spin-outs find challenging to deliver



Note 2: 1 = Not challenging, 2 = Somewhat challenging, 3 = Challenging, 4 = Very challenging, 5 = Extremely challenging

Given that TTOs and technology spin-out founders understand the criteria VCs are looking for, where do they come up short when it comes to securing investment? To examine this issue, 25 TTOs and 60 spin-outs were asked to score the factors they find the most challenging when developing their case for investment. The answers are summarised in Figure 7.

Both TTOs and spin-outs placed recruitment of key people at the top of the list of challenges. In the case of TTOs this is followed by investment issues, whereas spin-outs displayed a similar level of concern over most other factors.

The following table analyses these factors viewed from the TTOs' perspective into the four main areas that VCs look for in an investment proposition.

Area	Factor	Ranking
Innovation	Developing intimacy with customers to understand their needs	7
	Producing evidence to demonstrate proof of technology or principle	8
	Validating an unmet customer need for applications of the technology	10
	Developing intimacy with customers to convert technology into products	11
Team	Recruiting exceptional management to execute the business plan	1
	Identifying management with the required skills and level of experience	2
	Recruiting management having successfully created wealth for investors	3
Market	Identifying and assembling customer evidence and market data	9
	Establishing a clear route to market/availability of channels to market	14
	Determining market readiness for applications of the technology	15
Investment	Assessing expected time to exit	4
	Assessing the likelihood of achieving an exit	5
	Demonstrating a path to exit for investors	6
	Assessing the commercial value of the innovation or technology	12
	Demonstrating the ability to generate profits and positive cash flows	13

Because of the importance of understanding these challenges to informing the underlying purpose of this Review – to deliver practical assistance which will support the development of more successful spin-outs – focused interviews were held with spin-out companies, investors and TTOs. These interviews revealed the critical challenges to success where positive interventions could make a real difference. Five key themes emerged.

1. Recruiting entrepreneurial talent and experienced management to a spin-out.
2. Understanding the investors' perspective.
3. Delivering proof of market and technology.
4. Developing IP that is clean and robust.
5. Establishing a clear mission and aligning objectives.

[10] Quarmby, L., (2002) The Financing of University Spin-outs, Domestic Finance Division, Bank of England.

5.1 Recruiting entrepreneurial talent and experienced management

Difficulty engaging experienced entrepreneurial management is the number one recurring theme. TTOs and spin-outs know that this is important for building a successful investment case and at the same time find it very challenging to deliver. It is abundantly clear from the results in Figure 7 that TTOs and spin-outs agree their over-riding challenge is to recruit people with the skills and experience that can make a real difference to the business. Implicitly, their belief is that having an experienced entrepreneur or manager(s) as part of the spin-out team will enable them to address everything else that they find challenging.

"Access to venture capital funding depends on the existence of quality management, and the attraction of quality management depends on funds being available"[10]. How can this cycle be broken?

It is unrealistic to expect a TTO to identify, recruit and incentivise world-class entrepreneurs, for example, from Silicon Valley to help build a company in the UK. Neither is this required. Experienced entrepreneurial and management talent capable of leading a spin-out through its difficult early stages exist in the UK. In fact, the more experienced TTO respondents have put in place mechanisms to identify and engage with entrepreneurs and business angels and are actively working to broaden and deepen their links with such people.

However, the lack of entrepreneurial talent was found not to be the primary cause for a failure to attract high-calibre people into spin-outs. In many cases, TTOs' thinking is dominated by the perceived value of the science. As a result, they find it challenging to negotiate a compensation package that will encourage a talented entrepreneur to commit to a spin-out project which is poised to move beyond the proof of market and technology stage. Typically, an experienced entrepreneur is looking for equity (founders' stock or options) at a level which reflects both the all-round business value they bring and their commitment of time and energy.

Given the importance of this issue, and the fact that it has been highlighted by previous studies as a considerable challenge to the development of successful spin-outs, it should be given a very high priority in future initiatives designed to support the successful development of technology spin-outs from universities and research institutes. One of the mechanisms which is frequently used in setting compensation plans for CEOs and other senior team members in venture-backed businesses, is to compare experiences drawn from other companies in the same region, sector and at a similar level of development. It is suggested that this approach, which could be supported by TTOs and investors sharing information on an anonymous basis, could be a topic for debate in a future BVCA sponsored workshop involving TTOs, VCs, business angels and entrepreneurs.

5.2 Understanding the investors' perspective

The next most challenging area for TTOs is providing the information that investors look for in relation to an exit path for their investment. The value of this is as much for the spin-out as it is for the investor as it involves an education in development of an income statement and cash flow for the business and the generation of assumptions to feed the business model. Even at a rudimentary level, this requires the spin-out to become familiar with spreadsheet analyses and concepts such as volumes, pricing, revenues, margins, operating costs, capital investment, working capital, and so on. Further, thinking about the exit path for investors forces the spin-out founders to come to terms with their own ambitions, to educate themselves about IPOs and consider candidates for a future trade sale. Undoubtedly, there is a need for education and support for spin-outs in this area.

The University of Manchester Intellectual Property Ltd (UMIP): Taking research beyond the lab

UMIP was formed to help protect and, where appropriate, commercialise the results of research carried out by both staff and students within all departments of the university. Three characteristics of UMIP are noteworthy.

First, the underlying philosophy is to encourage IP transfer and to liberate the activity so that it can be achieved at scale and with momentum. The key is to incentivise strongly those academics who are thinking about commercialising research and thereby make it a preferred destination for innovators and creators of IP rather than getting focused on technology transfer being a money-spinning activity to plug under-funded areas in the university. This leads to a more facilitative environment between UMIP and staff and with investors and industry in which deals get done rather than bogged down.

Second, UMIP doesn't bottle up IP and works to add value where UMIP resources and its network of agents and contacts can be applied – it is very open to bringing in complementary licensing and venturing expertise 'upstream' in its process. Nor does UMIP try to control every interaction because that slows down and limits the potential.

