MIT Skoltech Initiative

Technology Innovation Ecosystem Benchmarking Study: Key findings from Phase 1

By Ruth Graham

January 2013

Executive summary

Creating a university environment for entrepreneurship and innovation (E&I) is central to the mission of Skoltech (Skolkovo Institute of Science and Technology). Building on its partnership with MIT, Skoltech's development will be informed by international best practice, drawing on the experience of universities with a broad range of cultural, economic and socio-political backgrounds. The Skoltech/MIT Initiative therefore commissioned a benchmarking study to provide a rapid overview of leading university-based technology innovation ecosystems. Conducted in spring/summer 2012, a major aim of the study was to identify the most highly-regarded entrepreneurial ecosystems across the world.

This summary report highlights key findings of the benchmarking study. It drew on interviews with 61 international experts as its primary data source. The expert consultations focused on three principal issues, as outlined below.

- ***The most highly-regarded university-based ecosystems across the world.*** The US and UK were highly placed in the 'expert ranking', with MIT, Stanford University and the University of Cambridge cited by the majority of experts. Expert feedback also provided insight into factors underpinning the success at each of the recommended universities.

- ***The most highly-regarded university-based ecosystems operating in more challenging environments.*** A greater diversity of views was apparent for this 'expert ranking'; however, a small number of institutions - Technion, Sophia Antipolis and the University of Auckland - were consistently cited. The challenging environments in which the universities operated were typically characterised as cultures that did not support E&I, geographic isolation and/or a lack of venture capital.

- ***Appropriate performance metrics for university-based ecosystems.*** Many experts regarded commonly-used research commercialisation metrics (number of spin-offs, licensing revenue etc.) as unreliable indicators of a university's long-term capability to support or develop a vibrant ecosystem. Instead, many favoured metrics that can be broadly identified as 'input indicators' and 'process indicators'; measuring a university's commitment to an E&I agenda, entrepreneurial culture and innovation capacity.

Acknowledgements

I am grateful to the 61 international experts who contributed so generously to this study by giving their time and sharing their recommendations, experiences and insights.

Contents

1. Introduction

1.1. Context and aims

A critical element of the mission of Skoltech (Skolkovo Institute of Science and Technology) is to create a university environment that promotes entrepreneurship and innovation. Through its partnership with MIT, Skoltech's development will be informed by international best practice, drawing on the experience of universities with a broad range of cultural, economic and socio-political backgrounds. The Skoltech/MIT Initiative therefore commissioned a benchmarking study to provide a rapid overview of leading university-based technology innovation ecosystems. The study considers two related but distinct types of institution: (i) universities that have nurtured/supported the world's leading ecosystems, and (ii) universities that have nurtured/supported thriving ecosystems despite operating in a more challenging environment.

This report is based on the first phase of the study, which asks "*which university-based ecosystems are held in the highest regard across the world*" and "*which of these examples would offer important lessons for the on-going design of Skoltech*". Distilling the experiences and insights of 61 international experts, this phase of work provides their assessment of the most highly-regarded university-based ecosystems across the world. It also captures information on the range of metrics they used to underpin these recommendations and the critical success factors apparent for each of the top-ranked institutions.

The primary data source was one-to-one semi-structured interviews with research experts in university entrepreneurship and those with practical experience in developing successful ecosystems. This approach offered two particular advantages. Firstly, it directly tapped the expertise of the comparatively small group of individuals with worldwide knowledge of this field and the metrics through which success can be measured, enabling the Skoltech/MIT Initiative to identify the world's most highly-regarded university-based ecosystems. Secondly, unlike a larger scale study, the process could be conducted quickly, enabling the findings to inform the on-going development of Skoltech.

The second phase of the study, to be conducted in late 2012 and early 2013, will involve an evaluation of a selected sub-set of universities identified in Phase 1. The focus will be on institutions that both share common features to Skoltech and appear

to have played a pivotal role in the success of their ecosystem. The final phase, due to start in mid 2013, will be an analysis of the case study evaluations and identification of the implications of the study findings for the on-going design of Skoltech.

1.2. The study approach

This initial phase of the benchmarking study was conducted over a six month period, between February and August 2012. It started with a snap-shot synthesis of current knowledge in the field to identify, (i) frequently-referenced international experts to target during the interview process, (ii) available performance metrics relevant to university-based technology innovation ecosystems, and (iii) existing benchmarking studies in the field.

The major component, however, was the consultations with international experts. These focused on the experts' views and recommendations in four areas: (i) the most appropriate metrics to evaluate the performance of a university-based technology innovation ecosystem, (ii) the world's most successful university-based ecosystems, (iii) the world's most effective university-based ecosystems operating in a challenging environment, and (iv) the critical factors seen to be underpinning the success of the top-ranked universities.

1.3. The experts

A total of 83 individuals, drawn from 23 countries, were invited for interview as part of this phase of the study. Invitations were sent out to an initial group of individuals recommended by the MIT/Skoltech team and identified through the literature. A 'snowballing' method was then used to identify further individuals for consultation, based on interviewee recommendation. Particular priority was given to individuals who were recommended by two or more experts.

Of those initially contacted, a total of 61 individuals across 20 countries were interviewed for the study, as illustrated in Figure 1. A list of the experts consulted is provided in Appendix A.

A common set of questions was asked in the interviews (see Appendix B), which were typically around 1 hour in length. During the later stages of the study, interviews with experts located at the emerging top-ranked universities were asked a broader set of questions (see Appendix C). These questions were provided to each expert in advance. Two individuals chose to respond to these questions by email.

