Imperial West as a world-leading Innovation District

A guide to best practice and feasibility

April 2014

Dr Anne ter Wal — Assistant Professor, Innovation & Entrepreneurship, Imperial College Business School

Christopher Corbishley — PhD Candidate, Innovation & Entrepreneurship, Imperial College Business School

Advisory:

Professor David Gann — Vice President, Development & Innovation, Imperial College London

Ian R. Smith — Chairman, Four Seasons HealthCare

This report was commissioned as an independent study to stimulate and inform discussion within Imperial College London on the development of an Innovation District at Imperial West. The authors acknowledge the support of the advisory participants and interviewees whose names have been omitted in the final report.

Table of Contents

Executive summary

This study has been commissioned to inform decision makers at Imperial College London about the **feasibility** of realizing an Innovation District at Imperial West that can live up to its promise of becoming a **world-leading cluster for science, technology and innovation**. The report aims to identify factors that might drive the successful creation of an interactive and entrepreneurial innovation district and provide guidance for best practice and insight into potential pitfalls. Recommendations are based on a review of the academic literature and case studies of a broad range of cluster initiatives and universities.

Cluster ecosystems flourish with a **balanced presence and contributions from universities, large corporates and start-ups**. Exchange of ideas and direct collaboration between academic, entrepreneurial and corporate actors form the cornerstones of the **cluster ecosystem** that succeeds in pushing science and innovation forward. **Government** typically also plays a key role as an advocate for the creation of a cluster ecosystem that contributes to local economic development and as an investment partner.

We believe it should be Imperial's ambition to grow Imperial West as an innovation district where university leadership co-exists with a balance between start-up, corporate and government initiative.

Provided Imperial West gets this balance right, it could be well placed to position itself as Europe's leading innovation district, **rivalling some of the most innovative and entrepreneurial "high-buzz" places** around the world. Our findings are organized along the four key components of a functioning ecosystem: universities, start-ups, large corporations, and government support.

Universities

The reason why start-ups and large corporations seek locations close to leading universities is to have access to **cutting-edge basic and applied science**. Imperial West must safeguard long-term funding for fundamental and applied science to ensure it remains world-leading in the areas of expertise on which the venture proposition is to be built.

Many interviewees advocated the view that in order for a cluster to gain **traction and visibility**, as well as attract government funding and corporate investment, **a clear profile** around a limited number of areas of excellence is advisable. This profile might be built on individual disciplines, but increasingly university science parks are organized around interdisciplinary **grand challenges**. The College will have to put forward a **bold vision** as to what **signature Imperial West** will have. A profile combining the **historical strengths** of the College with forward-looking **overarching themes containing clear promise** would heighten the appeal to investors, entrepreneurs and prospective tenants of Imperial West.

Commercialization expertise and translation capabilities in universities cannot be taken-for-granted. The College may want to review how current **education programmes** equip students with **entrepreneurial and industrial skills**. Current students should be seen as future alumni and must be prepared for their potential role in science and innovation ecosystems like Imperial West, for example through exchange programmes with high-buzz places. Part of the solution for ensuring that academics are prepared for science translation activities lies in the **selection of academics** in a cluster ecosystem. Selection of individual academics, through **competitive entry practices,** can be a crucial lever to foster an academic culture that promotes interaction with start-ups and large corporations.

Various cluster initiatives around the world engage in **international collaborations between universities** to access a **global pool of talent**. To widen the appeal of a cluster to foreign corporations, entrepreneurs and academics, the College may want to integrate its vision for internationalization into its vision for Imperial West, in particular in an attempt to harness entrepreneurial talent from emerging economies.

Start-ups

Cluster initiatives around the world have strongly embraced entrepreneurship – incubation and acceleration of start-ups in particular – as an essential component of a cluster ecosystem. Various interviewees have emphasized that selection of ambitious, high-growth entrepreneurs into the ecosystem is key. **Incubators** at Imperial West should opt for **quality rather than volume**, by creating prestige incubators and accelerators for example. Early high-quality entrepreneurs are more likely to **contribute to community building**, may act as **magnet tenants** for future entrepreneurs, and can act as **mentors** for future entrepreneurs.

Successful entrepreneurs might therefore take on mentorship roles for younger start-ups and play a key part in building an **ecosystem community**. Traditional incubation and acceleration models leave little scope for retaining a strong bond with successful entrepreneurs that have grown too successful for incubation and too large for acceleration. Given **space constraints**, **successful small businesses** are often forced to locate much further away. **Flexibility of space offerings** should feature prominently on Imperial West's agenda in order that growing start-ups can remain nearby and are not forced out of the ecosystem. The College could review its current incubation model and examine how best to accommodate the space and mentoring requirements of start-up companies at different stages of development.

Although start-ups are at high risk of failure and may fail to create positive returns for the cluster in the short term, in the longer term **it is their vibrant entrepreneurial community that appeals to corporate investors and government officials**. Yet it may be difficult initially to build **a viable financial model** around incubation and acceleration. This may in part be justified by the **value** that corporate investment, government bodies and subsequent entrepreneurs place on the **quality and vitality of the entrepreneurial ecosystem**. Once such a functioning system is in place, competitive (yet not subsidized) rents should make a **positive financial return** on incubation more feasible. Universities might not have to carry the burden of non-viable financial incubation models alone. **Corporations** who place value on creating such ecosystems can be **investment partners** in building incubation/accelerator space.

A final key ingredient to the entrepreneurial component of a cluster ecosystem is **access to risk capital**. University tech transfer offices help entrepreneurs to source venture capital. In the UK the venture capital infrastructure is less developed than for example in the US, making it a priority for the College to provide the right opportunities for early entrepreneurs to attract funding. For instance, some cluster initiatives in the US have appointed a **'Chief Entrepreneurial Officer'** who plays a key role in helping start-ups to establish connections with the investment community. It may also help to have entrepreneurial highflyers on the College management or advisory board - a model adopted by several high-profile US universities.

Large corporations

Corporations seek **vicinity to excellent breakthrough science, excellent students** and entry **into the "buzz" of promising start-ups entrepreneurs** who operate in pre-competitive areas of strategic importance to them. It is research excellence that is the major pull factor for corporations seeking entry into clusters. An **unambiguous message** on where Imperial West will excel will resonate strongly with the business world and help attract their investment. It is important that Imperial West deliberately seeks to **diversify corporate investment** to avoid dependence on single large-scale investments of companies that can be highly 'foot-loose'. Multinational corporations place great value in the ability to tap into the pool of entrepreneurial skill in vibrant cluster ecosystems, and are often ready to contribute towards creating such ecosystems via active investment in incubation and acceleration programmes.

Government support

The **formula of ecosystems** that combine research excellence of universities, the commercialization capabilities of large corporations and entrepreneurial energy and creativity have **very strong appeal** for government in the current political and economic climate. In other UK clusters, the government has played a key role in raising the profile of emergent clusters, generating international visibility and catalysing corporate interest.

The following page contains a **"checklist"** of questions that Imperial West may wish to consider, with reference to page numbers where the issue is discussed in greater depth.

Question	Page
Defining Imperial West's profile	
What are the College's core areas of strength - in basic and applied research - that lend themselves to forming a foundation for Imperial West?	11, 37, 38, 52, 56, 60-63
How can the College capture these areas of strength in a bold vision or profile based on 'grand challenges', which signal Imperial West's aspirations to the rest of the ecosystem?	11, 37, 38, 52, 56, 60-63
How can the College best safeguard long-term investment in its core activities of fundamental and applied research ("patient money"), as something which is core to the value proposition in the eyes of investors, entrepreneurs and prospective corporate tenants of Imperial West?	24, 35, 56, 62
How can Imperial West ensure that its vision balances the presence and involvement of large corporations and entrepreneurial activity? And how does it ensure implementation of the vision balances corporate and entrepreneurial elements?	41, 47, 61, 65
How can Imperial West ensure it sends an unambiguous message to prospective investors and tenants in terms of vision and profile?	27, 52, 57, 65
Should the College build a partnership with foreign universities to create greater international standing for Imperial West and ensure attraction of a global talent pool?	31, 34, 51
How does Imperial West's vision and ambition appeal to philanthropic funding?	57
Incubation and acceleration	
How does the College ensure that initial start-ups in Imperial West's incubation and accelerator space are of the highest possible quality? And how does the College ensure it strikes the right balance between quality and volume when populating its incubators?	60, 61
How does the College balance striving for a critical presence of high-quality entrepreneurs with reaching a viable financial model of incubation and acceleration?	42-45, 64
How does the College's current incubation model need to be adapted to best accommodate the needs of different types of start-ups (e.g. student businesses, staff spin-offs) at different stages of development?	43-45, 64
How does Imperial West's incubation and acceleration model ensure built-in flexibility of rental contracts such that tenants are offered realistic time frames to get off the ground whilst preventing that space from being occupied by underperforming start-ups?	42-43, 64
How can Imperial West be designed to ensure space offering is flexible enough for incubated/accelerated businesses to locate nearby and thus prevent them from being forced out of the ecosystem?	11, 37, 44-44, 52, 63
How can the College best help start-ups located at Imperial West to access risk capital?	22, 24
How can the College facilitate and accelerate the building of entrepreneurial skills in its education programmes that actively contributes to fostering a new generation of entrepreneurs?	32, 52, 63
Should the College consider appointing a Chief Entrepreneurial Officer who is responsible for managing a system that combines the highest quality start-ups with a viable financial model?	32, 64
Should the College establish a task force that establishes best practices for identifying promising start-ups?	63

Building a community	
How can Imperial West optimize shared space between academic and industrial scientists to facilitate the transfer of commercialization expertise and translation capabilities?	24, 27, 32, 48-60, 55, 63
How can the College take advantage of its alumni network to build an innovative and entrepreneurial community around Imperial West?	14, 48-49, 50
How does the College ensure that the university presence at Imperial West forms a coherent and cohesive set of activities prone to engagement, both within the academic realm and with entrepreneurs and corporate scientists?	30, 60, 63
What is the governance structure Imperial West should put in place to ensure university initiative is balanced with entrepreneurial initiative, corporate initiative and government support?	38, 62, 65
How can the College ensure the architecture of Imperial West incorporates investment in state-of-the-art digital infrastructure?	55, 64
How does the College ensure that its IP policy does not stand in the way when building industry collaborations and the engagement of academics in entrepreneurial activity?	58
Attracting corporate partners, investors and tenants	
How does the College ensure corporate investment in Imperial West is balanced and diversified in a bid to minimize dependence on just a few large investors?	47, 65
How does Imperial West ensure that its search for corporate involvement does not overlook opportunities for smaller scale investment?	47, 65
How can Imperial West design a mechanism that allows large corporations to (co-)invest in incubation and acceleration of start-ups?	27, 38, 65
What checks and balances could Imperial West adopt to ensure its vision and profile resonates with both the city and national government?	31, 65
How can university board membership help achieve corporate involvement in Imperial West?	52
Engaging Imperial's academics	
How can competitive entry of individual academics into Imperial West help to select academics likely to interact with entrepreneurs and corporate scientists?	33, 47-48, 52, 62
Should the College consider doing a Social Network Analysis of current staff to identify existing connections of academics to business parties that may be potential leads for corporate partners and investors?	62

1 Introduction

1.1 The changing pathways to innovation

Over several decades, the industrial context of innovation has undergone a massive transformation. Universities have widened their brief from an exclusive focus on research and education to a broader commitment to the translation of research into innovation. Notable exceptions aside, large technology companies increasingly struggle to obtain positive returns from R&D and to retain their role as leading innovators. Relative to smaller firms, they are slow to keep up with changing markets and often lack the agility to drive disruptive technological change. Large tech companies increasingly outsource parts of their R&D and acquire specialist technology companies whilst reducing spending on internal fundamental research in an attempt to innovate from within. Small tech companies seem to have taken the lead in driving such transformational change, yet their success cannot be seen in isolation from their dependence on universities and large corporates.

The changing pathways to innovation comprise an intricate web of interactions between large technology companies, entrepreneurial initiatives and universities. In light of these developments, Imperial College London needs to take a step back and reflect on its role as a world-leading university in the context of science and innovation in the 21st century. Imperial West is an unprecedented opportunity to rethink how the College can build and expand as a district of science and innovation that competes with the most innovative 'hotspots' from the world-stage. Imperial West can become an innovation district where large corporations, entrepreneurial activities and academic research and education form an ecosystem that excels in driving science and innovation forward over the next century. Learning from academic research on this topic, as well as in-depth studies of comparable initiatives, this study aims to understand how this ambition can be realized.

1.2 Study objectives

Inform decision makers at Imperial College London about the **feasibility of realizing an innovation district** that can live up to its promise as a world-leading cluster for science, technology and innovation.

- Identifying the factors that may drive the successful creation of an interactive and entrepreneurial innovation district
- Providing guidance for best practice and insight into the potential pitfalls.

1.3 Methodology

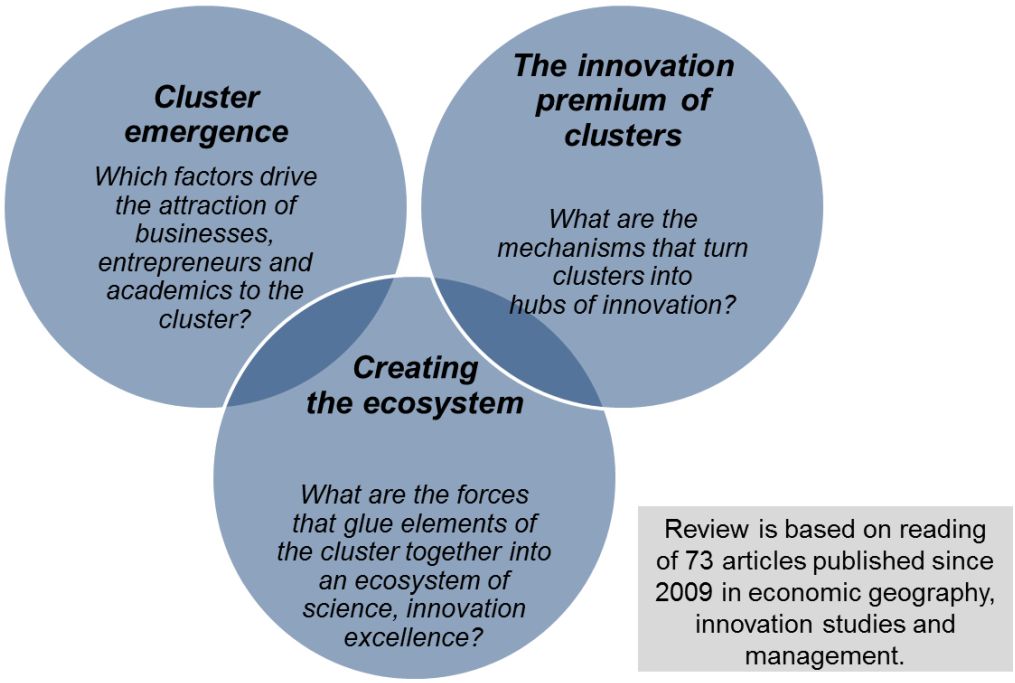
- Section 2: Review of the relevant academic literature
  - ➔ *We performed a full review of the academic literature on geographical clusters, incubation, and research valorisation. The review includes 73 articles published since 2009 in the main high-impact journals in management, science, innovation studies, and economic geography. Details of the systematic search can be found in Attachment 1.*
- Section 3: Conceptual framework for the creation of innovation districts
  - ➔ *On the basis of insights obtained from the literature study and observations at four leading US universities, we developed a conceptual framework that summarizes our thoughts on what an innovation district is and how it emerges, develops, grows, and flourishes. The framework defines universities, large corporates, small businesses and government as the four key constituents of innovation districts and argues that it is the functioning interdependencies between these four constitutes that can make or break an innovation district.*
- Section 4: Cluster case studies UK
  - ➔ *We then studied 8 UK clusters through interviews with key stakeholders and archival analysis. The clusters differ in where the early origins of their formation lie: large corporates, small businesses, universities or government. We analyse these 8 clusters in detail to see which factors have contributed to (or constrained) the emergence and growth as a district for science and innovation.*
- Section 5: Further observations from clusters around the world
  - ➔ *Based on recommendations from UK cluster interviews we went on to study the dynamics of 5 international cluster cases, selected from North America, South East Asia and Western Europe. Each case analysis is based on web research and interviews, which highlight different challenges and opportunities faced by the actors involved (predominately local governments, universities and property developers). Factors relating to cluster emergence in different geographical and industry contexts were considered. Implications for Imperial West are discussed.*
- Section 6: Observations from the US: NYU, MIT, Berkeley and Stanford
  - ➔ *On the basis of site visits and interviews, we have undertaken a review of how four leading universities in the USA. (MIT, NYU, Berkeley and Stanford – see Attachment 2) Each of these have responded to the changing context of innovation, in particular the increasing trend for collaborative modes of innovation between the corporate sector, entrepreneurial ventures and academia.*
- Section 7: Summary and conclusion: Building Imperial West as an Innovation District
  - ➔ *We used insights from interviews with stakeholders in a variety of UK and international cluster initiatives and observations from visits of four leading US universities to provide a set of best practice and potential pitfalls for the creation of successful cluster ecosystems. Our findings are organized along the four key components of a functioning ecosystem: Universities, start-ups, large corporations, and government support. Some reflections on the "makeability of clusters" are also included.*

2 Literature review

Research on clusters, science parks, university technology transfer and their impact on innovation is positioned at the interface of a variety of academic literatures. **Economic geography** is interested in the fundamental question of how the physical collocation of related and unrelated activity contributes to the generation of innovation. **Innovation studies** puts innovation itself centre-stage. An important question in this stream of research is how a variety of actors and institutions – including universities, corporations and entrepreneurs – contribute to driving innovation and economic growth. Finally, **management and organization** studies takes a different approach, which addresses how firms benefit from building innovation capacity by being connected to – and collocated with – external organizations.

This section presents a review of the relevant literature, consisting of 73 articles published since 2009 in geography, innovation studies and management, as well as a general understanding of the pre-2009 literature. Findings from the literature are organized around three main questions (see Figure 1), which are directly relevant to Imperial West.

Figure 1: Organizing framework for literature review



2.1 Cluster emergence

The concept of clusters has gained great popularity as a policy tool used by governments. Universities justify their ambitions to build science parks on the increased **belief that clusters can be "engineered"** from scratch. However, the academic study of technology clusters is founded on areas of economic and innovation strength that have grown **organically**. In the first instance, academic cluster studies are concerned with the question of which factors make related activities converge on a single space, as a self-organized, autonomous process. Two main theories have tended to dominate our current understanding of cluster emergence processes.

The first, based on **Arthur's theory of path dependence**, stipulates that geographic clusters are the result of a combination of serendipitous early-events that inform location decisions of the first entrepreneurs, followed by pattern reinforcing processes that lead to spatial clustering of related activities. In this case, **spin-offs** from the first entrepreneurs tend to locate in close proximity to their parent firm, which leads to initial clustering. This clustering drives a range of agglomeration advantages – e.g. access to skilled labour and local knowledge externalities – which make it increasingly attractive for new firms to also locate in the cluster. Although some clusters might originate from government, university or corporate initiative, the cluster literature is in strong

agreement that start-ups and spin-offs often make up the initial critical mass of activities that lie at the foundation of new clusters.

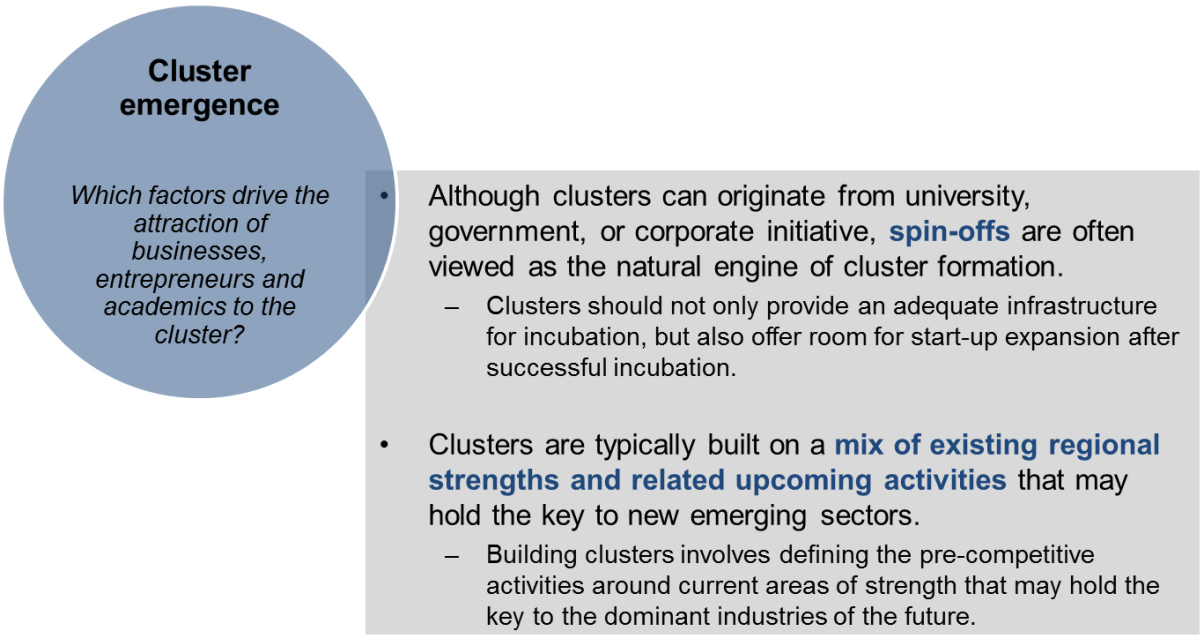
The second theory – a more recent perspective built around the concept of **related variety** – describes how new clusters, in new emerging industries often develop out of older, related industries. The reason why very few peripheral locations with limited prior industrial heritage fail to build clusters in new, emerging sectors may in large part be because an infrastructure of existing related industries is lacking. Economies that are characterized by specialization in a variety of related industries are best placed to conceive the creation of new industries, often built on the combination of prior industries. For example, the concentration of automobile production in the UK can be traced to prior existing producers of coaches and bicycles.

The literature on **policy-induced, organized initiatives** to build clusters is rather limited. Admittedly, attempts to build clusters from scratch – mimicking the success of organically grown clusters such as Silicon Valley - have been **largely unsuccessful** around the world. A notable exception could be Sophia-Antipolis, in the south of France. This cluster of life sciences and IT firms was built in a region lacking any industrial tradition, yet it took well over 30 years for any substantial clustering to take place.

So what can engineered cluster initiatives, including Imperial West, learn from these abstract theories of cluster emergence? First of all, **spin-off creation is the natural engine of cluster formation**. Universities play a key role in fostering the creation of start-ups by staff and students. These start-ups typically prefer to locate close to their parent organization. This implies that a cluster like Imperial West should **not only provide incubation space** for the youngest start-ups, but also provide the opportunity for s**uccessful start-ups to remain located nearby** when they wish to expand.

