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Sharing the Geoscience Ireland Cluster Experience
A Guide to Creating, Developing and Maintaining a Business Cluster

Dermot Duff, Trinity Business School. 2021

Geological Survey Ireland Report

GEOSCIENCE IRELAND
Exploring
Developing
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Geological Survey Ireland is a division of the Department of the Environment, Climate and Communications

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Foreword

In May 2020, Geological Survey Ireland published a report on the Formation and Maintenance of a Successful Business Cluster. I am now pleased to introduce a sequel to that report in the form of a more detailed Guide to the Development of a Business Cluster by Dermot Duff, a Teaching Fellow at Trinity College Dublin Business School. The guide includes a comprehensive review of research on clusters together with an assessment of the metrics used to measure cluster development.

The success of the Geoscience Ireland cluster is an example of collaboration between state, semi-state and private sector participants. The cluster has a well-developed network of links to these participants, to clusters in other countries, to funding agencies, to clients and to national and international research programmes. These networks provide contacts, market knowledge and analysis for Geoscience Ireland member companies - all factors which are essential for their ability to win business in international markets.

The sectors in which Geoscience Ireland companies operate include water supplies and treatment; critical infrastructure and the discovery and development of materials critical for renewable energy. This work aligns with UN Sustainable Development Goals and with Ireland's Climate Action priorities, while Cluster Development has been specifically targeted in Ireland's Future Jobs Initiative (2019) with the latest Programme for Government (2020) further referencing the support of indigenous SME.

Dermot Duff has been a member of the Geoscience Ireland Steering Committee since 2016 and has contributed significantly to its development by providing training, mentoring and strategic thinking to its members and secretariat. I hope that this Guide will contribute to the growth and development of sectoral clusters in the Irish economy.

Koen Verbruggen, February 2021.

Director, Geological Survey Ireland

Biographical Note

Dermot Duff is a Module Leader in International Business Strategy and in Operations Strategy in Trinity Business School, where he also manages student consultancy projects for the MSc degree portfolio.

An Electronics Engineer from UCD by initial profession, he held senior engineering management positions in ITT Alcatel in The Hague and was later European Transformation Manager for Digital Equipment Corporation (later HP) in Geneva.

His early career was in Seismic Oil Exploration in Africa, UK and the Middle East, followed by Design Engineering for a Canadian company and the Engineering Manager for a variety of high-tech companies, notably Documentation in Florida and Storage Technology in Boulder, Colorado.

He is a member of the Boards of several local companies, in cyber security, accounting, municipal services, executive education, capital equipment, global trading platforms and IT services.

Dermot has published numerous articles and books, including **Strategic Cost Reduction** (2011) and **Project Management: A Practical Guide** (2010), and a major work on **Managing Professionals - and Other Smart People** (2013, published by Chartered Accountants Ireland.

Dermot has an MSc in Management Practice from Trinity and he is also a qualified Black Belt, Executive Coach and an Enterprise Ireland Business Advisor. He is certified in Psychometric Science, Occupational Testing, DiSC, 16PF, EQi, and is familiar with Belbin, MBTI, Rowe Decision Making, Enneagram, Kilmann, FIRO-B, MLQ and similar profilers.

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Contact Geoscience Ireland:

Sean Finlay | Business Development Director
sean.finlay@geoscience.ie

Andrew Gaynor | Business Development Manager
andrew.gaynor@gsi.ie

Stephen D Walsh | Senior Market Advisor
stephen.walsh@gsi.ie

Jessica Allen | Market Advisor
jessica.allen@gsi.ie

Connect:

Geosciencelre

geoscience-ireland

Executive Summary

This guidebook from Geoscience Ireland shows how to create and sustain a vibrant business cluster, based on its extensive practical experience and also on recent studies on the development of a successful business cluster.

It showcases the lessons learned by Geoscience Ireland in stimulating remarkable job creation over the last decade, and offers new thinking into how clusters can simultaneously collaborate and compete.

It demonstrates how clusters can progress through the newly-developed “Four-stage cluster maturity ladder”, how the cluster life-cycle can be navigated successfully, and how companies can scale internationally through collaborative effort while maintaining their own independence. It also suggests some ideas on government policy on creating internationally successful companies.

Clusters provide the ultimate win-win-win scenario: companies can achieve scale without sacrificing their autonomy, while society benefits from sustained job creation, and government achieves a wider tax base.

Indeed, the liaison between academia, government and clusters (known as the *Triple Helix*) reinforces and makes real the connection between all three for mutual benefit.

Clusters are a new, effective, robust yet flexible organisational form, mitigating the problems inherent in arm’s length relationships without imposing the inflexibilities of vertical integration or formal linkages.

For a small domestic economy like Ireland’s, Geoscience Ireland-type clusters untangle the “paradox of location”, facilitating local companies to compete in a global economy, especially when assisted by a combined marketing approach and the privileged access to foreign markets that government support can provide.

Geoscience is literally at the very foundations of an economy: as well as creating sustainable high-calibre jobs in their own right, geoscience enables a multiple of other jobs downstream, in construction and in professional services. Moreover, the quality of the geoscience element is a major determinant of the success of infrastructural projects, such as the construction of hospitals, pharma plants, medical device facilities, technology centres that enables the economy and also enhances the quality of life.

The geoscience sector provides high-value skilled jobs which are regionally dispersed and sustainable: indeed, helping these established companies to scale at home and particularly

abroad is a more effective way of creating career jobs than funding start-ups, whose stellar promise is matched by their tendency to expire without creating sustained business success or employment.

Helping established firms to scale is a surer pathway to success, and this guide offers suggestions based on Geoscience Ireland's experience and the identification of the three pillars of scaling, namely insightful leadership, strong finances and distinctive reputation generated by a clear differentiation.

This guide also has a distinct perspective: how to grow an Irish cluster, with our own unique national characteristics, and the closeness of our "Triple Helix" of government, commerce and academia, plus our innate instinct to socialise, and our world-wide diaspora.

Ireland is not immune to the inevitability of the economic shocks predicted by economist Joseph Schumpeter as far back as 1934, and as is further evidenced by the impact of the Covid-19 pandemic here. The question must change from "what will we do ***if*** there is another shock" to what will we do ***when*** the next shock occurs – indeed, it would be prudent to prepare ***before*** the next shock. To survive these shocks, unity of common purpose is essential as exemplified by effective clusters, such as Geoscience Ireland who have shown how the "Triple Helix" of government, industry and educational institutions can work together for the common good.

Economic and societal progress is predicated on the ability to overcome natural distrust and the innate human desire for autonomy. It is by "competing and co-operating" simultaneously that enterprises can more readily achieve greater scale and sustainability. This guidebook shows how that can be done, using examples from across the world, as well as from Geoscience Ireland. Guided by strong cluster norms as well as the other human instinct – to be social creatures – Geoscience Ireland members have collectively grown revenues over a 10 year period from a very low base of several million Euro to €1.23 billion, operating in 70 countries and creating hundreds of career jobs in the process.

It is hoped this guidebook will assist cluster managers navigate the many obstacles in uniting individual competitors in common cause, despite the inherent instinct to compete rather than collaborate. It builds on an earlier publication of May 2020 by Geological Survey Ireland "The Formation and Maintenance of a Successful Business Cluster".

1 Preface

As well as proving research-based guidance on how to develop certain types of business cluster, this guidebook also addresses the 2016 and 2020 ‘Program for Government’s’ job creation targets, specifically the role of clusters as a policy instrument in creating and sustaining SME enterprises, especially those, such as Geoscience Ireland member companies, who have the potential for substantial foreign revenue and help isolate the industry from over-dependence on the volatile domestic market.

The commitment to establish a Regional Technology Clustering Programme is duly noted by Geoscience Ireland, and this guidebook offers ideas on how to create and sustain a vibrant cluster, based on Geoscience Ireland’s experience and research into global best practice, from New Zealand to Sweden, from Boston to Singapore.

Key authorities in the area of cluster development are the renowned Harvard Professor Michael Porter, plus members of The Competitiveness Institute (TCI, a group that promotes cluster performance) most prominently Ifor Ffowcs Williams (whose work greatly informs this guidebook).

Their focus is on the classic regional cluster, based on value chains in a particular industry, often in traditional occupations such as leather or clothing, whereas the focus here is on associations of modern firms in similar professional or technical businesses (as typified by Geoscience Ireland’s member companies). Such associations naturally benefit from less direct competition among members, and so create the environment for sharing information, generating ideas, formal and informal collaboration, often leading to joint ventures and co-delivery of larger projects, especially abroad.

This guide also has a distinct perspective: how to grow an Irish cluster, with our own unique national characteristics, with, on the one hand, a tradition of forming co-operatives since the 1800’s, led by Horace Plunkett, and a tendency to sunder organisations, as powerfully expressed by author Brendan Behan’s immortal phrase.

Managing this dichotomy is a particular challenge, and so attention is paid here on how to generate trust, how to maintain dynamism in a cluster and how companies can succeed on the world stage.

A *“*house divided against itself cannot stand*”*, as Abraham Lincoln proclaimed in 1858.

In some ways, there is a distinctly Irish advantage: our history ever since Horace Plunket’s time, over a century ago, creating the cooperative movement, and the closeness of our

"Triple Helix" of government, commerce and academia, plus our innate instinct to socialise, and our world-wide diaspora.

Ireland is not simply an economy – it is, of course, also a society, but societies rely on suitable employment, and Government plays a key role in creating "societal value":

Creating Public and Societal Value: Beyond basic economics

Professor Mark Moore's seminal book, 'Creating Public Value', stimulated a potential shift towards a wider definition of public value and correspondingly a more entrepreneurial public management approach based on the so-called strategic triangle. This strategic triangle encourages the public manager to manage "up" the hierarchy, to manage "outward" to the public (including businesses) and manage "down" to ensure the operational capacity is delivered. This, according to Moore and others such as Bryson *et al*, encourages a "restless, value-seeking imagination" as distinct to the more passive style of public administration. It underscores how entrepreneurial spirit, strategic action and leadership are key to creating public value, which in turns creates a virtuous circle of increased employment and a higher tax base.

The Triple Helix (so often instanced by cluster advocates) mirrors this approach, integrating government, business and the wider society in the common purpose of creating economic and social value.

Cluster managers and their Boards would do well to reflect on the degree to which this approach to public value is enshrined in the management of their cluster. This is an aspect in which Geoscience Ireland clearly excels, with dynamic leadership at both the cluster level and the level of the sponsoring body (Geological Survey Ireland) and the associated government departments.

The words of Aristotle (384–322 BC) remain moot and act as a guard against any naivety: he argued against common goods of the *polis* of Athens: "For that which is common to the greatest number has the least care bestowed upon it. Everyone thinks chiefly of his own, hardly at all of the common interest; and only when he is himself concerned as an individual. For besides other considerations, everybody is more inclined to neglect the duty which he expects another to fulfil; as in families many attendants are often less useful than a few."

On the other hand, a well-managed cluster can create the ultimate win-win by making it rewarding for all members to participate, even if not perfectly equally.