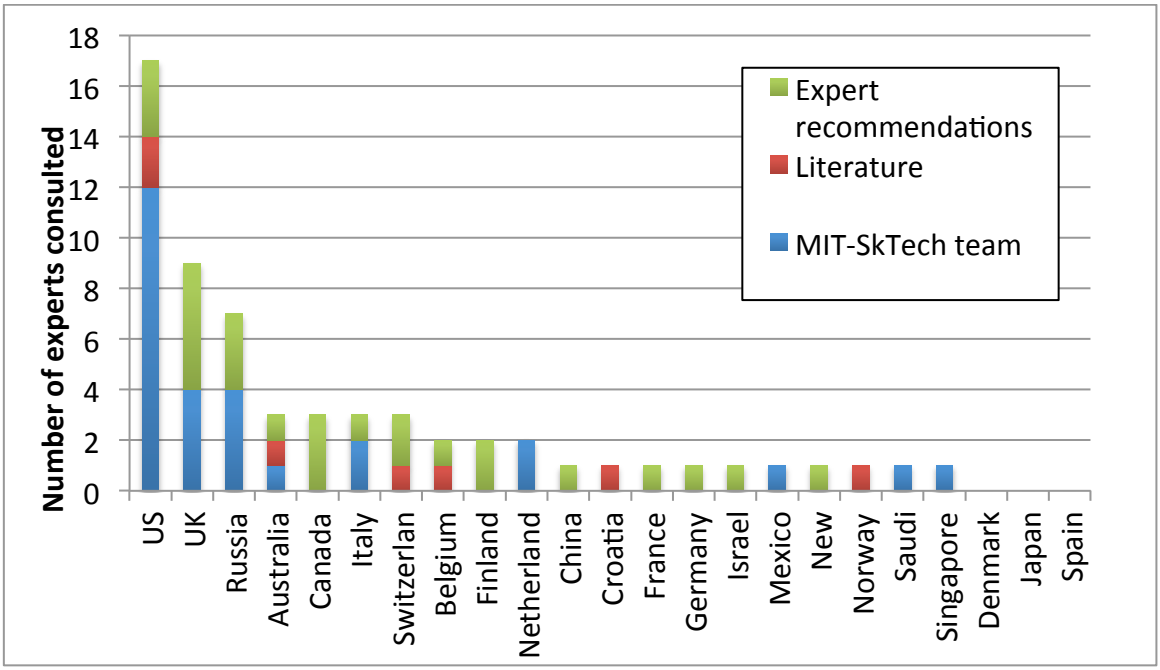

Figure 1. Experts interviewed, n=61, by country and how the individual was initially identified as a candidate for consultation (3 categories: by the MIT/Skoltech team, by the study literature review or through recommendation from another expert)

Two groups of experts were targeted for invitation:

1. Highly-cited research experts in the field with professional experience across multiple regions of the world. These individuals comprised around 25% of those invited for interview and they were largely identified through the snap-shot literature review conducted as part of this study.

2. Individuals with direct experience within a technology innovation ecosystem at a well-regarded university. These individuals comprised around 75% of those invited for interview, of which around a half were based within the university technology transfer office (or equivalent) and the remaining half were engaged in other key roles (entrepreneur, government funding sponsor, company manager, university president etc.). These experts were identified as suitable candidates for interview either through recommendation from the MIT/Skoltech team or through recommendation from other interviewees.

Findings from the expert consultations are summarised in Sections 2, 3 and 4 of this report.

2. Metrics of ecosystem success

2.1. Metrics recommended by experts

All experts were asked to identify metrics through which the performance/success of a university-based technology innovation ecosystem should be measured (see question 1 in Appendix B). A wide range of indicators was considered to be relevant. The metrics most commonly identified by the experts are summarised in Figure 2, where they have been grouped into three broad categories:

1. ***Input indicators: metrics concerned with the university strategy and approach.*** Such metrics were seen to highlight, in the words on one expert, "*whether entrepreneurship and innovation is at the core of the [university's] mission*", a metric widely-regarded to be a key measure of institutional commitment to supporting long-term ecosystem development. Interviewees with a research background in innovation and entrepreneurship were particularly likely to identify metrics of this type. Two sets of metrics were described in particular: firstly, the prominence of E&I in the university's policies and activities including resourcing levels and, secondly, the extent to which E&I education and training are available to all staff and students.

2. ***Process indicators: metrics concerned with entrepreneurial culture and innovation capacity within the university***. Three types of metric were described: firstly, attitudes to and participation in entrepreneurial activities by staff and students; secondly, the extent of connectivity between the university and industry and/or other ecosystem stakeholders, particularly where no short-term monetary gain was involved for any party; thirdly, the research quality and reputation of the university and the extent of its relevance to industry. As one expert commented, "*… it is important to measure the climate, the entrepreneurial behaviour or intention to do something – how many people inside and outside of the university are capable of working together, how many students are interested in joining entrepreneurship classes – all of these things will tell you where [the university] is and where they will be going in the future*".

3. ***Output indicators: metrics concerned with the impact of the university on the ecosystem***. Four types of metrics was recommended; firstly, the standard

1. Input indicators: institutional approach
1.1 University policies and activities:
Extent to which knowledge transfer and E&I activities are apparent within each school/centre in the university
Connections between the E&I activities/policies across the university
Whether the university has sought to employ international experts in E&I to deliver programs
Breadth of activity/resources in place at the university (e.g. incubator/accelerator, student competitions, proof of concept centre)
Level of university resource allocated to university/industry interactions
Extent to which innovation and entrepreneurship are considered in faculty recruitment/promotions procedures
Whether opportunities are offered by the university for partnership with regional companies
1.2 Education and development opportunities offered:
Amount of curricular time devoted to entrepreneurship and innovation across all engineering and physical science disciplines
Whether entrepreneurship and innovation training are offered to all university employees (including post-docs)
2. Process indicators: entrepreneurial culture and innovation capacity within the university
2.1 Individual student/staff attitudes and aspirations:
Student and staff career intentions and options (self reported)
The prominence of faculty entrepreneurs as role models
The extent to which peer entrepreneurial talent is recognised and admired amongst the student body
Percentage of engineering/technology students and staff involved in voluntary entrepreneurship and innovation activities
Whether student and staff participation in voluntary entrepreneurship activities is increasing
Faculty attitudes towards and level of trust in the university technology transfer office (or equivalent)
Percentage of faculty engaged in disclosures/patenting activity
2.2 Connectivity and university/industry engagement:
Levels of web connectivity between the university and industry
Number of students who combine study with jobs with high-tech firms
Proportion of engineering/technology students undertaking industry-based projects
Numbers of joint publications between faculty and industry
The number of joint university/industry initiatives launched (for any purpose)
Involvement of practitioners in teaching and mentorship (numbers of professors of practice, entrepreneurs in residence etc.)
The free movement of faculty in and out of the university
Growth in external attendee numbers (professional service providers, industry and investors) at networking events
Number of university patents that are transferred to industry partners at no cost
Amount of pre-transactional interaction with industry (i.e. engagement that it not directed at securing a contract or license)
2.3 Relevance and quality of university research:
Volume of industry-sponsored research (for some, this should be measured as a percentage of the total R&D budget)
Average impact factor of faculty publications
Volume of faculty consultancy with industry (measured by both the percentage of faculty engaged and by the total income)
International league table ranking for university
3. Output indicators: Ecosystem impact
3.1 Technology transfer office throughput (from university generated IP):
Number of disclosures and patents
Number of start-ups/spin-offs
Number of licenses or licensing success rates (number of licenses per year/number of invention disclosures)
Number of licenses bearing royalties
Income generated from licenses
3.2 The creation of sustainable companies (from university generated IP):
Company survival rate after 10-15 years
Numbers of companies with more than 20 employees (for some, total number of jobs created by companies)
Total money raised from external investors (for some, this should be measured as a percentage of research income)
Total sales in the marketplace resulting from commercialisations
Total financial value of the companies created
3.3 The impact of the university graduates:
Percentage of alumni remaining in or returning to ecosystem
Percentage of graduates working in technology-related businesses
Percentage of alumni (aged 30-40) engaged in starting new companies or engaged in innovation (self-reported)
Wealth created by companies founded by university graduates
3.4 Broader development of the ecosystem and beyond:
Whether people (companies, entrepreneurs, investors, professional service providers) are moving into the region for opportunities
Growth rate of all start-ups and high tech companies in the region (job growth, new investment etc.)
The extent to which university PhD students are employed by start-up and new companies in the ecosystem
Total employment generated by the ecosystem
Whether the university attracts entrepreneurially-minded, successful and ambitious students and faculty
Whether the university has contributed to changing policies in the country/region (such as creating national IP legislation)

Figure 2. A summary of expert responses to the question *"what do you consider to be the most appropriate metrics to evaluate the performance/success of a university-based ecosystem"*

metrics for technology transfer throughput; secondly, the extent to which university-generated intellectual property (IP) has led to the creation of sustainable companies; thirdly, the entrepreneurial impact and wealth creation of university graduates; fourthly, the broader development of the ecosystem and beyond. US experts in particular talked about the significant role played by university graduates in ecosystem development and the value of the Kauffman Foundation study of the impact of MIT alumni[1] in this regard – "*.. this tells us about the number of entrepreneurs we are turning out. This tells us about creating the fishermen and not the fish*".