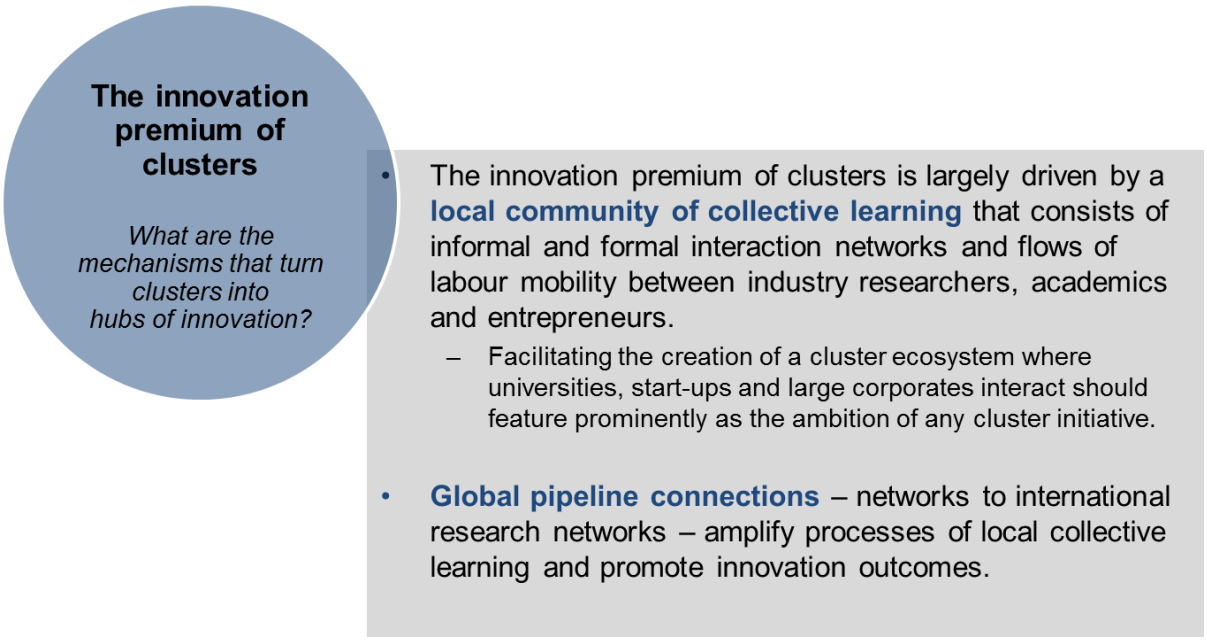
Second, clusters are best **built around existing competences, and related activities**. Attempts to build clusters around areas of expertise in which a region or city has only limited prior experience have been largely futile. London and, more specifically Imperial is home to a competitive mix of skills and capabilities. It is important for Imperial West to consider which **mix of current qualities** to build upon and to assess which of those **capabilities** might lead to the creation of **new sectors and industries** that will become dominant in future. While this is easier said than done, focusing on emergent, **pre-competitive activities** may ultimately hold the key to building an innovation district in emerging, rather than existing sectors that can compete on the world stage.

Figure 2: Summary literature review on "cluster emergence"



2.2 The innovation premium of clusters

Figure 3: Summary literature review on "the innovation premium of clusters"



Ever since the work of Alfred Marshall on agglomeration advantages at the end of the 19th century, economic geographers have been concerned with the question of why, and under which conditions, does clustered economic activity stimulate innovation and economic growth? In other words, what drives the alleged **innovation premium** of clusters?

Today, this question is tackled very differently than in the days of Alfred Marshall. In the traditional literature on clusters, the predominant explanations revolved around the availability of specialized, **skilled labour** and the presence of **specialized suppliers**. Although these factors are still important, the debate today is mostly concerned with knowledge-related advantages.

In the traditional cluster literature it was believed that firms collocated within a cluster could take advantage of "**knowledge in the air**", freely available to those within a cluster but inaccessible to those outside. Recent advances, in the literature, have challenged this view. Clusters need to exhibit **networks of local interaction** that can channel flows of knowledge between collocated organizations. Firms that are not connected to such networks have little chance of taking advantage of their location. So what do these local networks consist of?

Clusters typically exhibit **informal networks** of knowledge exchange and collective learning, often summarized as "**local buzz**". Entrepreneurs, academics and industry researchers come to know each other and contact each other for advice, input or even informal collaborations. In addition, employees in many, innovative clusters typically have high levels of **job mobility** channelling flows of knowledge between the local organizations from which they move. In addition to those informal, unplanned forms of exchange, clusters are also home to **more formal types of interaction**. In particular, a considerable share of **university-industry interactions** takes place on a local scale. There is increasing evidence that local engagements between high-profile universities and companies contribute more substantially to innovation than comparable long-distance university-industry engagements. Advantages of local relative to non-local knowledge exchange and collaboration are related to transfer of **tacit knowledge** and the build-up of **trust**, both of which remain easier at close geographic proximity despite the advance of digital technology.

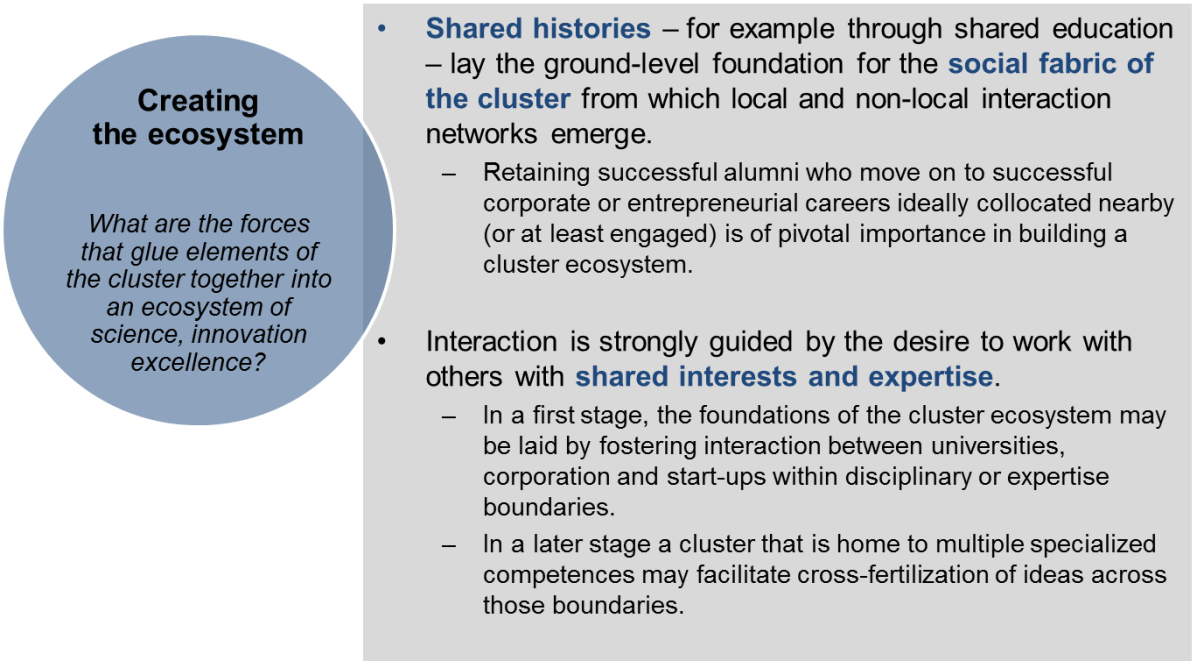
Despite the growing awareness of the importance of local, within-cluster networks, it is increasingly understood that clusters can only flourish when connected to global research networks. Typically

dubbed **global pipelines**, these international networks bring local knowledge into a global perspective. There is growing evidence that regional clusters struggle to remain competitive when they remain blind to market and technology developments unfolding further afield. In other words, **cognitive lock-in** may occur if firms do not keep track of new developments outside their core local network.

Cluster initiatives like Imperial West therefore need to consider carefully how to build infrastructure upon which local and non-local networks can emerge. Too many organically grown or policy-induced clusters have materialized as **mere agglomerations**, where students, academics, entrepreneurs, and companies form isolated islands of science and innovation activity and the "**added value of a community of collective learning**" is not realized. In particular, universities may operate relatively autonomously, failing to embed their staff in the local life of entrepreneurial activity. The following section will address how such an ecosystem – that is both internally cohesive and externally connected – can be created.

2.3 Creating the cluster ecosystem

Figure 4: Summary literature review on "creating the cluster ecosystem"



Given the importance of local collective learning, the question arises what are the factors that glue the elements of a cluster together to form an **ecosystem of science and innovation excellence**? Research at the interface of geography and innovation has looked into the determinants of **network formation** within geographical clusters. Two main insights have come to the fore as the key drivers of local network emergence.

First, both formal and informal interactions are built on a **social fabric of shared histories and experiences** among individuals. For example, informal networks of advice seeking from engineers working for different companies in the cluster tend to be based on shared professional experiences and educational histories. This is why **universities** in clusters such as Silicon Valley typically play a **pivotal role** in constructing a cluster social fabric from which future formal and informal interactions will emerge.

It may require **deliberate alumni policies** on the part of Imperial College London to retain graduates who move on to successful careers in business or as entrepreneurs, and keep them in the immediate vicinity of Imperial West or at least engaged as "global pipeline" connections. The approximate 30,000

Imperial alumni based in London form an invaluable resource for the early-stage social fabric of Imperial West. In a similar fashion, **international events** are crucial to facilitate global pipeline connections. Bringing experts together from around the world plays a key role in placing Imperial West on the world scene. Such **prominence** helps to ensure that leading global players see parties at Imperial West as worthy partners in science and innovation collaborations, making it easier, for example, for young entrepreneurs at Imperial to build global connections.

Second, networks of collaboration and interaction are most likely to emerge from shared interests, shared objectives and shared expertise. Often understood simply as '**common ground'**, the vast majority of exchange and collaboration relationships materialize when individuals are driven by the same set of goals. For that reason, it may comes as no surprise that communication and exchange within expertise areas is easier established than communication across different expertise areas. It has been found that **multi- and inter-disciplinary interaction** come about most easily, when all individuals involved share the same set of values and objectives. For this reason, interdisciplinary teams have been most successful when united around **'grand challenges'**, which ensure all members work towards the same objectives, despite substantial differences in their disciplinary backgrounds.

Multi- or inter-disciplinary interaction is considered an important driver in the **creation of novelty** and thus should feature prominently on the agenda of Imperial West. Although being united around grand challenges is an important facilitator of interdisciplinary interaction, it must be acknowledged that in first instance interactions may be more easily established amongst individuals within disciplines. Interdisciplinary networks in Imperial West may thus emerge in a two-step process. First, **early foundations for an ecosystem** of interaction are most likely to be laid amongst individuals with high levels of common ground. Particularly given that individuals already have to overcome obstacles of working with different types of institutions (e.g. universities working with industries; large corporates working with start-ups), they may exhibit a strong preference to engage within the familiarity of their area of expertise. In clusters where multiple specialized areas of expertise, preferably around a selection of grand challenges, are collocated, it may only be in a later stage that interaction across disciplinary and expertise boundaries occurs.

In summary, clusters can build potential for **novelty via knowledge recombinations** through a two-stage process. The first step involves a careful selection of the specialized target competence areas to be locally represented, in terms of academic, corporate and entrepreneurial presence. These competence areas are preferably organized around a selection of **grand challenges**, which will in turn facilitate interaction across disciplinary boundaries. **Specialization around key competence areas and grand challenges** help to build the foundations of local networks of collective learning. In a second stage **cross-fertilization** across competence areas and grand challenges occur. Such cross-fertilization processes are very hard, if not impossible, to predict and manage. Yet, by creating a local presence of multiple competences, Imperial West will be well-placed to facilitate them.

3. Conceptual framework for the creation of innovation ecosystems

On the basis of our reading of the literature, we developed a conceptual framework about how innovation ecosystems emerge and develop over time. The framework is rooted in the observation that **clusters create valued added for the parties present when they function as an ecosystem**. An ecosystem is a place where multiple types of agents cohabit, and where it is the interdependencies between those different agents that make the system as a whole work much better.

The two core assumptions of our framework are that:

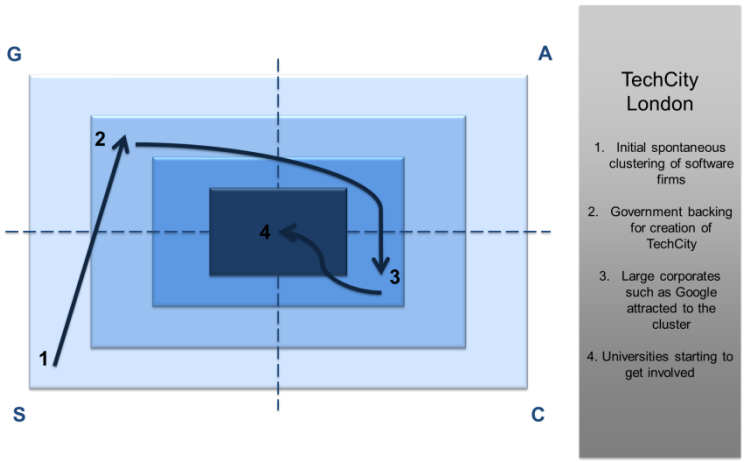
- **Small businesses, large corporations, academic organizations and government bodies form the key constituents of a well-performing cluster ecosystem.**
- **The performance of the ecosystem depends on the successful exploitation of synergies between the different constituents.**

We will use the framework to analyse our interview material. In particular, the framework provides a useful lens that helps interpret historic accounts of how existing clusters originated and developed and thus provide a useful platform from which to draw lessons from those clusters for Imperial West.

Clusters around the world differ in terms of where their very origins lie. Some clusters, such as Silicon Valley, are "**start-up-led**", in the sense that the cluster is built on the early foundations of a concentration of high-tech start-ups. It is on these foundations that later engagement of universities, government or large corporations is based. Other clusters, typically dubbed science parks, are "**university led**". Here the origins lie in the desire of universities to attract start-ups, large corporations, and governmental support. A third type of cluster is "**corporate led**". Throughout history, large corporations have been attractive to universities and entrepreneurs wishing to locate in their fringes. The technology campus around Philips in the Netherlands and the Stevenage Bioscience Catalyst around GSK UK are prime examples. Finally, there are clusters which are largely **government-led**. Particularly in areas in need of economic regeneration, it is fairly common that the initiative to create innovative clusters is with government.

Central to the framework is the idea that, regardless of which constituent sparked the cluster's early development, **it is the subsequent involvement of additional constituents that drives value creation and appropriation beyond the level that would be reached by cluster members individually.** For example, a cluster may start from the organic growth of start-up companies that lead to initial industrial concentration. However, it is only when academic, corporate and government components are added to the system that those start-ups begin to excel beyond what they could do purely by themselves and the creation of an ecosystem occurs. TechCity provides a good example (see Figure 5).

Figure 5: Development trajectory of TechCity



Before being labelled **TechCity**, the area around Shoreditch and Old Street in East London was already home to an initial concentration of small software businesses. On that basis TechCity is a start-up led cluster. When the area came onto the government's radar, it was serious government backing that put TechCity on the map and catalysed investment from large companies such as Google. The final step towards a complete ecosystem is that universities are increasingly involved in collaborative projects with start-ups. The gradual evolution of TechCity as a complete ecosystem is graphically depicted as a spiral where sequential involvement of different constituents shows a trajectory towards the centre of the graph.

Productive interdependencies between entrepreneurial, corporate, academic and government constituents thus form the basic building blocks of functioning cluster ecosystems. Figure 6 illustrates the interdependencies between the first three types of constituents with interview quotes. See Appendix 3 for a list of interviewees.

Figure 6: Interdependencies between start-ups (S), large corporates (C) and academia (A)

…depend on…

How does….	S	C	A
S	"It's part of the culture, that the older entrepreneurs, the more successful ones, will mentor the younger ones, start-ups, and invest in them and support them very closely."	"There's a lot of mentoring that goes on of new start-ups by established companies" "We see interesting concepts or interesting products [from start-ups] and we basically help them guide to the next stages of development. And we can do that with capabilities, with knowledge. We can give them money… or even control it, if we want to go that far."	"And in fact the most valuable thing the university has done is it's trained some very good employees." ""Academia needs to stay true to its value which is excel in fundamental science and long-term value creation".
C	"…regular interactions, investing time in building relationships and getting acquainted with people, understanding their ideas… We [large corporate] truly do believe that by investing time, together with the [university and start-up] innovators is the key investment that we will have to do… to identify where are the opportunities". "What Google in TechCity are able to do is get insight into talent and to ideas and to trends … a foothold in the community."	-	"…regular interactions, investing time in building relationships and getting acquainted with people, understanding their ideas… We [large corporate] truly do believe that by investing time, together with the [university and start-up] innovators is the key investment that we will have to do… to identify where are the opportunities". "University can play a role not as the standard setter, but as a place... as a convener where people who care about the standards get together, RFID, the World Wide Web Consortium, there are a bunch of other things MIT owns."
A	"Few academics have the skills to effectively commercialize scientific knowledge. They need to have the business and entrepreneurial skills locally available to help them achieve that"	"Few academics have the skills to effectively commercialize scientific knowledge. They need to have the business and entrepreneurial skills locally available to help them achieve that"	-

Start-ups depend on each other, particularly because of informal advice, exchange and mentoring between companies. They benefit from the presence of large companies in the ecosystem mainly because large corporates have the complementary expertise and skills to bring innovative products or services to market. Start-ups benefit from proximity to universities, naturally as a source of talent, but also as a direct channel to expertise on the fundamental scientific underpinnings of new technologies.

Large corporations benefit from the vicinity of start-ups to get a window on the latest technology developments, which increasingly originate in small tech-start-ups. Being near a vibrant community of start-ups helps them to stay aware of those developments and may give them a leading edge over

competitors for the identification of potential acquisition targets. Corporations benefit from engagement with universities in the ecosystem as a partner in their longer-term R&D projects as well as a sparring partner that keeps them grounded in the fundamental scientific principles which underpin their projects and products.

Academics benefit from the proximity of an entrepreneurial community and of companies eager to collaborate as a way of facilitating technology transfer, licensing, and the creation of academic spin-outs. For most academics, each of those activities is a substantial departure from their regular academic work. Positive reinforcement from entrepreneurs and corporates can help academics locate channels for research valorisation and commercialization.

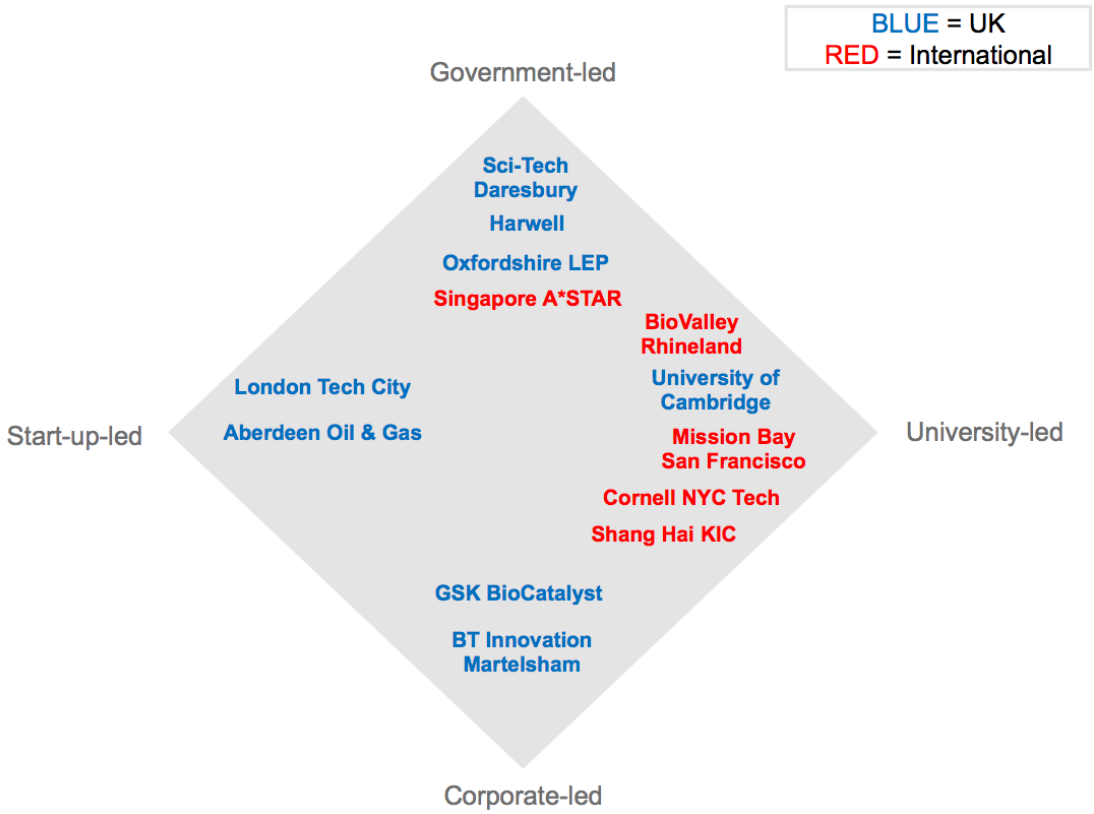
4. Analysis 1: Cluster case studies

4.1 Sampling of cluster studies

The conceptual framework in Section 3 has shown that clusters can originate from university, government, corporate or start-up initiative. It has advocated the view that an ecosystem starts to flourish when all these types of constituents are present in a cluster and when initiative is balanced between them. This section is built on the premise that Imperial West, in its quest to become an innovation district, can learn from how university-led, start-up led, government-led and corporate led clusters in the UK and internationally have emerged and developed. This section aims to show how clusters with different origins subsequently engaged other parties. How did university-led clusters attract corporate investment, start-up activity and government support? And how did start-up led clusters obtain involvement from universities, the corporate sector and the government? Given that Imperial West is a **university-led initiative**, the key question is how can it build **balanced government, corporate, and start-up involvement?**

We positioned our cluster case studies within a four-dimensional "initiative" framework as depicted in Figure 7. Seven UK cluster cases and three international examples were selected for analysis. This involved online research; site visits and a total of 16 key participant interviews, carried out either face-to-face or over the phone. Transcripts were uploaded into NVivo software and analysed using established qualitative techniques (e.g. categorical analysis). Attachment 3 shows the number of interviews conducted with individuals from the various settings.

Figure 7: "Initiative" framework for selected cluster cases



The **university-led clusters** include the cluster around the University of Cambridge in the UK and the new campus at Roosevelt Island (New York), established by Cornell University. **Start-up led clusters** have grown more organically; the cluster prospers largely because of entrepreneurial initiative or regional specialisation led by SMEs. **Governments** also play a significant role in cluster emergence, whereby regional economic policy provides essential impetus for investment, whilst government support mechanisms can also have a significant impact on cluster development and in some cases

*re*development. There are also clusters where **multinationals** play the dominant role, as is the case in BT Innovation Martelsham and GSK BioCatalyst in Stevenage.

Our conclusion is that while cluster emergence can be attributed to a key 'actor' providing the impetus for growth, clusters experience dynamic lifecycles which involve the involvement and interaction of multiple actors. This is demonstrated in our case studies, each of which experienced different development trajectories. We therefore consider:

What role (respectively) do start-ups, universities, multinationals and governments play in cluster emergence and development?

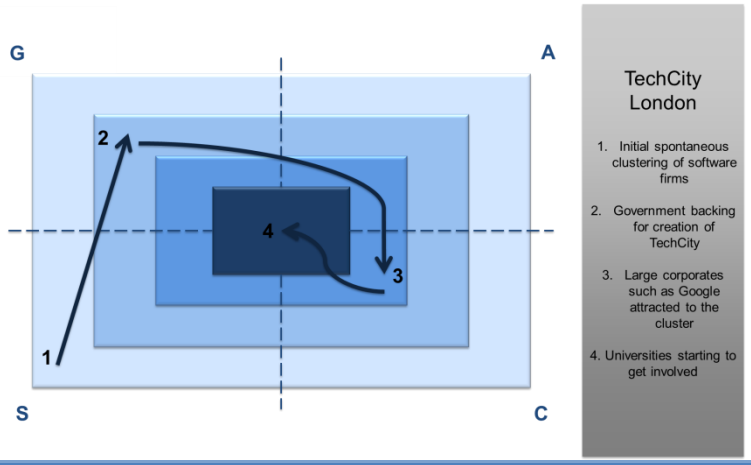
A brief narrative is provided on each case study and illustrated with interview quotes. Each sub-section is followed with a summary on each category.

4.2 UK clusters

This section considers the emergence and subsequent development of technology clusters; specifically the role of start-ups, universities, multinationals and government in seven cluster cases in the UK.

4.2.1 Start-up led clusters

Tech City, London



Est.	Sector	Trajectory	Facilities	Residents *		
				MNCs	SMEs	Univ.
1998	ICT	Start-ups-Government-Corporate-Academia	TechHub / TCIO / London & Partners	50	6,578	4

** Source BSD/Secure Data Service (Nathan, Vandore & Whitehead, 2012)*

Since the late 1990s and the lead-up to the dotcom bubble, a high-tech cluster has developed in Inner East London. Initially it developed organically, with a number of **software and internet start-ups** basing themselves around Shoreditch and Clerkenwell, gradually spreading across inner East London.