2 Clusters, Competitive Advantage and Society

Professor Michael Porter has stated that clusters are at the new frontier of competition, enabling cluster members achieve economies of scale without sacrificing their autonomy: “A cluster allows each member to benefit as **if it had greater scale or as if it had joined with others without sacrificing its flexibility”** (1998)**.**

Porter points out that competitiveness in the new world of work depends not just on the company itself but on the overall ecosystem: “Untangling the paradox of location in a global economy reveals a number of key insights about how companies continually create competitive advantage. What happens inside companies is important, but clusters reveal that the immediate business environment outside companies plays a vital role as well. This role of locations has been long overlooked, despite striking evidence that innovation and competitive success in so many fields are geographically concentrated—whether it’s entertainment in Hollywood, finance on Wall Street, or consumer electronics in Japan.”

The overall business, academic and societal environment, in which government (along with their agencies) plays a key role, therefore partly determines the success or otherwise of firms in the region.

This view is supported by Professor Torger Reve of BI Business School, Oslo, Norway:

“Clusters are as old as the ancient market place, but only recently have we been able to understand and tap the enormous development power of industrial clusters. Clusters are regional agglomerations of firms that compete and cooperate at the same time, building knowledge bridges across traditional boundaries in order to compete internationally. Firms interact with customers, suppliers, service providers, banks, universities, government agencies and all types of facilitators, building a more competitive local region. It has to do with creating industrial attractiveness in a world of increasing global competition, especially from the emerging Asian economies. In my own research on knowledge intensive clusters, I talk about building a stronger knowledge commons and creating stronger knowledge dynamics. **In order to build a stronger knowledge commons we need to attract a critical mass of firms in related fields, develop an educational system that provide the specialised talents needed, and actively utilise research and development in order to foster entrepreneurship and innovation, and a higher level of productivity. The research findings are quite clear: Strong industrial clusters deliver what they promise, given that they embrace the forces of change and do not seek protection from external competition**.”

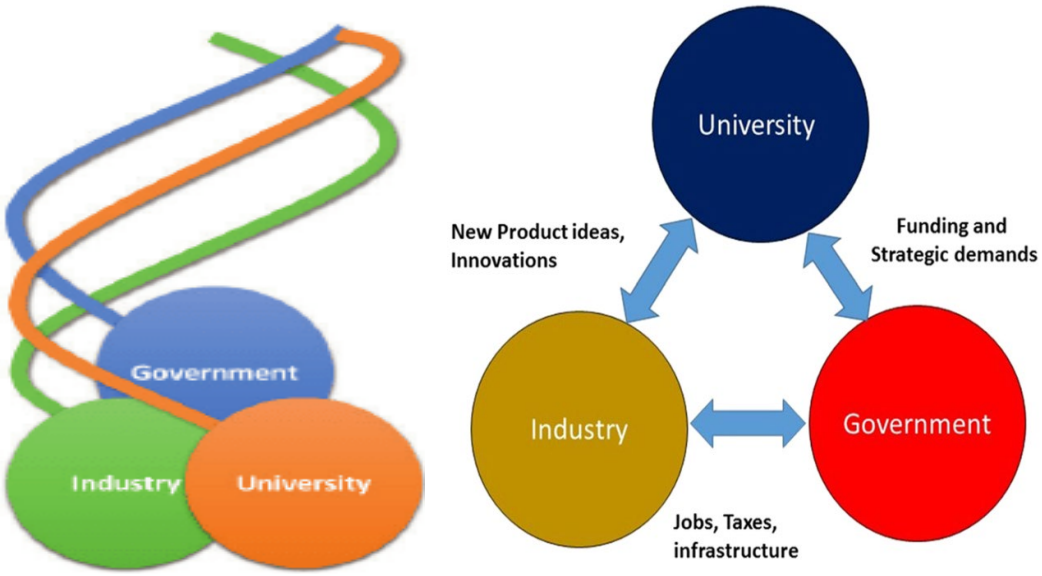
The question then arises: if clusters are indeed so productive, why has their adoption been so slow? The answer would seem to lie in the common reality that competition (not collaboration) is the basis of business. Companies (and individuals) guard their assets, including knowledge assets, and protect their property, including intellectual property. Yet recent management phenomena, such as collaboration along supply chains, and increasing levels of "co-opetition" among firms suggest that the old ways of deadly competition might now give way to fruitful collaboration. If that is the case, the management of clusters becomes critical: there is no simple formula for bringing together business leaders who would normally be in competition nor for bringing academics and business people together, nor for increasing collaboration between government and industry. **This guidebook addresses these issues, with a special emphasis on the role of the cluster manager, on trust-building and on maintaining vibrancy in a cluster.**

As renowned New Zealand cluster expert Ifor Ffowcs Williams explains "A cluster is not just a cluster. It's a living thing, which develops over time. For example, there is a big difference in the way in which an entirely new cluster and a mature cluster operates." Attention is given here to the development of clusters over time, from inception to maturity, and the management style that best suits each stage of development.

A point for government to note is that while start-ups rightly get substantial support, **there are greater returns (in terms of employment and societal value) to be had from supporting clusters**: after all, these have companies that have survived the initial growth challenges, proved their viability and often then seek to expand at home and abroad. Government investment in such proven winners, rather than start-ups, has greater (and more dependable) economic and social returns.

Similarly, university collaboration with a cluster of firms provides a wider base than collaboration with individual companies, both in terms of R&D (for example) and in providing career paths for graduates (geoscience being a prime example).

Combining the three threads (government, academia and business) in a "**Triple Helix**" is the goal: spinning the threads is the first challenge, stopping the threads fraying is the second challenge.



The Triple Helix of Government, Industry and Academia

Turning a ’clutter’ of fragmented companies into an organised cluster requires real leadership skill of a rare type: networking, leading without power, using influence and managing conflict, like a conductor orchestrating individual soloists (possibly even a few prima donnas) and creating symphony from a diverse chorus.

It is hoped that this guidebook sheds light into these obscure areas and to assist cluster managers navigate the hidden obstacles in turning solo players into a united band, despite the inherent business instinct to compete rather than collaborate.

3 Understanding Clusters

Porter provided the definitive answer: Simply put, industry clusters are regional concentrations of related industries. Clusters consist of companies, suppliers and service providers, as well as government agencies and other institutions that provide education, information, research and technical support to a regional economy. One might say that clusters are a network of economic relationships that create a competitive advantage for the related firms in a particular region. This advantage then becomes an enticement for similar industries and suppliers to those industries to develop or relocate to a region.

3.1 Business Sector Clusters

This guidebook focuses on sectoral clusters rather than regional ones. It is concerned with knowledge/skill-based professional services clusters, as exemplified by the Geoscience Ireland cluster with its diverse mix of loosely related organisations, not all of whom are part of the same value chain, as is often the case with regional clusters, such as the Varmland paper-industry cluster (by Anu Manickam) referred to later. These “modern” companies, dealing in knowledge, can transcend geographic barriers using technology and thereby resolve Porter’s “paradox of location”: Today’s economic map of the world is dominated by what I call *clusters:* critical masses—in one place—of unusual competitive success in particular fields. **Clusters are a striking feature of virtually every national, regional, state, and even metropolitan economy,** especially in more economically advanced nations. Silicon Valley and Hollywood may be the world’s best-known clusters. Clusters are not unique, however; they are highly typical—**and therein lies a paradox: the enduring competitive advantages in a global economy lie increasingly in local things—knowledge, relationships, motivation—that distant rivals cannot match.”**

In this sense, perhaps Ireland has advantage: intensely local, yet with an extensive diaspora and a long history of successful agri co-ops operating globally.

3.1.1 Sectoral Clusters and SME Innovation

The European Cluster Observatory is an initiative of the “SMEs: Clusters and Emerging Industries” unit of the European Commission’s Enterprise and Industry Directorate-General that aims at promoting the development of more world-class clusters in Europe, notably with a view to fostering competitiveness and entrepreneurship in emerging industries and facilitating SMEs’ access to clusters and internationalisation activities through clusters. The Observatory’s contemporary approach is similar to Geoscience Ireland’s cross-industry type of cluster: they say that the concept of a cluster has traditionally been often (mis-)understood

as a sectoral concept. Nowadays, the understanding of the concept has changed towards “clusters of related industries” and making better use of the complementarities between them to boost growth. The importance of cluster organisations as key drivers for industrial change is also a more recent phenomenon. Cluster organisations are important facilitators within clusters as they manage networks of companies, universities and research institutions that develop and sell products and services. Over the last years, there has been more and more evidence that cluster management excellence can make a difference. In other words, cluster management excellence matters.

Other authorities, such as Piore and Sabel, emphasise the potentially beneficial effects of clusters, in particular with relation to innovation:

i. in clusters competition is tougher and more transparent, which drives firms to innovate more and in more productive ways (Porter, 1998);

ii. knowledge spill-over, i.e. there are secrets of the trade that diffuse in the air, by labour rotation and from informal contacts, which makes it easier to start new firms and to develop existing operations (Marshall, 1890; Storper and Venables, 2003);

iii. greater opportunities for specialisation of labour and suppliers and higher productivity levels (Marshall, 1890; Piore and Sabel, 1984);

iv. cluster locations provide opportunities for user-producer learning which is an important input for firm innovation activities (Dahmén, 1950; Hirschman, 1958, Von Hippel, 2005); and

v. joint action, clusters are locations where it is easier for firms to collaborate in order to upgrade capabilities, goods and services and to undertake collaborative efforts (Piore and Sabel 1984; Malmberg and Maskell, 1999) and hence appropriate locations for deliberative innovation policies (Helmsing, 2001; Borrás, 2003).

Indigenous SMEs have a perpetual dilemma: global competition eventually arrives at their doorstep, so the mantra has to be “grow fast or die slow”, and a proven way to do this is to leverage the power of a suitable cluster. There is a real imperative to scale internationally, especially as the Irish domestic market is quite limited.

3.2 Enhancing the Value of a Company: Example of a Geo Professional Services Company

To systematically enhance the inherent value of a company, use these 8 drivers of value creation, customised for a stereotypical geoscience firm. By way of example, this may be considered to be an established specialised mid-size firm, currently serving the local Irish

market, but with some international business. The chosen perspective is the commercial value to a fictional prospective acquirer at some future date.

The typical Key Drivers of a Company's Value are:

1. Growth prospects

If a business has the ability to grow quickly then you have one of the true value creators. Such businesses may sometimes be "born global", as often happens with software, or have an inherently scalable model with near-universal appeal. It is less likely to occur in professional services, unless the company has a particularly deep and valuable specialisation or uniqueness that can be replicated in new markets.

2. Financial performance and recurring revenues

Earning higher margins than competitors generally reflect either more efficient processes or a willingness of clients to pay for a premium product or service.

Equally, steady growth is the hallmark of good planning, which increases the value of the company. three years of steady, planned growth portends good future performance. The reliability of future earnings reflects both the likely "annuity" aspect of the revenue stream but also the propensity of clients to return with repeat business.

3 Market influence

A company may achieve a degree of control either through market size, a brand, USP, or other barriers to entry. If the value proposition or service offer is not differentiated or is easy to source elsewhere, premium prices will not usually be achieved. It pays to clearly define your niche in the marketplace and why customers come to you instead of your competition. Even in B2B situations, create marketing messages that differentiate your business.