Experts were also asked to identify metrics of early ecosystem development, against which it may be possible to measure the performance of Skoltech five years after its establishment. Generally speaking, their recommendations focused on two categories of *process indicator*; firstly, the *individual student/staff attitudes and aspirations* listed in section 2.1 of Figure 2; secondly, the *relevance and quality of the university research*, listed in section 2.3 of Figure 2. Most also cautioned against "*overly ambitious targets in terms of research commercialisation*". They noted that the stable development of such activity, outside a one-off "*blockbuster*" innovation, would take at least 10-15 years.

2.2. Overall expert feedback on the influence of ecosystem metrics

Most experts noted that identifying a set of metrics to evaluate the performance of a university-based ecosystem was a considerable challenge, with concerns expressed about whether the standard metrics collected by organisations such as AUTM (Association of University Technology Managers)[2] were fit for purpose. Indeed, the issue of metrics was clearly an emotive topic for a high proportion of the experts consulted. Many spoke at length about how the application of currently-accepted metrics (see section 3.1 in Figure 2) can be misleading at best and retard ecosystem growth at worst. Expert feedback centred around two key issues: firstly, that these measures do not adequately reflect the true knowledge transfer capability or performance of a university; secondly, that their widespread application has had a significantly detrimental impact on entrepreneurship and innovation strategy at an

[1] Roberts, E. B and Eesley, C. Entrepreneurial Impact: The Role of MIT. Kauffman Foundation, Feb 2009.

[2] The AUTM Licensing Survey gathers information such as the number of university startups, number of licenses, number of invention disclosures, numbers of patents filed and licensing income.

institutional-level in universities across the world. Each of these issues is addressed in turn below.

Many experts, particularly those based outside the US, were highly critical of the "*standard metrics*" (see section 3.1 in Figure 2) that are "*convenient to collect, keep the funding bodies happy but do not tell you much about what is really happening*". Many also saw them as highly "*manipulable*" and "*easily distorted by a single blockbuster*". Their primary focus on the university outputs was also noted as a cause of concern – "*…you can't understand a system by only looking at the outputs and not the inputs… At a lot of the so-called successful universities, the input is enormous amounts of government funding and what comes out is only a tiny fraction of that*". Overall, the views are well summarised by the feedback from one expert, "*… there is no doubt that these metrics are easy to measure and no doubt that they tell us something about what is happening. But it is just one tiny piece of the whole picture. They tell us something about the outputs of the licensing office and the number of US Dollars that has been put into maintaining that. They tell us much less about the university as a whole and its contribution to the economy and its contribution to society*".

Given these concerns, it is perhaps not surprising that many experts spoke of the need to develop a new set of metrics. Like the existing metrics, these would capture and track activity at an institutional level, but would provide a much richer picture of the university's role in knowledge transfer and ecosystem development. A number of experts noted that the 2008 Unico-commissioned report[3] "*has probably come as close as anyone*" to achieving this to date. One expert commented, "*the [Unico] metrics report appeals to me because it was very culturally sensitive. The matrix varies by institution and country, and the spider graphs are very different for each university*".

The second major focus of expert feedback was how "*the easy to-measure metrics of technology transfer office performance have somehow become a proxy [measure] for the university's approach to E&I*", thereby skewing the strategy and focus of the whole institution. As a result of the widespread use of these metrics, universities were seen to have been focused on "*making sure the graph of their patent numbers or start-up numbers goes up and to the right*" and "*churning the handle of the licensing office*" rather than developing a long-term strategy for ecosystem development. In particular, an

[3] Holi, M. T., Wickramasinghe, R., & van Leeuwen, M. (2008). Metrics for the evaluation of knowledge transfer activities at universities. Cambridge: Library House.

over-riding focus on faculty-generated IP is seen by many to have come at the cost of elements such as alumni entrepreneurship or long-term strategic industry collaborations – "*universities develop the entrepreneurs of the future not the ventures of today… We need to be measuring our activity not our output*". As one expert noted, "*…a few start-up companies will make little difference in the long-run. It is our students that will make by far the biggest impact [to the ecosystem], but we pay this very little attention*". Indeed, when describing the world's most effective universities for this study, experts commonly spoke about "*enlightened leadership*" who "*understand that knowledge transfer is not all about making a fast buck*" and developing broad-reaching and long-term strategies that "*look[ed] beyond the short-term gains of licenses or spin-offs and nurture[ed] a culture of entrepreneurship in the staff and students that will stand the test of time*".

3. The expert ecosystem 'rankings'

3.1. The most highly-regarded university-based ecosystems

All the experts were asked to identify the universities that they felt had created/supported the world's most successful technology innovation ecosystems (see question 2 in Appendix B). A total of 120 different universities across 25 countries were identified by the 61 experts consulted.

The 10 institutions most commonly cited by experts are summarised in Figure 3. It makes clear the dominance of MIT, Stanford University and the University of Cambridge, identified by over 80% (MIT and Stanford) and over 60% (Cambridge) of the experts.