During these early stages of cluster development, there was little evidence of knowledge transfer between local firms normally observed in technology clusters. One interview with a company based in Old Street, described how *"little interaction was taking place at the time between resident companies"*. Subsequently, the company began to offer networking opportunities and office space to East London start-ups. It later emerged as an important interface between SMEs and larger companies in the East London tech scene, which up until that point had been poorly networked. It provided a place *"where different elements of the tech start-up ecosystem could come together in one place"*. By engaging corporate partners, resident start-ups, as well as local government and universities, it demonstrated the possibility of building an ecosystem with 'everything under one roof', a model soon adopted by the coalition government.

Strong **government interest** was based on the recognition that the future of advanced economies like Britain relies on the growth of an innovative, knowledge-based technology sector, as well as the existing importance of the digital economy to the UK economy, already taking the largest share of national GDP among the G20 countries. The labelling of the area as 'Tech City' in 2010 was a government initiative set up to propagate digital technology and attract global talent and investment via its flourishing start-up sector. By 2010 the clustering of small and medium sized enterprises in Inner East London accounted for over 3,200 firms suggesting its importance to both the national and the local economy. Reflecting this, Government Tech City had three related but distinct objectives:

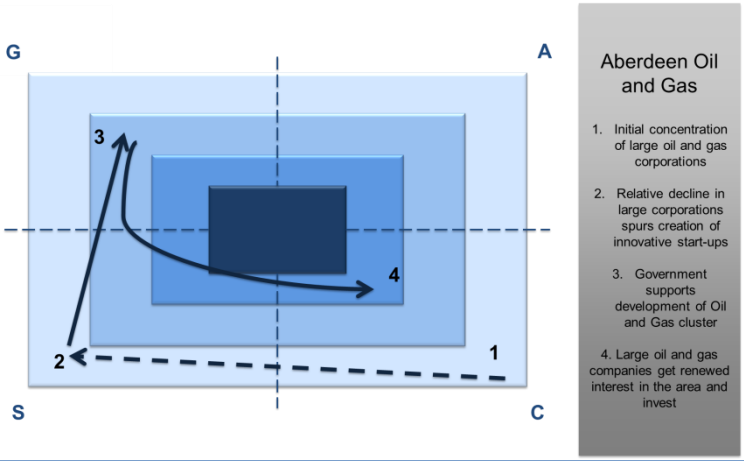
- Foster small and medium sized businesses in the area;
- Promote international investment;
- Encourage its spread eastwards to the Olympic Park and surrounding areas.

The principal agencies tasked with delivering this strategy are: the Tech City Investment Organisation (TCIO) – an organisation, originally a section within UK Trade and Investment, which channels £2.1m/year towards engaging industry with the area, London & Partners – London's Foreign Direct Investment organisation, and the London Legacy Development Corporation.

One government representative explained that the primary aim was initially: *"to drive investment into East London in the lead up to and during the Olympics"*. Since then, it has been increasingly taking on a national focus, with plans to *"build a bridge between Tech City and a dozen other tech clusters in the UK"*. The TCIO and the Mayor of London's Office have successfully attracted **investment from large multinational corporations** into the area, with Cisco, Google, Microsoft, Facebook, Intel and Vodafone opening up offices and contributing to its innovative climate and reputation.

Finally, **local and non-local universities** have also started engaging with Tech City, most notably around Olympic development projects such as the Intel Incubator and the Cisco-UCL-Imperial Future Cities Centre. Policy initiatives aimed at private sector developments more broadly have included the introduction of an entrepreneurship visa, R&D tax credits and the Enterprise Investment Scheme - all of which have been created *"on the back of challenges identified by the start-up business community, which have seen their way into policy in a very short space of time"*, as one participant remarked positively. Despite providing some useful incentives enabling SMEs to attract international talent and domestic financing, the government's drive to accelerate growth in the area has been criticised by resident SMEs. Independent reports suggest companies have gained very little as a result of policy aimed at redeveloping the area. Larger corporate entrants have pushed up rent on commercial property, forcing businesses out into other areas; not necessarily towards the Olympic Park as initially intended in the 'Tech City' plan.

Aberdeen Oil & Gas Cluster



Est.	Sector	Trajectory	Facilities	Residents*		
				MNCs	SMEs	Univ.
1969	Energy	(Corporate)-Start-ups-Government-Corporate	ACSEF / PILOT	50-100	1000+	2

** Source: Oil & Gas UK*

To provide an alternative context in which SME activity triggers initial cluster emergence, we included a case study on the oil and gas service cluster in the City of Aberdeen and surrounding area. Although the start-up activities that emerged in the early 2000s were built on the remnants of large multinationals, the revival of the cluster in the City region can be ascribed largely to the initiative of small firms. Although some may argue Aberdeen may best be described as a multinational-led cluster, we classify it as a start-up led cluster because of the central role of start-ups in regenerating the area.

While the development of the North Sea oil industry has brought considerable wealth to Aberdeen since the 1970s, early oil exploration and extraction was dominated by externally controlled **multinational corporations** (MNCs). The heavy reliance on large foreign companies raised concerns about the long-term prospects of the local economy. During the second half of the 1990s, a combination of large-scale outsourcing by MNCs and **government policy** following the 1998 oil crisis were the triggers that helped transform Aberdeen from an outpost of multinational North Sea oil and gas exploration into a global source of innovation and expertise in offshore drilling technologies. This important transition was led by **small and medium sized enterprises (SMEs)**, emerging out of the vertical disintegration of the North Sea oil industry. It was prompted by multinational oil companies seeking to reduce costs by outsourcing to specialist oil operators and engineering contractors, most famously by British Petroleum (BP), under then-CEO John Browne. Scholars have long recognised vertical disintegration as an impetus for innovation more broadly. In Aberdeen it was described as a 'transfer of expertise into new vehicles (SMEs)', which led to a deepening of local knowledge as well as a decreased risk that activity would relocate abroad.

Despite much of the talent being drawn from the oil giants themselves, the diversification of SME activity around Aberdeen in the early 2000s helped to enhance the transfer of accumulated knowledge and skills to other markets and sectors worldwide, making SMEs vital to the future growth of Aberdeen's economy. With more than 1,000 firms located within the cluster, SME activities incorporate the full range of products and services supplied to the large oil operators and contractors, from the manufacturing and repair of specialist drilling equipment and well-logging services to more generic business and IT services.
An interview with the founder of Nautical Petroleum, (previously a BP employee for 17 years) demonstrated how, as a result of the expertise available in the cluster, a small oil operator based in London, with no more than 9 employees could leverage the diversity of available contracting services to apply specialist drilling techniques to oil fields previously considered 'non-commercial' by MNCs. The discovery of smaller, less accessible oil fields combined with the knowledge advantages of regional agglomeration have given the Aberdeen cluster a new lease of life. Since 2008, the area has received **renewed interest from multinationals**, with the establishment of several new company headquarters, including Halliburton which opened new headquarters housing 500 staff previously working in separate locations. BP also opened up a new £60million headquarters in Dyce. As of today, universities play no significant role in the Aberdeen Oil and Gas cluster.

Table 1: Summary start-up-led clusters

What can IW learn from start-up led clusters?

Clusters grow organically when **built on existing regional specializations** and areas of strength.

The presence of start-ups in a cluster are a **force of stability**, as home-grown start-ups are less likely to leave than footloose multinational firms.

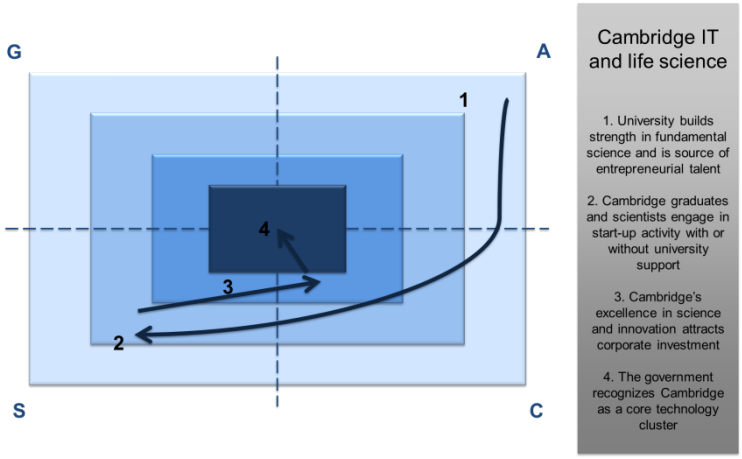
A **critical mass of of networked start-ups** is required to attract government attention and pave the way for large-scale investment.

Well-functioning capital markets – and in particular a **venture capital infrastructure** – are key requirements for the long-term growth and viability of local start-ups.

4.2.2 University-led clusters

Universities have traditionally played a limited role in cluster emergence and development, owing to a 'laissez faire' attitude towards entrepreneurial initiative emanating from the university and a lack of coordination of university-industry interaction. At most, UK universities have played a supporting role in so far as they have provided key factor inputs in the form of essential knowledge and raw talent. Universities' direct involvement in local "research valorisation initiatives is relatively recent. As a result of financial pressures and a mandate from the government to improve their translational activities, UK universities have become increasingly involved in a variety of research valorisation activities, a large part of which have a local orientation. Universities have set up new programmes with a focus on entrepreneurship and industry relevance, improved links with industry in research, and established technology transfer offices, incubators and accelerator programmes that offer funding and facilities to 'spin-outs' from staff and students. While there are many recent examples of university-led cluster development in the USA, the most relevant case in the UK is the Cambridge University cluster known as 'Silicon Fen'.

Cambridge ICT & Life Sciences Cluster



Est.	Sector	Trajectory	Facilities	Residents*		
				MNCs	SMEs	Univ.
1970	ICT/Life Sciences	Academia-Start-up-Corporate-Government	Cambridge Consultants / St. John's Innovation Ctr / University of Cambridge (Cambridge Enterprises)	50-100	1400	3

** Source: Cambridge Technopole Report, 2010*

Over the past 30 years, Cambridge and the surrounding area has become the UK's leading high-technology business cluster. In 1978, there were 20 high-technology companies within a 25-mile radius of Cambridge. By 2010 there were over 1,400 firms employing 43,000 people with combined revenues of £11.8bn (Technopole Report, 2010). Cambridge has since become renowned for expertise spanning technology areas vital to the UK economy, including ICT and life sciences, both of which share an important foundation in basic research.

The University of Cambridge has had a major input in the growth and development of the regional cluster around Cambridgeshire. It provided the impetus to transform itself from a 'medieval seat of learning to a great educational centre and knowledge-based business centre' (BVCA, 2012). Early on, an important supporting role was also played by technology consultancies such as Cambridge Consultants, which helped to incubate a family of **start-ups connected to the university**. Similarly the establishment of institutional R&D which followed close research links with MNCs has been important in attracting corporate investors. **Large companies** were important in injecting capital as well as applied knowledge into the university, especially during the 1990s when the cluster started to receive more systematic forms of private equity and venture capital funding.

Initially, the university took a 'laissez faire' attitude to the valorisation of university knowledge. This led scholars to characterise the cluster as a grassroots development, where new entrants such as Cambridge Consultants were acting in the face of a hostile university which 'frowned on commerce' as well resistance from the City and County Councils, which 'actively sought to prevent any industrial expansion in Cambridge and the surrounding area' (Kirk & Cotton, 2012). While this may have been the case early on in the cluster's development, attitudes have since changed. An effective cluster ecosystem has helped to create an enduring sense of community as well as a powerful networking and support structure, which provides start-ups access to laboratories, technology, skills, office facilities, business expertise, venture capital and financial advice.

The University of Cambridge has since indirectly produced, and in some cases nurtured, a number of spin-off and start-up companies based in Cambridge's science parks and incubators. Despite some early reticence, the university has become more involved in the ecosystem, fostering its own spin-outs through the establishment of a technology transfer office. An interviewee from the university's Technology Transfer Office suggests that after the financial crisis the university became more proactive in cluster development. This is partly due to pressure from the central government *"requiring that all universities attempt to take a stake in their spin-out companies and show a return from licensing new technologies"*. But it is also due to the recognition that most spin-outs in the high tech sector are linked directly or indirectly to the university. *"Yet the official university spin-outs are a very small proportion of the total'"*, suggesting the university could be doing more to appropriate value from their innovations.

Despite the strategic importance of the technology developed by Cambridge cluster firms, the UK **government** has had limited involvement in its development. This has also changed since 2008. The financial system that existed prior to this is cited as a root cause for preventing the region *"from becoming more important in the UK economy than it could have been"*. One interviewee claimed *"it's a wonder that it happened at all given the complete lack of support from the UK financial system that Cambridge companies have received… now it's the great white hope of the future. But the opportunity cost over the past three decades is incalculable'*.

However, a key strength of the Cambridge cluster has been the strong network established over many years of development. Starting as informal groups of like-minded individuals, it has become a diverse ecosystem of formal and informal organisations catering to different needs. These include entrepreneur-specific groups (e.g. St John Innovation Centre); investor support groups and sector and industry groups. The cluster's focus on fundamental research is identified by participants as having facilitated this continual transformation and allowed it to weather external challenges such as the recession.

Table 2: Summary university-led clusters

What can IW learn from university led clusters?

Universities' **strength in basic research** form the very fundament from which start-ups seek to commercialize **breakthrough** science and forms the main **pull factor** for investment from large corporations.

Commercialization expertise and **translation capabilities** cannot be taken-for-granted in universities.

University spin-outs are **capital-intensive** and require access to capital markets.

Development of cluster ecosystems can be stymied by **inertia and 'laissez-faire'** attitude within universities.

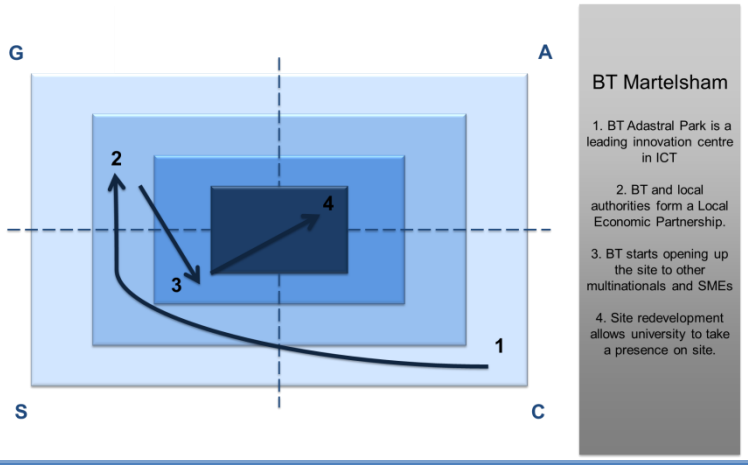
4.2.3 Corporate led clusters

A recent phenomenon in cluster emergence has been the role of multinationals in actively developing 'innovation districts' attached to corporate headquarters. In contrast to European cases such as in Sophia Antipolis, where agglomeration amongst large corporates occurred in order for MNCs to benefit from the colocation of R&D, we see in the UK that individual corporations take the initiative to foster their own cluster ecosystems and incubators for start-ups. This can be considered an important step, above and beyond corporate VC activity aimed at investing in innovative start-ups. In this way, corporations go the extra mile to create their own small-scale incubators at arms-length in order to keep up with fast-paced technology change, typical in sectors such as telecoms. Orange Vallée and Telefonica's Wayra are two examples of such initiatives.

We have studied BT and GSK, which in recent years have both been trying to build an open innovation ecosystem around their Research and Development facilities. Working with local government partners via LEPs (local economic partnerships) or universities to establish an open innovation ecosystem, their aim is to foster a suitable environment in which start-ups can flourish, and the multinationals themselves can keep track of technological developments amongst innovative start-ups.

BT and GSK differ in the model they have adopted to create such an ecosystem, but both provide start-ups with a wide range of facilities ranging from the use of specialist laboratories, to simply providing office space. While the first case (BT) adopts a more hands-off model as 'lead tenant', acting more as rent-collector, the second demonstrates an alternative model in which GSK has created an ecosystem that is specific to pharmaceuticals and seeks to attract spin-outs from local universities, by offering access to their labs and in some cases offering financing.

BT Innovation Martelsham



Est.	Sector	Trajectory	Facilities	Residents*		
				MNCs	SMEs	Univ.
2009	ICT	Corporate-Government-Start-ups-Academia	ICT cluster Incubator /Mentor Group/ Networking	20	20	71

** Source: BT Martelsham Prospectus (June, 2013)*

Adastral Park in the East of England is the location of BT's Global Research Development Headquarters. Having carried out pioneering work in optical technologies and telecommunications software for over 40 years, it is recognised as one of the world-leading centres of innovation in communications technology. Innovation Martelsham was established in 2009 as a joint initiative between British Telecom (BT) and local government authorities (Suffolk County Council). This **multinational-government partnership** was intended to encourage ICT-related companies to 'co-locate, collaborate and innovate' within BT's Adastral Park.

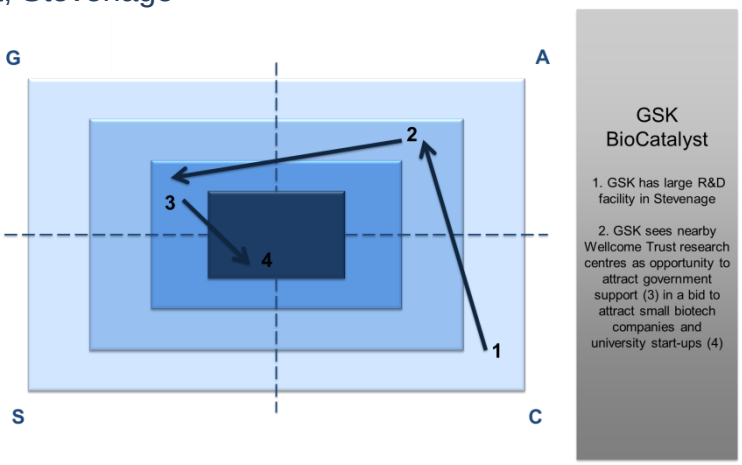
Although led by BT, Innovation Martelsham is part of a regional development programme launched by the Coalition government to promote '**Local Economic Partnerships**' (LEPs) across the UK. These

are formed on a geographical basis, although, in contrast to arrangements under the previous government, they are predominately *business*-led. The role of the UK government in Martelsham has been to source funding from EU and local growth funds and thus channel investment into regional development programmes such as the New Anglia LEP which received 80 million euros in 2012 for infrastructure-related projects. These grants will also help to fund the development of Innovation Martelsham, which has become one of the biggest centres for jobs and commercial activity in the East of England.

Today there are more than 4,000 ICT professionals working onsite at Adastral Park. The majority are employed by BT, but 600 of them are based in partner organisations which make up the ICT cluster. These include large **multinational companies** such as Alcatel-Lucent, BT, Cisco Systems, Fujitsu, Nokia Siemens Networks and Huawei Technologies as well as **smaller ICT companies** based within Innovation Martelsham. Besides being home to large companies and SMEs, it also includes an ICT business **incubator**. The incubator aims to nurture technology companies in their early stages, providing rent free office space and communications for at least six months as well as commercial advice from mentors who can provide support to help develop their businesses.

To ensure continued growth, BT is working with local and national government to redevelop the current Adastral Park site, together with neighbouring land. This will increase the available employment floor space and develop an expanded **university** presence at the site. BT acts as the **anchor tenant** without a formal board. Instead, it has a *"set of stakeholders that offers advice and checks that we're actually on track for our own targets, it consists of the local authority, Suffolk County Council, Suffolk Coastal District Council, but it also involved a local university (University Campus Suffolk), the new Anglia LEP, and decision makers within BT"*. Having worked as a BT employee in Adastral Park for most of his career, the Director of the initiative expressed concerns that the cluster should remain focussed around IT and communications, warning against government dilution of cluster activity as a result of 'political expediency'.

GSK BioCatalyst, Stevenage



Est.	Sector	Trajectory	Facilities	Residents		
				MNCs	SMEs	Univ.
2011	Pharma	Corporate-Academia-Government-Start-up	Bio-incubator / Accelerator / 'The Hub'	1	25	4

Stevenage Bioscience Catalyst is a £38 million joint venture between the Wellcome Trust, the UK government, GlaxoSmithKline (GSK), the East of England Development Agency and the Technology Strategy Board, to develop a bioscience park adjacent to GSK's R&D facilities in Stevenage, Hertfordshire. Located amid **a cluster of academic centres and other pharmaceutical companies**, the Bioscience campus is intended as a hub for early-stage biotechnology companies. It aims to provide small to medium-sized biotech and life sciences companies and start-ups with access to the expertise, networks and scientific facilities traditionally associated with multinational pharmaceutical companies.

The campus was established in 2012. Development is led by GSK which has so far provided land, facilities and investment of almost £11m to help build and launch the campus. With long-term plans to expand the campus fivefold, it offers a range of equipment, expertise and commercial opportunities that would be impossible for small or medium-sized enterprises (SME) to develop alone. Facilities include office and lab space within an **incubator** for start-up biotech companies, **an accelerator for late stage start-ups** to grow and a networking space in the form of **"**The Hub"**.** Tenants retain full independence and the freedom to interact with any commercial partners.

One GSK representative described the ambition for the incubator and accelerator space was to attract university start-ups, suggesting they would play a pivotal role in future: *"The University of Cambridge has a spot there, UCL is going to have a spot there, Imperial should have a spot there, and then lots of individual biotechs that have come out of Cambridge, London Colleges and Oxford… so it's a combination of space for incubating start-ups that are actually hosted by the universities, or biotech companies that have come out of universities, or academic labs".*

Table 3: Summary corporate-led clusters

What can IW learn from corporate led clusters?

Multinational corporations have **indispensable capabilities for commercializing innovation** and thus form a key ingredient of a cluster ecosystem.

Multinationals have a **direct interest in developing incubators** that should contribute towards creating vibrant ecosystems and thus should be seen as target **investment partners in new incubation** and acceleration initiatives.

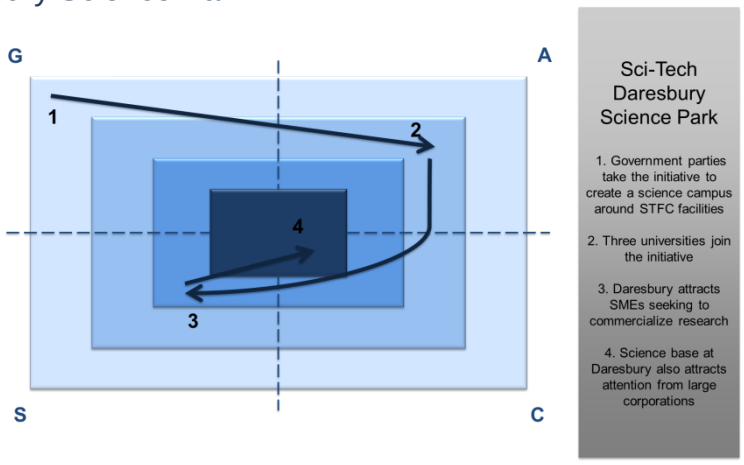
Multinationals can play a role in cluster ecosystems by providing **access to facilities** as well as **funding** for start-up firms and university research.

4.2.4 Government-led clusters

In 2010, the Hauser review was commissioned to investigate the current and future role of technology and innovation centres in the UK. As part of the inquiry, consideration was given to Germany's *Fraunhofer* model and whether it would be applicable in the UK. Founded in 1949, the **Fraunhofer Gesellschaft** is a research organization which undertakes applied research 'that drives economic development and serves the wider benefit of society'. Its services are solicited by customers and contractual partners in industry, the service sector and public administration. With its mission of application-oriented research and its focus on key technologies of relevance to the future, it was the inspiration for the UK's **Catapult Centres** – a national network of world-leading technology and innovation centres, which will receive more than £1bn of investment over the next few years.

We identified two government-led research clusters for our case study analysis – two of the UK's national science and innovation campuses: 1) Sci-Tech, Daresbury in Cheshire, home to the Accelerator Science and Technology Centre (ASTeC) and the Cockcroft Institute; 2) Harwell, in Oxford at the heart of Science Vale UK - a regional development programme for South Oxfordshire, comprising public and private sector bodies. Both clusters have a shared history under the remit of the Atomic Energy Authority. Historically, John Cockcroft (the British physicist who split the atom), established the two research labs in the field of nuclear physics; one known as the 'electron lab' (Daresbury) investigating lighter particles, and the other known as the 'proton lab' (Harwell), studying heavier particles. At the time, government science was a stand-alone enterprise and the concept of integrating government, academia and industry did not exist.