Third, UMIP proactively educates its community about all aspects of commercialising research, including protecting IPR, licensing, joint ventures and spin-outs and spin-ins. This is achieved through a rolling high-quality programme of training, including issuing dedicated Researchers' Guides, in close co-operation with the IP department of the lawyers Eversheds in Manchester.

5.3 Delivering proof of market and technology

Great science does not lead inexorably to great companies. Furthermore, creating a lot of spin-out companies in the hope that a few good ones will emerge and flourish is a wasteful process. A larger supply of weak investment proposals may also reduce the credibility of academic entrepreneurs, TTOs and universities if they attempt to secure funding for the development of projects that fall below an acceptable quality threshold. In this context, the progress of science to a concept that has been validated both technically and by customer contact is the critical step in the spin-out journey. Alongside continuing work on the technology, proof of market needs to be assessed by engaging with potential target customers. Positive evidence from these parallel investigation areas is required as the basis for a considered business case for a spin-out company. This business case should then be subjected to formal concept assessment with the team to determine the next step – spin-out; selling or licensing the IP to another company; partnering; retaining ownership, but making the IP freely available to use by others; or shelving further work. Without formal assessment of this business case there is a danger that resources continue to be applied to developing applications of a technology for which there are no realistic prospects of a successful business.

5.4 Developing intellectual property that is clean and robust

IPR are fundamental building blocks of a technology spin-out aspiring to become a successful company. VCs want to be assured that appropriate checks have been undertaken by the TTO and the spin-out into prior art and that the IP which is invested in the spin-out is adequately protected.

From a VC's perspective, it is the TTO's job to ensure the IP created is robustly protected, and that prior art has been examined thoroughly to ensure there is freedom to use the IP and freedom to operate in a particular field of innovation. Unless this crucial step is performed rigorously, any IP complications that arise down the line will undermine the value and perhaps even the viability of a spin-out.

VC respondents quote examples where TTOs have filed patents, assigned IP into a shell company, and delivered a business plan without having completed a thorough examination of the IP landscape. VCs would prefer TTOs to focus their resources on:

- creating a robust IP position; and
- engaging experienced entrepreneurs or managers who can lead projects and work with founders to construct a business plan.

Based on responses to the Review questionnaire, 89% of spin-outs commented that securing access to IPR and negotiating contracts with the university is a lengthy process. Not only does this apply to the licensing or assignment of IP at the time of company formation, but also to the ability of spin-outs to secure options on future rights to new scientific discoveries that complement and strengthen an existing IP portfolio.

5.5 Establishing a clear mission and aligning objectives

Our survey of TTOs revealed that just over three-quarters (76%) of the 25 universities and research institutes questioned, highlighted substantive differences between the missions and objectives of the universities and the objectives of their respective TTOs.

In many cases, TTOs do not have a 'business plan' for their own department's development, nor do they have clear strategic and commercial objectives. Not only does this reduce the credibility of TTOs in the eyes of academic spin-out founders, it also diminishes their authority in front of investors, particularly when senior TTO staff are not empowered by university management to take commercial decisions on spin-out projects.

Respondents to the Review also drew attention to poorly aligned or non-aligned expectations, and objectives amongst stakeholders and organisations throughout the spin-out process. As a result, a system that sets out to facilitate the creation and development of spin-outs contains numerous disconnects which impede the process of creating successful spin-outs. For example, to varying degrees, there are inter- and intra-organisational disconnects between TTO management

and TTO staff, TTO and university management, TTO staff and academic researchers, TTOs and investors, TTOs and entrepreneurs, universities and regional policy makers, academic researchers and academic departments, academic researchers and their peers. In certain cases this situation leads to hold-ups during negotiations and adds complexity for investors and entrepreneurs seeking to finance spin-out companies. In other cases, where the expectations, objectives and incentives are significantly more aligned, respondents point to better outcomes for all parties.

5.6 The US experience

It is important to recognise, despite the prevailing perception, that there is no single 'best practice' technology transfer model in the US which could be imported here. In fact, just like the UK, there are models in operation covering the spectrum from the 'hands-off' approach where the TTO only addresses IP licensing and contracts to the more hands-on approach where there is active practical support for spin-outs.

Stanford University is an example of the 'hands-off' approach reflecting the maturity of the ecosystem for which the university is the undoubted epicentre. Sun Microsystems, Google and Yahoo are examples of the large number of world-famous companies that have spun-out from Stanford University. Based on the many successful experiences, there is an easy relationship between the TTO which focuses on IP licensing and contracts, academic departments, professors, researchers and external constituencies, including: business angels, VCs and entrepreneurs who in the heady late '90s "wandered the halls looking for opportunities". These informal relationships are matched by more formal interactions with experienced external people sitting on university panels and advisory boards.

Getting ready for investment: The importance of proof of concept and technology development

Professor William Bonfield, CBE, commenced interdisciplinary research in the late 1980s to engineer the optimum structure for a safe, effective bone graft material that closely approximates natural bone and provides a base for new bone growth. This eventually led the group to discover novel methods for tissue engineering which allowed the architecture of the synthetic material to be carefully controlled.

Company name	**ApaTech Limited**
Incorporation date	01/03/2001
Spin-out from	Queen Mary College University of London Cambridge University
Location	London, UK
Sector	Life Sciences
Business stage	Product Development
Investment status	Series B
VC investors to date	3i MTI
VC funding raised to date	£9.5 million
Employees	7

Source: Library House Spin-out Monitor

Having identified that the technology had not been applied to an acute need in the orthopaedic healthcare market for synthetic bone grafts, Professor Bonfield understood that proof of market and technology development work would be crucial to securing investment. He also knew that investors would undertake thorough due diligence to discover any gaps in the IP, examine the validity of the perceived market opportunity, and assess the ability to develop commercial applications of the technology suitable for manufacture. Any unresolved issues would inevitably show up at this point and have a negative impact on an investment decision including, the terms of investment and the valuation offered for the company.