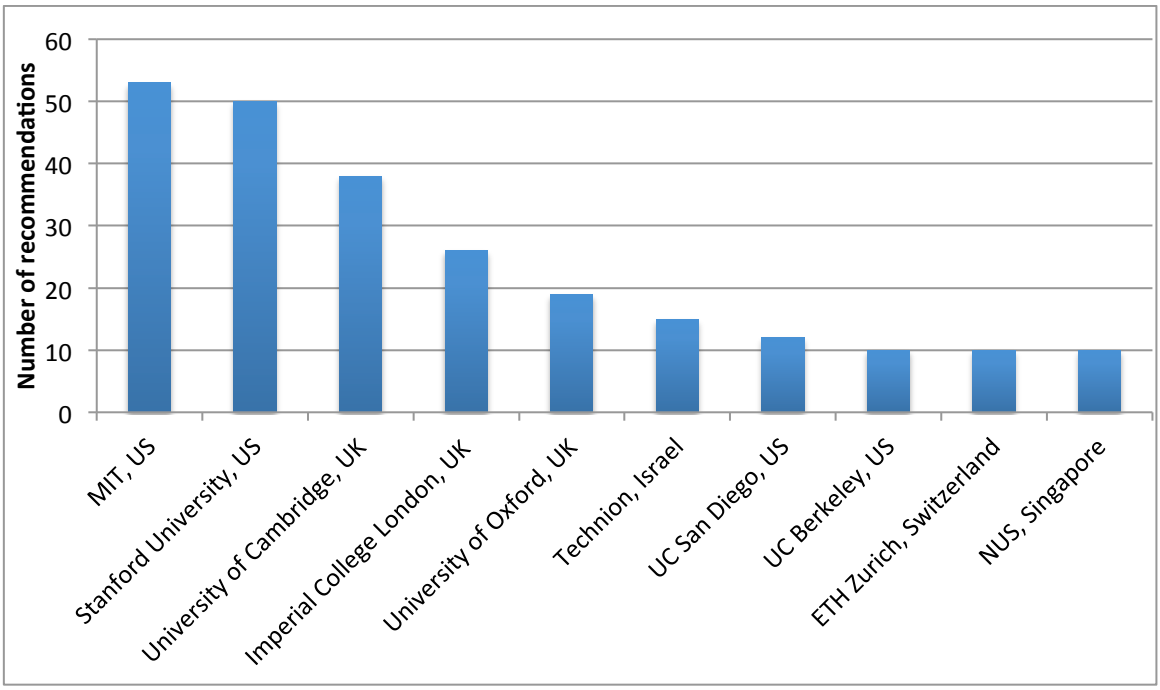

Figure 3. Top 10 responses to the question *'which universities would you identify as having created/supported the world's most successful technology innovation ecosystems'*

To ensure that the leading positions held by these three institutions in the experts' 'top 10' was not skewed by the relatively high proportion of interviewees from the US and UK, the data were reanalysed to take account of the country of residence of the expert. This second analysis excluded from the expert's 'top 10' those institutions located in their country of residence; for example, it excluded recommendations for US universities made by US-based experts. As Figure 4 indicates, MIT, Stanford and Cambridge retain their premier position within this revised ranking. We can

therefore be confident that the high proportion of US and UK-based experts is not skewing the results.

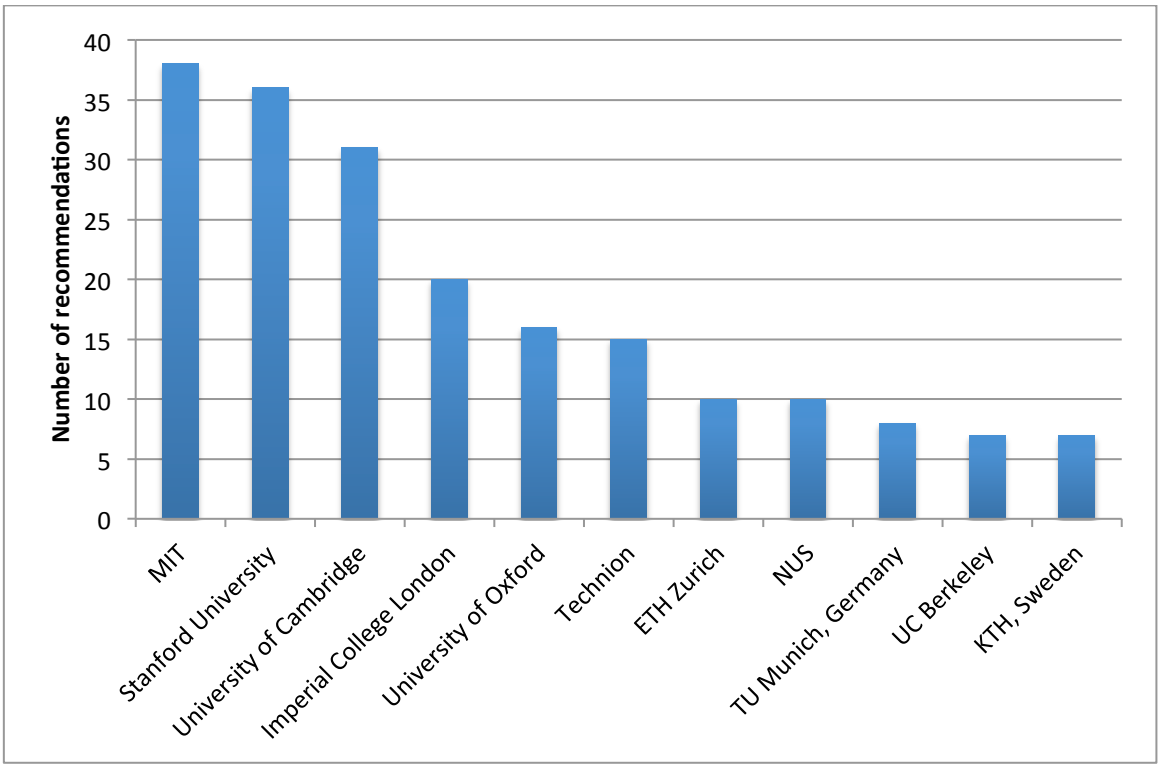

Figure 4. Top 10 responses to the question *'which universities would you identify as having created/supported the world's most successful technology innovation ecosystems'*, with the results adjusted for country of residence of the interviewee

Figure 5 presents the data on the leading universities by their country location. As expected, successful technology innovation ecosystems are seen as most firmly embedded in the US and the UK. Again, the analysis has taken account of the country of residence of the experts.

Experts were also asked to discuss the reasons for their selections and the critical success factors for each of these universities. Selected feedback is summarised in Section 4 of this report.