Sci-Tech Daresbury Science Park



Est.	Sector	Trajectory	Facilities	Residents*		
				MNCs	SMEs	Univ.
2011	ICT/Life Sciences	Government-Academia-Start-up-Corporate	Innovation Centre / Vanguard House Innovations Technology Access Ctr	3	80	3

** Source: STFC Website & FOI requests*

Sci-Tech Daresbury, in Cheshire is one of two national science and innovation campuses established by the North West Regional Development Agency (NWDA). It is part of a **government-led development** programme which includes the Science and Technology Facilities Council (STFC), Lancaster, Liverpool and Manchester Universities, and Halton Borough Council. Established in 2011, the aim of the campus is to promote world-class science, innovation and enterprise and support successful collaborations which will result in new business creation.

The Sci-Tech Campus intends to leverage the international reputation of the STFC Daresbury Laboratory and Cockcroft Institute, both of which are government research programmes that have been carrying out basic research and development for over 50 years. A senior representative in the Cockcroft Institute explained that the ambition is "*to combine academia, national laboratories and industry under one umbrella"*. He went on to explain some of the challenges, in particular relating to the different time frames for research and development: *"Academic research has very long time scales. It could take twenty or thirty years for knowledge generation to occur. Then there's government led, infrastructure-heavy laboratories like the Rutherford lab, expected to produce something visible within ten years or so, and then combine that with industrial exploitation of this knowledge… So you're talking about integrating activities which are very long range, which are medium range, and which are very short range, under one umbrella".*

By establishing an Innovation Centre in 2005, the STFC sought to attract **small and medium sized companies** looking to commercialise research in areas as diverse as advanced engineering, digital/ICT, biomedical and energy and environmental technologies. The science park is aimed at providing access to world class technology and support 'from concept to finished product' through established research facilities and support systems present on Campus. STFC backing has allowed Daresbury to establish a powerful network of stakeholders from academia, government science, the public sector and the broader business community.

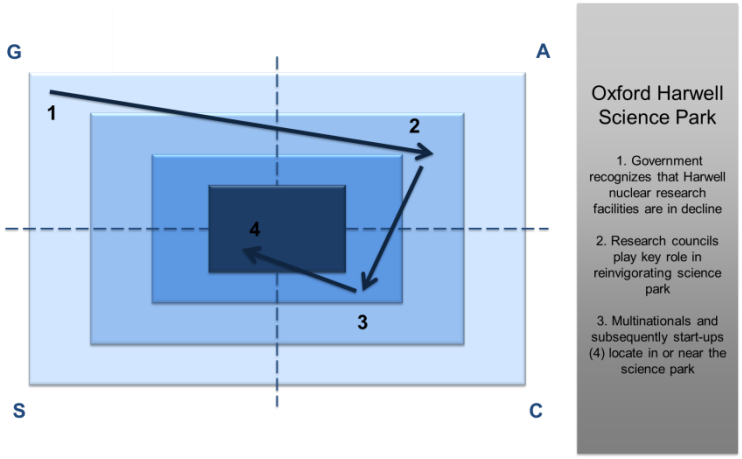
By offering a managed campus environment, which includes operational support and other services, the facilities are intended to attract small and medium sized businesses specifically, to collocate with firms already resident in the Daresbury cluster. However, one participant explained that **larger companies** and blue chips are engaged more easily with the science base of the research carried out at Daresbury: *"They can pulse into the core intellectual firepower of Daresbury in a way that smaller companies will struggle to do"*. Interestingly, in spite of gaining support from three nearby universities,

engaging academics around industry related research has been the biggest challenge for Sci-Tech Daresbury.

Similar initiatives have been attempted in the U.S. but our interviewee explained how the majority of these failed after gravitating towards one of the three actors: "*You start out thinking of combining the three but it ends up being entirely part of a university, or entirely part of industry - like Bell labs - or it becomes just a little sector within a national lab. They have failed. But here we seem to be succeeding, because we have the goodwill of the universities, the research council. Also the government wants to see it happen"*. Although it's a 'long way before the UK will see the benefits', countries such as Germany and the U.S. have propagated models similar the Cockcroft Institute, also combining universities with research societies.

Hence a major consideration when adopting a multi-party cluster initiative is the 'legality' of combining administrative systems. For instance, a research council laboratory is very different to industry and university administrations: *'To integrate the administrative aspects is a nightmare, legally and politically... We require a very good governance model to ensure this type of multidisciplinary, value added centre can be properly governed'.* This is achieved through a representative board of governors, meeting quarterly to set key objectives, representing the interests of all parties. It comprises the Vice Chancellors of each University (Liverpool, Manchester, Lancaster), the Chief Executive of the STFC and a senior representative from the relevant industry body. The strategy set by the board is *"not to be regional but to be associated with major universities and research labs across the UK. Deliverables are intended to be enhancing national technology as well as develop it in the international scene*". In this way, strategically important projects are prioritised, such as leading upgrades at the European initiative CERN as the UK 'partner of choice'.

Harwell Science Park, Oxford



Est.	Sector	Trajectory	Facilities	Residents*		
				MNCs	SMEs	Univ.
2006	Energy	Government-Academia-Corporate-Start-up	Science Park / Research Campus	50	150	5

Harwell Science Park is a joint venture between various **government and academic research institutes** including the STFC, the UK Atomic Energy Authority (UKAEA) and the property developer Goodman. The larger research community based in Harwell is made up of 4,500 researchers, engineers and innovators from more than 150 different high-tech organisations including the STFC, the Medical Research Council (MRC Harwell), Diamond Light Source, European Space Agency Harwell, Satellite Applications Catapult and Harwell Innovation Centre.

Today the residents also include **start-ups and multinational corporations** covering a variety of commercial applications including healthcare, medical devices, space, detector systems, computing, green enterprise and new materials. The Harwell Science Park represents a tiny proportion of the broader Harwell cluster. It is a smaller campus designed to bring SMEs together in order to benefit

from expertise at every stage of the new technology development process, from fundamental scientific research through to early-stage start-ups and large corporations.

The drive to turn Harwell into a science park in 2006 was a reaction to a ten year decline in the research work that had previously taken place in the Harwell campus, which had coincided with the gradual demise of the UKAEA. In contrast, the neighbouring Rutherford campus had flourished, taking with it much of the talent. The science park was established as a way of salvaging what was left, bringing it closer to the work of the Rutherford Laboratory and promoting 'spin-in' activity from external organisations and universities. In the beginning, despite a strong presence of academic researchers, one interviewee suggested a degree of resentment towards the way it had been imposed on residents: *"without some kind of a push, or an incentive, like a very prestigious senior position, the STFC realised it probably wasn't going to fly very easily"*. Therefore, investment by the government to attract the right kind of people to the Science Park allowed the research campus to reinvent itself as an industry-facing research cluster.

An interview with a retired lead scientist at the STFC in Harwell described the point at which the former Harwell cluster was dismantled and "*left to find its own future"*, following the privatisation of the energy sector. During the 1990s, nuclear power ceased to be a national priority and public involvement in the labs decreased. He described with a sense of loss, the Harwell cluster's 'raison d'etre' and its lack of cohesion as a Science Park: *"There are a couple of hundred companies on the website, but there doesn't seem to be any cohesion, they no longer have a director and each company seems to have to find its own way… Some are product manufacturing and development companies and only some are still high-tech. They have some of the people left, but the vast majority who were experts in nuclear power moved away"*.

The cluster has since diversified into new areas apart from its traditional basis in nuclear energy. While expertise still remains in fields such as renewable energy, the general view of resident scientists seems to be that government decisions which seemed sensible at the time were *"in fact very short sighted"*: Following the rejection of nuclear energy from the UK energy agenda, "*everyone [scientists at Harwell] were pretty shocked when they closed the facilities down"*.

Oxfordshire Local Enterprise Partnership

Est.	Sector	Trajectory	Facilities	Residents		
				MNCs	SMEs	Univ.
2011	Advanced Engineering / Space technology / Life Sciences	Hybrid: 1) Corporate-led and 2) Academia-led – networked by government	STFC / Oxford University; ISIS / Enterprise Zone /	50-100	1400	3

Source: Oxfordshire LEP Website

The wider area of South Oxfordshire has recently become part of a broader government vision under the Local Economic Partnership (LEP) framework. Having previously had one of the highest concentrations of research and development activity in Western Europe and an existing concentration of firms, universities and research centres, the purpose of government involvement is to develop a regional ecosystem. Through government intervention the vision is for it to become more heavily networked, connecting its constituent parts by offering support and encouraging inward investment through the provision of business incentives. The region comprises the global headquarters and R&D facilities of large high technology companies, STFC government research labs such as Harwell (above), Oxford University and a local Enterprise Zone, set up by the local government to attract SMEs and start-ups to the region.

There are three strategically important clusters based around South Oxfordshire. They should not be considered government-led clusters, since they build on pre-existing clusters of firms and research institutes that government action seeks to reinforce and thus are different from the cases above where government research institutes in relative decline form the basis for cluster policy. Yet, the three clusters are indicative of the role government has in further cluster development.

- ***Motorsport Valley*** is home to four Formula 1 teams based in the county. It is supported by 4,000 high performance engineering companies in the local area, providing a range of specialist offerings. Composite materials form a particular specialism with well-known companies active in this area.
- ***Oxfordshire Bioscience Network*** is the driver behind Oxford's life sciences cluster. It relies on long-standing relationships between academia, research and industry which offers an environment that promotes clinical understanding, research, development expertise, and patient implementation.
- ***UK Space Sector*** is predominately based in Oxfordshire, around the Harwell science and innovation campus. It includes several international space collaborations including the Satellite Applications Catapult, the European Space Agency's European Centre for Space Applications and Telecommunications (ESCAT) facility, RAL Space, and the UK Space Agency - all of which work with international partners to facilitate the commercialisation of space research.

The emergence of the Oxfordshire LEP can be seen as a hybrid form, whereby some elements of cluster activity were initially corporate led (Motorsport Valley) and others more academia-led (bioscience) or government-research led (UK space sector). To bring together all these elements, the LEP has sought to open access to talent and foster collaboration networks amongst government, academia and industry and nurture the creation and growth of businesses. A key actor in this initiative has been the University of Oxford, which encourages spin-out businesses via its technology transfer company, Isis Innovation which has created over 60 companies and files, on average, one patent application a week. Similar examples of successful collaborative partnerships with academia include a motorsport and automotive engineering degree course developed by Oxford Brookes University in partnership with automotive companies and racing teams including Lotus Renault GP F1; Faraday Advance - an academia-industry collaboration on automotive and aerospace materials including the University of Oxford, Oxford Brookes, Cranfield, MIRA and the Oxford Trust; and The Oxford Centre for Diabetes, Endocrinology and Metabolism (OCDEM) - a working partnership between the NHS, Oxford University and Novo Nordisk, Takeda Chemical Industries and Servier Laboratories. This centre is a world leader in diabetes, lipid and metabolism research and provides a good example of how effective collaboration across multiple actors can lead to the emergence of a successful cluster.

Table 4: Summary government-led clusters

What can IW learn from government led clusters?

The government evidently is keen to support initiatives that aim to stimulate business creation, particularly when located in areas of relative economic decline.

The objective of cluster initiatives to stimulate network creation among universities, research institutes, small business and large corporates has been key to winning substantial government support.

The government plays a key role in fostering visibility of clusters and can catalyse corporate interest for investment as well as boost its reputation for innovative entrepreneurial firms.

It is worth noting that local or regional governments play very different roles in the acceleration of cluster developments. Although local city or regional governments play a pivotal role in identifying opportunities for cluster development and bringing the right stakeholders together, it is the national government that can put 'political clout' behind such initiatives, which may in turn boost visibility and reputation.

4.3 Learning from international clusters

This section contains analysis of three further international case studies, which are relevant to our context of university-led clusters and creating a suitable environment for research translation activities. The following three cases were included based on recommendations from our UK case interviews.

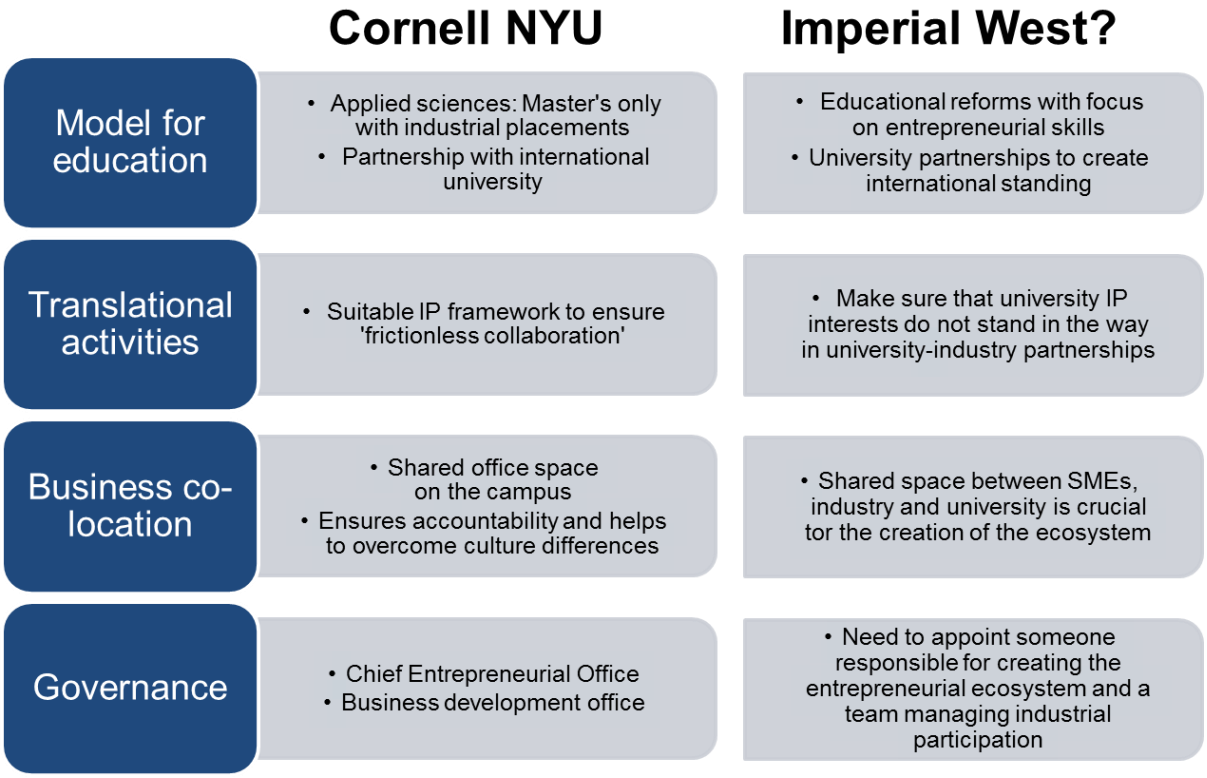
Cornell NYC Tech, Roosevelt Island

Cornell NYC Tech is a new graduate school focusing on applied science. It was announced in 2011 that Cornell University and its partner, the Technion Israel Institute of Technology, had won a bid for a new campus on Manhattan's Roosevelt Island. It represents a **bold experiment** on several fronts: a major expansion for a local university, a high impact real estate venture for Roosevelt Island and an innovative collaboration with a foreign university closely backed by local government stakeholders in City Hall. However, its most significant point of departure is the relationship it intends to build between university and industry; one in which **enterprise and education are indistinguishable**.

As part of its new framework, the school has pitched itself as an 'educational start-up' where students are 'deliverables', and companies seeking to hire new graduates are clients who can choose from a 'suite of products'. The programme structure is designed to ensure that students carry out industrial placements, whilst their progress is not just supervised by an **academic supervisor** but also an **industry mentor**. Colleges and universities in the USA are looking to Cornell as a model for finding new sources of finance for scientific research, as well as a potential **model for translational activities**.

In contrast to other universities such as Stanford and MIT which seek close ties with industry, in the case of NYC Tech, it is not simply an outcome but the 'founding premise' on which the new campus has been built, according to Cornell President: "The campus was set up specifically to increase the talent pool in New York City… to positively influence the New York City economy."

Figure 8: What can IW learn from Roosevelt Island?



Daniel Huttenlocher, the dean of Cornell NYC Tech, has highlighted **conflicts** in the new academic model, which he described in an article in the New York Times (January 21, 2013):

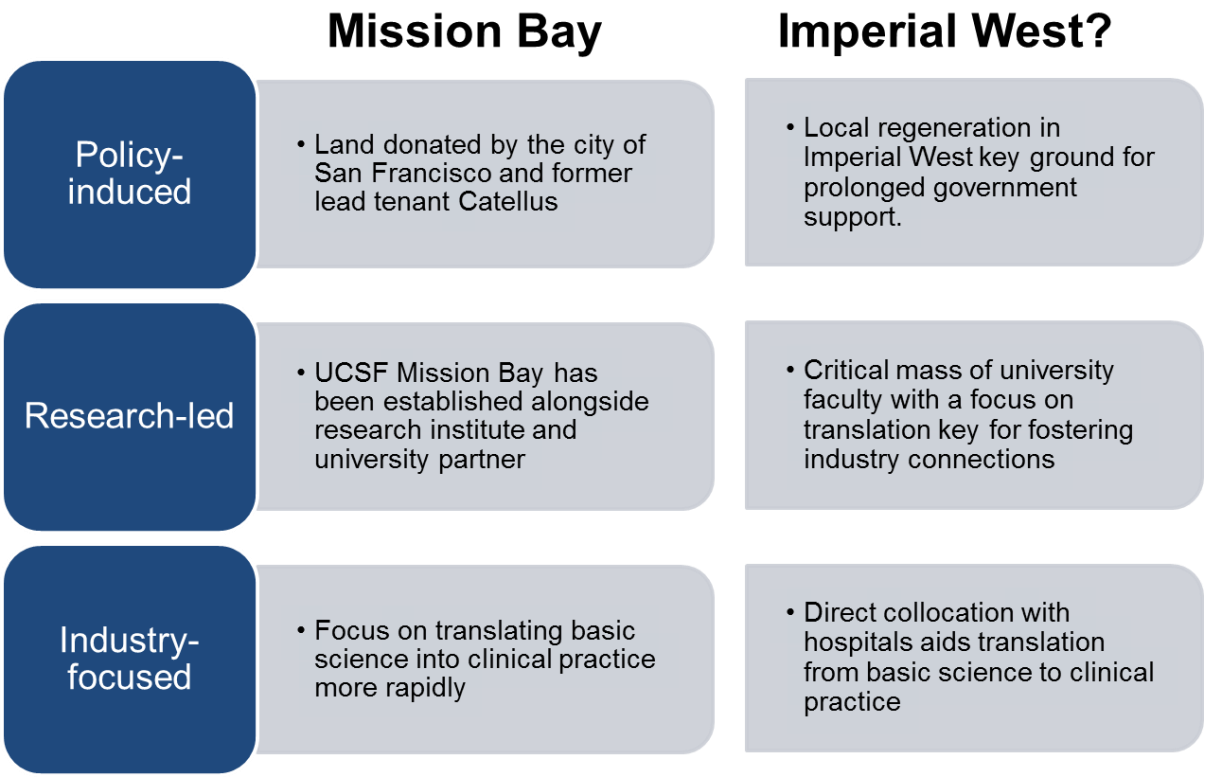
> *"I think there are lots of risks in trying to bring what are fundamentally different cultures and sets of goals together…. Companies need to make a profit. Universities have different motives — partly societal good, partly education — and that leads to different value systems." For starters, he said, "if a student that a faculty member is advising is working at a company that the faculty member has a financial interest in, is the faculty member really keeping students' interests in mind?"*

There were similar concerns relating to the student-work relationship and the issue of working for free during industrial placements. However, the opinion of industry players has been overwhelmingly positive. Greg Pass, the former Twitter executive who is Cornell NYC Tech's '**chief entrepreneurial officer**', explains that it is a way to catch up with how innovation occurs these days, which he argues is different from the manufacturing age when innovation beginning in university labs, then made its way into corporate R&D and years later to some consumer application. Today, he argues that many of the most innovative ideas come from the market itself, and only later undergo intensive research. *"In my own experience at Twitter"*, he said, *"we had to backfill expertise into the most difficult areas of technological challenge*".

In order to ensure 'frictionless collaboration', IP issues relating to collaborative projects will be designed to limit the usual appropriability concerns associated with university-industry projects, whilst a **business development office** has been set-up to attract prospects for cooperation and even allow the opportunity for businesses to 'collocate' in office space on campus.

Mission Bay Campus, San Francisco

Figure 9: What can Imperial West learn from Mission Bay?



Mission Bay is a 300-acre neighbourhood in San Francisco, California. It was created in 1998 as a **redevelopment project** for a disused rail yard, and has since emerged as a wealthy neighbourhood of luxury condominiums, high-end restaurants and a cutting edge research site, following the establishment of a biotech campus by University of California, San Francisco (UCSF).

San Francisco has since become the **centre of biotechnology** in the surrounding Bay area. The transformation of **UCSF** Mission Bay into a thriving biotechnology centre has brought an economic boon for San Francisco, according to an economic impact report released in 2010. UCSF's presence at Mission Bay has enabled San Francisco to attract bioscience back within city limits, growing from one company when UCSF's Genentech Hall opened in 2003, to more than 100 in 2013. The campus is immediately surrounded by a growing and **collaborative ecosystem** of more than 50 bioscience start-ups, nine established pharmaceutical and biotech companies, ten venture capital firms, and leading scientific Institutes, including the J. David Gladstone Institutes, the California Institute for Quantitative Biosciences (QB3) and the Veterans Affairs research centre, all of which are affiliated with UCSF.

Multinationals are attracted by the prospect of collocation with a world-class research university and a network of **incubators**, partnered with surrounding institutes including UCSF, Berkeley, Santa Cruz (known collectively as QB3) and the California Institute for Regenerative Medicine. UCSF Mission Bay has subsequently emerged as a vital campus and biotech hub, where academia and industry converge. UCSF Mission Bay has a **daily population of 4,000 faculty**, staff and students including the next generation of basic scientists, clinical researchers, doctors, nurses and pharmacists. In addition, the campus is about to start building a $1.52bn **hospital complex**, designed to set new standards in patient care and supporting partnerships between basic science and clinical research.

With the medical centre at Mission Bay, UCSF aims to transform academic medicine in part by **translating basic science into clinical practice** more rapidly through increased collaboration among scientists and clinicians, accelerating development of new diagnostic and treatment approaches for children, women and cancer patients, and training the next generation of health care practitioners using new tools and technology in facilities that foster teaching and learning.

A*STAR (Agency for Science Technology & Research), Singapore

Over twenty years, Singapore has transformed itself from an entrepôt economy to one driven by knowledge and innovation. This important transition has resulted from **strategic investment by the government in science, technology and medicine**, enabling it to improve its position in the global value chain and overcome its size limitations to become Asia's 'innovation capital' and global R&D hub.

At the heart of this transformation is the *Agency for Science, Technology and Research* (A*STAR) – until 2001 known as the National Science & Technology Board – which represents a major conduit for financing the country's cutting-edge research facilities, as well as coordinating collaborative R&D with global business partners. Most of its 14 biomedical, physical sciences and engineering research institutes are located in One-North, a wooded **200-hectare innovation hub** where research facilities, business parks and educational institutions can 'meet, share and discover'. Impressive breakthroughs in cancer drug discovery, nanotechnology and 'smart' systems are the result of a world-class innovation ecosystem in which **front-line research is carried out alongside global research partners**, including multinational corporations and some of the world's top universities.

A*STAR has an **open innovation model** which offers appropriate incentives to private actors in order to obtain a critical mass of multinational companies. Relocating corporate R&D facilities is a risky and expensive business, based on long-term strategic objectives. To overcome this, the government actively courted multinationals to base their investments and set up corporate laboratories in A*STAR, touting **policy incentives**, generous government grants, directed at translational research, as well as Singapore's proximity to a vast Asian market.