Between 1998 and 2001, the tissue engineering process was enhanced through a series of development steps. This work optimised the process and reduced the time taken to produce high quality bone tissue from 40 days down to less than 7 days. At the same time a raft of patents were secured for the technology.

Having completed proof of concept and technology development work ApaTech Limited was formed in 2001 with the rights to bone materials research and IP from Queen Mary University of London and the University of Cambridge. Venture capital was secured from 3i and MTI in a later round. Since formation ApaTech has gained approval for its first bone graft substitute ApaPore® in all orthopaedic applications. ApaPore is now in use in patients and selling to hospitals in Europe and Australasia, initially for spinal fusions, bone tumour void filling and fractures.

On the other coast, MIT and Columbia University are examples of the more 'hands-on' approach. Wherever the 'hands-on' approach is applied, the emphasis is on first validating before connecting technologies to the marketplace.

Columbia University has an active portfolio of over 50 technology spin-out companies which have raised almost $1 billion from VC and public markets. These companies have created more than 1,500 jobs and generate annual revenues ranging from $30 million to $750 million. University of Columbia New Ventures exists to manage licensing of IP to spin-outs when it believes the market opportunity is great enough to attract first-rate founders, funders and customers. In a broader sense, it also aims to aid society by quickening the pace with which new discoveries and innovations leave academe for the advancement of the public good. It facilitates this process by bringing in external expertise instead of trying to do the job of an entrepreneur or a VC. It makes introductions between faculty members and the resources they will need to succeed, including potential management team members, joint venture partners, angels and VCs.

At MIT, the fundamental work to secure and manage IP is complemented by programmes such as the MIT Entrepreneurship Centre, the $50k Global Start-up Workshop, and the Deshpande Centre for Technological Innovation. MIT has a long tradition of nurturing innovation, providing the technology for new companies, and of building successful relationships with larger corporations that fund research. But historically, obstacles remained in the innovation process, between initial concepts and commercialisation. MIT senior management, faculty, and alumni recognised that unproven ideas had little opportunity to advance beyond their theoretical stages and younger companies lacked ways to discover and fund new ideas. The Deshpande Center is working to connect MIT's innovators with the marketplace and to bridge the innovation gap. Any technological innovation that addresses a market opportunity is a potential candidate for assistance from the Deshpande Center.

University of Southampton: Developing a culture for success

The University of Southampton is one of the top 10 research-led universities in the UK and has achieved consistently high scores for its teaching and learning activities. Technology transfer and entrepreneurship are key tenets of the university's strategy. As part of its mission statement, the university aims to be the most entrepreneurial university in the UK. It recognises the importance of entrepreneurship is a cultural issue and is applying policies across the entire university to ensure commercial activities are given an equal standing alongside research and teaching activities. These policies set expectations for successful entrepreneurship across students, academic researchers, academic and administrative departments, and university management. The pursuit of excellence in commercialisation of research is the targeted outcome of these policies.

This well-considered approach is also reflected in the metrics applied to measure success. For example, the university's success criterion is that all technology spin-outs created should go on to raise significant amounts of third party funding, in whatever form that may take – through industry involvement; through licensing, partnering or investing to gain access to technology; or, through venture capital or private equity funding. As a result, The TTO only regards itself as being successful if a third party investor endorses its judgement in a significant way.

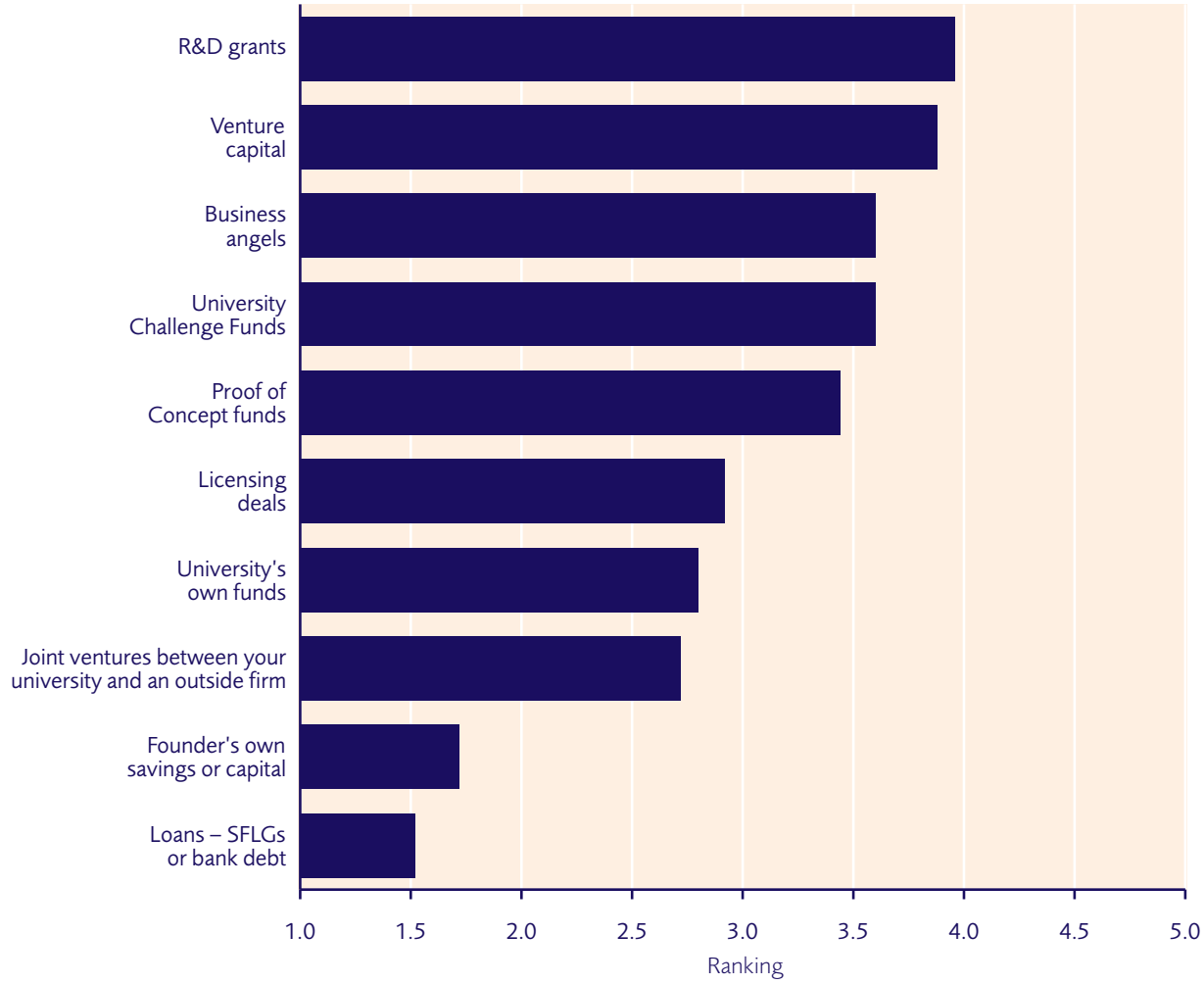
Policies that align expectations and behaviour have also been applied to university staff. For example, enterprise activity as well as research excellence is taken into account in deciding academic promotion. In addition, wherever possible, experienced entrepreneurial individuals from outside the university are recruited into the TTO rather than training academics or administrators recruited from within the university. Certain TTO staff participate in the overall returns to the university, which promotes team work and a commercial outlook.