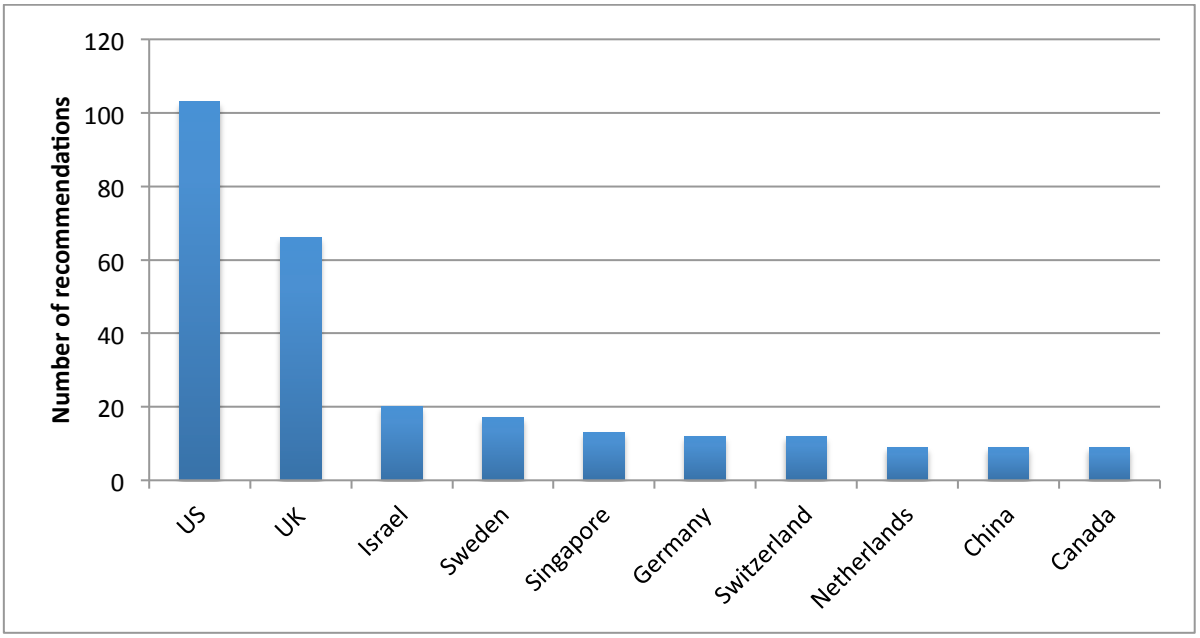

Figure 5. The most frequently cited countries in response to the question *'which universities would you identify as having created/supported the world's most successful technology innovation ecosystems'*, with the results adjusted for country of residence of the interviewee

3.2. The most effective university-based ecosystems despite a challenging environment

All experts were asked to identify the universities that they felt created/supported an effective technology innovation ecosystems despite a challenging environment (see question 3 in Appendix B). In response to this question, experts identified a total of 131 different universities across 35 countries. The institutions/ecosystems most frequently cited are detailed in Figure 6.

Figure 6 points to a wider spread of views, and without the dominance of a few institutions that emerged from the experts' assessments of the universities most successful in facilitating technology innovation ecosystems (Figure 3).

When discussing the perceived challenges faced by the universities being recommended, experts were most likely to identify the following factors: (i) a culture that does not support entrepreneurial behaviour and risk-taking, (ii) geographical isolation and/or limited local market, (iii) lack of venture capital or multi-national companies in the region, and (iv) no existing high-ranking research-led university within the ecosystem base.

Figure 7 presents the data on the most highly-regarded universities by their country location, with account taken of the country of residence of the experts.

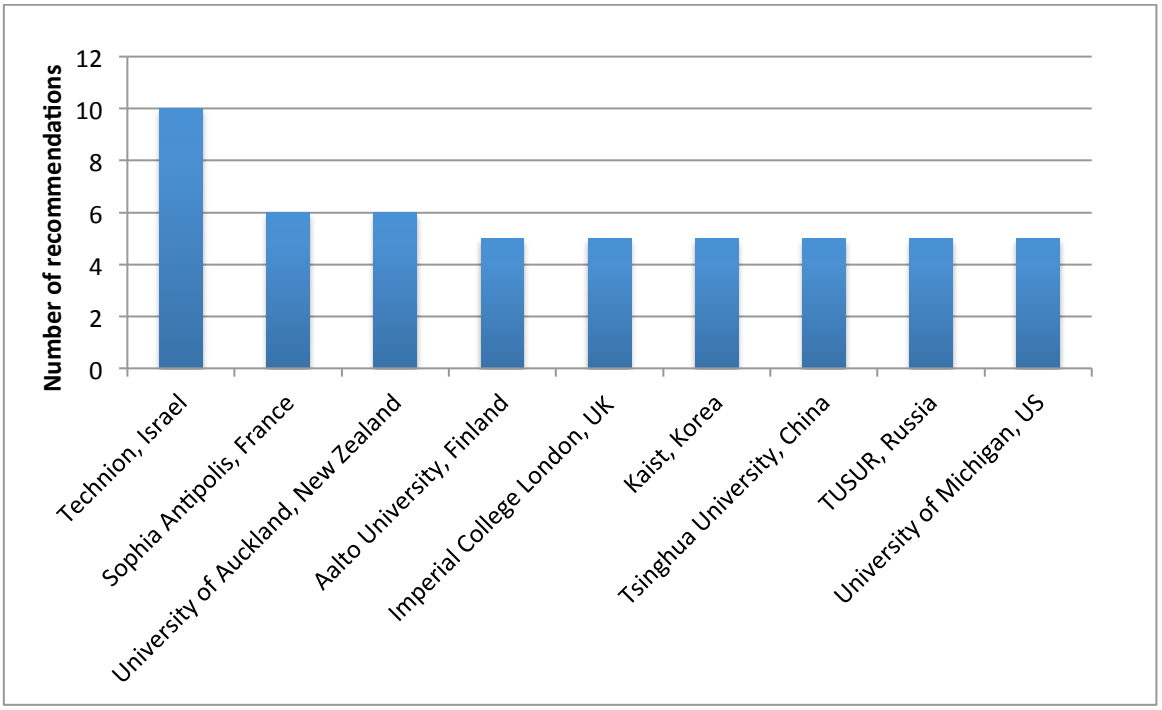

Figure 6. Top responses to the question *'which universities would you identify as having created/supported highly effective technology innovation ecosystems despite a challenging environment'*[4]

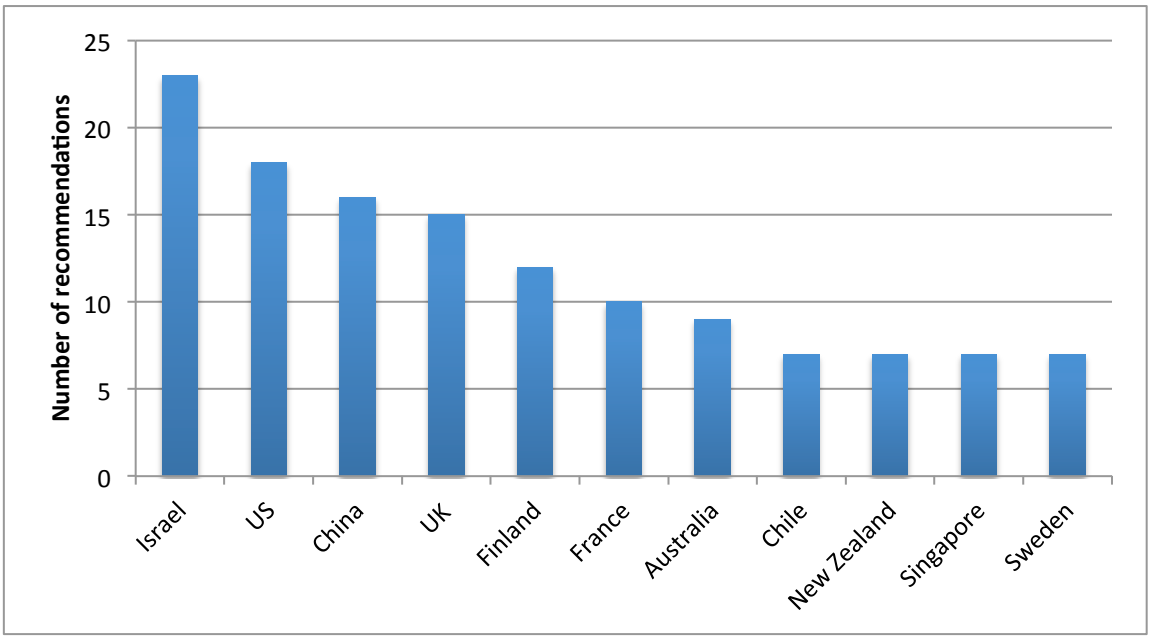

Figure 7. The most frequently cited countries in response to the question *'which universities would you identify as having created/supported highly effective technology innovation ecosystems despite a challenging environment'*, with the results adjusted for country of residence of the interviewee