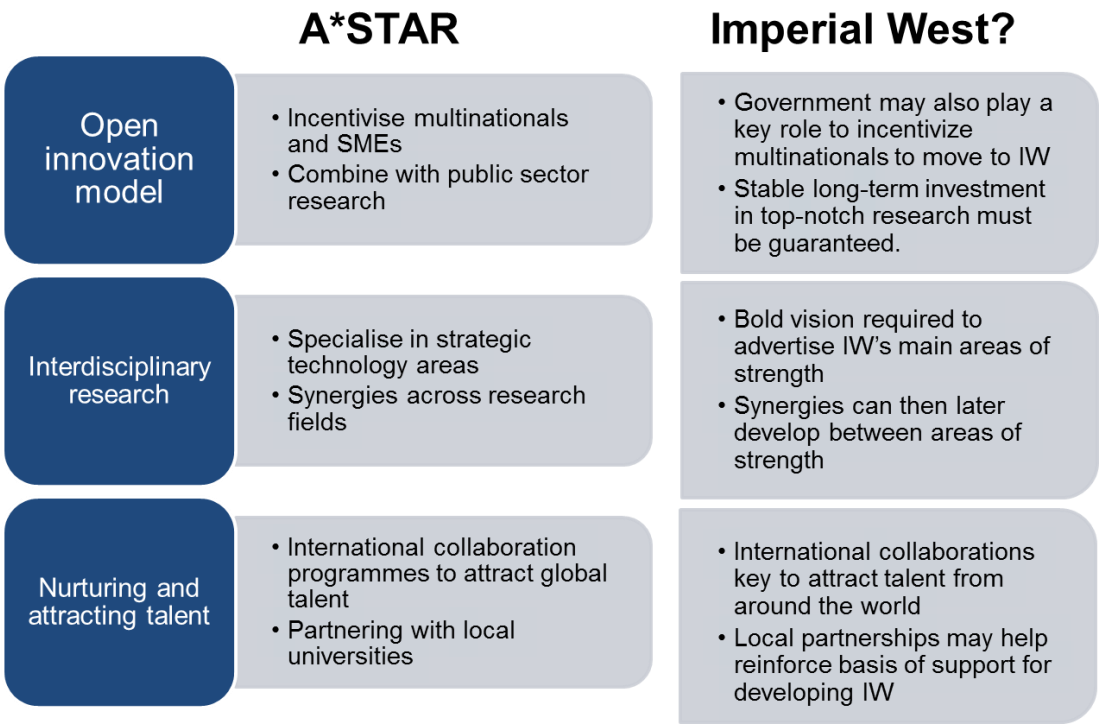
GlaxoSmithKline and Novartis, two high-profile pharmaceutical companies with R&D labs in its Biomed research centre *Biopolis*, have since been leading the way, with a number of collaborations with research institutes in Singapore, as well as the two main universities. A*STAR is also home to initiatives such as HP Research Labs and the Experimental Power Grid Centre (EPGC) which leverages Singapore's superior telecommunications and energy infrastructure and its research strengths in computer science and 'intelligent grids' to test and deploy front-line technologies in distributed energy resources. Singapore also offers a **sophisticated market of early adopters** and unique opportunities for innovative public-private partnership.

The second important factor, which precedes involvement of multinational companies, is a long-standing research base, especially one that has evolved to promote and propagate **interdisciplinary research**. In the early days, the cluster focused on a single strategic research area, with the Institute of Molecular and Cell Biology representing A*STAR's first foray into life sciences R&D in the 1990s. Early research institutes were established and incubated within universities to support emerging industry clusters around research areas that were complimentary to the R&D objectives of target companies.

The prestigious Biopolis Research Centre which evolved out of these early research institutes was part of a **bold vision** to establish biomedical sciences as a key pillar of the Singaporean economy, which would then catapult the country onto the world R&D stage. The strategy worked, and more mergers followed along with the formation of new research institutes in engineering and information technologies to broaden its spectrum of R&D capabilities. A*STAR has since been able to **foster synergies** across different research disciplines in order to better tackle complex challenges posed by new cross-disciplinary research categories such as systems biology and high value manufacturing.

Finally, integrated support programmes to **nurture and attract talent** from local and global talent pools have been essential in establishing A*STAR as a vibrant innovation ecosystem with global reach. It has managed this through numerous **international partnerships** as well as internal programmes alongside local universities. Singapore benefits from a small but highly educated population. Coupled with its world-class research infrastructure, global networks and open policy towards international talent, its research institutes and centres benefit from a highly effective, international talent pool. As part of this drive, the government has attracted universities from overseas to complement its growing research pedigree. Twelve leading US institutions have set up branches in Singapore, including Harvard and Stanford, whilst twenty European universities have some form of research partnership or talent development programme, including Imperial College London's own Graduate Scholarship with A*STAR.

Figure 10: What can Imperial West learn from A*STAR Singapore?



Shang Hai Knowledge & Innovation Community (KIC)[1]

Shang Hai KIC is a joint venture between *Shui On Land* Development Ltd (70% interest) and the regional Yangpu government (30% interest), beginning in 2006. The vision behind the masterplan was to 'eliminate the traditional boundaries that exist between businesses and residential communities, allowing a **complete interaction between home and place of work**, and to create a haven for entrepreneurial pursuits'. Spanning more than 1 million square metres, the project comprises 4 core facilities:

- **KIC Plaza** for office buildings and commercial services. Located within the central district, it is the hub for high-tech enterprises, R&D institutes, creative design practices and modern service providers, which form the support backbone for the new knowledge-based economy.
- **KIC Village** for residential homes, offices, retail, recreation and entertainment facilities, a boulevard which stretches from Fudan University through the entire KIC Village, featuring cafes, teahouses, art galleries, book shops, supermarkets and so on.
- **Jiangwan Sports Centre** built in 1935. After extensive renovations, it consists of a football stadium, a multi-purpose hall and an indoor swimming pool.
- **KIC Tech Park** is targeting to become a world leader in research and development. KIC is set to become a digital community and be a blueprint for the future development of cities in China.

The focus of the **Tech Park and Plaza** is on nanotechnology, and therefore relies heavily on the research base established by Fudan University and medical school, which are located less than 1km from the centre. Other target sectors include: Information technology, biotechnology and environmental technology. The Tech Park aims to attract **three key tiers of private sector companies**: 1) Incubator or start-up companies; 2) Small-Medium Enterprises; and 3) Multinational Companies. The logic is that larger companies provide confidence and critical mass for the project, as well as outsourcing their own R&D activities through investment in the smaller companies.

The key attributes for success identified by the parties involved were: Availability of talent; proximity to other similar industries and support services; access to capital and a desirable quality of life. The project was part of a broader vision by the government to establish an innovation culture, which would help China **shift from a manufacturing economy to a knowledge economy**, and therefore to ensure a fertile environment for nurturing new ideas into successful technologies and being a tool to commercialise knowledge and science coming out of Chinese campuses.

The KIC was completed in 2013 following several phases. Phase 1 was centred on providing the space for the 'Mentor' (large multinational) companies in nanotechnology, which would later attract a handful of 'innovators' (SMEs) to collocate as well as the creation of a generator/incubator for early stage start-ups. In hindsight, a representative from SOM highlighted the following learning points to inform similar projects in future:

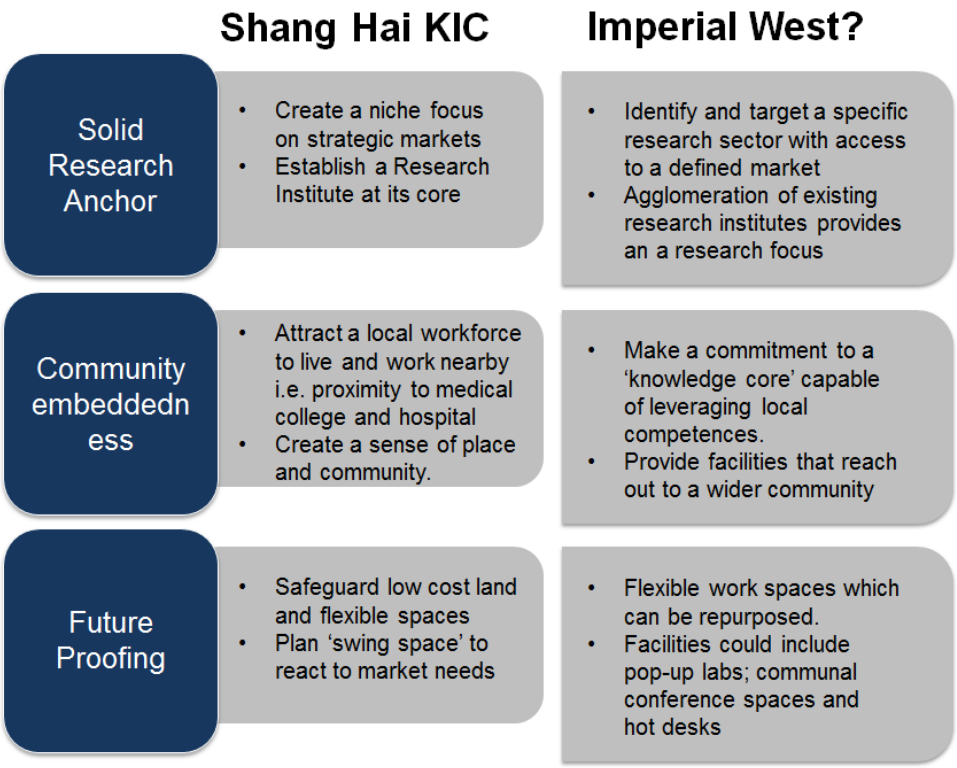
1. **Start with a solid academic anchor:** The anchor university must be in place in order to attract outside companies from the private sector
2. **Establish a Research Institute at the Core:** Get the University to work within a Research Institute framework in order to expedite new technology reaching the market place
3. ***Set the Culture Right from the Outset***: Get interest from 'risk-takers' and companies who can weather early 'failures'
4. ***Attract Local Workforce***: 10% of the local working population was attracted to return to the area after having left to country for other opportunities
5. ***Create a 'Germination Seed' for the Wider Community***: Make an intense commitment to a 'knowledge core' (even speculatively) in order to create a catalyst for interest in the project and help drive the success of the wider community
6. ***Create a Niche Focus***: 'Zero-in' on unique market opportunities not yet taken full advantage of (such as Nanotechnologies applied to regional products or sciences)

[1] This case study was recommended by Skidmore, Owings & Merrill (SOM); the master-planners working with Imperial College London to develop the Imperial West site.

7. ***Target Key Investors***: Set up platforms for Venture Capital Resources, Private Equity and 'Angel' Investors
8. ***Create a Sense of Place and Community***: The urban design is of paramount importance to create a unique sense of place and community as well as a lifestyle to attract and retain the best and brightest
9. ***Ensure Future-Proofing***: Safeguard low-cost land and flexible floor space in order to react quickly to the ever-changing market place by building into the plan 'swing' space

Considering that it was a government-led initiative to begin with, a set of local government policies were considered to attract private companies, top researchers, professors and students. For instance, the local government set out plans to designate a foreign trade zone to provide **preferential tax treatments** for businesses, **state-of-the-art utility infrastructure**, as well as **targeted recruitment** of desirable technology companies facilitated by government policy and financial incentives. Other policy incentives were also considered including: Issue of municipal bonds to fund creation of research centers and the formation of government or trade organizations to promote training and network opportunities.

Figure 11: What can Imperial West learn from Shang Hai KIC?



Upper Rhine BioValley, (Switzerland, France & Germany)

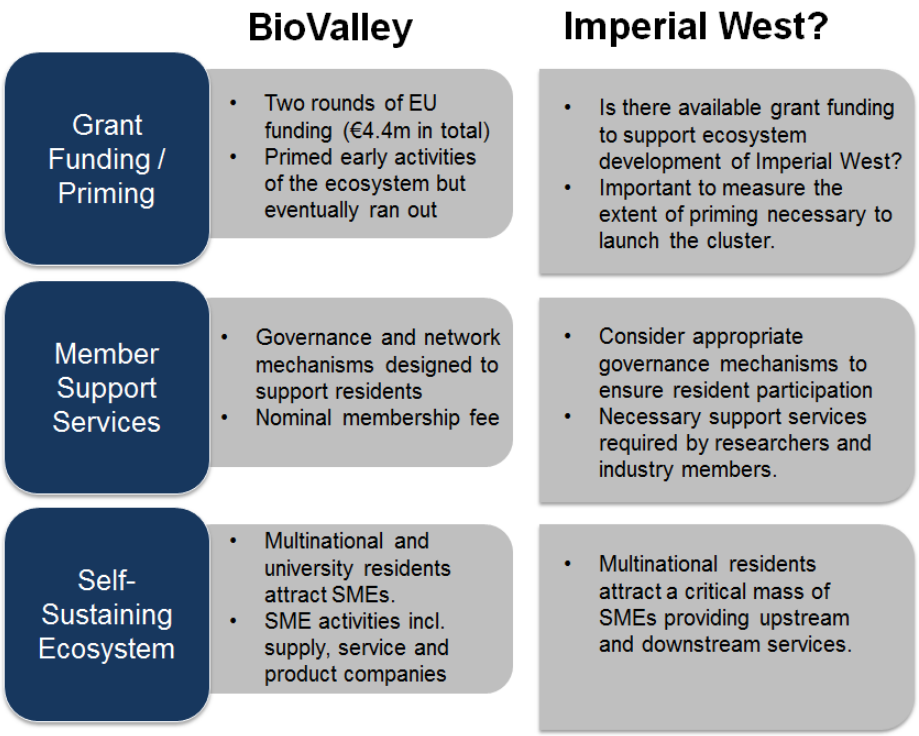
Located at the intersection of France, Germany and Switzerland, BioValley is a leading biotechnology region in Central Europe. Its **tri-national status** has brought with it both some unique opportunities and challenges. The cluster concept established in the 1980s built on a pre-existing network of its constituent members including the University of Basel in Switzerland, as well as multinational pharmaceutical companies and start-ups.

Geographically, BioValley is situated in the Upper Rhine Valley encompassing the Alsace in France, the Northwest of Switzerland, and the region of South Baden in Germany. It contains the operations of **40% of the world's pharmaceutical industry**, including almost 400 biotechnology companies and more than 150 academic or public institutions. Fifteen thousand scientists are based in the area along with 70,000 students, making BioValley one of the top three densest European regions specialising in

biosciences, alongside the Cambridge life science cluster in the UK, Medicon Valley in Copenhagen, Denmark, and SkŒne, Sweden.

The cluster developed as a result of large corporates basing their activities in the region decades ago. For instance, Millipore, a bioscience company that provides technology, tools, and services for the development of new drugs, set up their facilities in Molsheim, Germany - an area that would eventually become a part of BioValley - as early as 1973. Its central location, **spanning multiple European markets** and knowledge centres or universities has made it attractive to large pharmaceuticals to base their headquarters there. Aware of the region's attractiveness to biotech companies, BioValley as an organisation was conceived by two local entrepreneurs, Georg Endress and Hans Briner in the late 1980s. However, it was the merger of Ciba and Sandoz into Novartis in 1996 and the establishment of their international headquarters in the area that gave it initial impetus. By the following year, a **Promotion Team** was in place, the project quickly gained media interest and the BioValley concept was implemented in the Upper Rhine Region.

Figure 12: What can Imperial West learn from Upper Rhine BioValley?



A key consideration for BioValley was to develop a set of **governance and networking mechanisms** to create a sense of oneness and cohesion amongst its residents. In 1998, each member country of BioValley founded a national association, including: BioValley Platform Basel, BioValley Deutschland and Association Alsace BioValley – each of which would serve under the BioValley Central Association created in 1999. Individuals, students and companies join their respective national associations and **pay annual membership**, ranging from 10 euros for students to 500 euros for companies. Members include representatives from academia (50%) as well as industry broken down into supply industry (20%), services industry (20%) and product companies (10%).

Facilities to members include access to a **'yellow pages'** of life science companies, public and private research institutions and all other organisations involved in the cluster. An internal communication network keeps members informed of the latest news and allows **partnership exchanges**. Regional roundtable discussions also take place to connect students, researchers and venture capitalists, as well as an annual conference which presents the cluster's research

achievements to the science world. Research outputs are also included in the **BioValley Journal,** which is published quarterly to report life science and applied research taking place in the region.

In order to finance the cluster initiative, the BioValley partners in each country agreed to seek out **EU Interreg funding**[2] to achieve the following goals: to speed up technology transfers and boost the creation of biotech start-ups; to become the most attractive European biotech region for new investments, and to promote new alliances with international partners. From 1997 to 2001, BioValley received total Interreg funding of 2.2 million euros, which helped develop the services available to their members and support 150 new companies in the area. A second round of EU Interreg funding injected a further 2.4 million euros to complete BioValley's transition from a life science network to a self-financing biotech cluster. Since 2005, following the cessation of EU funding rounds the goal, has been to privatize BioValley. Whilst early on, the cluster benefitted from **significant priming** as a result of EU funding, the ecosystem activities have diminished over the last decade. Member services and website maintenance are largely funded by membership fees as well as some minimal financing from the treasuries of the three nation members.

[2] The European Union started the Interreg initiative in 1990 to bring the border populations in and around the EU closer together and to support regional, cross-border activities, especially in the fields of business, science, culture, and tourism.

5. Analysis 2: General learnings from the interviews about the creation of innovation ecosystems

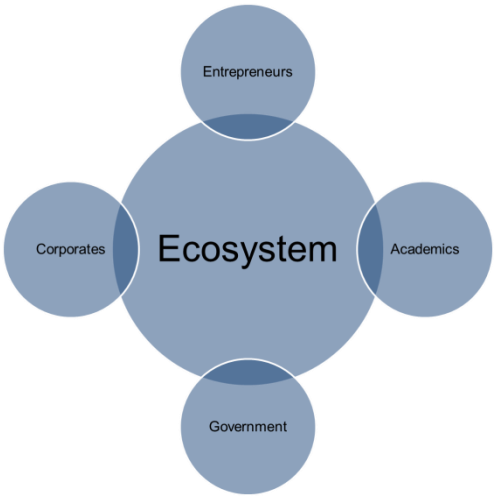
Whereas the previous section described the evolution of specific clusters, this section aims to develop more general insights into how clusters can become effective innovation ecosystems. This summary is based on a **systematic analysis of stakeholder interviews** involved in cluster creation.

The interviewees included:

- people working for large corporations seeking investment in high-technology clusters or creating business parks themselves;
- people working in scientific or corporate incubators;
- professionals at UK and US universities involved with the creation of science parks or related initiatives;
- experts on the emergence and evolution of geographical clusters.

A full **list of interviewees** is attached in Appendix 2. To safeguard the anonymity of our interviewees, quotes are not attributed to specific individuals. The discussion is organized around the four main components of a successful innovation ecosystem as discussed in Section 3, preceded by a broader perspective on the "makeability" of cluster ecosystems.

5.1 Can cluster ecosystems actually be engineered and if so, how?



The preceding sections of this report have advocated the view that collocation of academic, corporate and entrepreneurial parties only creates value beyond what individual parties can do, if these parties form a community where ideas are exchanged and collaboration takes place. The term of choice for describing clusters that contain such communities is **"an ecosystem"**. Many would agree that clusters thrive when they contain a well-functioning "ecosystem", where universities, small businesses and incubation activities, large corporates, and government form pieces of a puzzle that add up to more than the sum of its parts.

Yet, many of our interviewees, despite being involved in the creation of thriving clusters and science parks, held quite **critical views about whether cluster ecosystems can actually be engineered**. For instance, many critics would support the view: *"Silicon Valley cannot be replicated; rather clusters organically grow into existence".* Across Europe, there have been many attempts to build the infrastructure to create a "Silicon Valley", but many such initiatives have been largely devoid of true innovative and entrepreneurial activity, failing to create the valued added that collocation and interaction ought to generate. As one of our interviewees commented: *"Just because you have the infrastructure and you have all the facilities and you have money available and everything doesn't mean you have a successful ecosystem".*

This raises the question, whether and to what extent successful cluster ecosystems can be engineered. All in some way involved in or knowledgeable about the creation of clusters and science parks, many of our interviewees would agree that **entrepreneurship is the key ingredient to well-functioning cluster ecosystems**: *"You need entrepreneurs to be there who will create an entrepreneurial environment, which will attract other entrepreneurs to come in around them. You build an ecosystem by putting high quality start-ups and entrepreneurial people together in a space".* As we will see in the remainder of this analysis, it is the entrepreneurial culture that academics commercializing science, as well as large corporates seeking entry into clusters, are looking for. In TechCity high levels of entrepreneurial energy played a key role in attracting corporate investment. *"Demonstrating that there is a critical mass of young, innovative start-ups has definitely brought*

investors into the area in droves". Therefore, ultimately, it may be the entrepreneurial culture that once in place, may justify premium rents for a location in the ecosystem.

Figure 11: Implications for Imperial West - The makeability of ecosystems

Ecosystems

- The ambition should be that Imperial West becomes an innovation ecosystem or an "Innovation Hub" where entrepreneurial, corporate and academic parties form a community where members interact in a joint drive to excel in science, entrepreneurship and innovation.
- Entrepreneurship is the key ingredient of a successful innovation ecosystem. Although start-ups' high failure rates and their limited ability to create positive financial returns for Imperial West early on may limit their appeal, in the longer term it is the presence of a vibrant entrepreneurial community that appeals to corporate or government investors.

Creating an innovative, entrepreneurial ecosystem may sound **a lot easier in theory than it is in practice**. An entrepreneurial culture that is celebrated among start-up-related, academic and corporate parties cannot be created overnight. *"The key insight here is that you're crazy if you think that it's pure causal. It's not like mass production. You want to move away from the notion of control theory and it's all makeable. If we put X in, we'll get Y out".* The remainder of this section provides insights into best practice and potential pitfalls regarding the creation of cluster ecosystems and offers food for thought on Imperial West's strategy.

5.2 How do you attract and select the right entrepreneurs to settle in an ecosystem?

Academic and corporate incubation

Academic spin-outs are an important **source of entrepreneurial activity** for the creation of cluster-based innovation ecosystems. As the interviews with Cambridge, Oxford and Imperial incubators pointed out, we can distinguish four types of academic start-ups.

First, there is a category of **accelerated growth firms** which typically seek to attract venture capital funding. These are built around major scientific breakthroughs in combination with a big market opportunity and an outstanding management team. The second category consists of companies that grow through smaller capital injections and therefore develop more organically. *"These tend to be smaller start-up companies where the market is there but it doesn't justify a £2 million initial investment followed by a £10 million VC round".* The market size may not be big enough to justify accelerated growth, yet at a slower pace many of those companies can become successful profit-making ventures. The third category are "enable" companies that get limited support from university incubation or tech transfer offices: "We will enable you, the academic, to form a business. "*We'll give you the tools you need, but after that we're not going to sit on the board and we're not going to work with you".* The fourth category is **student-led spinouts**, which are typically incredibly fast-moving: *"They pivot all the time, change their business model. You have to screen a lot more ideas to*

find the really good ones. We're screening 200 ideas to fund three propositions".