5. Client satisfaction

Superior customer experience has become a key differentiator and is the core value of many successful companies, gaining them superior margins through customer loyalty, customer referrals or recommendations.

6. Key-person dependency: working ON the business, not just IN the business.

As Richard Branson put it, a business owner's job is to 'put themselves out of business'. Dependency on a key man / woman, unless they are unusually good at delegating, creates an automatic dependency and inhibits staff proactivity. Where the business has been founded by a "technical" person, the transition of that person to a hands-off managerial role is often fraught: he / she may not want to weaken their original identity as a "technical"

expert, and the life-long focus on the rational task elements of work might inhibit the development of more subjective “people skills”. If you are the main holder of expertise, customer relationships or service delivery then you essentially are the business. **Founders flounder if they cannot cross this managerial chasm**.

The business might need to be systemically de-risked by actively developing deputies, forming a management team, having a solid culture with well-documented systems and smart management decision-making mechanisms. Actively seek to reduce reliance on a major client by expanding the customer base.

7. Privileged Assets

The tangible assets, such as equipment, and the intangible assets (such as an entrepreneurial culture) generate the company’s cash flows, but there are other abstract assets, such as privileged relationships, that also have a future value.

8. Innovation and the Product /Service Development Pipeline

The first seven value drivers reflect the historical performance of the company’s product and service portfolio, yet the ability to innovate is a further driver of future performance.

There are many other factors in the real value of a business: leadership, strategic fit, entrepreneurial ability, “lean” philosophy, systems, brand reputation, client goodwill, political links, certifications, patents, stakeholder relationships, and intensity of industry rivalry.

3.3 Clusters and National Competitiveness

Professor. Ron Johnston’s classic report also proved prescient (2003). He asserts that the drivers for this growth of interest in clusters have been the conditions for achieving national and firm-level competitiveness in the emerging knowledge economy. In particular, the need to access knowledge and learning, to effectively innovate, and to achieve benefits of scale beyond a firm's capacity, places a great pressure on firms to look beyond their own resources by linking with other firms and organisations.

Increasing complexity, costs and risks in innovation are enhancing the value of inter-firm networking and collaboration in order to reduce moral hazard and transaction costs, spurring a multitude of partnerships between firms with complementary assets, in addition to traditional market-mediated relations.

In addition to increased interaction with other firms, there is also a growth in interaction between firms and other organisations involved in the innovation process, such as universities, government research agencies, consultants and technical service providers.

Historical Development of Cluster Concepts

Clusters have long been part of the economic landscape, with geographic concentrations of trades and industries apparent long before the Industrial Revolution. Attention was first drawn to the phenomenon by the Cambridge economist Alfred Marshall in 1890, who noted the tendency for specialised companies to be concentrated in 'industrial districts'. Schumpeter, in his now highly influential exposition on the role of entrepreneurs and the 'creative forces of destruction' in economic activity, noted the evidence of clustering of innovation activities.

However, as indicated above, it was Porter's seminal analysis of the competitive advantage of nations, and why some countries produce, relatively, so many more competitive firms, that brought the concept of industrial clusters to the attention of both analysts and policy-makers. The competitive advantage of firms is presented as resulting from the operation of a 'diamond' of four interacting forces - factor conditions, demand conditions, firm strategy, structure and rivalry, and related and supporting industries. It is the last of these that points toward the remaining importance of location, and an explanation for the well-known success of Silicon Valley in electronics, and Hollywood in the film industry.

Today's economic map of the world is dominated by what I call clusters - critical masses, in one place, of unusual competitive success in particular fields. Clusters are a striking feature of virtually every national, regional, state and even metropolitan economy, especially in more economically advanced nations. Clusters are not unique, they are highly typical, and therein lies a paradox: the enduring competitive advantages in a global economy lie increasingly in local things - knowledge, relationships, motivation.

But it is more than just 'local things'; it is a shift from a focus on the performance of the firm, to inter-firm linkages. In the context of the knowledge economy, industry specific knowledge is becoming cumulative and embedded in a particular region or area rather than in a specific firm.

When all the elements of the 'diamond' are working effectively, benefits flow forward, backward and horizontally. Aggressive rivalry in one industry tends to spread to others in the cluster, through the exercise of bargaining power, spinoffs and related diversification.

Entry from other industries within the cluster spurs upgrading by stimulating diversity in R&D approaches… Interconnections within the cluster lead to new ways of competing and entirely new opportunities.

For the record, Porter's 1990 analysis only incidentally addresses propinquity as a factor in successful clusters.

The 'first generation' of clusters largely resulted from the opportunities for economic transactions between firms. The benefits were explained in terms of economies of agglomeration:

‘Agglomeration economies consist of a local concentration of customers (or downstream firms) sufficient to permit suppliers to achieve economies of scale in production or distribution, great enough for local firms to amass sufficient demand to warrant the provision (usually by or via local governments) of specialised infrastructure, and large enough to realises specialised local division of labour’.

A typical **first-generation** cluster consists of a large, demanding purchaser, such as a multinational firm, or a major hospital, surrounded by a 'halo' of suppliers.

However, in the context of the knowledge economy, of which Geoscience Ireland members are a part, the emphasis of **'second generation' clusters has shifted to learning and knowledge access**:

Innovation and the upgrading of productive capacity is a dynamic social process that evolves most successfully in a network in which intensive interaction takes place between those 'producing' and those 'purchasing and using' knowledge. As a result, there is an increasing focus on the efficiency and efficacy with which knowledge is generated, diffused and used, and on the dynamics of the related networks of production and innovation.

While there has been a great emphasis on physical co-location, it should be recognised that co-location may assist, but it will not guarantee collaboration. Many of the failures of technology parks and incubators can be traced to assumption that mere propinquity would generate effective interaction, ignoring the need for the players to see commercial value resulting from the interaction.

At the other extreme, advances in technology have demonstrated the viability of virtual clusters. These may take the form of predominantly international clusters based on emerging technologies, or "communities bounded and bonded by values which create an ability to share ideas easily across great distances".

3.4 Importance and Surprising Scale of European Cluster Activity

Industrial clusters are responsible for a significant share of European jobs, SME growth and specialisation within regions. Cluster strength for Europe's regions has, for many years, been measured using the "cluster star" methodology introduced by the European Cluster Observatory measuring strengths in size, specialisation and productivity. The European Observatory for Clusters and Industrial Change is an initiative of the "SMEs: Clusters and Emerging Industries" unit of the European Commission's Enterprise and Industry Directorate-General that aims at promoting the development of more world-class clusters in Europe, notably with a view to fostering competitiveness and entrepreneurship in emerging industries and facilitating SMEs' access to clusters and internationalisation activities through clusters. This methodology has added two new dimensions measuring the presence of high-growth SMEs and the presence of innovation leaders.

This report (by Prof. Solvell) analyses cluster strength across 51 exporting industry sectors in Europe and identifies **2,950 regional industrial clusters**, which (perhaps surprisingly) account for almost e**very fourth job in Europe (61.8 million jobs or 23.4% of total employment) and about half of employment in exporting industries (50.3%).**

The report also introduces a new, further refined distinction for strong clusters according to performance levels. It identifies **198 high-performing clusters across Europe**, which are regional concentrations of exporting industries where the number of cluster stars across the five cluster star dimensions is at least 13. Moreover, it identifies 898 medium-performing clusters where the number of cluster stars is at least 10 (and less than 13) and 1,854 basic-performing clusters where the number of cluster stars is at least seven (and less than 10). Regional areas of exporting industries where the number of cluster stars is six or fewer are said to have no cluster strength. The European Cluster Observatory and the 2019 Panorama report refer to traded industries, the concept introduced originally in the US cluster mapping exercise. As firms in *traded* industries "sell products or services across regions and countries", an intuitively more straightforward name is exporting industries.

3.5 Clusters Have A Multiplying Effect On Job Creation

The report also compares results from recent literature that show that clusters contribute positively to employment growth, firm growth and urbanisation. Clusters such as Geoscience Ireland can have a “multiplier” effect because they play a material role in the superior development of vital industrial and national infrastructure that enables the creation of subsequent sustainable employment.

Using the Porter cluster aggregation scheme, Tim Slaper of the Indiana Business Research Centre estimated output, employment and total value-added multipliers for particular industry clusters. For example, an employment multiplier of 1.9 in the medical devices cluster suggests that for every 10 employees hired in that cluster, another nine jobs would be created in the region. The multiplier for petrochemical manufacturing is estimated to be 4.4 indicating that for every 10 employees hired in that cluster, another 34 jobs are created.

Members’ collaboration in clusters acts as an important factor in the internationalisation of SMEs, according to Osarenkhoe and Fjellström. Seminars or interactive groups act as a platform to exchange experiences, services and increases participation. When member companies grow together, it increases sales and visibility, therefore benefiting everyone. Running joint projects help companies to share their knowledge base and grow. The cluster makes the member companies improve their performance, expand their horizons, and achieve more of their goals, helping gain them recognition on a greater scale.

4 Cluster Members Simultaneously Compete and Collaborate

As Porter points out, clusters are abstract entities, with different purposes, so there is no single global definition of clusters that satisfy all. Rather than adding to the debate, for our purposes here Clusters are defined as geographic concentrations of interconnected companies and institutions in a particular field, such as geoscience. Clusters encompass an array of linked entities, for example, suppliers of specialized technological services, governmental and other institutions—universities, state agencies, regulatory bodies, think tanks, vocational training providers, and trade associations.

Porter notes that clusters rarely conform to standard industrial classification systems and significant clusters may even go unrecognized. In Massachusetts, for example, more than 400 companies, representing at least 39,000 sustainable jobs, are involved in medical devices in a direct way. The cluster long remained all but invisible, however, buried within larger and overlapping industry categories such as electronic equipment and plastic products. Executives in the medical devices cluster have only recently come together to work on issues that will benefit them all. This model is repeated here in Ireland in the mid-west MedTech cluster, convened by Clodagh Barry.

Clusters promote “coopetition”- simultaneous competition and cooperation. Rivals compete intensely to win and retain customers. Without vigorous competition, a cluster will fail. Yet there is also cooperation, involving companies in related industries and local institutions. Competition can coexist with cooperation because they occur on different dimensions and among different players, and ultimately all win in the longer term, provided trust is not fractured.

Clusters represent a kind of new form, somewhere in between arm’s-length markets on the one hand and vertical integration, on the other. A cluster, then, can be regarded as an alternative way of seeing the value chain. Compared with arm’s-length transactions among dispersed buyers and sellers, the proximity of companies and institutions in one location—and the repeated exchanges among them—fosters better coordination and trust. Thus clusters mitigate the problems inherent in arm’s length relationships without imposing the inflexibilities of vertical integration or the management challenges of creating and maintaining formal linkages such as networks, alliances, and partnerships. A cluster of independent and informally linked companies and institutions represents a robust organizational form that offers advantages in efficiency, effectiveness, and flexibility.

As noted elsewhere by Ifor Ffowcs Williams and others physical “propinquity” is not the essential ingredient, rather it is psychological closeness based on affinity and trust.