[4] It should be noted that Sophia Antipolis was one of the few expert recommendations that described a technology park rather than a university

4. Success factors for the most highly-regarded universities/regions

After their recommendations for the world-leading university-based ecosystems were captured (see section 3), experts were asked to discuss their reasons for these selections and the factors perceived to underpin the universities' success. This section provides a brief summary of their responses.

4.1. Broad feedback on the top-ranked universities

When asked to describe the world's most highly-regarded universities, experts often described the institutions using one of the following three characterisations:

1. Universities that had benefitted significantly from a "*rising tide that floats all boats*" at a national/regional level or from very significant government subsidies. In other words, the university is seen to have played a relatively limited role in the development of the ecosystem; instead its success is largely credited to contextual factors, such as strategic government policy/investment, a strengthening national economy or the influx of new entrepreneurial talent.
2. Universities whose strong international reputation for knowledge transfer is not necessarily supported by evidence of their performance. Some universities were described by experts as "*presenting some good-looking numbers and talking the talk*" but were regarded, on closer inspection, to have relatively limited entrepreneurial activities and made a relatively modest contribution to their regional ecosystem.
3. Universities who had played an active, positive role in a vibrant and strengthening ecosystem. In other words, the success of the universities was viewed to have been genuinely a product of an effective university strategy rather than circumstance or national/regional fortune.

It is the strategies and approach of the universities within the third of these groups that are likely to provide the greatest insight into the design of future ecosystems. Expert feedback highlighted, in particular, universities whose distinctive path in their E&I policy was designed in response to the particular barriers faced in their environment. A number of these examples are discussed in Section 4.2.

Many experts also observed that the ecosystem rankings emerging from this study should not be considered to be static. With an increasing engagement with the E&I agenda, they reported a rapid improvement in the impact and reputation of many universities and the likely emergence of "*new leaders from outside the US*" in the coming 5-10 years.

The continuing dominance of MIT and Stanford, however, was not questioned. These institutions were seen by almost all experts to be "*far and away the world leaders*". Their long-standing success did lead a number of experts to observe that universities wishing to emulate the fortunes of MIT and Stanford "*would be much better off studying their early history that trying to copy what they are doing now*". Expert feedback also highlighted a number of "*emerging giants*", such as Technion and Imperial College London, whose reputation had grown considerably in recent years.

Finally, experts spoke about the "*rising stars*" – universities whose current trajectory suggested a strong international presence in the future. Examples consistently identified by experts included the University of Auckland, Aalto University and the University of Michigan. A number of universities in China and Brazil were also discussed in this context, although no particular universities dominated amongst the spread of recommendations made within each country. Although many US-based experts noted considerable interest in the early ecosystem development in New York ("*young entrepreneurs are flocking there*"), most also commented that it was " *too early to say whether this will come together*".

4.2. Success factors amongst the leading universities

Experts were asked to identify the factors underpinning the success of their selected university-based ecosystems. Their responses painted a rich and often very consistent picture of the elements contributing to ecosystem impact and reputation in each case. When looking across these descriptions, seven types of success factor were repeatedly highlighted by experts. Each is briefly discussed below.

- ***Institutional E&I culture***: institutional E&I culture was almost universally described by experts as an "*essential*" ingredient of a successful ecosystem. For a number of the world leading universities, their E&I ethos was seen to have been either "*sown into the fabric of the universities from their very foundation*" (as credited to MIT and Stanford) or benefitted from a national "*ethos to make things happen*" (as credited to Technion). However, most of the feedback

focused on other universities and the challenges they faced in catalysing a change in their E&I culture. Many experts noted that *"British universities are the most interesting examples"* of those that had successfully implemented such a change. As one expert explained, *"They had excellent universities, but no venture industry, no internal industry and not much entrepreneurial spirit. They have been able to overcome a lot of this*". The University of Cambridge was noted as a primary, and on-going, example of a university whose successful cultural change was challenged by "*800 years of history*" and "*active hostility to setting up technology transfer activities*". Through celebrating the achievements of faculty role models, a relatively unstructured mix of E&I activities across campus, and a freedom for faculty to devote time to entrepreneurial ideas, the university is now seen to enjoy an increasingly entrepreneurial culture.

- ***Strength of university leadership***: The names of particular university leaders were repeatedly raised as playing a pivotal role in establishing a strong E&I strategy and sewing the seeds of a vibrant university ecosystem. Some such individuals were seen as the driving force behind the establishment of new ecosystems from a green field site - such as the case of Pierre Lafitte at Sophia Antipolis. However, more frequently identified were leaders associated with changes in previously underdeveloped ecosystems. They were credited with enacting a fundamental change in university E&I culture and strategy that led to a significant strengthening of ecosystem performance. For example, a name strongly associated with the strengthening E&I reputation of Imperial College London was Richard Sykes, who served as university Rector between 2001 and 2008. Previously CEO of GlaxoSmithKline, Richard Sykes was seen to bring a culture of "*celebrating the success of entrepreneurs, sending the message that academics can get rich without loosing their credibility as a world class researcher*". Richard Sykes also exerted pressure on the existing technology transfer office, Imperial Innovations, to "*demonstrate the value of their activities*". In the years that followed, Imperial Innovations was transformed into "*something very unique – an independent company that handles the whole technology transfer process for the university*".

- ***University research capability***: Many universities in the expert rankings have a long history as an international research powerhouse, and this quality and capacity was seen as a cornerstone of the ecosystem's success. For example, at

ETH Zurich, the university's "*long standing history of excellence in research*" with a considerable international focus was noted by experts as key to the ecosystem's strength.

- ***The local or regional quality of life***: The attraction of the locality itself was seen as a major benefit to ecosystem growth. For example, many experts described the "*gorgeous location*" of Sophia Antipolis as the "*key to its success*". As one commented, "*…it sounds trivial, but location and lifestyle is a big factor. They were taking the Silicon Valley summery lifestyle and setting it up in the south of France*". The design of the park itself was also seen as an influencing factor – "*… it is not a science park as you would expect. The buildings are scattered throughout the hills. It is like nothing else I have seen*". The pre-existing tourist industry also made region "*open to the world*", with international schools, an international airport and high-speed train lines to the rest of Europe.