Not all four types of academic start-ups are equally suitable for location in a cluster-based ecosystem. It is the accelerated growth firms and the student start-ups (if selected carefully) that would **contribute most strongly to building the ecosystem**. As one interviewee from the US commented: *"Most universities have multiple incubators and most of them go for volume, meaning as many companies as possible, as fast as possible. They claim victory when they have 100 start-ups in their incubator. My advice is: don't go for volume, go for quality. And why go for quality? Because, especially in the first batch, if the first few companies that exit incubators are highly successful companies you will attract the next best batch of entrepreneurs to this incubator because entrepreneurs, no matter what ecosystem you build in your place, they have the choice. They may come with you or may decide to go somewhere else".*

It may therefore be very important **to be selective on which start-ups from a university incubator programme deserve a place in** the emergent innovation ecosystem, keeping the quality threshold high to send an important signal as to the level of entrepreneurial skill expected. In the experience of many incubators, it is the **serial academic entrepreneurs** who have repeatedly been successful in commercializing their research who are most likely to be successful again, and who are most agile in the community. Academic entrepreneurship is deeply focused around relatively few people and that is not necessarily a problem. Eventually entrepreneurial behaviour may cascade to other academics through the network of those serial entrepreneurs, which may be the most powerful route to **identifying new academic entrepreneurs**. Some leading US universities have **'prestige' incubators** where only a limited number of start-ups are selected through competitive entry: *"These incubators, you'd better keep them initially small, like less than 20 companies. And you go for quality, and then maybe over time you grow. In our case, entry is competition-based. You get selected. There is a selection committee which is a mix of venture capital people and industrial people and academic people".*

A great share of commercially relevant academic research may better find its way to commercial application through **licensing** rather than spin-out creation. Particularly when the technology is very early-stage and the entrepreneurial skills of the academic are lacking, the technology may be better commercialized through licensing. The proximity of an ecosystem with successful entrepreneurial and innovative activity may increase the chance that suitable licensees are found in these circumstances. *"The tendency today may be to generate income from such technologies from licensing, as the time scales working through incubation are too short, and perhaps too rigid, to support high-risk, high-potential long-term initiatives".*

A second source of entrepreneurial activity is **corporate spin-outs**. Many companies have incubator programmes, where they allow space for their own entrepreneurial staff as well as outsiders starting a company with mentorship from the large corporation. Many of those forms follow a "Dragon's Den type" approach, where they will test the business case and the idea, after which they will be offered space and mentoring for a given period of time to get the company up and running. Companies may be interested in locating such incubator activities in a well-developed cluster ecosystem.

Incubation as fly wheel

Incubation is meant as a "fly wheel", providing initial mentoring and support to give promising start-ups a flying start, which **by definition is of a temporary nature**. Opinions differ on whether timelines in the incubator need to be strictly enforced. Some incubators advocate the view: *"You either pass or you don't. We look at their business plans and we make an assessment on what we actually see. We then, every quarter, a couple of us would actually sit down and review the progress. We might be saying to them, well, you've had your chance, we're now going to stop giving you the facilities and let it go to someone else".*

Other incubators were in favour of more flexible timelines: *"We don't go and withdraw our support at a critical point. There is a point at which the start-up needs to stand on its own, but honestly, that's some way down the line"*. In practice, the right time requirements for successful incubation seem to depend largely on the sector. In biotech for example, where drug approval procedures are long and uncertain, strict enforcement of incubation times may be unrealistic, whereas in other sectors such as

software development, strict deadlines may be required to provide appropriate incentives for progress. Also, it is argued that more **strict selection of start-ups** into the incubator may decrease the need for tough exit deadlines: *"We're very selective on the going in and then on the going out we are flexible. You have a target. I don't know; whatever it is, after four years or five years you're looking to get the company out, but you don't have to rigidly stick through it… stick to it, and the reason for that is that because every company is different, every circumstance is different".*

The imperative for closely monitoring progress in venture creation is that incubators sometimes **offer space at sub-market prices** in the expectation that the venture will create a **big return in the longer term**. There are important limitations to such an approach, as we discuss later. Typically this first success is defined as the moment in which they have successfully raised capital: "*So when the start-up is off the ground enough, they can now afford to rent accommodation".*

Space and support requirements for different start-ups at different stages of development

Start-up companies have different needs for mentoring and support and different space requirements dependent on their type and development over time. For example the space and support requirements for accelerated growth companies (whether they are corporate or academic spin-offs) are very different from those for student start-ups.

Student start-ups first and foremost need access to facilities and mentorship and the **need for self-contained space may be limited**. *"They want good advice and they want somewhere to hang out with fellow colleagues where they can kick ideas around between them and have the space to go and build businesses".* Importantly, they need critical **access to university facilities** which may be too costly for independent early-stage investment. Some incubators use the services of external providers to equip (student) start-ups with the necessary facility and service support. *"There's a company that actually provides kind of lab services, there's an LMR machine, there's a fax machine, there's all sorts of central core lab equipment that anyone there can access, which is quite helpful, for a small start-up that hasn't got a lot of money. They've got access to all the kit that they need to, that they can't get on their own bench".* For many early-stage student firms **flexible pods** for administrative and design work and access to high-quality shared facilities for their research and development work may satisfy most of their needs, at least initially. Such space may best be provided under quite **stringent time constraints**, in order to incentivize speedy development of business plans and attraction of capital.

Academic start-ups and corporate spin-outs might equally benefit from shared facilities, but may have strong needs for self-contained work space. Most likely, they will initially be most concerned with access to high-quality management support. However, in particular for accelerator businesses, the most important aspect of their space requirements is **flexibility over time**. Certain incubators, admittedly outside London, make flexibility of their office spaces one of their key areas of strength. *"We can modulate the offering according to the stage in the business and we will go from a hot desk all the way through to some 1,000 square feet of office space and lab space and so on."*

Flexibility of office space is important for the **long-term viability of the ecosystem**. Given the fact that many entrepreneurs will fail, it will be nonsensical to limit space to those companies that succeed and grow, in order to keep them actively engaged in the ecosystem. In fact, successfully incubated start-ups may be very valuable to retain, as they **help raise the profile and reputation** of the incubator as well as **take on mentoring tasks** for new, early-stage start-ups. In an extreme case, an incubator decided to keep one of the successful start-ups for longer: *"We want to keep the company in the incubator, but that's against the rules. They said, it's really important that we don't squash the life out of this little company. But it actually turned out to be exactly the right thing to do because they became that magnet tenant for the other companies in there. They became that superstar tenant. These guys have made it. They can talk to them. They've made it; they're rich. This is fantastic. They've been there. They've done all the problems. They know how to handle VCs. They know how to raise money. They know how to sell their company, and that attracted more people in there. "If you can keep them, they can motivate and train five other companies".*

Some incubators differentiate between early-stage **incubation space** and **accelerator space** for growing companies. Growing companies have complex space requirements that are difficult to meet on the standard commercial property market, and where tech clusters may thus provide dedicated solutions: *"Even though they're a bit more established, more stable company – one of the things that they still have a challenge with is flexibility in terms of workspace. Because if you're a 25 person company that was a 15 person company six months ago, that was a three person company eight months before that, spending a lot of money, a lot of overhead on taking out a five-year lease on a property that can accommodate 50 people when you won't be at 50 people until year three or four, doesn't make sense. And that's something that we are able to offer them and it's very difficult for a larger landlord to offer because of the risk".*

Yet, accelerator space is also of temporary nature and therefore does not provide **a long-term solution for successful start-ups to remain part of the local ecosystem**. *"So now those companies need to move out. So, okay, move out. They need to go to Cambridge, need to go to Oxford. And in that process they're going to lose 50% of the people, because the people are not going to be able to move with you".* The alternative is securing a location in or near the cluster that facilitates **the retention of staff as well as maintaining interaction with the cluster community**. *"It means that they're not just relocated in an office off somewhere else. They're still surrounded by those other companies and those other founders and interact with them, not just because they're physically adjacent to each other but because they come to the events that we run. These things are still incredibly valuable even once you reached that kind of size".* And another interviewee commented: *"So if the company becomes a success, you can't believe how motivated those people are to help your company start up. They will help them to be successful. They're going to give back. They're going to give back in knowledge and capabilities and capital to people who want to follow them. And all of those companies are going to be supplying products and services to each other, so I think that's the trick. It's absolutely the trick".*

A viable financial model for incubation

In a well-functioning ecosystem there may be **no need for subsidised rent**. The first step is to create a **critical mass of high-quality start-ups**, and in those circumstances good companies may be attracted through very competitive, possibly subsidized rents. Such rents can be partly off-set against a stake that the university takes in start-up companies, which should pay off when companies succeed. However, **payback from successful entrepreneurs to the university** has been limited in the experience of other universities, and more systematic payback models may need to be developed to ascertain financial returns on investment in start-ups to the university. As one interviewee explained:

"Just letting entrepreneurs use the university facilities and then make money out of spin-out companies and give nothing back to the university is not necessarily directly beneficial to the university, although it may be indirectly beneficial to boost the university's reputation. But I don't see many signs of direct payback by successful entrepreneurs. I think the Glasgow model [of getting return on university IP] is the best one: a universal licensing system whereby people have free access to the IP, but companies register for use of the IP and if they make money out of the IP, then they contribute back to the university. But they don't have to go through all the bureaucratic requirements that many say were deterring start-ups under the old regulations".

Once a functioning ecosystem is in place, one should not be afraid to charge **market price rents** also to start-ups, and various incubators of leading US and UK universities with well-functioning ecosystems in fact offer rents at competitive, but not subsidized prices. An additional way in which ecosystems can increase the available space for start-ups is by relying on the **private sector**. Various companies have their own dedicated incubator programmes, where in many cases they provide subsidized or even free rents to their start-ups, naturally offset by taking a stake in those companies.

Figure 12: Implications for Imperial West - Attracting entrepreneurs into the ecosystem

Entrepreneurs

- Incubators at Imperial West should go for quality rather than volume by creating **"prestige incubators"** or accelerators where entry of start-ups – whether academic or student spin-outs – is highly competitive. Early high-quality entrepreneurs are more likely to contribute to building a **"community"**, may act as **"magnet tenants"** for future high-quality entrepreneurs and can acts as **mentors** for future entrepreneurs.
- **Flexibility of space offerings** should feature prominently on Imperial West's development agenda such that **successful growing companies** can – after successful incubation and acceleration – **remain located nearby** and **prevent being forced out of the ecosystem** one was so hard trying to build.
- Although subsidized rents may be offered to attract an initial critical mass of high-quality entrepreneurs to Imperial West, once a **functioning ecosystem** is in place **competitive, yet not subsidized rents** for start-ups can be justified.
- **Corporate investors** seeking to relocate some of their facilities to Imperial West may also be interested in funding incubator space. Such offerings may form part of negotiations with prospective corporate partners.

5.3 How does one attract the right large corporates to invest in an ecosystem?

Why are large firms seeking cluster locations?

There may be two main reasons why large corporations seek cluster locations. First, large corporations see clustered locations of academic institutes and entrepreneurial activity **as a major source of innovation**. *"What corporate investors really wanted was to engage with the community, both to access innovation culture but also being able to look at opportunities for partnership collaboration and potential acquisition. They see it as incredibly valuable to come and spend time here mentoring some of our start-ups, providing engineering skills or whatever sort of skills that may they have in-house that they can offer".*

Large firms find it hard to justify uncertain, long-term investment in fundamental science, leaving basic R&D and early-stage development largely to the academic sector. At the same time, relative to young, dynamic start-ups, large firms are often not as innovative and agile in responding to technological change. As one interviewee commented: *"We are very good in late stage development, marketing, positioning the products correctly and bringing them to the market. But at really early stages of innovation big organizations aren't always the best. That's why we have to reach out to clusters of academic and entrepreneurial excellence".* Firms thus often seek to locate in clusters **to facilitate intense forms of cooperation**. Although digital technology has greatly facilitated collaboration at a distance, firms still often seek to locate near high quality sources of knowledge. In particular, university-industry and small-firm large-firm interactions often take place on a local level, as **proximity** greatly helps parties with different backgrounds and ways of working to get to know how to work together. A reason why Google invested in TechCity, for example, is that it wanted to locate near a community of app developers for the Android operating system in order to optimize mutual coordination and learning.

A second reason why large firms, particularly well established, "less innovative" sectors seek to locate in vibrant high-tech clusters is to get **a window on the world of early-stage technology development**: *"For many large organizations, R&D is not about innovation. It's about insurance. They're afraid that some small company from Imperial or MIT is going to come up with something that will screw up their business and that they'll have to buy it, so they need to have some knowledge of what's going on".* Engaging in the community of a cluster ecosystem can be an important means for established corporations to be at the forefront of the latest technology development and **identify target companies for acquisition**.

The extent to which companies believe in the need to open actual R&D sites in these ecosystems varies considerably. Some organizations are **highly selective** as to where in the world they would like to concentrate their R&D investment. The fundamental part of the value proposition that prospective corporate investors buy into is the quality of breakthrough science and the quality of the students: *"The most important thing for Imperial West is, do good work. Do world-class work".*

Attracting large-scale investment from companies seeking to relocate some of their R&D operations is of prime importance, particularly also as a signal that "*global companies are recognizing the area as a place worth investing in".* However, a second group of companies should not be overlooked, as they play a **pivotal role in building up corporate involvement in the ecosystem** early on. During the interviews, it became clear that many would rather fragment investment by opening smaller **satellite offices in a multitude of locations** rather than concentrating all investment in a limited number of locations: *"We could basically decide to bring a 1,000 or 2,000 scientists to Boston or to Cambridge here in UK and co-locate or locate them in the vicinity of a couple of big research institutes. We decided not to do that because there is the likelihood that those 2,000 scientists are going to just work among themselves. We're going to bring a small team, going to bring top scientists with a ton of research and development experience who are really outward-looking, who can really help and guide and mentor scientists in academia to be successful".*

To a large extent, this strategy might be the result of **hedging bets**, and is common for established companies that are innovation followers rather than leaders: *"It will be key to keep a fair degree of freedom to operate with innovators not only in one ecosystem but in different ecosystems. Innovation can happen everywhere and we believe that many innovators can evolve interesting ideas at the same time. We don't want to end up in one bucket, associated with one partner because then you limit the option of innovation that you can ultimately bring to the market."*

Ensuring diverse corporate investors also has the advantage that one **avoids strong dependence on a few small investors**. *"You want an ecosystem that is capable of being agile and adaptive…What happens when your biggest sponsors go bankrupt? That's why you want to have hedge, that's why you want to be careful".* Also targeting selective presence from large companies may help create an engaged community of innovation-oriented entrepreneurs, as professionals from those organizations may be more incentivized to participate if they come in smaller numbers. *"Entrepreneurs are individuals, not institutions. I would never turn aside an IBM, but let's not expect an IBM to be able to respond with alacrity".*

Likewise, the attraction of large-scale corporate investment should not come at the expense of creating and attracting entrepreneurial start-ups. Entrepreneurial firms and large corporations are both pivotal components of an innovation ecosystem. That said, some interviewees raised concerns that it may be tricky to keep a balance between the presence of large and small firms. One interviewee commented on TechCity: "*There was this real desire to attract large US technology firms into opening an office in this area in London. And I think in the early days that the focus on trying to make that happen was actually slightly to the detriment of supporting local businesses to grow".*

Figure 13: Implications for Imperial West - Attracting corporates into the ecosystem

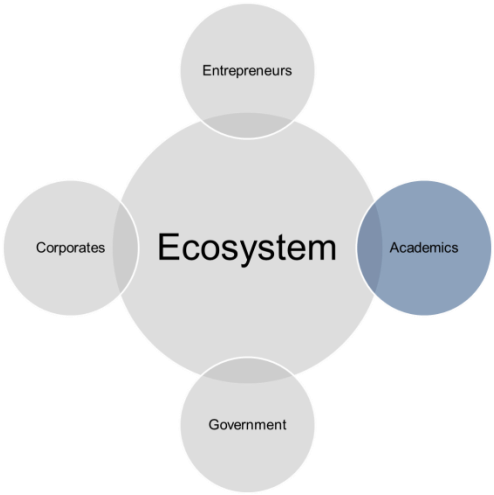
Corporates

- It is of critical importance that **Imperial West's value proposition** to prospective corporate investors is **built on areas of strength in fundamental science**. Companies seeking to relocate parts of their R&D operations are looking for excellence in breakthrough scientific research and excellent students. Core long-term funding for fundamental research is required to safeguard continuity in attracting top talent and advancing science in key areas of strength.

- Despite the importance of attracting large-scale corporate investment, many large companies may be seeking a relatively small presence on site, which should not be neglected. Specialized teams from such companies, highly motivated to participate in the ecosystem, may play an important part in **catalysing corporate participation in Imperial West's community** early on. Attracting this type of investment, may call for dedicated approach to marketing that is quite different from the approach used to target major R&D relocations.

- It is important that Imperial West deliberately seeks to **diversify corporate investment** to avoid dependence on single large-scale investments of companies that can be highly footloose or whose fortunes can change in unexpected ways. Also focus on the attraction of large-scale corporate investment **should not be at the expense of building a critical mass of innovative start-ups**.

5.4 How can academics be selected who will contribute to building a value-adding innovation ecosystem?



In a cluster where large businesses, entrepreneurs and universities or research institutes collocate, it is typically the entrepreneurs and members of large corporations present that naturally participate in the local community and thus contribute to building a functioning ecosystem. For many academics, interaction with non-academic neighbours in a cluster may be a big departure from their habitual ways of working. One interviewee commented on the creation of a cluster ecosystem: *"I would say the academics are a latest piece in this jigsaw puzzle. So the guys who get this fastest are entrepreneurs, government stakeholders, and even the private sector."* In that light, it is perhaps not surprising that in the case of TechCity, involvement of universities and academics is the most recent element added to its growing community.

It is incredibly important therefore, that the academics – or university departments – that are to locate in the ecosystem are **carefully screened**. In a vibrant ecosystem where academic knowledge represents a key component, academics need to be *"entrepreneurial types"* who are keen to see their research translated once they have finished the basic research phase. *"Only if you get that mindset ingrained, then the ecosystem will really start to thrive"*. Based on this insight, at the CITRIS institute in Berkeley, academics were recruited into the new institute **through competitive entry** whereby their motivation for research translation and commercialization weighed heavily.

Yet, **academics with a strong entrepreneurial orientation** may be relatively rare: *"There might be a 2% rule, where your top academics can do this [participating in the ecosystem] in a way that is just*

very elegant". Creating an entrepreneurial culture amongst academics on site might be best achieved through selecting those individuals that are highly motivated to seek commercial applications for their research. This small, highly select group may then create early momentum, set a role model for others, and perhaps even *"become evangelists*" for their colleagues to set in motion a process of peer-to-peer viral translation. **Peer-to-peer influence** can work very well, particularly amongst academics who typically *"don't need anybody to tell them what to do".*

At a more aggregate level, creating an ecosystem with academic involvement can be accelerated through **selecting academic centres or departments that are business friendly**, for example because they have historically high levels of university-industry collaboration or a proven track record of successful university spin-outs: *"The main group of people who start companies who are linked with the university are the* **post-docs***. And they often will take a technology that they've developed for their PhD or for their subsequent research and spin it out, as it were, for the professor who doesn't have time to do it".*

Figure 14: Implications for Imperial West - Attracting academics into the ecosystem

Academics

- It is important that university departments located in Imperial West are **business-friendly**, ideally with a strong tradition of **university-industry engagements** and a **proven track record of university spin-outs.**
- Individual **academics** are ideally **carefully screened**. New research institutes to be established at Imperial West may use **competitive entry procedures** to select the highest quality academics with strong motivations to ultimately see their research impact practice, even if their research may be fundamental in nature.

5.5 It's great to have academics, entrepreneurs and large corporates in the same place. But how does thecommunity between them develop?

Attracting the right entrepreneurs, corporates and academics is but the first step in building a successful innovation ecosystem. Although it certainly helps, as advocated in the preceding discussion, to select entrepreneurs, academics and corporates who are motivated to interact, more may have to be done to trigger the development of the **community** that will ultimately be so important for the ecosystem's reputation, innovative success and financial viability.

The advantages of a local community feel are in some way **intangible**. As one interviewee explained in regards to TechCity: *"You have a lot of entrepreneurs and what those types of people have in common is that they're all individuals who want to do something new and independent and do something in their own way. The ability to socialise where you work is incredibly important particularly for entrepreneurs because when your work is your life, it's important to have friends that understand your type of work".*

However, other residents suggest the **community feel** gives the location a **competitive edge**, which justifies **premium land rents**. *"I'm often asked, for all the decades I've lived in Silicon Valley: so what's so special about it? In my mind it's in the air, meaning this is a very open place where people exchange views and things and meet often. So the physical proximity is very important. It's like a city. You want to create a place where people will find the place so attractive that they will want to stay there. They will want to have coffee there, meet their friend there and that creates a constant flow of ideas".*

The community in a local cluster is sometimes referred to as the location's **social fabric**, or the **infrastructure through which ideas can flow and information, expertise and advice are exchanged**. It is the web of communication that exists beneath the surface of formal inter-organizational networks that seems to matter the most. *"When you ask the top managers of*

companies in a particular sector if they collaborate, they say, oh no, we don't do that. They're our competitors. But if you talk to their employees, they say that they're on the phone to people in the other companies all the time for advice and help". Occasionally, the time and effort that individual members of an ecosystem put into socializing and exchanging seems to **pay off in unexpected ways**. Links to potential investors or important university-industry deals are often not the result of high-level talks between managers. But when a strong social fabric exists in a cluster that community may be the place where important deals are made: *"It's certainly very annoying for people, that if they approach an investor, they're supposed to have a member of the technology transfer office with them. And obviously the culture [in an entrepreneurial ecosystem] is that you have a beer with somebody in a pub and discuss whether they would invest in your company. And you don't make a sit-down appointment in the technology transfer office with an official present in order to discuss possibilities of that kind".*

Although a community feel cannot really be engineered, several factors help to facilitate a more interactive culture among academic, corporate and entrepreneurial members of a cluster. First, **shared experience** is a primary driver of strong ties between cluster members. *"There's a lot of interaction between the start-up companies and a lot of interaction between the staff. They share a common background because they went to the same university. And they move, there's a lot of job hopping between companies".* Universities in particular play an important role in building talent and expertise, but perhaps as important is its role as a platform where young professionals build strong, lasting ties, many of which remain throughout their lifetime.

A second factor facilitating a sense of community is the build-up of **shared identity**. Even when people are co-located, many individuals will be limited in the extent to which they identify with the "place" and might identify more strongly with the organization in which they work for example. Although "place identity" might just need time to develop and mature, **organized events** can contribute to the creation of identity and community. *"It took us a long time to build that community feel when we first built the incubator. It was a couple of years before we really got that community feel going, and we had to work at it. We had to organise lots of parties and seminars and make sure there was free coffee so people gather around the coffee machine. And you've really got to work at it all the time. You have people on the ground making that ecosystem happen. If it just reaches a real estate, a property play – here's some rooms; you rent them; pay your rent; we'll keep the taps running – it's, again, doomed to failure. I think once it's established, you can relax a bit. You don't have to work quite so hard because it becomes self-fulfilling".*

A final, decisive factor in fostering a sense of cluster community is its **spatial design** and **connectivity**. For instance, one aspect of clever design concerns mixed space. The layout within buildings can be designed in order that **people are mixed** in a way that maximises casual encounters. As someone commented on the design of a new incubator space: *"And so you need to create the space where people with diverse backgrounds – engineers, biologists, physicians come together so that they cross-fertilize".* Another comment on Eindhoven's Technology Campus around the company, Philips was: *"That is a great thing, when you go onto the Eindhoven site, to see a research institute, a building, that's got a mix of, you know, PhDs coming from universities, plus businesses all working in the same building, that is a neat idea".*

Another aspect of clever space design could relate to its open character. To stimulate interaction it is important and that people have **a constant, salient awareness of being in a shared environment**, rather than secluded in isolated offices: *"So that's why I decided to keep the group relatively small – I don't think we will grow to over 35, 40 people – to really force continuous dialogue and exchange of thought between people with very different backgrounds. So I mean, we have our investors, our license people, our transaction people, our scientists of different sectors, all here in one space. Also although we now have 25 people, we have eight offices. The rest is all open space, so it really forces continuous dialogue".*

Apart from the layout of individual buildings, it is also important that extensive thought is put into how several buildings on a single site are configured. It is of critical importance that walking between buildings is made easy: *"I'm setting up a company. I have three, four people. Although you can do a lot of things virtually, I need to be able to walk over to my funder. I need to walk over to the clinical lab. I need to be able to chat with some of my best scientists, and if it always is going to take me an*

hour to get there, that's very inefficient". Also shared spaces should be created where occupants of various buildings regularly meet, deliberately or by coincidence. *"People are walking… you should be able to walk down, have a coffee with a clinician, walk back up and be back in your basic lab. And so the bigger the hurdle you generate to help people cross boundaries and go from one discipline to the other discipline, I think, you start losing".*

Figure 15: Implications for Imperial West - Developing a community in the ecosystem

Community

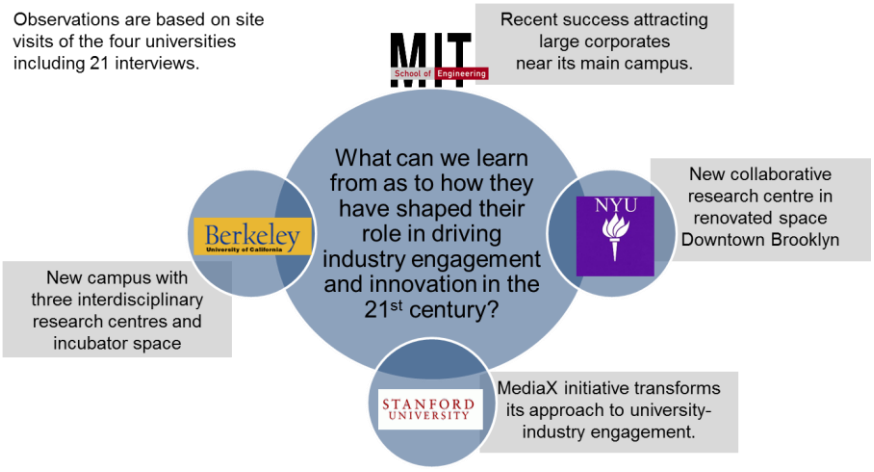
- Although a community among entrepreneurs, academics and corporate members will **take time to develop** organically in Imperial West, **organized events** may help create a shared identity.
- The most important way in which the **social fabric** of a cluster is built is through **shared experience**. University **alumni** are therefore a powerful target group to play a role in Imperial West as entrepreneurs, employees of large corporations on site, or in academic careers.
- The **layout and configuration of buildings** on the site can be designed such that interaction between individuals of different backgrounds is facilitated. **Open space** in buildings and shared, **public space** between buildings are two crucial components of clever spatial design.