4.1 Why Clusters are Critical to Succeeding against Contemporary Global Competition

The sophistication with which companies compete in a particular location, however, is strongly influenced by the quality of the local business environment. Companies cannot employ advanced logistical techniques, for example, without a high-quality transportation infrastructure. Nor can companies effectively compete on sophisticated service without well-educated employees. Businesses cannot operate efficiently under onerous regulatory red tape or under a court system that fails to resolve disputes quickly and fairly. Some aspects of the business environment, such as the legal system, for example, or corporate tax rates, affect all industries. In advanced economies, however, the more decisive aspects of the business environment are often cluster specific; these constitute some of the most important microeconomic foundations for competition.

Clusters affect competition in three broad ways: first, by increasing the productivity of companies based in the area; second, by driving the direction and pace of innovation, which underpins future productivity growth; and third, by stimulating the formation of new businesses, which expands and strengthens the cluster itself. A cluster allows each member to benefit *as if* it had greater scale or *as if* it had joined with others formally—without requiring it to sacrifice its flexibility.

As explained earlier, some sectoral clusters, such as geoscience, enable this kind of synthesis and even have a “multiplier” effect, whereby the excellence of the infrastructure created in turn promotes the further development of the benefitted industries.

Being part of a cluster allows companies to operate more productively in sourcing inputs; accessing information, technology, and needed institutions; coordinating with related companies; and measuring and motivating improvement.

Companies in vibrant clusters can tap into an existing pool of specialized and experienced employees, thereby lowering their search and transaction costs in recruiting. Because a cluster signals opportunity and reduces the risk of relocation for employees, it can also be easier to attract talented people from other locations, a decisive advantage in some industries.

4.1.1 Ingredients for Success

A recent OECD analysis has pointed out that every cluster is different, and that there is no best model for cluster formation or success. It points out that, at the same time, the lure of the extraordinary gains in production, employment, wealth generation and innovation evidently resulting from successful clusters remains. The various attempts to support cluster formation have been driven by four distinct objectives, though with frequent overlap or confusion of them:

- to improve the national advantage of certain sectors;
- to improve SME competitiveness;
- to improve the attractiveness, economic performance and development of a region; and
- to intensify industry-research collaboration.

Each of these objectives may be entirely appropriate, but their conflation and confusion have severely hindered attempts to assess the basis of success, and of failure. Mapping the contribution of clusters will require a clear delineation of the different objectives that are being pursued.

Not all cluster initiatives are effective, as indicated by the 'Six Secrets of Failure' in establishing regional clusters, apparently the product of bitter experience. The ways to fail are to:

- concentrate on attracting outside investment;
- use political forces to push for the creation of various components of an industry cluster;
- provide government assistance to firms where market failures are identified;
- allow government agencies to plan the development of an industry cluster; and
- keep all information confidential until the proposal has been finalised.
- focusing on premises, offices rather than action

The only effective clusters are 'natural' clusters. But their naturalness only becomes evident in hindsight. And there are a wide variety of factors that contribute to their success or failure. One of their greatest contributions may yet turn out to be in breaking down the traditional assumptions of 'who is responsible for what' in the economy and breaking the stranglehold of market failure as the sole basis for consideration of government initiative.

Lowe, J., and Miller, P., 'Business Clustering: Panacea or Placebo for Regional Australia', available at http://www.regional.org.au (accessed March 2003).

4.2 Nature of STEM and Geoscience-type Professional Services Clusters.

Taking Geoscience Ireland as an example, clusters of this nature are based on specialised companies with a particular expertise, sophisticated technology, high cognitive capabilities and deep understanding of the profession. They differ from traditional clusters in that they are part of different value chains, rather than a single value chain: they serve different industries, have quite distinctive specialisms and can operate outside the home region. Indeed, such clusters are often formed to generate business abroad, for the obvious commercial reasons, but also to be acknowledged as globally-significant experts. Achieving such international significance requires advanced business development, and later sections of this guidebook offer advice on how to expand successfully. Briefly stated, success in international business development is predicated on having highly capable leadership, robust systems, flexible organisation, staff willing to travel extensively, deep financial resources and especially having a distinctive and valued expertise that is marketed cleverly. Later sections delve into these areas.

4.3 Examples of Notable Clusters

As well as well-known examples, such as Silicon Valley, Hollywood, Boston MedTech corridor, Milwaukee Water, Houston Oil, there are many prime examples of technology clusters, such as Aarhus (Denmark's 'Capital of Wind Energy'), Auckland (New Zealand's 'City of Sails') and Bangalore (producing one-third of India's software and IT exports).

The California **wine cluster** is a good example. It includes 680 commercial wineries as well as several thousand independent wine grape growers. An extensive complement of industries supporting both wine making and grape growing exists, including suppliers of grape stock, irrigation and harvesting equipment, barrels, and labels; specialized public relations and advertising firms; and numerous wine publications aimed at consumer and trade audiences. A host of local institutions is involved with wine, such as the world-renowned viticulture and oenology program at the University of California at Davis, the Wine Institute, and special committees of the California senate and assembly. The cluster also enjoys weaker linkages to other California clusters in agriculture, food and restaurants, and wine-country tourism.

While the Japanese government played a pivotal role in developing the Japanese **electronics** and software industries, deliberate intervention by a public agency has generally proved disappointing: Ifor Ffowcs Williams points out that successful clusters are generally

grown “organically” but can be nurtured by government, provided a true cluster leader can drive the cluster:

“Hsinchu Science Park, Taiwan is frequently referred to as an example of a government ‘creating‘ a cluster, following a visit by Taiwanese authorities to Silicon Valley in the 1970’s. Growth was stimulated by an integrated package of extensive public support, including encouraging the return of Taiwanese engineers with technical and management skills, the provision of finance and on-going connections to Silicon Valley. A go-getting godfather, Morris Chang, played a key role in the cluster’s development.” (Williams)

Dr. Grainne Miller PhD, founder of GM Innovations, highlighted in 2016 two successful Irish clusters, in **food** and also **animation**: “One example is in Denmark, where the Danish Food Cluster, initiated by their food industry in 2014, has practically the whole country in its cluster covering approximately 75 per cent of the total turnover in the food industry, with the original aim to become the world leader in food innovation.

While co-location of enterprises on a sectoral basis is a feature of the Irish enterprise landscape, actual clustering dynamics are relatively limited in practice, according to Government’s Action Plan for Jobs. Yet without this willingness to embrace new ways of working together it is hard to see how any type of world class cluster can get off the ground. EU data indeed confirms this to be the case.

4.4 Notable Irish Examples

To explore this, let’s look at two areas of the Irish economy that have being going from strength to strength over the last five years: the audio-visual industry – with a focus on animation - and the agri-food sector.

The animation industry has experienced substantial growth since 2010 and has emerged as a central component of Ireland’s digital and creative economy. Animation studios Brown Bag Films and Cartoon Saloon have been nominated twice for Oscars with a raft of BAFTA, Golden Globe and Emmy awards and nominations between them.

Animation Ireland, the industry body who works collectively to promote Ireland’s world class sector internationally, cites Ireland’s favourable tax credits as one of the most attractive in Europe. There are also internationally recognised animation degree and further education courses based at IADT and Ballyfermot to develop the talent and specialised skillset now demanded by new technology.

In terms of Ireland’s agri-food sector, the government’s FoodWise 2025 strategy foresees an agri-food sector that acts more strategically and achieves a competitive critical mass in the

international marketplace. Initiatives such as Bord Bia's Origin Green has over 80 per cent of Ireland's food and drink industry signed up to the world's only national sustainability programme for food and drink.

Food Works, a collaboration between Bord Bia, Enterprise Ireland and Teagasc (Ireland's farm advisory and research organisation) helps launch and scale new food business for global success.

Enterprise Ireland's Food for Health Ireland combines world-class science and industry expertise to improve health through innovation in food. Add to that the string of Local Enterprise Office-supported training programmes, networks, incubators and hubs from Dublin to Drumbshanbo and one could argue that Ireland is already a world leading food cluster.

Not so, according to UCD's report on Innovation in the Agri-food Sector in 2013 which concludes that world class performance is not seen as the norm for the Irish agri-food sector which currently lies fifth behind Denmark, Finland and the Netherlands. One of the key reasons given for this is the lack of collaboration among all stakeholders." This is a salutary note of warning about the need to unite in the search for progress, and clusters offer that opportunity.

4.5 Clusters Role In Increasing Members' Competitiveness

Cluster initiatives and Cluster Organisations

Cluster initiatives are "… organized efforts to increase the growth and competitiveness of a cluster within a region, involving cluster firms, government and/or the research community" (Sölvell et al., 2003). Cluster initiatives are most often led by a cluster organisation, which initiates and strengthens joint activities among its members related to: innovation (new technology, new business models, and new processes), networking, influencing the business environment and human resource upgrading.

The purpose of cluster organisations is to strengthen the competitiveness of the members themselves. The structure of these initiatives, their roles, funding and activities varies, but in broad and idealised term they most often:

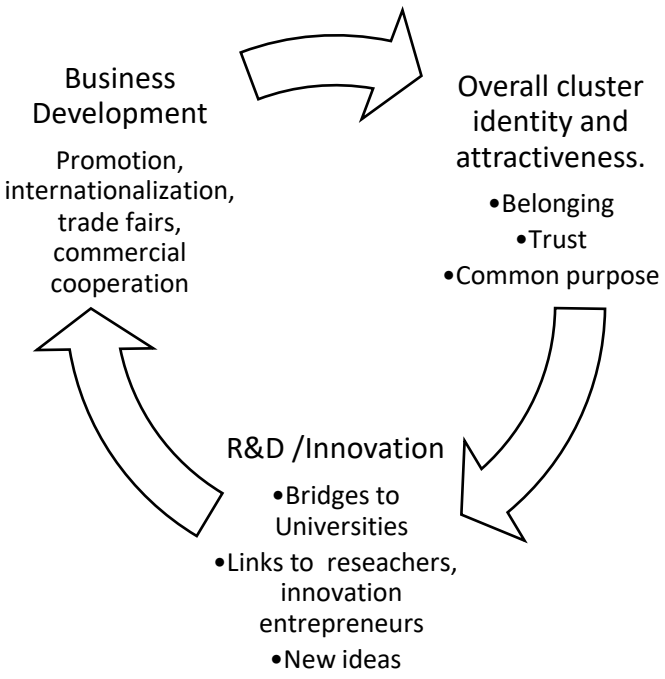
- Are based on a form of "Triple Helix" (Etzkowitz, 2008) membership, with private sector, academic and public sector members actively contributing.

- They work to cater to the needs of the different members, both directly in current identified needs, but also sometimes initiate activities with a more long-term perspective and of more radical innovative character.
- They have good networks in all these three spheres, have an understanding of the culture and how these domains operate and are skilled in bridging between them.
- They initiate projects including actors from these different spheres.
- They lobby and try to influence legal frameworks and standard setting to better match the needs of the cluster members.
- They arrange matchmaking and network meetings.
- They often carry out business intelligence.
- They often work with internationalisation arranging with business opportunities and setting up international R&I projects.

The European Cluster Observatory (see Appendix for details) similarly agrees that an integrated portfolio of key impact-relevant services that have an effect on business and R&D activities of SME cluster participants by sequencing services such as internal member matching to bring cluster participants together, organising workshops or thematic events to further discuss ideas that developed from the matchmaking and apply for funding for projects that are the outcome of workshops or thematic events.