The university has fostered relationships with a range of investors, from the UCF – Sulis Innovation Fund, to well-known European and US venture capital and private equity funds. Southampton Asset Management (SAM) is the university's seed-corn fund raised by university spin-out specialist IP2IPO. SAM provides spin-out projects with access to capital, but more importantly to wider networks, market knowledge and commercial expertise required for these projects to develop successfully.

Experienced entrepreneurs and managers are attracted to the university by ensuring that new spin-out projects have at least 18 months of funding to support technology and market development.

6. The financing of technology spin-outs

Figure 8: The most important sources of funding according to TTOs



Note 3: 1 = Not important, 2 = Somewhat important, 3 = Important, 4 = Very important, 5 = Extremely important

6.1 The importance of accessing different types of finance

Technology spin-outs, in common with all innovation-based start-ups, require access to different financing options at different stages in their development including grants, equity and debt finance. As part of this Review, TTOs and technology spin-outs were asked to identify the most important sources of finance for developing technology spin-out projects and companies.

TTOs indicated five different sources of funding as being 'important' or 'very important' to developing technology spin-out projects and companies.

R&D grants were ranked by TTOs as the most important source of finance for developing technology spin-outs. Further questioning revealed these grants were regarded as particularly valuable for supporting proof of market and technology development work. It may be a reflection of the availability of proof of concept funds

that these were not accorded a higher ranking, but as argued elsewhere in this Review, this form of grant funding is more relevant for the proof of market and technology stage. R&D grants may be better targeted at the technology development stage.

Moving to equity finance, VC, business angel and UCFs were viewed as being important, not just for the funding itself, but also for the external validation and implied credibility for the spin-out venture. TTOs also drew attention to resources beyond the money that VCs and business angels contribute to development of a successful early stage technology company including: access to a network of industry contacts; help in recruiting experienced management talent; and access to market intelligence.

Licensing technology to an industry partner to co-develop the technology and bring in early revenue is also a strategy used in the life science and IT hardware sectors. This mechanism also opens up the opportunity to form partnerships for co-developing applications of the technology. If successful in getting applications of the technology to market faster, this strategy will in turn facilitate an opportunity to raise VC.

For spin-outs, respondents were asked to provide separate inputs for seed and post-seed stage funding. Looking at the seed stage, the low ranking of Proof of Concept funds again stands out and as previously argued may well be more a reflection of their availability rather than their utility at the proof of market and technology stage. The top ranking of R&D grants (formerly SMART Awards) bears testament to the attraction of this source of grant funding.

As to be expected, equity finance from VCs and/or business angels only appeared as the most important source after development had progressed beyond the point of validation of the market and technology opportunity.

In certain cases, consultancy projects and joint ventures between a spin-out and industry provided access to funds. Typically, this was employed by spin-outs to add value to their IPR by targeting core technology at specific early commercial applications.

Neither TTOs nor spin-out companies considered the founder's own savings or bank debt to be important sources of money for creating or developing spin-outs at any early stage of the process.

Based on responses to the Review questionnaire, there is clear evidence of positive progress in the relationship between VCs and TTOs with 60% of VC respondents reporting a noticeable improvement in TTO skills. From the perspective of the TTOs, all 25 respondents reported that they value the advice they receive from VCs with 68% reporting improvements in their dealings with VCs in the previous two years.