- ***Regional or government support***: Many universities featured in the expert rankings have clearly benefitted from significant external support for ecosystem development in form of generous government subsidies and advantageous regional policies. In some cases, experts observed that these interventions allowed universities to present a highly successful façade that masked an ineffective or very limited E&I contribution by the institution itself. However, experts also highlighted a significant number of cases where regional or government interventions had achieved much more positive and sustainable results. For example, the collaborations across universities, business and local government in the city of Tomsk, Siberia, were seen as a major factor in the emerging E&I environment at Tomsk State University of Control Systems and Radioelectronics (TUSUR). When describing the growing vibrancy of this university ecosystem, one expert commented, *"[TUSUR] did not do this alone. There was an openness between the university and the [rest of the] ecosystem. They have combined the general city facilities with the university facilities with business facilities*". Through this mutually-reinforcing collaboration, the city is seen to have become open and attractive and a place where "*entrepreneurs would want to move their ideas*".

- ***Effective institutional strategy***: Experts described at length the university strategies associated with successful ecosystem growth. Some effective strategies appeared to be relatively independent of the university size,

location and profile. Examples included approaches where the institutional focus for E&I did not reside within a single group or centre, but was allowed to emerge as multiple, and often unconnected, activities operating across and beyond the campus. Other strategies described were specifically tailored to the university context, often in direct response to the challenges faced in that environment. For example, the size and geographical isolation of New Zealand together with the absence of multi-national companies led the University of Auckland to develop a strategy of "*associating our capabilities with the needs of other nations*". Experts pointed, in particular, to the performance of UniServices, an independent but university-owned institution managing all research contracts and commercialisation activities for the University of Auckland. UniServices have focused on the development of long-term strategic partnerships with large multi-national companies and carefully positioned themselves "*in specific segments and markets*". One expert described how they had created "*a support environment in New Zealand that allows people to think globally about their business*".

- ***Powerful student-led entrepreneurship drive***: "*Student energy in entrepreneurship*" was viewed by experts as an increasingly prominent driver of ecosystem development, particularly amongst emerging ecosystems and those operating in more challenging environments. One university highlighted by experts in this context was the recently established Aalto University in Helsinki. The university was formed through the merger of three highly-regarded schools of business, engineering and design, with a explicit focus on "*innovation based entrepreneurship*". Many experts commented that, after only two years of operation, the "*levels of student engagement [in E&I] are phenomenal*", supported by an array of activities and resources across campus. The decreasing dominance of the major employers of Finnish graduates, such as Nokia, was also seen to have supported a wave of interest in entrepreneurial careers amongst student populations within the country, with emerging national role models such as the developers of *Angry Birds*[5].

[5] Angry Birds is a video game developed in Finland in 2009

5. Conclusions

5.1. Summary comments

This study, the first of a broader three-stage inquiry, aimed to identify the world's most highly-regarded university-based ecosystems, including those operating in challenging environments, and the metrics by which their performance should be assessed. Consultations with experts were used to provide a rapid and reliable mechanism through which to identify the leading university-based ecosystems and the metrics that these individuals have used to inform their views. Sixty one individuals with high-level expertise in university ecosystem development were consulted; each was interviewed separately, without knowledge of the views expressed by other participants in the study. The list of interviewees was generated from the Skoltech/MIT team, peer recommendations from the experts themselves and the outcomes of a snap-shot review of the literature.

With respect to both ratings and metrics, a clear consistency of views emerged. The same group of highly-regarded universities was repeatedly identified, a consensus of view suggesting that increasing the number of experts in the consultation would not have dramatically changed the picture that emerged. Although some experts, particularly US-based, selected relatively few non-US and non-UK examples, this only had a marginal effect on the final rankings generated.

The outcomes of the expert consultations are summarised below:

1. **The most appropriate performance metrics for a university-based ecosystem:** Ecosystem metrics were an emotive topic for many of the experts consulted. A majority of experts volunteered that commonly used research commercialisation metrics (number of spin-offs, licensing revenue etc.) were often not a reliable indicator of a university's long-term capability to support or develop a vibrant ecosystem. Many favoured metrics that were termed in the study as 'input indicators' and 'process indicators'; measuring the university's commitment to an E&I agenda, entrepreneurial culture and innovation capacity. Indeed, many experts went further in their criticism of the current metrics set and proposed that their widespread application has distorted university strategy in E&I and distracted attention from critical areas for growth such as student entrepreneurship.

2. **The most highly-regarded university-based ecosystems across the world:** The US and UK emerged very strongly from these consultations, with MIT, Stanford University and the University of Cambridge cited by the majority of experts, a premier position consistent with their international rankings for research output. Within the top 10 institutions identified, only two were based outside the US and Europe: Technion and NUS.
3. **The most highly-regarded university-based ecosystems that are operating in a more challenging environment:** Although a wider spread of recommendations were made in response to this question, a clear picture still emerged, with Technion, Sophia Antipolis and the University of Auckland at the fore. The challenging environments in which the universities operated were typically characterised as a culture that did not support E&I, geographic isolation and/or a lack of venture capital. A high proportion of the most commonly-cited universities have taken relatively unusual approaches to knowledge transfer, often in direct response to their circumstances. It is perhaps these university models that will be of most interest to the wider E&I community. Although these universities may not necessarily rank highly using traditional metrics of research commercialisation, expert feedback suggested that their performance as measured by 'input' and 'process' indicators are laying solid foundations for future success.

The second phase of the benchmarking study will be conducted in late 2012 and early 2013. It will involve a detailed case study evaluation of a selected sub-set of the highly-regarded universities identified in Phase 1, focusing on those institutions that share common features with Skoltech and that appear to have played a pivotal role in the successful growth of their ecosystem.

Appendix A The experts consulted

Abhari, Reza	Professor of Aerothermodynamics, ETH Zurich, Switzerland
Alzaharnah, Iyad	Assistant Professor, King Fahd University of Petroleum & Minerals, Saudi Arabia
Arriaga, Juan	Professor of Entrepreneurship and Innovation, EGADE Business School, Tecnológico de Monterrey, Mexico
Aulet, William	Managing Director, Martin Trust Center for MIT Entrepreneurship and Senior Lecturer, MIT Sloan School of Management, MIT, US
Barge, Brian	President and CEO, The Evidence Network, Canada
Barrow, Abi	Director, The Massachusetts Technology Transfer Center, US
Belik, Vitaly	Consultant and Director of Commercialisation, Skolkovo Institute of Science and Technology, Russia
Byers, Tom	Professor and Co-Director, Stanford Technology Ventures Program, Stanford University, US
Califano, Howard	Director, SMART Innovation Center, Singapore
Cardwell, Will	Head, Aalto Center for Entrepreneurship, Aalto University, Finland
Chalmers, Rob	Managing Director, Adelaide Research & Innovation, University of Adelaide, Australia
Chan, Lily	Chief Executive Office, NUS Enterprise, NUS, Singapore
Cook, Tim	Professor, Oxford University and Consultant in Technology Transfer, UK
Cooney, Charles	Professor of Chemical Engineering, and Faculty Director, Deshpande Center for Technological Innovation, MIT, US
Crawley Edward	President, Skoltech, Russia
Cullen, Kevin	Chairman, NewSouth Innovations, University of New South Wales, Australia
del Palacio, Itxaso	UCL Teaching Fellow, UCL, UK
Dines, Allen	Assistant Director, Office of Corporate Relations, University of Wisconsin-Madison, US
Dubinsky, Ilia	Director, Center for Entrepreneurship and Innovation, Skolkovo Institute of Science and Technology, Russia
Durvy, Jean-Noel	General Manager, Sophia Antipolis Foundation, France
Etzkowitz, Henry	President, Triple Helix Association and Research Fellow, Stanford University, US