4.6 Three Pillars of Cluster Organisations

The Observatory promotes the concept of three “pillars” on which a cluster may be based. The first pillar is about overall cluster identity and attractiveness. Here the cluster organisation is deeply involved in building a sense of belonging and identity, generating trust and developing business networking; in short, building the cluster commons. The second pillar relates more directly to R&D and concrete innovation projects, where the cluster organization helps build bridges and stimulate traffic across the innovation gaps. Bridging to public organisations can lead to improved regulation and redirection of public investments. Bridging to research can involve incubator services and commercialisation of research results, and bridging to education can improve HR supply and upgrading inside the cluster. The third pillar involves business development among member firms. Typical objectives and activities include export promotion/internationalisation, joint trade fairs, joint purchasing and other commercial cooperation, often between SMEs not large enough to carry out these activities on their own.



Three Pillars of Cluster Organisations

4.7 Geoscience Ireland Example

Along with the many "soft" activities, such as maintaining close relationships with members, inducting new members, encouraging business development and fostering innovation, the main formal activities Geoscience Ireland are involved are:

Promotion of members interests at trade fairs, exhibitions, conferences, government colloquia

Proactive Tender screening on behalf of members using a specially-developed app

Market intelligence and trend analyses – ie analyses of what happens on the market for the special field of this exact cluster

Industry analysis, strategic segmentation and strategy (value chains and sub-clusters)

Innovation collaboration promoting joint developments

Making privileged introductions to foreign Government departments and agencies

Contributing to **R&D** and academic research, sponsoring research in iCRAG, Trinity and elsewhere

Shared procurement and assisting the provision of common insurance, export guarantees

Facilitating the sharing of **sector-specific information** and **tacit knowledge**

Enabling joint tender responses and **collaborative contract delivery**.

Monitoring and managing **stakeholder interests** across the Triple Helix

Informing the public and press of pertinent issues and advancing the cause of the cluster

Enhancing public **social value**

Raising professional **standards**

Developing educational programmes at third level and higher to enhance **talent development**

Addressing skills shortages by seeding apprenticeship programs in Technical Institutes

Providing social and business **networking**, providing a “listening service” when needed.

Cross-fertilising business and technical **ideas** among members across the island of Ireland

Providing a level of implicit **endorsement** for member companies

Benchmarking other clusters to achieve excellence in cluster management and other areas.

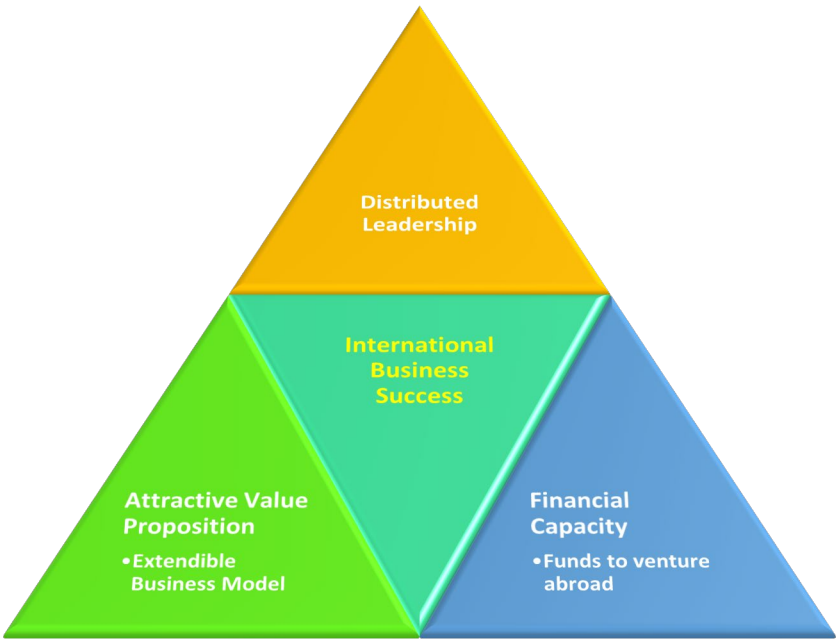
Clustering with other clusters for shared learnings, mutual understanding and practical benefit

4.8 Scaling Internationally: How Clusters Can Assist International Development.

Clusters can do more that help member companies exist: they can help them scale internationally.

In the case of a small, open domestic economy such as Ireland, the growth imperative is vital. Curiously, the literature on scaling is scant, as scaling falls somewhere in the must-trodden space between start-up entrepreneurship and large-company internationalisation.

If an SME is to grow beyond its domestic market, many elements of the business model have to be right, but the crucial ones are strong distributed leadership, superior value proposition and deep financial reserves to fund overseas expansion – clearly, none of which are easy to acquire: a separate section deals with this in more detail.



The International Business Expansion Success Triangle

Strong organisation-wide leadership

To succeed internationally requires greater than average leadership capability (calibre / quality) and leadership capacity (to lead in multiple jurisdictions simultaneously). While these again are vast subject areas, for the purposes of this White Paper, the essential resources can be said to be those by Daniel Goleman, Jim Collins, Patrick Lencioni and John Antonakis, along with the classic works of Edgar Schein, Henry Mintzberg and Peter Drucker.

The qualities of particular importance could be listed as:

- The ability to recognise current realities but simultaneously future possibilities so that a realistic but attractive vision (corporate ambition) is formulated and effectively communicated.
- The ability to excite “followers” to deliver outstanding performance and contribute a high degree of discretionary effort in pursuit of the vision.
- Enough business acumen to identify real opportunities and threats, and to avoid false dawns and wolves in sheep’s clothing.
- Creating and sustaining an entrepreneurial culture.

In addition, it usually requires that the organisation has enough managerial capacity to handle foreign expansion and domestic operations simultaneously. The companies that succeed in this usually have the benefit of self-sacrificing leaders, or, better still, a management development program that produces capable successors and deputies.

Strong Finances

Companies expanding to near-field countries abroad will incur substantial costs in the first 2 years of establishing a presence abroad, even if this is done in a minimalist way (e.g. sharing offices, eschewing full-time agents, leveraging home resources). A rough guide for Irish companies setting up in Denmark or the Netherlands would be a minimum of €100k over 2 years, done in a minimalist way, and double that if full-time staff or owned offices are used. This establishes a foothold in the market, and the additional of local staff may be necessary to deal with financial, legal or country-specific technical matters.

This foot-hold stage moves a company from a “bed-and-breakfast” mode (flying in and out only as needed): the next stage is having a fully-fledged company abroad. This “international” stage can then lead to a truly “transnational” company, one that is not reliant on the domestic office, but leverages talent and resources in a variety of foreign locations. Few companies reach this stage, exceptions being found in the truly global industries such as software, pharma or automotive.

Strong Value Proposition and Reputation

Most of all, companies venturing abroad must bring something unique or special to the new market, such as a particular expertise, different business model, better service, new technology or possibly lower costs. A strong company reputation or “brand” must be allied to this superior value proposition to give the client additional comfort in contracting with a “new” supplier.

Clusters can help member companies in significant ways: providing easier access to foreign clients, making privileged introductions, international promotional activity, sharing experiences, joint venturing, combined marketing, knowledge pooling, affordable insurance, certification and general support.

4.9 Example: The Karlstad Swedish Cluster Success Story

The Karlstad Varmland region in Sweden is heavily dependent on the paper processing industry, and their experience in cluster development has many lessons for Ireland and elsewhere, as noted by Anu Manickam.

Karlstad's shift from an industrial paper and pulp landscape to a cluster landscape had been successful in many ways but still the dominance that industry impacted the new cluster approach. This was overcome by organising in a strategic way that helped break the lock-in effect of the paper and pulp industry's dominance. The key points were:

a) Innovation as a driver of economic growth through new technology, products and services.

b) Thinking in value chains beyond the paper and pulp industry.

c) Interdisciplinary and inter-sectoral collaborations and thinking. Examples were the biomedicine and sustainable forestry initiatives.

d) Network and inter-cluster collaboration with more emphasis on triple-helix linkages. New collaborations between clusters were initiated, and these could extend to beyond the region and country as purported by the EU's cluster policy.

e) "Local-global" strategies for the region, as opposed to individual businesses and clusters.

By employing a different way of thinking about the region's future economic opportunities (by re-defining its scope and identity), new economic directions were discovered that unified the cluster and created critical mass.

The Karlstad region needed to join forces to create new value chains and collaborations to rise to its challenge of re-defining itself to overcome redundancy and economic malaise should the paper and pulp industry fail in a global competitive market. The businesses that served the paper and pulp industry needed to take ownership of their own future and to find collective solutions through collaborations, such as the following:

- Networks and collaborations as essential for new business
- Regional scope needs to be replaced by a "local-global" scope
- Ownership of the region by all stakeholders instead of reliance on the dominant industry

Different roles and behaviours

The creation of new business and economic growth by the region's stakeholders meant that new and different behaviours were needed. They collaborated more than in the past, and provided incentives in many different ways:

a) Orchestrating role of policy that included raising awareness, offering incentives and creating new opportunities for new, different types of collaborations amongst stakeholders.

b) Collaboration instead of competition became the main business mode. There was a realisation that collaboration was needed to create mass, to share risks and to create different opportunities to launch into new markets globally.

c) Test beds, pilots and new initiatives were set up that allowed for collaborative learning and (open).

Innovation and accelerated new value adding chains. The creation of ecosystems of innovation that builds on latent trust in the region enhanced innovation capacities.

Implications and Application of the Cluster Strategy Toolkit

The Karlstad cluster had developed a useful "Cluster Strategy Toolkit" that addressed "wicked problems" and issues of real complexity:

1. Dealing with issues of real complexity
    - The analysis was comprehensive and deep: it not only described the wood and pulp industry or only the regional development, but it includes the historical perspective, the forces at work from within and without the system, the roles of stakeholders, the (missing) competencies in the cluster, the opportunities that arise from thinking about inside and outside of clusters, visions, goals, plans, actions, and collaborations.
2. Sense-making
    - Rather than taking a simplistic approach, or hoping for a "silver bullet" strategy, Karlstad mapped the processes and patterns such as influence of history on current developments, the dynamics between stakeholders, the role of government and other stakeholders, and so offered deeper insights of the system interactions and developments.

3. Capturing cluster development
    - The Karlstad success story captures how clusters develop, how perceptions evolve and influence emerging interactions and collaborations within and outside the cluster, how new stakeholders are engaged, how new strategies are developed, how new competencies and networks are created and how these lead to new actions and performance that in turn, influences thinking about the future.
4. Successful ecosystems
    - The approach makes explicit the successful (and less successful) developments in the system and thereby offers opportunities for learning about the ingredients in successful collaborations, stakeholder involvements and the impact of such interactions, about competences and infrastructures contributing to new successes, and about distinguishing fertile and less fertile ecosystems. The case study offered insights into Karlstad as an ecosystem that encompassed The Paper Province as a cluster within a larger regional system that included other clusters, local and regional policy agencies, competences, knowledge developments, new opportunities and spin offs from within and outside the cluster.