6. Analysis 3: Observations from NYU, MIT, Berkeley and Stanford

MIT, Berkeley, Stanford and NYU: what can we learn from the experience of these four leading US universities as to how they have shaped their role in driving industry engagement and innovation in the 21st century?

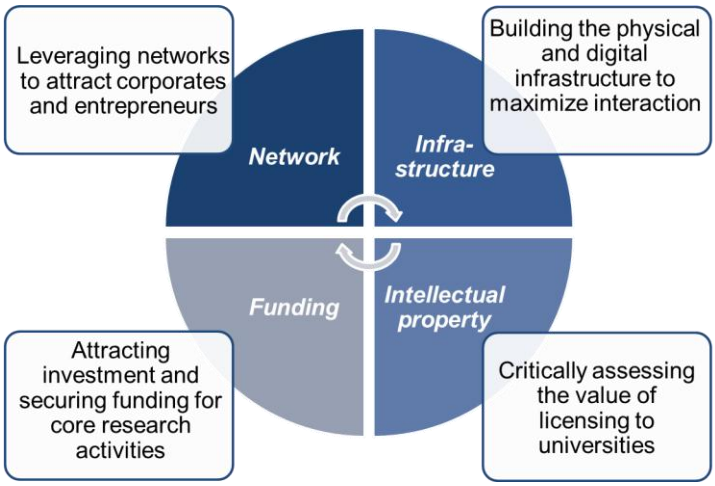
Each of these universities has recently engaged in major initiatives to set up new centres of collaborative research and incubation (see Figure 16). MIT has been very successful in attracting large corporate partners to its campus near Kendall Square. Berkeley has recently established a new campus that hosts three new interdisciplinary research centres as well as an incubator that, since its inception ten years ago, has spurred 35 start-ups. Stanford has transformed the way it shapes its university-industry interactions in the form of its Media X initiative. NYU is in the midst of establishing a new collaborative research centre covering up to 150,000 square feet of renovated space in Downtown Brooklyn, but struggles to attract corporate investment despite backing of Bloomberg.

Figure 16: Observations from four key players in the US



We have interviewed a broad range of people involved in these initiatives, as well as people from IBM and Citi Group in order to cover the industry's perspective. Attachment 2 contains a full list of interviewees. Insights from these interviews are summarized around four key themes. Main insights and reflections are graphically depicted in Figure 17 below. More elaborate background and explanation can be found in Sections 3.1 to 3.4.

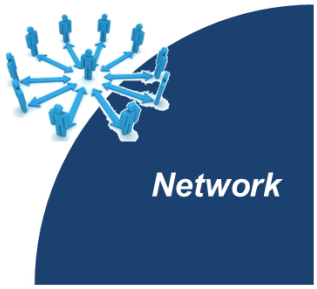
Figure 17: Key themes



6.1 The Network

Too many cluster initiatives have failed simply because of a lack of interest from the corporate sector. How did Stanford, MIT, Berkeley and NYU go about getting large technology corporations to commit? What can we learn from them about how they incubated start-ups? At the inception of a new initiative the secret to building a cluster ecosystem may reside in having a network with the right mix of people, tying in prospective corporate partners at the right level, and making sure you have a receptive home base of academics keen to engage with industry. Figure 18 summarizes the most important observations.

Figure 18: Leveraging networks attract corporates, entrepreneurs and academics



Corporates

- Biotech Boston built on 20-30 years of fundamental research. Berkeley's new campus built around "pre-competitive" core expertise areas.
  - IW should consider which **mix of qualities to put forward** to differentiate itself from competitors.
  - IW needs a **clear, unambiguous signal to the corporate sector** to trigger their interest as funders or partners.
- Stanford commissioned a social network analysis of staff industry collaborations and alumni relations.
  - A **social network analysis** of Imperial staff's current industrial engagement may reveal important leads to corporate partners.
- A lack of senior industry representation in NYU's board led to difficulties in attracting corporate funding for new CUSP centre despite backing from Bloomberg.
  - University **board membership** should include **senior industrial leaders**, VCs and entrepreneurs to achieve success in major collaborative activities.

Entrepreneurs

- MIT has a hands-off approach in incubation. It attracts corporate and entrepreneurs to locate in close proximity to its campus based on reputation effects.
  - Does IW offer space for such developments to occur at its fringes?
- Incubation is a relatively new phenomenon in the Bay Area. Stanford and Berkeley focus on coaching start-ups to prepare for investor pitch.

Academics

- A campus should host academics prone to engage with industry and start-ups. This formed a major selection criterion at Berkeley's $1 billion CITRIS centre.
  - How will IW manage its staff's willingness to engage?
- Oxford engages in exchange programmes with Silicon Valley.
  - Imperial may consider setting up exchange programs with high-buzz places, in an attempt to transfer some of that mindset onto its most entrepreneurial students.

Attracting corporates

In the changing pathways to innovation of the 21st century large tech companies appear increasingly eager to collocate with universities and start-ups. Being embedded in the "local buzz" of interaction with students and entrepreneurs is given increasing importance in their strategic location decisions. There is a growing trend towards **in-sourcing** i.e. corporates establishing R&D facilities on university campuses. Around MIT, for example, there is a development of impressive scale where several technology companies, including Novartis and Microsoft, are moving their R&D facilities into Kendall Square, adjacent to MIT's main campus.

Attracting large tech companies is a tough and competitive game, even for the worlds' top universities. First, only a very select number of locations around the world seem to offer that alluring **mix of skills, talent and ideas** that these companies aspire to tap into. Second, large tech companies simply may not have the bandwidth to have a presence in multiple locations. In our conversations with IBM, for example, it became clear that they would be very careful not to duplicate resources. They are constantly approached by universities and city authorities to invest in new centres. Yet, rather than hedging bets and "slicing the cake", IBM, and many other larger companies are likely to pick only one location to develop their major new collaborative research centres.

In an attempt to differentiate themselves from rival institutions, universities may therefore have to consider **what mix of qualities to bring to the fore** when attempting to lure large corporates into their vicinity. The success in and around MIT has been driven by MIT's commitment to long-term fundamental research. The start-ups in biotech are built on a basis of 20 to 30 years of core funding for fundamental research, which has been the flywheel for drawing in corporate R&D and kick-starting entrepreneurial activity. Imperial may wish to consider which of its strengths and areas of expertise to focus on when taking Imperial West forward, in order to send **a clear and unambiguous signal to the corporate sector** and provide direction.

This may require clarity, and perhaps difficult **choices** on what **main areas of expertise are located in Imperial West**. By building three new research centres on its new campus, Berkeley intends to be the "go to" university for energy research: energy in water, farming, food, and manufacturing. Paul Wright – founder and director of CITRIS, (one of the three new centres) commented that Berkeley would be sliding in rankings and failing in its mission if it had not invested in these three new facilities. To define the main competences going forward, it may be good to involve the "next-generation kids". Students currently involved in incubation activities or successful start-ups incubated locally may be able to provide a fresh perspective on what Imperial's new innovation hub should look like.

In that respect, it is important to have a **name that conveys our long-term scientific, technical and business vision**. US colleagues did not think "Imperial West" clearly conveyed the essence of our capabilities and activities. Perhaps the term "translation", used mostly within medicine, is also problematic in that regard.

Important leads to prospective corporate funders and partners may be **leveraged** from the university's **network of current collaborators**. Suitable candidates interested in engaging may be leveraged from the sum of relations to the corporate world held by the universities' own staff. Stanford commissioned a social network analysis to study its networks of collaboration with industrial partners and assess its engagement with alumni.

Yet, **conversations** with prospective corporate partners also need to be held **at the right level**. NYU's Centre for Urban and Social Progress (CUSP) has been struggling to attract high-profile business partners, partly because of a lack of partnerships at the CEO level. Its corporate research funding had traditionally been PI-led with relatively few large grants. So when NYU decided to scale up its research funding and established $10m "Grand Challenge" projects across multiple faculties, the board of NYU failed to represent the new direction of research. The board's network lacked access to VCs, CEOs of major technology companies and fast growing tech ventures. Thus, to ensure major collaborative investment, it may not be sufficient to build strong connections to CTOs and others in senior technical roles. Such pre-existing levels of engagement – at multiple levels, globally and locally – form admittedly the fundamental ground-level patchwork that ties the university and the corporate together, but it ultimately is the CEO, Chairman or President that needs to be

enthused about investing in a new centre. Therefore, **university board membership needs to include senior industrial leaders**, VCs, and entrepreneurs in order to achieve success in major corporate collaboration.

Advice from Stanford is not to let relationships become too settled in order to keep ideas flowing and ensure that the **university remains at the heart of a dynamic ecosystem**. For instance, Stanford caps government-funded programs because they are thought to constrain how questions are asked and how projects are run. Its MediaX initiative has been designed to keep levels of flexibility and fluidity high in university-industry engagement. MediaX connects businesses with Stanford's faculty and studies. Its approach differs through its **strong orientation towards business needs,** trying to get the best questions from industry for faculty to work on. MediaX runs forums, meetings, conferences that trigger the corporate sector to provide insights on future research needs, using several techniques for engaging public and industrial interests. The initiative provides catalytic sponsorship for concept-proving research that can amount to $100k for pilot projects. Yet funding is limited to 5- and 10-year timeframes to keep a **high churn rate for collaboration**. To prevent lock-in, Stanford does not sell university land and where possible avoids long-term agreements.

A word of **caution** must be sounded about a **blind focus on new high-growth tech companies** as these may have a very strong go-it-alone mindset. It may require strong setbacks for companies to realize the value of external engagement. Companies, such as IBM and Microsoft who have lived moments of failure through their recent histories, may be better able to collaborate with universities than some newer high-growth tech companies. As Irving Wladawsky-Berger, Chairman Emeritus of IBM's Academy of Technology, voiced: *"You need to have your heart broken to be a really good blues singer. It teaches humility".*

Attracting and generating entrepreneurs

At MIT, incubators are developed and managed by third-parties, adjacent to the MIT campus. That is, incubators take advantage of the local presence of university talent, but the university itself does not get directly involved. In the Bay Area, Berkeley and Stanford take a more active approach to facilitating entrepreneurial activities than staff and students, yet start-up incubators are a relatively new phenomenon in the Bay area. With VCs increasingly retreating from early-stage funding, angels have stepped in. This has resulted in about 20 incubators established in the Bay in last five years. The philosophy of the Bay Area is far removed from the "expensive glass, concrete, and steel" mentality of the typical incubator. Instead, it is about **coaching start-ups** in "garages and on rooftops" in their very earliest steps towards realizing their ideas.

One example is Berkeley's *Foundry*, which is connected to its CITRIS research centre. Over the past ten years, about 35 start-ups have been created out of CITRIS, which are all still alive to date. Although this is well below their ambition to create several hundred start-ups, it is felt that the current generation of students do not want to go into an office; it's an **entrepreneurial generation**. The Foundry focused on systems start-ups: sensors, products and systems. Currently, there are six companies in the Foundry. The incubation involves creating business plans and prototypes up to the point where it is possible to pitch to investors.

Academics prone to engagement

Having a critical mass of corporates and entrepreneurs on site is just one side of the story. The university's **academic staff** needs to be **receptive to engaging with industry and start-ups**, and certain activities, and certain individuals, are more suited to that end than others.

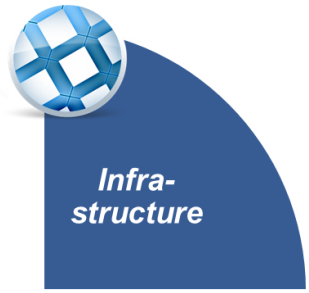
At Berkeley's new campus **prowess to engage with industry** formed an important recruitment criterion. Everyone in CITRIS, a major new research centre on campus, is under 50. All are instructed to work with start-ups one day per week. Berkeley may be helped by the strong entrepreneurial culture in and around Palo Alto that may be very different from most other university-technology clusters. Students and faculty tend to show very high commitment to creating and building ventures, accepting risk and learning from failure. For this reason, several universities, including Oxford, have exchange programs in place. Imperial may consider forging strong connections, and perhaps similar **exchange programs with such high-buzz places**, in an attempt to transfer some of that mindset to its most entrepreneurial students.

New York's **urban environment** is a big endowment for NYU. Its provision of NYU apartments have helped attract "big name" academics including Richard Florida and Steve Koonin. Although NYU experienced problems with previous contracts that gave unlimited use and made it difficult to get some academics out, Imperial may equally exploit London's urban appeal to attract high-profile academics.

6.2 The infrastructure

Interaction between students, academics, corporates and entrepreneurs is key to a vibrant cluster. How did MIT, Berkeley, Stanford, and NYU design their campuses to facilitate and encourage that interaction? And what can we learn from these universities about the role of digital infrastructure in driving collaborative innovation? Figure 19 summarizes the main observations.

Figure 19: Building the physical and digital infrastructure to promote interaction



Physical infrastructure

- NYU, Berkeley and Stanford each have designed buildings with **open studio architecture** and buildings **within walking distance** from each other to maximize interaction between industry researchers and academics.
- Stanford **does not sell university land** and tries to prevent lock-in in long-term agreements to keep a **high churn rate** in collaboration.
  - IW needs to reflect how it can ensure strong commitment from the industrial sector, whilst maintaining the flexibility to allow for parties to come and go.

Digital infrastructure

- Design of **digital infrastructure** should be included in Imperial West's vision from the outset. It is crucial to connect to research networks around the world and to reshape education and learning in the digital era.

The physical infrastructure

NYU, Stanford and Berkeley have each designed buildings with **open studio architecture** to facilitate students, faculty and industry researchers to mix. At Berkeley, it was observed that **direct proximity between academic and industry researchers** promoted interaction. A recent joint research institute between HP Multi-Media Centre and Tsinghua University explicitly desired an on-campus location to maximize that interaction.

At NYU, the Centre for Urban and Social Progress (CUSP) plans to occupy 150,000 square feet of renovated space in Downtown Brooklyn, adjacent to NYU-Poly campus, by 2017. They take an adaptive reuse approach to renovate the building, which will contain an additional 40,000 square feet of **business incubator space**. CUSP's interim home at MetroTech includes 35 private offices, 48 open workstations, two large visualization labs, a light electronics lab, two conference rooms, a 70-person seminar room, and seven flexible collaboration spaces.

At Stanford, the open studio architecture is realized in the Town and Country shopping mall, which has let its second floor to start-up incubators providing lightweight flexible working spaces. People mix in the restaurant and food court areas of the mall and around the hotel. Stanford typically **does not sell university land** and aims **to prevent lock-in long-term agreements** for anyone: staff, students, start-ups, companies, investors. Imperial College London needs to reflect on how it can ensure strong commitment from the industrial sector, whilst maintaining the flexibility to allow parties to come and go.

At CITRIS, Berkeley, it was clearly communicated that CITRIS was **more than just a new building**: it was a whole new way of running the university, with three hyper-interdisciplinary centres strongly tied to industry and society needs. The buildings were designed with an open studio environment where students, faculty and industry researchers mixed together. At the new Berkeley campus, it was also considered important to locate activities within **walking distance**. Direct proximity between university and industrial labs attracted talented researchers, from Bell Labs for example, to work in Berkeley. Imperial could consider **bicycle routes** to connect Imperial West with the South Kensington campus. Bicycles are being used to great success on Googleplex's 3-mile campus.

MIT prefers to keep their own facilities for core, fundamental research, drawing impressive investment from corporates and start-ups around MIT's fringe. It has a **hands-off approach** to attracting businesses and incubation to their **fringe**, and relies on indirect attraction of business through reputation effects. This raises the question of whether Imperial envisages there would be enough space for businesses to develop their own facilities adjacent to Imperial West.

A **hotel** played a central role at the heart of the campus in all four universities visited, e.g. Durant at Berkeley and Marriott at Kendall Square, MIT. With London being a hub in the worldwide airport network, it is best placed to **host high-profile events**. Yet, currently a lack of adequate hotel and venue facilities seem obstacles for Imperial taking advantage of this to the extent desired.

The digital infrastructure

Building the innovation district at Imperial West from scratch offers a unique chance to drive a step change in the productive use of digital technologies to deliver education, research and innovation. **Digital platforms**, including social networks, cloud computing and big data, are becoming a force multiplier.

Digital platforms intensify innovation processes. The present-day relevance of clusters of collocated science, business and start-up activities demonstrates that face-to-face interaction still has a large role to play in driving innovation. Yet, for clusters to thrive it is more important now than ever to be **connected to research networks around the world**. Digital platforms accelerate and intensify the value of global "pipeline" connections for driving innovation in clusters.

Digital platforms can also **reshape education and learning**. Although it is and will always remain important for students and teachers to interact in a physical classroom, online education has taken flight. At Stanford, Coursera is an online teaching experience targeted at opening up education to a very broad range of participants. Coursera is run by a small but busy start-up office in Palo Alto with more than 40 people. Both founders are leading Stanford computer scientists and had good understanding of the core technology platform for online learning. They received $30 million of venture funding. The platform rapidly grew to 3 million students. These large scale activities may not be the desired direction for Imperial, yet in an increasingly globalized world – and given Imperial's highly diverse student population - it is worth reflecting on how education in the 21st century will look.

6.3 Funding

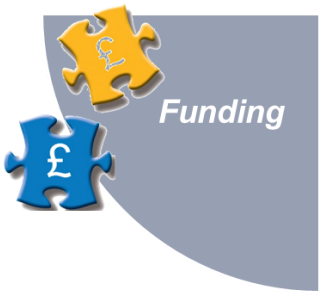
The Silicon Valley model is changing with high net-worth individuals demanding larger returns in shorter timescales, skewing investment to technologies with the potential to grow swiftly in new markets. As one interviewee at MIT explained, universities may instead be looking for **"patient money"**, i.e. investors willing to commit themselves to large sums of money that would only pay back in the longer term. This raises the question of whether Imperial is targeting the right types of funding?

CITRIS at Berkeley raised $1bn of research funding for the University of California since inception in the past 10 years. If it had followed a 'start-up' venturing model, it would not have generated 1/10th the volume of funding from license fee income. Berkeley's $1bn research-funding success is attributed to choosing a theme that **positioned the research clearly in a pre-competitive space** and having the right corporate partnership leader. Although very successful in attracting mega-donations, Berkeley has struggled to attract $100-200k mid-range donors. It felt that establishing long-term relationships with entrepreneurs is the way to connect to people donating at mid-range in the future. To do this, UC Berkeley takes equity in entrepreneurial ventures, for example at 2% pre-valuation.

NYU has made marked improvement in **philanthropic funding** for science. Endowments grew by $2bn in 10 years from 2002–2012. Substantial improvements came from exposure to new programmes in Innovation and Entrepreneurship, including festivals with Jack Dorsey, Twitter founder. NYU also focuses on building connectivity with capital markets. After Silicon Valley NY City has the second largest venture capitalist activity.

Imperial College London needs to present a **uniquely attractive offer to high net-worth individuals** who are seeking to fund. Funders in Silicon Valley suggested that wealthy donors do not need another building named in their honour, nor another dinner. They wish to see their donations making a major impact for example in health or in the environment. This may be a departure from the Silicon Valley technology investment model. Investors are sick of 1% returns, and are now seeking new areas for growth, with greater and faster returns.

Figure 20: Attracting investment and securing funding for core research activities



- MIT's success is largely built on **"patient money"** that secures long-term investments in the core research that underpins the success of its biotech cluster.
  - Does IW target the right type of funding for securing its **core research activities**?
- At Berkeley choosing a clear **theme in a pre-competitive space** helped to attract corporate funding.
  - IW should consider which **mix of qualities to put forward** to differentiate itself from competitors.
  - IW needs a **clear, unambiguous signal to the corporate sector** to trigger their interest as funders or partners.
- **Philanthropic funding** is an increasingly important source of funding at high-profile US universities.
  - IW needs uniquely attractive offer towards high-worth individuals.

6.4 Intellectual Property

Universities today are quite diverse in terms of the stance they take on the **value of intellectual property protection** and the **relevance of licensing income** as a source of university income.

At Berkeley, they take the view that for most projects **not enough money** is at stake **to make licensing worthwhile** as a revenue source, except perhaps in biotech. Therefore, IP arrangements and deal structures for their university-industry engagements are likely to be a major issue only for programmes that are larger than traditional mid-sized corporate project investments. From that perspective, Berkeley aims to keep their IP policy simple, using progressive licensing terms. The existence of a license on the partner's side prior to collaboration is not an issue. It helps smooth collaboration as both sides need recognition and traceability.

Generally, attempts by universities to make money from licensing have been futile. In addition, there is anecdotal evidence that a more aggressive stance of universities towards the capture of IP may hold back successful industry engagement. Our IBM informants referred to a multi-billion nanotechnology research initiative with Albany to explain how a rigid focus may complicate university-industry collaboration. In this engagement, IBM managed the IP agreement to give confidence to business to enable further investment of €1bn, i.e. acting as the *anchor tenant* for major investment to follow from other participants. It took 5 years for Albany University and local government to come to terms with the IBM's deal structure and retention of IP.

Ahead of its step change to intensify industry engagements within the frame of Imperial West it may

be worthwhile for Imperial to critically assess its **IP policies**, balancing the desire to capture revenue from IP with a realistic attitude to let go and keep engagements in healthy shape.

Figure 21: Critically assessing the value of licensing to universities

- Most attempts by universities to make money from licensing have been futile. A university's blind focus on IP may form an obstacle for industry engagement to proceed.
- Berkeley has adopted a simple IP policy, with progressive licensing terms, seeking to capture value only from the biggest industry engagements.
  - It may be worthwhile for Imperial to critically assess its **IP policy**, balancing the desire to capture revenue from IP with realistic attitude to let go and keep engagements in healthy shape.