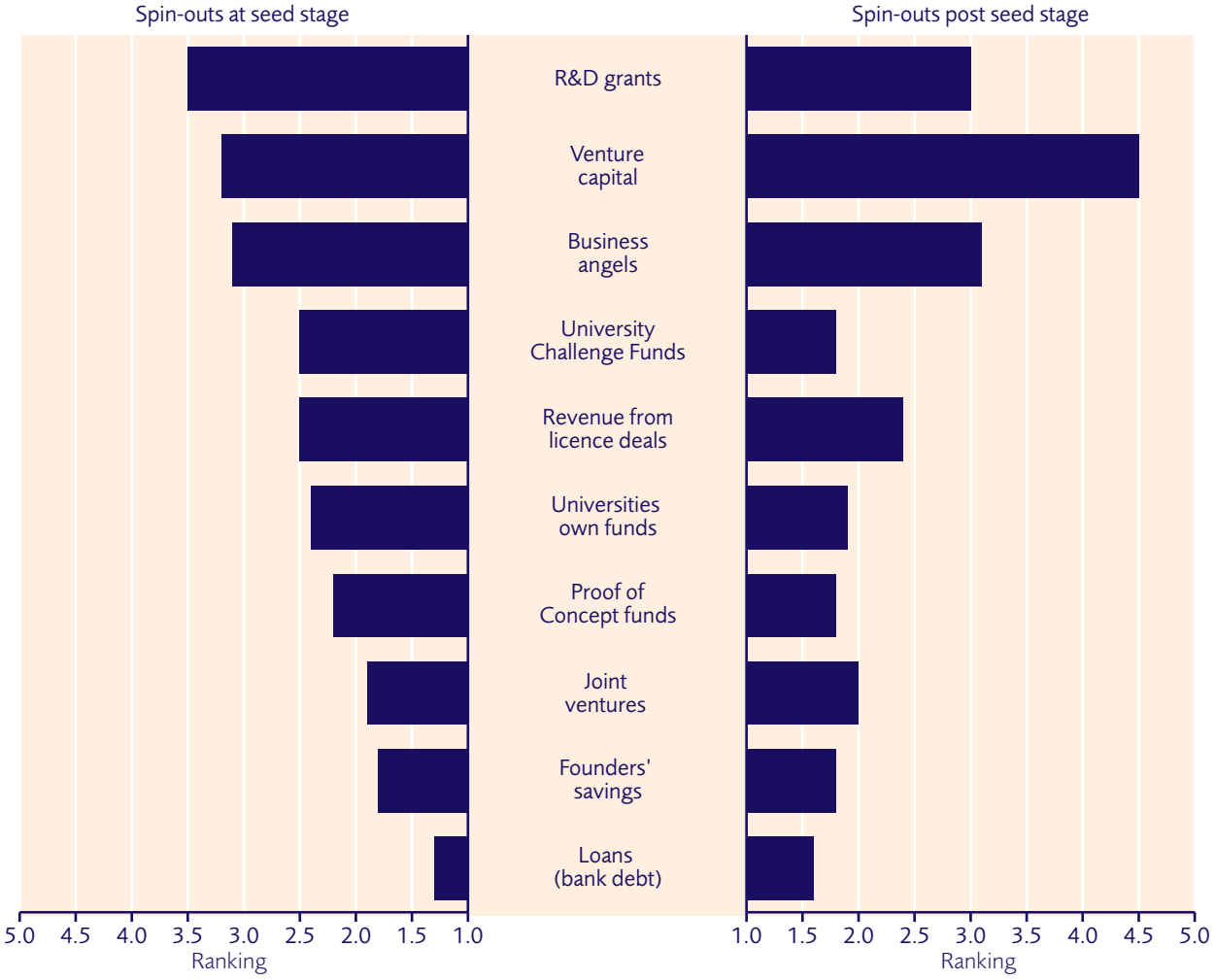
From in-depth interview discussions with each set of stakeholders, it is clear that potential investors, VCs and business angels, are contributing to TTOs and spin-outs prior to projects arriving at the point of investment readiness. This advice covers a range of topics including: how to create more value from the technology before attempting to market it; how to capture more of the value created by targeting specific market segments; identifying relevant market channels; and providing insights into individual customers' needs. The benefits to be derived from closer VC interaction at seed and post-seed stage come not only from investment in a spin-out, but also from advice provided to TTOs and entrepreneurial teams on how to create and develop a more successful company that can be venture-backed.

6.2 Comparing spin-outs with other early stage technology ventures

Analysis of VC funding data for the past five years shows that university spin-outs received between £0.35 million and £1.32 million in early stage VC funding, compared with between £0.82 million and £2.37 million which VCs invested in other early stage technology investments.

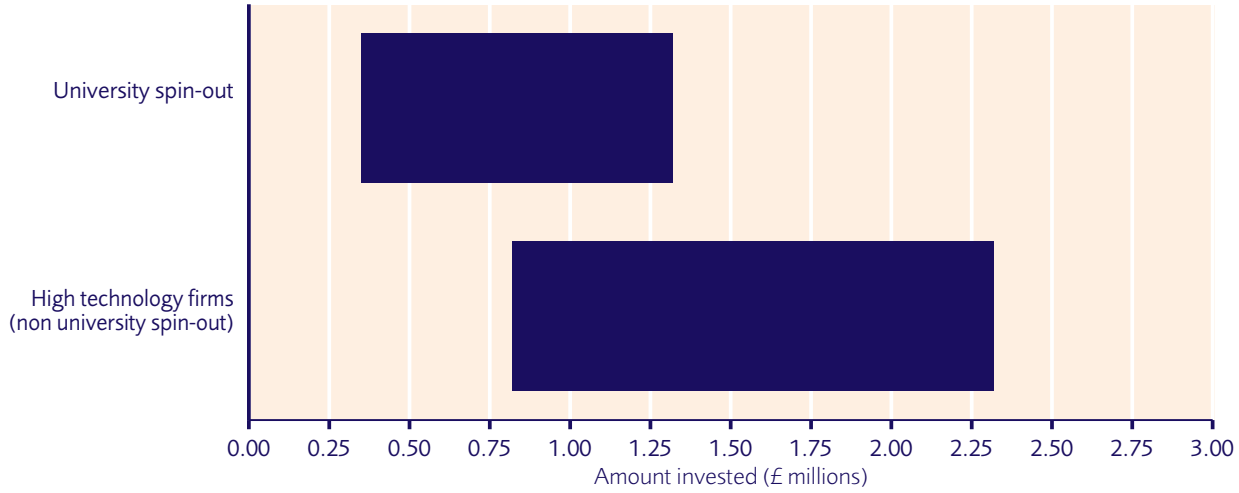
Based on responses to the Review questionnaire, 87% of VCs and 100% of TTOs currently view the typical university spin-out as an undeveloped prospect for VC, in comparison to other high-technology ventures. The comparative immaturity is reflected in the lower levels of investment shown in Figure 10. A key question posed to VCs as part of this Review is: what differentiates high