Concluding Insights from the Karlstad Varmland Example

The complex Karlstad approach has been applied to other clusters and serves to show how deep analysis of the multiple roles and relationships can lead to real breakthroughs in cluster formation, even in such difficult circumstances.

5 Industry Development, Sustainable Job Creation

In similar manner, Eric Rolf Hansen of the Economic Transformations Group, says:

*"*In the hundreds of clusters we have worked with in over 40 countries, leadership and collaboration are the "**secret sauce**" of dynamic clusters, whether it comes from the private sector, government, or universities. In the take-off and growth of emerging clusters, charismatic and tenacious leadership by private sector entrepreneurs is often key – as in the case of Robert Mondavi's transformation of the Napa Valley wine cluster into a world player, and Dr. Bob Breault's championing of the laser/optics cluster boom in Arizona. These leaders and brokers of innovation bring together diverse private and public leaders to collaborate on forging new industry and regional competitiveness, and now importantly, sustainable economic development." (Eric Rolf Hansen)

6 The Cluster Life Cycle Ladder: 4 Stages of Development.

Clusters can be said follow a life-cycle model, just as products, companies and individuals do, from the exciting initial stages through adolescence (so to speak), maturity and decline: however, companies (and indeed whole industries) can re-invent themselves through innovation and renewed cycles of growth – that is their beauty. To an even greater extent, clusters of companies, due to their very diversity and agility, can re-invent themselves at an even quicker rate, provided they innovate and stay current. Darwin's theory of the survival of the fittest applies here: only those that can adapt as quickly as the (business) environment changes will survive. Throughout this cycle, the cluster manager plays a vital "parenting" role, starting with the early formation stages and guiding the cluster to adult self-management, but always keeping a watchful brief.

This development life-cycle is analogous to Larry Greiner's classic organisation model, where progression from one stage to another is far from guaranteed – there are "chasms" to be crossed, for example, a cluster will not reach Stage 2 if there is no consensus around the common purpose.

A cluster won't achieve the level of organisational performance required in Stage 3 unless there are adequate procedures and norms. Yet, ironically, those rigidities often strangle the ability to reach Stage 4. Stage 4 is diagrammed here as an end state, whereas actually the end of Stage 4 can be the inception of a new cluster, not so much out of the ashes, but as newly emerging offspring. Indeed, a common occurrence is the emergence of a "cluster of clusters", with even greater power and potential for growth.

The Cluster Life Cycle Ladder: 4 Stages of Development

Different management styles needed for different stages of cluster development

There's a big difference on how a cluster facilitator has to manage a potential cluster, an emerging cluster and a working cluster. A new (2020) article ref from PhD Scholar Mads Bruun Ingstrup and Prof. Torben Damgaard stresses this issue.

The article, entitled Cluster Facilitation from a Cluster Life Cycle Perspective, describes the way in which the role as a cluster facilitator develops concurrently with the life cycle of the cluster. The article is based on case studies of nine Danish clusters and shows that there is a major difference in the tasks that e.g. the facilitator of a potential cluster and the facilitator of a mature cluster must be able to carry out. The role as a facilitator requires different competencies and different personal skills depending on the stage of the cluster life cycle at which the facilitator has to act.

For example, in a potential cluster the role of the cluster facilitator is first and foremost to be able to build the framework for the cluster's operations and to network between the members. Therefore, he or she especially needs good communication skills, the ability to arrange social events and to spread the cluster's message. Furthermore, at the early cluster stage, the facilitator would benefit from having flair for politics.

In a mature cluster, the role as a cluster facilitator is more about business development, and the facilitator must be good at integrating the many actors of the cluster and be able to see

their mutual business potential. In this event, especially knowledge of the trade and innovative skills are required. Furthermore, it's an advantage if, at this stage, the facilitator is good at solving collaboration problems, the article states.

According to Mads Bruun Ingstrup, the article emphasises the importance of continuous matching of the cluster's development stage with the cluster facilitator's role and competencies.

1. Formative: Clusters don't spontaneously occur; they are sparked into life by seminal event, a crisis, a fresh business opportunity, as in the Irish med-tech cluster, but often by a serious business problem such as the collapse of a mainstay business , an economic shock or a technological disruption, as if common now.

As with Geoscience Ireland, economic necessity is the mother of invention: a hero must be found, and a few brave believers must take the risk of committing their time and energy to giving the embryonic cluster the necessary momentum.

Clusters can, and do, emerge from other clusters, often to focus on a particular field or specialism, as shown in the above model.

The Need for a Cluster "Champion"

In the initial stages, especially, a cluster must be championed i.e. a dedicated leader must pioneer the movement, generating support among like-minded peers, garnering support, acquiring resources and taking risks in the manner of a "social entrepreneur". The journey is accelerated if the necessary "seed funding" is made available, and the initiative is not starved of resources: the parallels with Geoscience Ireland are obvious.

As the cluster progresses, this leadership style must shift, taking on a "servant leadership" style, enabling and facilitating the group so that more and more of the members actively contribute and, in a sense, become leaders themselves. Where this is taken to excess, the group can fragment and splinter into sub-groups, or indeed factions.

Once again, it is evident that the enablement of the cluster is progressing well, with each member encouraged to contribute. The diagram below illustrates Geoscience Ireland's approach to building trust and creating commercial opportunities for members, including joints bids and working abroad.

Without an heroic champion, such as a driven entrepreneur or a Government official, the spark will be just light without heat: the new venture needs traction, the support of government agencies and some fellow-travellers. In the case of Geoscience Ireland, enough

supporters were found in private industry, government departments and in Enterprise Ireland (the state development agency) for the fledgling cluster to emerge. Of course, progress came in fits and starts, then growth spurts, with other member companies joining the mission. At this point, clusters are an unformed agglomeration of firms, a *clump*. Progress depends on sharpening the focus and securing some early wins. That is the first chasm that must be crossed, and many clusters fail at this breaking point. The dynamism and often the charisma of the champion or cluster manager is critical at this point, if the butterfly is to emerge successfully from the chrysalis.

The main activities of an emerging cluster are as follows, according to Ifor Ffowcs Williams:

- Clarification of the cluster's specialisation
- Networking and entering into non-binding collaboration
- Recruiting suitable members, including those at the fringes of the cluster’s domain
- Network meetings with relevant speakers
- Knowledge sharing
- Study trips, seminars and workshops
- Company visits
- Drawing up a cluster strategy
- Branding the cluster
- Training – of both the cluster's own employees and the members' employees
- Collaborative projects

2.Growing: If the cluster can generate a unity of purpose, and organise its activities effectively, the early wins and curated social interaction can foster enough trust to generate informal collaboration, sharing information, initially of a general kind (not commercially sensitive information) and creating useful business relationships and indeed a spirit of kinship. At this juncture, the cluster may have enough solidity and reputation to solicit more support from government, universities and trade associations, leading to the next stage of evolution, provided the next chasm can be crossed – that of formalisation of cluster activities.

In this stage, the imperative is to gain traction by attracting more members to “enlist”: the dilemma here is that those early adopters may understandably resent those who are

perceived to have sat on the fence, the band-waggoners or the opportunists. At a pragmatic level, the early pioneers may simply resent the intrusion of business rivals.

This is a pivotal time, and demands diplomacy and guile from the cluster manager (who may still be an unpaid volunteer). The cluster manager needs to artfully smooth ruffled feathers, present a vision of a better joint future and amplify the win-win aspects for all parties. As quoted earlier, a house divided against itself cannot stand.

6.1 Building Social and Psychic Capital

In recent years, more recognition has been given to intangible assets, such as brand value or intellectual property, as well as social and relational capital. These are the valuable intangible but truly real assets that a successful cluster creates. They are abstract and ephemeral assets that take time and skill to build - but can be destroyed in an instant, by a breach of trust, a conflict of interest or simply a distaste for the ethos of the cluster or a lack of faith in the cluster leadership. Physical, social and psychologic closeness are essential. As M.P. Feldman says “Knowledge crosses corridors and streets more easily than oceans and continents.” (The Geography of Innovation, Kluwer Academic Press, 1994)

Similarly, Porter says that: “Geographic, cultural and institutional proximity provides companies with special access, closer relationships, better information, powerful incentives and other advantages that are difficult to tap from a distance. The more complex, knowledge-based and dynamic the world economy becomes, the more this is true. Competitive advantage lies increasingly in local things-knowledge, relationships and motivation that distant rivals cannot replicate.” - Clusters and the New Economics of Competition, HBR, 1998. The clear message is that the cluster leadership must be savvy, quietly energetic, well connected and emotionally intelligent.

In today’s hyper-aware environment, almost all organisations need a “social licence” to operate and a cluster can help garner social support for their members’ legitimate activities through proactive prior communications and shining a light on the benefits to society of their activities.

6.2 The Tragedy of The Commons: Towards Resolving an Eternal Conundrum

The classic scenario, illustrated in 1833 by British mathematician William Forster Lloyd, is where every individual with rights to a common pasture grazes as many animals as possible, acting in self-interest for the greatest short-term personal gain. Eventually, they use up all the grass in the pasture; the shared resource is depleted and no longer useful. A conundrum

“hidden in plain sight” it was until 1968, when ecologist Garrett Hardin published his influential paper “The tragedy of the Commons”, in which he wrote “Ruin is the destination toward which all men rush, each pursuing his own best interest in a society that believes in the freedom of the commons. Freedom in a commons brings ruin to all.”

The same grim logic is behind many of our biggest problems. Common resources, such as fisheries, forests, and even the air are threatened by selfish individuals and nations taking what they can, even though they know the resource will be wiped out if everyone does the same. Hardin’s solution was to cede our freedoms to the state, to be bound by “mutual coercion mutually agreed upon”: however, this solution has often been found to be less successful than schemes, such as the Montreal CFC accord, outlined below.

For example, Shui Yan Tang, examined case studies of 47 irrigation systems, some owned by farmers and some by governments. Tang measured the effectiveness of their water supply, levels of maintenance, and how well users followed the rules of the scheme. Among the government-owned systems, he found that 43% performed well. However, farmer-owned systems did better, 72% performing well, despite generally being low-tech constructions, in contrast with what Ostrom called the “fancy engineering” of the government systems.

After sifting through data on a range of commons problems, Ostrom identified a set of design principles for managing resources sustainably. For example, decisions must be made collectively, letting most users give their say. There should be graduated sanctions: so if you break the rules by taking too much water or grazing too many cows, you face mild censure at first, followed by increasingly stiff punishments for further offenses. One of the most vital design principles is that users should have a way to make their own rules.

In a recent study of forests, Agrawal’s team backed up the need for local rule making, and also challenged a common assumption that human livelihoods must be at odds with biodiversity. His team looked at 84 forest sites in east Africa and south Asia, and found that where local users are involved in rule making, not only are their subsistence livelihoods usually better, but forests also tend to be healthier in ecological terms, with more types of tree species.

Although these broad design principles seem solid, no one has been able to identify specific rules that will always lead to successful resource management. Ostrom concluded that there are no panaceas. The world is complicated. Partly for this reason, she recommended “polycentric governance,” suggesting that layers of government and community oversight on different scales can deal with complexity better than one central authority. In 2009, Ostrom received the Nobel Prize in economics.