7. Summary and conclusion

7.1 Objectives and methodology

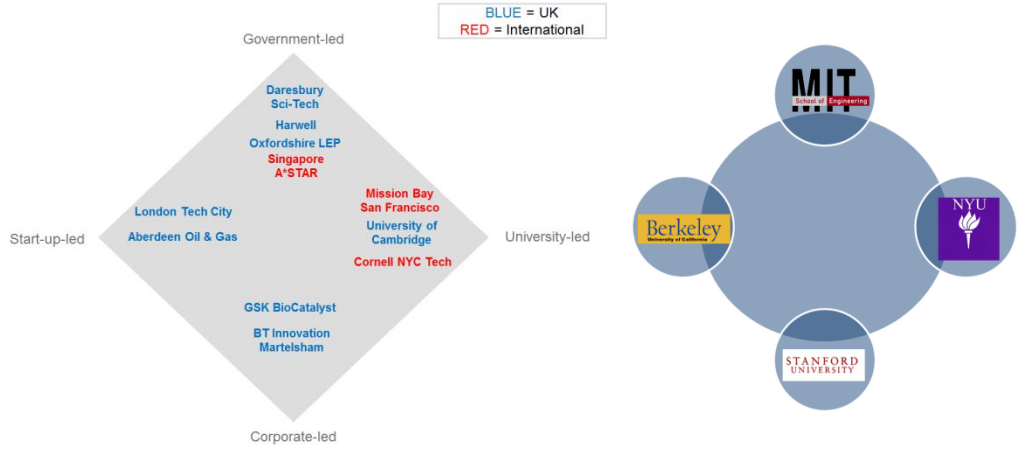
Imperial College London stands at the forefront of an **unprecedented opportunity** to build upon its excellence for basic and applied research and reinforce its global role in fostering science and innovation for the remainder of the 21st century. Imperial West should not be considered as simply an additional campus helping to relieve shortages of space and capacity for growth in the College's current campuses, but should be embraced as a once-in-a-lifetime opportunity to build a **district of science and innovation** that will help raise the College's profile to an even higher level.

This study has been commissioned to inform decision makers at Imperial College London about the **feasibility** of realizing an Innovation District at Imperial West that can live up to its promise to become a **world-leading cluster for science, technology and** innovation. As such, it fits seamlessly with recent initiatives particularly from leading US universities to build such entrepreneurial science and innovation ecosystems. More specifically, this report aims to:

- Identify the factors that may drive the successful creation of an interactive and entrepreneurial innovation district
- Provide guidance for best practice, and insight into the potential pitfalls.

This report has relied on a multi-method design to get insight into the forces of successful cluster creation. It includes a review of the relevant academic literature which led to the development of a conceptual framework of cluster emergence and growth. In turn, the conceptual framework forms the cornerstone of a series of in-depth cases studies of cluster initiatives and universities, including seven UK-based clusters, three international clusters and four leading US universities.

Figure 22: Cluster and university case studies



7.2 Literature review: how do clusters emerge and grow?

The literature review is organized around three core questions.

Cluster emergence

In most basic terms, a cluster is defined as a **geographical concentration of related activities**. The central idea is that collocation of related activities promotes interaction between them. It is these **networks of interaction** that are believed to **promote innovation** and therefore make clusters a **desirable location** for firms, entrepreneurs and universities.

What factors drive the attraction of businesses, entrepreneurs and academics to a cluster? The academic literature portrays **spin-off firms are the natural engine of cluster formation**. The main theory of cluster emergence stipulates that initial clustering emanates from corporations or universities that generate spin-offs. As such spin-offs typically locate near their parent organization, subsequent instances of firm creation set in motion a path dependent process that leads to spatial concentration of related activities.

This implies that **incubation and acceleration** of start-ups are pivotal for Imperial West to become a cluster that is more than a university campus. Clusters should not only provide adequate infrastructure for incubation of start-ups; more importantly it should make sure that it offers the **capacity for these firms to grow** and remain part of the cluster in a bid to broaden the base from which again new firms can emerge.

- ➔ Building initial entrepreneurial capacity in Imperial West is key to setting in motion a self-reinforcing cycle of building entrepreneurial critical mass as a key component of the ecosystem.

A second insight in the cluster literature – described by the concept of **related variety** - is that clusters typically emerge from a mixture of existing regional strengths and related upcoming activities. For instance, the area of Coventry that became home to the British automobile industry based on existing strengths in coach building and the emerging expertise in combustion engines.

- ➔ Imperial West thus ideally takes **current areas of strength in basic and applied research** as the foundations for the cluster's identity and faces the challenge to identify **pre-competitive activities** related to such strengths that may hold the key to dominant industries of the future.

The innovation premium of clusters

Theories of agglomeration economies are central to arguing how clustering promotes innovation. Today, the academic literature favours the presence of **local communities of collective learning** and **global pipelines** to international networks as two key factors that underpin a cluster's innovation premium.

The most innovative clusters around the world are home to informal **communities** where individuals exchange ideas and learn from each other **beyond the boundaries of the organizations in which they work**. Industry researchers, academics and entrepreneurs know each other and rely on each other for inspiration, advice and learning. Facilitating the creation of an ecosystem where such a community can thrive is crucial for the vibrancy and innovative potential of clusters.

- ➔ The creation of a community of academics, industry researchers and entrepreneurs should feature prominently on Imperial West's agenda, as it forms a critical component of why innovative and entrepreneurial individuals want to "be there".

Clusters are typically innovative because the communities within them contain individuals who are strongly networked (particularly internationally). Where the local community networks form the basis for collective learning, it is global pipeline connections that offer a perspective on science and technology developments around the world, giving insights into global markets and channels of capital.

- ➔ Imperial West should leverage its international reputation as a leading science, technology, engineering, medicine and business university contributing to the global connectedness of Imperial West's local community of academics, industry researchers and entrepreneurs.

Creating the cluster ecosystems

Creating a local ecosystem with a thriving community is easier said than done. The **social fabric** of a cluster takes **time** to develop, but two main factors have been identified in the literature as stimulators of network formation in clusters.

First, **shared histories** between individuals lay the ground-level foundation for the social fabric from which cluster communities and global pipelines develop. In particular, for most individuals bonds created during education often last a lifetime.

- ➔ The College should incorporate its alumni policy into its vision for Imperial West, leveraging the power of bonds between its alumni to foster community. Retaining successful alumni who have moved into successful corporate or entrepreneurial careers can provide the first stepping stone to building the Imperial West community.

Interaction between individuals in a cluster is strongly guided by **shared interests and shared expertise**. In the first stage of ecosystem development in Imperial West, interaction between academics, industry researchers and entrepreneurs most likely to take place **within disciplinary boundaries**. Once shared expertise between these parties has given rise to communities around various specializations, **cross-fertilization** between those communities may emerge.

- ➔ Imperial may consider portraying Imperial West as focusing on a limited number of 'grand challenges' that involve expertise areas in which the College is traditionally strong to foster relationship between academics, entrepreneurs and industry researchers. Initially these may mostly take place within single domains. In a later stage, interactions between domains may then lead to cross-fertilization and breakthrough innovation across domain boundaries.

Although collocation is not a miracle that will foster interaction between individuals from different backgrounds, clever design of space in Imperial West may help to create a community feel. Buildings with **open studio architecture** are conducive to accidental encounters and promote interaction. **Shared, public spaces** between buildings such as bars, cafes and green spaces are important to foster interaction between individuals in different buildings.

7.3 Conceptual model for the creation of cluster ecosystems

The literature review has revealed that cluster ecosystems flourish with a **balanced presence and contribution of universities, large corporates and start-ups**. Exchange of ideas and direct collaboration in pushing science and innovation forward form the cornerstones of the **cluster ecosystem**. **Government** may also play a key role as advocates for the creation of a cluster ecosystem that contributes to local economic development, and as investment partner. We believe it should be Imperial's ambition to grow Imperial West as an innovation district where university leadership co-exists with balanced start-up, corporate and government initiative. When Imperial West gets this balance right, it may be well placed to position itself as Europe's leading innovation district that can **rival the most innovative and entrepreneurial "high-buzz" places** around the world.

Our observation is that clusters around the world differ as to **where there early origins lie**. Many clusters start as an initial concentration of start-up activities and small businesses. By reaching a critical mass of firms such **start-up led clusters** then often succeed in **attracting government support**, investment from and location of **large corporations** into the area and engaging with **universities**. Other clusters are built around the early initiative of universities, government or large corporations. They are university-led, government-led, or corporate-led clusters. Our premise is that, regardless of where the early initiative for cluster emergence lies, each cluster only becomes a **vibrant ecosystem** when involving its other constituents. In other words: small businesses, large corporations, academic organizations and government bodies form the key constituents of cluster ecosystems. The performance of the ecosystem depends on the **successful exploitation of synergies** between them.

Governments around the world, including the UK, have been found to be eager to support initiatives that seek to build such ecosystems with academic, corporate and entrepreneurial components. Although not physically present in the ecosystem, they often play a decisive role in getting the creation of the ecosystem off the ground.

- ➔ Imperial West must seek to **balance between the academic, corporate and entrepreneurial presence**. These components form the crucial ingredients of an ecosystem where the interdependencies between them make the **sum greater than its parts**. It is the ecosystem that **appeals** to prospective academic, entrepreneurial and corporate residents at Imperial West, and it is the vision of such an ecosystem that resonates well with **government policy**.

7.4 Analysis and recommendations for Imperial West

Interviews with stakeholders in a variety of UK and international cluster initiatives and observations from visits to four leading US universities have revealed important insights into best practice and potential pitfalls for the creation of successful cluster ecosystems. The findings are organized along the four key components of a functioning ecosystem: universities, start-ups, large corporations, and government support. But before that, we offer some reflections on the "makeability of clusters".

The makeability of clusters

Despite the fact that governments, universities and businesses around the world have implemented policy to create clusters, the academic literature provides little support for the idea that clusters can be engineered from scratch. Also a large share of our interviewees has voiced concerns that clusters cannot be made, but can at best be facilitated and supported to grow. Clusters and their ecosystems take time to develop and must stand on strong foundations of existing areas of strength.

- ➔ Imperial West should have the ambition to become a cluster ecosystem with entrepreneurial, academic and corporate elements who each share the drive to excel in science and translation. Yet, it must realize that it takes time for such an ecosystem to develop.

Universities

The reason why start-ups and large corporations seek locations near to leading universities is to have access to **top-notch basic and applied science**. Although science translation by universities themselves has become increasingly important, universities need to be careful that it does not undermine its investment in its core mission of basic and applied research. For example, Boston's biotech cluster is built on a strong foundation of decade-long investments in basic science at MIT and the confidence that MIT will continue contributing breakthrough insights to that field.

- ➔ Imperial West must safeguard long-term funding to ensure it remains world-leading in the areas of expertise on which Imperial West's venture proposition will be built. Imperial College London would need access to **"patient money"**, i.e. philanthropic investment from people who believe in the value of fundamental research and are not too concerned by short-term returns.

University-led cluster initiatives come in various shapes or forms. Some have a very strong disciplinary profile (e.g. Boston, US), whereas others are built around a broader spectrum of sectors (e.g. Cambridge, UK). Yet, many interviewees advocated the view that in order for a cluster to gain **traction and visibility** and attract government funding and corporate investment, **a clear profile** around a limited number of areas of excellence would be advisable. Such a profile can either be pure discipline based, but increasingly university science parks, for example, are organized around interdisciplinary **grand challenges**.

A clear disciplinary focus, or ones around well-defined grand challenges helps community building, as networks are more easily formed within, than between, disciplinary boundaries (particularly true for connections between different types of constituents, e.g. university-industry interaction). When crossing such boundaries, being united around **shared goals and objectives** seems an important prerequisite for interaction to emerge. Second, a clear signature profile built around emerging, pre-competitive areas related to traditional area of strength would **heighten the appeal** of the cluster for prospective investors and cluster residents.

- ➔ The College will have to put forward a **bold vision** as to what **signature Imperial West** will have. It is of crucial importance that Imperial West differentiates itself in the global arena of science and innovation clusters in order **to be the prime cluster of choice in main areas of excellence** rather than a secondary or tertiary choice in other domains.
- ➔ This implies that Imperial West faces the challenge of building a profile for Imperial West that, on the one hand, builds on areas of **academic excellence** that the College has shaped over its history, whilst, on the other hand, occupying a space with **clear promise** for the future. A profile that would **combine historic strengths of the College with forward-looking grand challenges** would heighten the appeal to investors, entrepreneurs and prospective tenants of Imperial West.

Commercialization expertise and translation capabilities in universities cannot be taken-for-granted. **Educational reforms** may in the long-term be required to build entrepreneurial skills for the future generation of start-ups. Cornell NYU Tech on Roosevelt Island, for example, has largely overhauled their education programmes on site, placing more emphasis on industrial placements and applied subjects. A key way in which clusters can ease the transfer of **translation capabilities** from industry to academia is through **shared space**. In Mission Bay, San Francisco, collocation of university scientists and hospitals are believed to ease the translation of basic science into clinical practice.

- ➔ The College may want to review how current **education programmes** equip students with **entrepreneurial and industrial skills**. Current students should be seen as future alumni and must be prepared for their potential role in science and innovation ecosystems like Imperial West. **Exchange programmes** with high-buzz places, for example in the US, may also facilitate some transfer of entrepreneurial skills and mindset to future Imperial West occupants.
- ➔ The design of Imperial West ideally foresees shared space between academic and industrial scientists to enable transfer of commercialization expertise and translation capabilities.

Part of the solution for ensuring that academics are prepared for science translations activities lies in the **selection of academics** in a cluster ecosystem. Unsurprisingly, certain disciplines lend themselves to achieving a higher success rate of translation into practice. However, selection of individual academics can also be a crucial lever to foster an academic culture prone to interact with start-ups business and large corporations. CITRIS at Berkeley used **competitive entry practices for academics** entering its multidisciplinary research centre. This helped to select academics keen on seeing their research impacting practice, even if their research was fundamental in nature.

- ➔ It is important that, when deciding on which elements to relocate to Imperial West, the College takes the **"business friendly-ness"** of the discipline into consideration. Departments with a proven track record of university spin-outs and a strong tradition of university-industry engagements would lend themselves better to location in a cluster ecosystem.
- ➔ When establishing new research centres at Imperial West, the College may consider using **competitive entry practices** to select academics more prone to engage with industry.
- ➔ A **social network analysis** of College staff may also create insight into corporate connections held by current employees. Stanford commissioned such an analysis to find potential leads on to potential corporate partners and investors.

Various cluster initiatives around the world engage in **international collaborations** to access a **global pool of talent**. To widen the appeal of a cluster to foreign corporations, entrepreneurs and academics, both A*STAR in Singapore and NYU Cornell in Roosevelt Island partnered up with foreign universities.

- ➔ The College may want to integrate its vision for internationalization into its vision for Imperial West, in particular in an attempt to harness entrepreneurial talent from emerging economies.

Start-ups

Cluster initiatives around the world have strongly embraced entrepreneurship – incubation and acceleration of start-ups in particular – as an essential component of a cluster ecosystem. Various interviewees have warned that selection of ambitious, high-growth entrepreneurs into the ecosystem is essential. The first entrepreneurs must set the bar high, so as to heighten the appeal to follower entrepreneurs as well as to large corporates seeking to tap into the pool of innovative start-ups.

- ➔ **Incubators** at Imperial West should go for **quality rather than volume**, for example by creating prestige incubators and accelerators. Early high-quality entrepreneurs are more likely to **contribute to community building**, may act as **magnet tenants** for future entrepreneurs, and can act as **mentors** for them.
- ➔ Selection of quality entrepreneurs typically is a process of "hit and miss" and general guiding principles for **identifying promising start-ups** are rare. It is advisable that Imperial West appoints a **task force** to learn from leading universities (e.g. CITRIS Berkeley), seed and angel investors about the practices they have in place for start-up selection.

Successful entrepreneurs may thus take on mentorship roles for younger start-ups and thus play a key role in building an **ecosystem community**. The traditional incubation and acceleration models leave little scope for retaining a strong bond with successful entrepreneurs that have grown too successful for incubation and too large for acceleration. Given **space constraints**, such **successful small businesses** are often forced to locations further away. This problem is particularly salient in London where growth capacity for small firms is limited and they often seek refuge in locations such as Oxford and Cambridge. Yet, given their crucial role in building the local ecosystem, the cluster would greatly benefit from keeping them in their vicinity. It would help the long-term stability of a cluster itself, as home-grown start-ups may be less willing to move out than more footloose multinationals, and of the community in the ecosystem.

- ➔ **Flexibility of space offerings** should feature prominently on Imperial West's agenda so that successful growing start-ups can remain located nearby and are not forced out of the ecosystem they contribute to.

Start-up companies have different needs for mentoring and support and different space requirements dependent on their type and development over time. For example the space and support requirements for accelerated growth companies (whether they are corporate or academic spin-offs) are very different from those for student start-ups. **Student start-ups** first and foremost need access to facilities and mentorship and the **need for self-contained space may be limited**. Importantly, they critically need **access to university facilities** that may be too costly as independent early-stage investment. **Academic start-ups and corporate spin-outs** may equally benefit from shared facilities, but may have strong needs for self-contained work space, although they may initially be most concerned with access to high-quality management support. However, particularly for accelerator businesses, the most important aspect of their space requirements is **flexibility over time**. Particularly for start-ups access to state-of-the art **digital infrastructure** may be a primary pull factor.

- ➔ The College could review its current incubation model and examine how it can best accommodate the space and mentoring requirements of start-up companies at different stages of development.
- ➔ It is recommended that planning of Imperial West would incorporate digital infrastructure from the outset.

Although start-ups are high-risk and may fail to create positive returns for the cluster in the short term, in the longer term it is the vibrant entrepreneurial community that appeals to corporate investors and government officials. This implies in some cases that a viable financial model for the entrepreneurial component of a cluster ecosystem may be hard to achieve. Opinions differed amongst our interviewees about whether entrepreneurs should be incentivised to locate in a cluster through subsidized rents. Reputation of the university may in part justify market rents, yet when high-buzz alternative locations are nearby, initial entrepreneurs may be lured into the emerging cluster through financial incentives.

- ➔ Entrepreneurship is a key ingredient of an ecosystem, yet it may be difficult initially to build **a viable financial model** around incubation and acceleration. This may be part justified by the **value** that corporate investment, government bodies and subsequent entrepreneurs place in the **quality and vibrancy of the entrepreneurial ecosystem**. Once such a functioning system is in place, competitive, yet not subsidized rents should make a **positive financial return** on incubation more feasible.
- ➔ A **viable rental income model** stands or falls with a functioning **"flywheel"**: start-ups will be willing to pay a (close to) market rent if they perceive the location as high-status. It must be ensured that **flexibility of rental contracts** is maintained such that **underperforming start-ups** do not occupy space for too long and endanger the desirability of the location. At the same time, it must be ensured that **high-performing start-ups** have opportunities for nearby relocation and expansion, such that their success may shine on the incubator or accelerator.
- ➔ As recent coverage of TechCity in the Guardian showed, there is a **risk of overcharging** rent to start-ups. Many clusters initially built a **critical mass of successful entrepreneurs** that were attracted to the area because of relatively affordable rents. These may move away when rents increase too steeply (for example because of investment from large corporates).
- ➔ Some US cluster initiatives have set up **dedicated teams responsible for the management of the start-up ecosystem**. Such a team could be headed by a Chief Entrepreneurship Officer, who is able to handle the balance between getting the best start-ups and setting up a financially viable model.

Universities may, however, not have to carry the burden of non-viable financial incubation models alone. **Corporations** who place value on creating such ecosystems can be **investment partners** in building incubation and accelerator space.

- ➔ In negotiations with prospective corporate residents of Imperial West, it may be well worth considering the corporate role in, and contribution to the incubation of start-ups.

A final key ingredient of the entrepreneurial component of a cluster ecosystem is **access to risk capital**. University tech transfer offices may help entrepreneurs find venture capital, but particularly in the UK, the venture capital infrastructure is less developed than for example in the US.

- ➔ It should be a priority of the College to ensure early entrepreneurs are able to attract funding. Some cluster initiatives in the US have appointed a **Chief Entrepreneurial Officer** who may play a key role in helping start-ups achieve this. It may also help to have entrepreneurial highflyers on the College management or advisory board - a model adopted by various high-profile US universities.

Large corporations

We conducted various interviews with stakeholders in the corporate arena and discussed what they believed corporations are looking for when seeking to relocate (part of) their R&D facilities in cluster locations. The unambiguous message was that **corporations seek vicinity to excellent breakthrough science and excellent students,** as well as entry **into the "buzz" of promising start-up entrepreneurs** who operate in pre-competitive areas of strategic importance to them.

- ➔ Research excellence is the major pull factor for corporations seeking entry into clusters. An **unambiguous message** as to where Imperial West will excel will resonate strongly with the business world and help attract their investment.
- ➔ Imperial West may want to consider putting a **governance structure** in place with responsibility for the **communication strategy** of Imperial West that transcends the level of individual buildings and centres and emphasises the **coherence and cohesion** of activities and parties attracted to the site. The governance structure ideally has **balanced representation** of university, corporate, entrepreneurial and government stakeholders.

Despite the importance of attracting large-scale corporate investment, many large companies may be seeking a relatively small presence on site, which should not be neglected. Specialized teams from such companies, highly motivated to participate in the ecosystem could play an important part in **catalysing corporate participation in Imperial West's community** early on. A major pitfall that some interviewees pointed at is the **footloose nature** of corporate investment. For example, when the fortunes of prospective investors change in unexpected ways, corporate investment into clusters may be one of the first areas where costs are cut.

- ➔ Attracting this **smaller-scale corporate investment** should not be neglected and may call for a dedicated approach to marketing that is quite different from the approach used to target major R&D relocations.
- ➔ It is important that Imperial West deliberately seeks to **diversify corporate investment** to avoid dependence on single, large-scale investments of companies that can be highly footloose.

As **corporate-led clusters** illustrate, multinational corporations place great value on the possibility of tapping into the pool of entrepreneurial skill in vibrant cluster ecosystem, and might also be ready to contribute to creating such an ecosystem through own investment in incubation and acceleration programmes.

- ➔ Imperial West's search for prospective corporate residents may include negotiations on the corporate role in setting up and investing in the incubation and acceleration of start-ups.

Government support

As the Government's convincing support for TechCity and various Catapult centres around the UK illustrates, they are very **keen to support the creation of cluster ecosystems**. Particularly when such initiatives help **regenerate areas in relative economic decline**, that it may be willing to support through significant government investment.

The **formula of ecosystems** that combine research excellence of universities, the commercialization capabilities of large corporations and entrepreneurial energy and creativity have **very strong appeal** to government in the current climate. Although policy is destined to vary with subsequent governments, it is unlikely that future governments would not at least in part buy into the vision of building an innovation ecosystem in an area in need of regeneration. In other UK clusters, the government has played a key role in raising the profile of emergent clusters, generating international visibility and catalysing corporate interest.

Attachment 1: Literature review protocol

Studies are organized along three topic areas:

1) Cluster emergence – Which factors drive the attraction of businesses, entrepreneurs and academics to the cluster?
2) The innovation premium of clusters – What are the mechanisms that turn clusters into districts of innovation?
3) Creating the cluster ecosystem – What are the forces that glue elements of the cluster together into an ecosystem of science, innovation and translation?

Search by journal

- Pre-2009 literature
    - Covered in doctoral thesis Anne ter Wal
- Post-2009 literature
    - Systematic search through top Management journals (*Academy of Management Review*, *Academy of Management Journal*, *Administrative Science Quarterly*, *Organization Science*, *Strategic Management Journal*) and Geography and Innovation journals (*Journal of Economic Geography*, *Economic Geography*, *Regional Studies* and *Research Policy*).

Search by citations to key works in the field, through Google Scholar

- Cluster emergence
    - Arthur, W.B. (1994). *Increasing returns and path dependence in the economy*. Ann Arbor: University of Michigan Press.
    - Klepper, S. (1997). Industry life cycles. *Industrial and Corporate Change* 6(1), 145-181.
    - Casper, S. (2007). How do technology clusters emerge and become sustainable? Social network formation and inter-firm mobility within the San Diego biotechnology cluster. *Research Policy* 36(4), 438-455.
- Innovation premium of clusters
    - Baptista, R. and Swann, P. (1998). Do firms in clusters innovate more? *Research Policy* 27(5), 525-540.
- Cluster ecosystem
    - Powell, W.W., Koput, K.W. and Smith-Doerr, L. (1996). Interorganizational collaboration and the locus of innovation: networks of learning in biotechnology. *Administrative Science Quarterly* 41(1), 116-145.
    - Bathelt, H., Malmberg, A. and Maskell, P. (2004). Clusters and knowledge: local buzz, global pipelines and the process of knowledge creation. *Progress in Human Geography* 28(1), 31-56.

Search by key word

- Geographical clusters / collective learning
- Regional innovation systems
- Science and technology parks / business parks
- Industrial districts
- Incubators / cluster firms
- 'Research valorisation initiatives'