Fetters, Michael	Walter Carpenter Distinguished Professor, Babson College, US
Froumin, Isak	Education Specialist at the World Bank and Professor, Higher School of Economics, Russia
Galitsky, Alexander	Co-Founder and Managing Partner at Almaz Capital, Netherlands
Graves, Brian	Director of Commercialisation Services, Imperial Innovations, Imperial College London, UK
Greenblatt, Sherwin	Director of Venture Mentoring Service, MIT and former President of Bose Corporation, US
Groen, Aard	Professor of Innovative Entrepreneurship, University of Twente, Netherlands
Heller, Nick	Head of New Business Development, Google Europe, Switzerland
Heller, Page	Director, Office of Technology Commercialization at the National University of Science and Technology - MISIS, Russia
Henderson, David	Managing Director, UniQuest, University of Queensland, Australia
Hinoul, Martin	Business Development Manager, KU Leuven, Belgium
Hockaday, Tom	Managing Director, Isis Innovations, University of Oxford, UK
Holly, Krisztina	Vice Provost for Innovation and Executive Director, USC Stevens Institute for Innovation, University of Southern California, US
Horowitt, Greg	Co-Founder and Director, Global Enterprise, University of California, San Diego, US
Khokhlov, Alexei	Vice-Rector. Head of Department for Innovations, Informatization and International Scientific Cooperation, Moscow State University, Russia
Kohlberg, Isaac	Senior Associate Provost and Chief Technology Development Officer, Harvard University, US
Ku, Katherine	Director, Office of Licensing Technology, Stanford University, US
Lee, Peter	CEO, New Zealand UniServices, University of Auckland, New Zealand
Livingstone, Angus	Managing Director University-Industry Liaison Office The University of British Columbia, Canada
Malinen, Pasi	Professor, Vice-Director, Business and Innovation Development BID, University of Turku, Finland

Marmier, Pascal	Director, Consul, swissnex Shaghai, China (formerly Boston, US)
Minshall, Tim	Senior Lecturer in Technology Management, Institute for Manufacturing, Cambridge University, UK
Mitchell, Andrew	Business Manager, Edinburgh Centre for Carbon Innovation, UK
Nelsen, Lita	Director, Technology Licensing Office, MIT, US
Nijhawan, Vinit	Managing Director, Technology Development Office and Lecturer School of Management & Director Enterprise Programs, ITEC, Boston University, US
Pietrabissa, Riccardo	President, Netval, Italian Association of University and EPR Technology Managers, Italy
Rasmussen, Einar	Research fellow, Bodø Graduate School of Business, Norway
Redi, Nicola	Senior Partner at Fondamenta SGR and Chief Technology Officer for TTVenture, Italy
Robinson, Max	Entrepreneur in Residence, Newcastle University, UK
Sandler, Leon	Executive Director, Deshpande Center, MIT, US
Secher, David	Independent consultant in research commercialisation, UK
Seidel, Victor	Strategy & Innovation Group, Said Business School, University of Oxford, UK
Shmueli, Oded	Executive Vice President for Research, Technion, Israel
Singer, Slavica	UNESCO Chair in Entrepreneurship and Head of the Graduate Program in Entrepreneurship, J.J. Strossmayer University, Croatia
Sobrero, Maurizio	Professor of Technology and Innovation Management, University of Bologna, Italy
Stevens, Ashley	Special Assistant to Vice-President of Research, Boston University, US
Tidona, Christian	Managing Director, BiORN Cluster Management GmbH, Germany
Toivonen, Nikolai	Vice-Rector on Innovations and Dean of the Enterprise Faculty, St. Petersburg National Research University ITMO, Russia
Treurnicht, Ilse	CEO, MaRS Discovery District, Toronto, Canada
Van de Velde, Els	Senior Consultant, IDEA Consult, Belgium
Wilson, Karen	Senior Fellow, Kauffman Foundation, and Founder GV Partners, Switzerland

Appendix B Interview questions

Provided below are the questions used to frame each expert interview (typical duration 1 hour).

1. What do you consider to be the most appropriate metrics to evaluate the performance/success of a university-based technology innovation ecosystem?

2. Which universities would you identify as having created/supported the world's most successful technology innovation ecosystems? For each university-based ecosystem, what factors do you feel are most responsible for their success?

3. Which universities, from across the world, would you identify as having created/supported highly effective technology innovation ecosystems despite a challenging environment? For each university-based ecosystem, what factors do you feel are most responsible for their success?

4. What do you see as the critical factors in achieving success within your technology innovation ecosystem? What role have university activities/policies played?

5. Could you recommend any other individuals whom you feel should be consulted as part of this study?

Please note that question 4, relating to the success factors in the expert's own ecosystem, was only included (where appropriate) in interviews arranged after 23rd March 2012.

Appendix C Interview questions for experts location at top-ranked universities

Provided below are the questions used, during later stages of the study, to frame discussions with experts located at the emerging top-ranked universities.

1. What do you consider to be the most appropriate metrics to evaluate the performance/success of a university-based technology innovation ecosystem? What key metrics do you track at your university?

2. What do you see as the critical factors underpinning the success of your technology innovation ecosystem?

3. Was there a particular event that changed or shaped the university's strategy in knowledge transfer? When did this occur?

4. Did the university benefit from any pre-existing strengths or fortuitous events as the ecosystem developed?

5. When compared to other effective university-based ecosystems across the world, what particular, distinctive challenges do you face?

6. How would you describe the university's strategy in knowledge transfer? How is this likely to change over the coming 5 years?

7. What role have local and national government played in the development of the ecosystem?

8. Has the university developed a culture of accepting and celebrating entrepreneurship amongst staff and students? If so, how did this come about?

9. What challenges do you envisage that your ecosystem will face over the coming 5 years?

10. To what extent could your university's approach to knowledge transfer be translated into other regions or cultures across the world?

11. More broadly, which universities would you identify as having created/supported the world's most successful technology innovation ecosystems?

12. Which universities, from across the world, would you identify as having created/supported highly effective technology innovation ecosystems despite a challenging environment?