6.2.1 Change the Game, not the Players.

The solution might lie in playing a completely different game instead. The Montreal Protocol, for example, successfully got all countries to phase out ozone-destroying chlorofluorocarbons (CFCs), and the ozone hole is now starting to close instead of growing to become a global hazard. What did Montreal get right? The fact there was a viable CFC substitute certainly helped. But there was more to it, some argue.

Starting in 1989, Columbia economist Scott Barrett has been studying this issue, examining not just Montreal but other successes, like the 1973 MARPOL marine pollution convention. These successes tend to have one thing in common: each imposes trade penalties on countries that do not join or comply. Using game theory to model this situation shows that it can turn into a different kind of game, called a coordination game, in which there are two Nash equilibria. In one equilibrium, nobody cooperates; in the other, everyone does. The critical thing here is that once enough nations are on board, it hurts to jump ship and leave the treaty: suddenly you have hardly any trading partners.

“It was only in the last year that I finally understood the general point,” says Barrett. “Countries are good at coordinating and bad at cooperating voluntarily”.

6.3 Generating Trust and Social Capital

“It is a greater compliment to be trusted than to be loved.” George McDonald, Scottish writer.

Trust is essential to healthy business and personal relationships. Since it implies a certain degree of uncertainty, trust is the willingness to be vulnerable to the action of others. In that sense, trust is a choice. It implies a willingness to take some risk in order to get a worthwhile reward, such as a contract that would not have been gained acting alone.

Trust means that cluster members have confidence in the intentions and motives of other members.

When a breach in trust occurs, the effect can be far-reaching, seriously undermining relationships, and often causing deep-seated bitterness. Trust and distrust coexist, in an ambivalent manner.

Microsoft CEO Satya Nadella emphasises the role of trust in revitalising that sleeping giant. He says that trust must be treated “like a bird – hold it gently but firmly”. In true engineering fashion, he offers this equation on generating trust: **Trust = E + SV + S + R =T/t**. In words, this means that **T**rust is the result, earned over Time, of **E**mpathy added to **S**hared Values, **S**afety + **R**eliability.

Trust is “the glue of life”, according to author Stephen Covey. Trust is an essential yet intangible ingredient in the success of any cluster. Even though it is an abstract entity, and hard to define, trust can be earned through two essential approaches – “**e**ffective trust” and “**a**ffective trust”.

Effective trust can be earned if the parties involved have been seen to deliver on commitments reliably, that their professional expertise is sound, and their overall performance is dependable.

Effective trust usually emerges from a series of successful interactions and grows incrementally and organically. For example, consistently meeting deadlines enables trust to grow. It can be seen already that part of the success of the Geoscience Ireland cluster rests on the fact that so many members attend consistently and contribute willingly to discussions. As LinkedIn CEO Jeff Weiner says, “Trust is consistency over time”. Given the openness of contributions at Geoscience Ireland Forums, where members freely share information, tip and news (both good and bad news!), and the continuing high attendance rate, Geoscience Ireland have clearly earned members’ trust, and the integrity of the leadership in both Geoscience Ireland and in Geological Survey Ireland is surely a major factor.

While effective trust is a necessary component, it is still not sufficient for members to consider undertaking joint work: the other party (an individual or organisation) must still be seen to have “acceptable” values i.e. be liked - or at least respected. This is known as “affective trust”.

Perhaps because of the similarity of the members’ professions, there seems already to be high degrees of mutual trust, respect, and indeed liking, among the Geoscience Ireland members.

Having some social activities can reinforce affective trust, and it seems that the “club” atmosphere in the Geoscience Ireland forum promotes a degree of “affection”.

Strategies to Build Trust

First: Trust with generosity. Jerome Blattner once said, “a person who trusts no one, can’t be trusted.” In other words, be the first in trusting. Paraphrasing Mother Theresa, “give the world your trust and you may get hurt. Give the world your trust anyway.”

Second: Be patient and flexible. Be tolerant of mistakes and don’t be an inflexible judge. Be considerate of events and negative experiences that might have affected one’s ability to trust. Trust is built over time.

Third: Be Dependable. Don’t make up excuses and take responsibility for your own mistakes. Don’t be afraid of apologising, when necessary.

Fourth: Be consistent. You will be trusted, if you consistently follow through with promises made and commitments taken.

Fifth: Be open. Be open and transparent in your communication. With respect and sensitivity, share your ideas and honest opinions, even when they contradict those of others. Being open and transparent in

The behaviours inferred above are a sampling of those regularly seen from engaged people. If these aren't the behaviours seen most of the time, it is not an engagement problem, it is a trust problem.

Finally, author Barbara Misztal highlights three fundamental things that trust does in the lives of members: It makes social life predictable, it creates a sense of community, and it makes it easier for people to work together.

3.High-performing Clusters with activities formalised and the cluster well established, with an international reputation, a critical mass emerges.

Pursuing leading edge research, working with world-leading firms, linking with centres of excellence, vigorously acquiring new knowledge and fostering constructive competition, benchmarking against international high-performers, study tours, interacting with entrepreneurs, associating with start-ups, conversing with thought-leaders, publishing research findings, communicating good news, highlighting success stories, enticing premier companies to join the cluster: all these activities will help keep the agenda sharp, the ambition levels high and the energy flowing.

Social events (aligned with business networking) can cement the busines bonds as well as creating the opportunity for sharing tacit knowledge and even serendipity – cluster members realising new common ground and pursuing joint activities, such as business development abroad, market intelligence, or joint R&D.

Unless fresh energy is injected (such as the addition of new members, entrepreneurs, stimulating discussions, vibrant events, international exchanges) the tendency will be for momentum to stall. This is not inevitable: dynamic leadership can see the signs and freshen up the cluster, pushing boundaries, encouraging innovation and extending the network. Unless the energy deficit is closed, momentum will stall, that chasm won’t be crossed, and entropy may ensue.

Warning Signs in Cluster Development

Low team spirit among members, unwillingness to share insights, tepid culture

Limited ambition, uninspiring vision, conservative mindset, risk aversion

Excessive bureaucratic intervention

Fear of mistakes, political gaffes

Not realising that clusters are primarily a social system

Positive Signs in Cluster Development

Vibrant initiatives, progressive agenda, a penchant for action, positive outlook.

Prompt engagement with pressing issues.

Warm relations with government departments, agencies and stakeholders.

Never surprised, always a step ahead, closely connected with decision-makers.

Egalitarian in approach, seen to be fair, open-minded, encouraging weaker members.

Promoting a focussed R&D strategy, with some degree of commercial orientation.

Co-development, co-specialisation and co-opetition.

Cluster Managers that are animators, catalysts, connectors and “know who knows what.”

Cluster Boards that are serious about business.

Decision making that moves at pace.

Businesses willing to contribute to funding the clustering initiative.

Inclusive - embracing those companies at the cluster’s boundaries.

On-going support, including management training.

4. Leading-Edge Clusters Leading-edge clusters are characterised by their demonstrated ability to significantly assist the development of best-in-class member companies – those that are setting the pace in technological or business development, with dynamic value propositions, enthusiastic client base, international reputation and suitably progressive cultures. This assistance may have been through formal assistance (leveraging university connections, R&D support, advanced training, government intervention, identification of tender opportunities, promoting joint ventures, facilitating mergers & acquisitions, creating a high-talent pipeline, sponsoring awards, showcasing members’ achievements, publishing

cases, educating stakeholders, promoting the segment, earning social licence, engaging communities) or informal assistance. Informal assistance takes many forms, are often abstract: creating the eco-system by putting the right elements in place and refreshing the formula, making privileged introductions, match-making suitable business partners, shaping the research agenda, knowing the key players in government, promoting the firm abroad, offering timely business suggestions or simply providing hope and solace at the right times. Again, the cluster manager's role is crucial, now guiding and coaching at an advanced level, leveraging the experience and expertise of the cluster Board and staff.

The above relates to the advancement of cluster members: the cluster itself similarly forges a path – not just follows a well-worn one. Other clusters are keen to know the magic formula, and will travel to see these ingredients of success. Sometimes, as with formal clusters in places such as France, Denmark and New Zealand, to name a few, the success is based on a sound structure, with sufficient government or company support (such as Pole Avenia in France, with the support of major oil companies), a communitarian spirit and a culture of creative design (as in Denmark) or in a need to band together for export potential (as in New Zealand). Often, the magic ingredient is the presence of a champion who brings the cluster into life and guides it through adolescence, and then, like any good parent, knows when to stand back.

Often, it is that intangible but undeniably real quality – charismatic transformational leadership. Charismatic leadership comes in many forms, but always has sufficient quantities of these four elements: intellectual stimulation (being eternally curious, insightful, discovering the findings), inspirational motivation (having foresight, showing the way forward, providing encouragement), idealised influence (showing integrity, being a role model, respected) and showing individualised consideration (recognising individuality and treating people accordingly). Simply stated, it helps if the cluster leader knows all the key players (foibles and all), is ahead of the game, sees further into the future, and can shine a light on the path ahead. These are rare qualities for a single individual to have: lucky indeed is the cluster with the right person leading at the right time. Better to have such qualities contained within the leadership of the cluster (such as a high-functioning Board) in as far as possible rather than the appointed leader. The Geoscience Ireland Board is fortunate to have, not just a charismatic leader, but a charismatic Board, with dynamic government members, leading-edge businesses and a potent combination of executive talent and progressive administrators.

6.3.1 Developing an Industry as a Whole Entity: Ireland's Geoscience Sector

Other means of developing the industry, as distinct to individual companies, include:

Getting benefits of scale by aggregating purchases, services

- Examples: procuring specialist tax services, joint tendering, joint R&D, common platforms, pooled HR advice, common branding, regional promotion.
- Build the support ecosystem and any infrastructure needed.
- Assist government in developing policies that favour clusters and that leverage the potential of clusters in creating jobs and wealth.

Promoting M&A to consolidate the industry (have fewer but bigger firms)

- Have fewer, but bigger firms.
- Encourage and enable M&A activity.

Professionalising the management of member firms.

- Through tailored courses and thought leadership, specialised advice and sector-specific guidance (as distinct to generic advice).

Declining OR Transforming Clusters. At this point, it might simply be that time has moved on, the end-market may have declined or investment subsided. This is particularly true where there is an over-dependence on a single end-customer.

Alternatively, the energy in the cluster may have dissipated, with fewer members, less social interaction, an obsolete agenda, entrenched cliques, dogmatic thinking, fossilised routines, moribund relationships with government, universities or R&D units, an inward focus, excessive free-riding or just an inability to note the decline – or to address the situation.

Once again, the cluster manager needs the wisdom of Solomon to see the warning signs sufficiently early – and take timely corrective action. The support of government, and especially the active support of an experienced and united Board, always important, is now crucial if the cluster is to be re-invigorated - or indeed transformed, following new opportunities. There may well be enough impetus to either re-invigorate the cluster, or, more likely, find pastures new and thereby transform itself, rather like the regional Varmland (Sweden) cluster described here, often driven by new technology. This renaissance will often be based on new products & services, and the cycle can begin again, with new clusters spawned.

According to Deloitte, spin-off clusters typically emerge from mature clusters. For example, from a mature cluster working with wind energy, a spin-off cluster specialising in a certain technology or service for wind energy can emerge.