Figure 9: The most important sources of funding according to spin-out companies



Note 4: 1 = Not important, 2 = Somewhat important, 3 = Important, 4 = Very important, 5 = Extremely important

Figure 10: Initial amount of early stage capital invested by VCs in spin-outs and other high-tech firms



Source: Spin-out Monitor, Library House, 2005

technology companies and technology spin-outs that are successful securing venture backing, from spin-outs that are not successful? Consistent observations from VCs point to their perception that many unsuccessful spin-out projects:

- fail to provide a commercially realistic development plan and/or are unable to demonstrate value being created in a realistic time frame;
- have not demonstrated proof of market or technology but continue to exist and seek capital;
- would not have been allocated additional capital beyond the point of proof of market and technology had appropriate commercial criteria been applied; and
- are too early for the market.

As a consequence, some technology spin-outs continue to exist but are unable to build a sustainable business – the technology may remain too immature to be licensed or commercialised into product applications without significant further development work. In other cases, where the science underpins potentially disruptive technologies that could drive new markets, development of the technologies required for practical applications of the innovation may prove to be a very lengthy process with all the associated investment risks.

Looking at this from another perspective, what would it take to make spin-outs more investable? As discussed in the previous section, recruitment of an experienced entrepreneur and/or manager(s) into a spin-out would be a giant step forward. In addition, deeper understanding of the factors that VCs and business angels look for prior to making an investment would assist TTOs and spin-outs.

6.3 Government interventions

A number of Government interventions have had an impact on technology spin-outs. The results in section 6.1 highlight the important role of R&D grants (formerly SMART Awards) in enabling technology spin-outs to progress with applied research, proof of market and technology development projects. These activities are not suited to equity funding from business angels or VCs, given the risks involved at this early stage.

UCFs have provided up to £250k of funding for a share of up to 50% of the equity. Equity funding is not attractive for early stage development work and as The Lambert Review recommended, more funds allocated to support for proof of market and technology work would make a valuable contribution. Further discussion of UCFs is included below.

A criticism from TTOs, spin-out companies and VCs was that although the guidelines and rules governing these schemes are clear in their intent, there is a lack of clarity and understanding amongst the administrators on how best to put this into effect. This confusion inevitably leads to time delays and additional expenditure which has a detrimental impact on the ability of entrepreneurs to move quickly to develop commercially promising opportunities.

Contributors to this Review also commented on the value of tax incentives that have benefited the operation of the Enterprise Investment Scheme (EIS) and Venture Capital Trusts (VCTs). However, further commentary on these is beyond the remit of this Review.

6.4 University Challenge Funds

Most TTOs,VCs and spin-outs agreed that UCFs have made a valuable contribution by encouraging new relationships between universities and investors, and provided mechanisms for university projects to be developed into licensing or spin-out opportunities. The rules governing UCFs are seen as having been carefully crafted in a way which takes account of diversity in the university sector. UCFs are regarded as an effective mechanism that has forced the public and private sectors to work together over the past five years.

The advantages to VCs in working with UCFs or in managing UCFs include:

- strengthening technical due diligence capabilities;
- improving the ability to evaluate technology risk as an investor;
- creating deal flow that could benefit other early stage investors in a VC's network;
- enhancing a VC's reputation as a specialist early stage technology investor and thereby providing

differentiation from other investors; and

– engaging with corporate investors.

A valuable aspect of UCFs that has provided stability and a degree of credibility in the eyes of investors is their independence, both from academic institutes and individual investors. Having a hybrid governance structure solves the problem of being tied to a particular research or commercial institution – a situation that can give rise to tensions and rivalries that become barriers to developing investable commercial projects. In many cases, UCFs forced the public and private sector to work together, thereby applying much needed commercial expertise to evaluating emerging technologies.

The Government's decision as part of HEIF 2 to devolve the control over UCFs to universities was a change that challenges the independence of UCF funds. In addition, budgetary constraints at an individual university level make it difficult for these funds to operate in an economically sustainable way. Investors, including VCs, are frustrated that a valuable mechanism that was starting to become effective has been made less stable and is not receiving the support required for further development.

7. Looking to the future

This section summarises a number of initiatives already in development, or proposed, which will contribute to the creation of more successful technology spin-outs.

7.1 HEIF 3 funding

In line with The Lambert Review recommendations, the Government has confirmed its support for HEIFs as a permanent third stream of funding for universities in England to support knowledge exchange and productive interactions with business. HEIFs also aim to address funding gaps inhibiting the translation of research and expertise into the market. The Government has announced increases in the funding available under HEIF 3 to £238 million over the two-year period August 2006 to July 2008[11]. At the time of preparing this Review, consultations are being held regarding the application and allocation of HEIF 3.

With the findings of this Review in mind, applications and allocations that promote quality economic and social 'outcomes' over volume-based 'outputs' would be beneficial. In particular, there is an opportunity for higher education institutions (HEIs) and Government to target some of the challenges highlighted in this Review inhibiting the successful translation of research into the market, by:

- providing incentives for entrepreneurs and experienced managers from industry to engage with universities and contribute their talents directly through joining spin-outs or indirectly through mentoring or participation in specialist advisory panels (see below), to help convert promising scientific discoveries into innovative solutions that address real-world problems and needs;
- channelling grant funding for proof of market and technology work; and
- demonstrating the value of quality by supporting an annual awards programme open to all university spin-outs which secure VC funding in a given time period. Nominated companies could be categorised according to region, sector and funding stage and be reviewed by a panel of experts. This would highlight the importance of university spin-outs and enable a number of awards to be given in addition to an overall award.

7.2 Implementing a UK equivalent of the US SBIR Program

A key instrument of US policy is the SBIR Program originally set up over 20 years ago. The SBIR requires that 2.5% of R&D expenditure by US Government agencies is spent with small businesses. It operates through a series of competitive tenders at intervals through the year. Contracts worth about $1.8 billion a year are awarded through the SBIR, although the total level of Federal R&D contracts awarded to small US firms may be even greater. Sun Microsystems, a spin-out from Stanford University, was a major beneficiary of the SBIR.

Introduction of a scheme like SBIR in the UK would offer the potential for the exploitation of university science through the development of new world-leading technology firms.

[11] Higher Education Innovation Fund round 3 Funding Proposals, joint consultation document from HEFCE and the Office of Science and Technology, July 2005.

7.3 Specialist advisory panels

Developing the commercial side of a business opportunity is as important as developing the technology. Efficient allocation of early stage funding (including proof of concept grants and UCF funding) relies on applying knowledge and expertise across the breadth of business experience. This Review has shown that as the university knowledge transfer sector has matured, relations between VCs and TTOs are improving. Some VCs are already engaging with universities to provide guidance and insight on potential spin-out opportunities, even at proof of market and technology. However, these engagements tend to happen on a casual basis unless the VC has a direct (or indirect) relationship with a university through management of a UCF. Respondents to this Review confirm there is appetite among VCs and universities to formalise relationships through dedicated specialist advisory panels which could also include participants from the corporate community and business angels. These panels could assist TTOs in the following ways.

- Reviewing candidates for proof of market and technology grant funding.
- Assessing candidates at the conclusion of this stage for their spin-out suitability.

Lessons learned from the operation of UCFs since 1999 demonstrate that these hybrid structures can operate efficiently and have a positive effect so long as they:

– remain independent in order not to be tied to any one investor's or university's agenda;

– are not overburdened with bureaucracy but have administration support for preparation of papers and meeting notes;

– select participants carefully;

– provide a single interface to investors;

– operate transparently to speed up decision-making; and

– build a reputation that encourages positive rather than reluctant participation.

7.4 Rewards for commitment to technology transfer

HEIs are continually measured by the RAE for the quality of research produced by university departments. In this way excellence can be recognised and rewarded through the associated funding formulae. However, The Lambert Review of university-business interaction, expressed concerns about the ability of the RAE to recognise adequately and thus promote the value of interdisciplinary and applied research that universities undertake in collaboration with industry and other partners. At present, no appropriate incentives exist alongside the RAE to recognise a commitment to transferring research and expertise into the market. A danger of augmenting the RAE inappropriately is that the quality of fundamental scientific research conducted is inadvertently diminished due to a narrow basket of metrics that account for collaborative research, licensing of technology and technology spin-out creation. At the same time, absence of recognition of academic departments and inventors for their commitment to facilitate the transfer of their technological expertise does not legitimise this activity as economically or socially valuable.

Through its Science and Innovation Investment Framework 2004-2014 (SIIF) publication, the Government has proposed that the Office of Science and Technology (OST) and Department for Education and Skills (DfES) will work together with HEIs and Public Sector Research Establishments (PSREs) to create a long-term career path for academics and technology transfer professionals who wish to focus on interacting with business and external partners. Any changes to how academic researchers are assessed should focus on

recognition of involvement in third stream activities to facilitate technology transfer, rather than accounting simply for the volume of technology transfer activity.

7.5 BVCA workshops

In the course of undertaking this Review and from the discussions it prompted, it became clear that the BVCA and individual members have a role to play in improving the potential for the development of more successful university spin-outs. With this in mind, the BVCA is looking into hosting workshops involving TTOs, VCs, business angels and entrepreneurs which will address issues such as:

- understanding what it really takes to secure business angel or VC investment; and
- the importance of simplifying access to and managing the rights to IP.

7.6 The Gauntlet

The Gauntlet (www.the-gauntlet.com) is a HEIF 2 funded collaboration between the London School of Economics and Political Science (LSE) and Library House. Its objective is to improve the conversion of the UK's world-renowned science into world-beating companies. The starting point was the belief that company founders and entrepreneurs have an inadequate understanding of what investors look for in an investment case. Based on extensive international research and analysis and discussion with entrepreneurs and VCs in the UK, The Gauntlet distills the fundamentals that investors look for into four elements: Innovation; Team; Market; Investment. These four elements drive 16 question pairs which form the basis of a self-assessment, on-line journey culminating in a score-card supported by extensive feedback. In answering the thought-provoking questions, entrepreneurs encounter essential concepts and terms, video clips and reflections from well-known UK figures, and, courtesy of the BBC, material from Dragons' Den illustrating things to avoid! Collectively, these deliver a dynamic educational experience for spin-outs and start-ups that have the aspiration to build great companies based on their science and technology and supported by VC investment.

The Gauntlet permits a research team at any university to confidentially assess their business idea, review their score-card and associated feedback and then address any shortcomings. In doing this they will be better informed about the expectations of investors and avoid the disappointment inherent in premature applications for funding.

The Gauntlet was launched in May 2005 with extensive media coverage and a stream of enquiries from entrepreneurs, TTOs, RDAs, business schools and investors all interested in using the service. The East of England Development Agency also announced their 'runningthegauntlet' competition, offering companies in their catchment area the opportunity to win a share of £1 million in VC funding.

The LSE and Library House are enthusiastic to see widespread adoption of the Gauntlet by TTOs and spin-outs.

Appendix A – Glossary of terms

Consumer discretionary
Includes: Broadcasting and cable TV, Consumer electronics, Internet retail, Photographic products.

Energy
Includes: Consumption, Energy efficiency, Generation, Infrastructure, Upstream.

High technology
To qualify as a high technology company, it must exclusively own certain (but not necessarily all) proprietary IPR (patents, copyright, design rights, know-how, etc) which are critical, fundamental and materially add value to its products and business, and which, along with the products exploiting them, must have been developed in-house by the investee company's full-time employees.

HEIF
The Higher Education Innovation Fund (HEIF) supports higher education institutions (HEIs) in knowledge exchange and productive interactions with business, public sector organisations and the wider community, for the benefit of the economy and society.

Industrials
Includes: Aerospace and defence, Commercial printing, Services & products, Data processing services, Electrical components and equipment.

Information technology
Includes: Application software, Communications hardware, Computer storage and peripherals, Computing systems hardware.

Intellectual property (IP)
See 'High technology' for description of intellectual property rights (IPR).

Life sciences
Includes: Biotechnology, Devices, Instruments & supplies, General life science services, Pharmaceuticals.

Materials
Includes: Advanced materials, Commodity chemicals, Diversified chemicals, Fertilizers & agricultural chemicals.

Proof of market/technology funding

Funding applied to the reduction to practice of a hypothesis laid out in technical papers and validation of an addressable market opportunity. Typically funding is applied to conduct feasibility studies that convert theoretical knowledge into practical results and to confirm validity of assumptions behind commercial concepts. Proof of market/technology projects usually occur after:

- advances have been made during curiosity-driven or strategic research;
- an invention report has been submitted to the licensing office, and most often a patent application has been filed with the patent office;
- the inventor articulates why this invention matters to the addressable markets; and
- a plan is drafted outlining the resources and time needed to demonstrate feasibility.

In general, funding for proof of market/technology projects precede:

- full scale demonstration of the technology; and
- product development.

Research Assessment Exercise (RAE)

The RAE is a peer review exercise to evaluate the quality of research in UK higher education institutions. This assessment informs the selective distribution of funds by the UK higher education funding bodies.

Small Business Innovation Research (SBIR)

SBIR is a US Federal Government program administered by 10 federal agencies for the purpose of helping to provide early stage R&D funding to small technology companies (or individual entrepreneurs who form a company). The SBIR program is a highly specialized award to perform cutting-edge R&D that addresses critical scientific and engineering needs in the US. These needs span the technology spectrum from aviation and agriculture to medicine and manufacturing.

Seed stage

To allow a business concept to be developed, perhaps involving the production of a business plan, prototype, technology development and additional market research.

Series 'A', 'B' and 'C'

When a company raises VC it typically designates the shares of preferred stock sold in that financing with a letter. The shares sold in the first financing are usually designated 'Series A', the second 'Series B', the third 'Series C' and so forth. Shares of the same series all have the same rights, but shares of different series can have very different rights.

Spin-out companies

As used in this Review, spin-outs are companies or traders as persons engaged in businesses that depend on licenses or assignment of technology for initiation, from a public research institute (university, government laboratory, etc.).

Technology Transfer Office (TTO)

The university office or department that undertakes all activities associated with the identification, documentation, evaluation, protection, marketing and licensing of technology and IP management.

Telecommunications

Includes: Alternative carriers, Integrated telecommunication services, Wireless telecommunication services.

University Challenge Funds (UCF)

A public source of funds to enable universities to establish seed funds, designed to assist the successful transformation of good research into good business.

Venture capital providers (VCs)

Providers of equity capital for businesses in the seed to early stages of development. Venture capital (VC) is a subset of 'private equity' – the term normally used to describe the industry as a whole, encompassing seed to buy-out investment.

Appendix B – Methodology

Data on 435 university spin-outs created by the UK's 36 leading research universities (ranked by research income) was accessed from the 2004 Library House Spin-out Monitor. This data provided the basis for analysis of these spin-outs by stage of development, market sector, and by stage of funding requirement.

Qualitative data was collected from three questionnaire surveys – one for universities, one for VCs and one for technology spin-outs. The surveys were conducted between January 2005 and April 2005. Questionnaires were completed by 25 TTOs that had created technology spin-outs, 42 VCs that identified themselves as being active investors in technology-based small firms (TBSFs) and a random sample of 60 technology spin-outs.

Each respondent was also interviewed to capture more information about their experiences in creating and developing technology spin-outs. In April 2005 the data collected was analysed and where appropriate, additional information was sought to clarify emerging findings, and to ensure that the proposed recommendations are well founded.

Interviews were also conducted with large multinational companies. Finally, comparisons were drawn with leading US universities.

Appendix C – About the authors

About the BVCA

Founded in 1983, the BVCA (British Venture Capital Association) represents the overwhelming majority of private equity and venture capital firms in the UK. The UK industry is by far the largest in Europe, accounting for some 52% of the European market (in 2004) and is second only in size to the US. The BVCA is devoted to promoting the private equity industry and improving the performance and professional standards of member firms and the individuals within those firms. Its members include UK-based private equity firms and those companies actively involved in the industry, including advisers, accountants and lawyers. The BVCA provides publications to potential private equity users, their advisers and other interested parties, and carries out a wide range of private equity research.

About Library House

Library House is a supplier of data and research on innovation-based companies. Library House discovers, measures, and monitors innovation companies as they progress through their lifecycle from initial investment to preparation for purchase, partnering or public offering. Since its founding in 2002, Library House has provided investors, corporations, universities and government the most complete view and direct access to the innovation companies in the UK and Europe through its database, reports, events and analysis.

BVCA

3 Clements Inn
London WC2A 2AZ

T 020-7025 2950
F 020-7025 2951
bvca@bvca.co.uk
www.bvca.co.uk

LIBRARY HOUSE

Kett House
Station Road
Cambridge CB1 2JX

T 01223-500 550
F 01223-472 716
www.libraryhouse.net