As Ifor Ffowcs-Williams (2014) says, “cluster development is in part about moving from the naturally occurring ‘wild cluster’ to the ‘domesticated’ cluster, but hopefully not all the wildness is tamed out. Some chaos at the edge is invariably needed!”

6.4 Maintaining Success: Geoscience Ireland’s 5 Measures

In order to maintain Geoscience Ireland’s success as a cluster, several lessons have been learned and by the Geoscience Ireland management team and its member companies. Joining a networked community such as this facilitates the growth of members, concentrates power, accelerates technical development, deepens the talent pool, leverages research and promotes innovation.

1. Developing Social Capital: Ensuring Trust and Demonstrating Collaboration

Delivering on actions as agreed with members is a tangible method to develop and sustain trusting relationships, while confidentiality and responsiveness allows Geoscience Ireland’s secretariat of four staff to be regarded as “trusted advisors”.

Developing such a dynamic has helped develop a high level of social capital between Geoscience Ireland, its members and its stakeholders. Geoscience Ireland can be said to be a relatively cohesive association of members, who compete and simultaneously collaborate within the cluster. The Geoscience Ireland experience shows that, since its formation in 2012, social capital is strong and new members feel at ease quite quickly upon joining the cluster and demonstrate reciprocal trust thereafter.

Such collaboration may not come naturally to all companies. This can lead to members being disengaged, to free-rise or simply to leave the cluster; the principle of coopetition requires one to relinquish a degree of control and power for a mutually beneficial outcome. Geoscience Ireland, over time, has communicated this outlook to its members and shows results by way of joint bids between members on commercial tenders or simply working together at international trade shows; nonetheless, overly cautious businesses ultimately may decide not to engage with a cluster’s objectives or its *raison d’etre*.

Communicating success stories is a key component when demonstrating success in a collaboration-focussed cluster. Collaboration happens in numerous ways from sharing

experiences in identifying and solving industry-related issues to jointly identifying and bidding on commercial contracts.

2. Ensuring Committed Leadership and Government Support

The Geoscience Ireland initiative now operates across government and includes continuous interaction between its sponsor Geological Survey Ireland and its parent Department of the Environment, Climate and Communications, and its supporting governmental stakeholders: Enterprise Ireland and the Departments of Foreign Affairs and of Enterprise, Trade and Employment. In 2018, the government, through DBEI, published its 'Action Plan for Jobs' and included Geoscience Ireland as a successful case study focussed on exports, job creation and economic development. Geoscience Ireland aligns very well with the evolution of a "Team Ireland" approach to developing international trade. In addition, Geoscience Ireland has established close links with trade and commercial bodies in Ireland and abroad as outlined in the government's 'Global Ireland 2025' and its 'doubling Ireland's footprint' policy, thus enhancing promotion and connectivity.

The Irish Government actively engages overseas markets by way of trade missions, market study visits and inward buyer visits, and Geoscience Ireland compliments and engages with such programmes when its key sectors are represented.

3. Delivering High Quality Services

Geoscience Ireland offers full-time tender tracking, market intelligence and support for joint bid activity. In 2020 it is rolling out its Procurement Hub which will act as platform for automating tender activity and for collaborative bidding, and will also provide up to date and advanced focused market intelligence and market access information.

By pooling market knowledge, sourced by Geoscience Ireland, and leveraging Team Ireland's support services, companies can expand their global reach and identify opportunities that would not otherwise be visible.

GI is a member of several industry, commercial and professional organisations, thus widening the networks for collecting market intelligence, creating contacts and raising the awareness of the sector and of Geoscience Ireland member companies.

4. Operate at Key Industry Events

GI actively promotes member companies in a wide range of international exhibitions, conferences, trade shows, industry fairs and business networking. Geoscience Ireland seeks and maintains a high level of privileged access to business networks, project sponsors, funders and gateway stakeholders.

Geoscience Ireland has participated on Enterprise Ireland Market Study Visits and Ministerial-led Trade Missions to Ghana, Nigeria, Kenya, Ethiopia, Australia and the UK to promote Ireland's geoscience expertise, to meet key market clients and agencies and to assess routes-to-market on behalf of Geoscience Ireland member companies.

Individual Geoscience Ireland members would not have the time, staff or resources to cover all of these potential opportunities, where Geoscience Ireland can now effectively represent their offerings, with high-level government backed access and support.

Key trade shows include annual mining conventions: PDAC in Toronto, Mining INDBA in Cape Town, the Mining Show, Dubai, and AME Roundup in Vancouver which are well-attended by Geoscience Ireland companies and are supported by Enterprise Ireland and the Irish consular network. Conferences and trade shows focussed on broader natural resources, energy and civil infrastructure include INTERMAT, Paris; Ground Engineering & Tunnelling, London; AMP Water, London; Trafikverket, Stockholm and Geo Energy Days with Pole AVENIA in France.

5. Research and Development: Maintaining an Innovative Edge

Geoscience is representative of many areas of the Science, Technical, Engineering and Math (STEM) discipline. By way of annual Geological Survey Ireland research calls and its larger research programs, geoscience companies maintain themselves at the forefront of this technical industry. Enterprise Ireland supports business in many ways from innovation funding, to business development (both internal workings of the business and assistance in growing export business).

Geoscience Ireland will ensure collaboration between stakeholders and that its members are knowledgeable of the cross-Governmental supports which are designed to keep Irish SMEs in a competitive position (by way of innovation) in international markets.

Geological Survey Ireland and Department of the Environment, Climate and Communications relationship with the SFI-funded iCRAG research centre is important for Geoscience Ireland as it exposes member companies to the research community; the relationship reciprocates as Geoscience Ireland facilitates introductions to geoscience companies and key clients both in Ireland and overseas. Learning from the Irish Context – Practical Steps in the Continued Development of a Cluster.

7 Maintaining Cluster Momentum

While much has been written about how to set up a cluster, there is less guidance on how to maintain momentum once the first flush of excitement ebbs away: like a good marriage, the romance must be maintained! In this section, some suggestions are made, based on Geoscience Ireland's own experience. To avoid stagnation, the Cluster must be kept open to the changes in the industry, to new ideas, market shifts, technological advances, changing business models, industry entrants, and to fresh management ideas.

Geoscience Ireland responded to industry movements and remained responsive to members' requests: indeed, the key is to be proactive and lead from the front, especially in thought leadership and in analysing the market.

Grow the Membership Basis in a Concerted Manner

Geoscience Ireland kept the flow of new ideas by attracting new members, especially larger companies to the cluster. This also helped to complete an internal value chain, as often the larger companies are better equipped to pioneer new markets or develop business abroad.

Concentrate your International Marketing and Business Development Initiatives

As the cluster evolved, Geoscience Ireland concentrated members' efforts in carefully selected markets: this focus consolidated marketing efforts in attractive markets and made collaboration more likely.

This concentrated approach laid the platform for assessing and addressing specific challenges when internationalising, such as meeting different sets of foreign regulations, business practices, legislative regimes, logistics, and indeed labour market challenges. This focused approach also made it feasible to suggest alliance partners, agents and Government contacts.

Encourage Partnerships

PDAC and Mining Ireland; the latter being a mini-PDAC in Dublin to garner both inward investment and selling Ireland's geoscience expertise.

Develop Thought Leadership

Geoscience Ireland also brought top tier experts and international guest speakers into its regular Forums with members, thereby widening the experience base and bringing distinctive, fresh new voices into discussions.

Expertise and Talent Development

Geoscience Ireland also supported Leadership programs in association with the Irish Management Institute, most notable with a 9-day high-level executive education program featuring Professors from Instead and elsewhere.

Geoscience Ireland also introduced an innovative, flexible two-year Geo Drilling Apprenticeship in association with Carlow Technical Institute and geo-industry companies. This is an example of taking members concerns on board and resolving an industry-wide issue.

8 Developing Member Companies – The Geoscience Ireland Experience

Annual Visits and Assessments

Geoscience Ireland hold an Annual Review with each member: these are one-to-one meetings with Members to identify ambitions, potential projects, and to inform future workshops. This also allows Geoscience Ireland to identify commonalities with other members. This is a two-way process: the company also educates Geoscience Ireland by relating lessons from the front line, providing useful market intelligence and industry news.

These Geoscience Ireland visits assist in the company's development, especially in its capability to expand internationally. A benchmarking-style assessment is conducted, with a special emphasis on managing the sales pipeline and exploring business opportunities. This has proved very valuable, and a short additional questionnaire is now being considered **to assess the company's business "health"**; this succinctly covers areas such as leadership, innovation, culture, operations and systems. See the draft version in the Appendices, along with the Appendix on strategy formulation and execution.

Quarterly Workshops – Forum-style engagement with members

Geoscience Ireland hold open and collaborative forums that allow regular and ongoing contact with members and which engage Geoscience Ireland as a sounding-board for new business and provide updates on sector-specific events.

To reduce group-think, care is taken to invite representatives from other countries, such as foreign cluster representatives, international technical specialists, researchers, entrepreneurs and regulators.

It also invites representative from potential clients, such as from HS2 in the UK.

These quarterly forums are kept vibrant through judicious selection of relevant themes, a conducive atmosphere of engagement, astute chairpersonship and enough free time to allow members congregate and converse with one another.

9 Learning from World-Leading Clusters

Australian cluster expert Dr Nicola Watts, at a webinar organised in August 2020 by Clodagh Barry (CEO of The Cluster Centre) takes Porter's teachings further: she points to the Smart Specialisation (S3) process in Europe as an ambitious experimental example of tackling clusters in a different way, using a combination of **top-down policy** coupled with **bottom-up** approaches to innovation harnessing 'active involvement across the quadruple helix of industry, researchers, government and community'.

Dr Watts advocates 7 principles that underpin successful clustering.

7 Principles

- 1. Colocation
- 2. Collaboration
- 3. Co-Innovation
- 4. Connectivity
- 5. Capability
- 6. Communications
- 7. Commitment to act

Barry agrees with Dr. Watts's points that "the agility to act, adapt and pivot underpins successful clusters", as well as the more elusive human element of trust and social capital. Regardless of policy the real glue remains human.

10 Lessons for Ireland

According to Dr. Watts, Ireland has a widespread selection of 'peak bodies' and top down traditional policy making. Nicola suggests these measures for assessing – and improving - cluster performance:

Key Lessons for Ireland	Shared awareness on the power & potential of clustering
	How to harness the collective power of the various actors in an ecosystem
	Increase 'bottom up' decision making and flexibility on cluster formation
	Focus on communication and building of trust

The potential of clustering is clear. Old thinking and chasing shrinking customer bases with intense competition will not realise the rewards that a global economy can offer. Like any new business approach clustering could falter on early failures to address fundamental issues and require a systematic approach. The clear message is the collective is more powerful than the individual.

10.1 Practical Steps in Developing an Irish Cluster for International Growth: Example

FIAL is the Food Innovation Australia cluster that promotes innovation and international market development for member companies. Its three "pillars" emphasise capability building, connections and innovation. Their Report (2016) similarly found that cluster initiatives must be approached from the bottom up, as well as the top down. Businesses must own and drive the collaborations within the clusters, while the role of government is as both a financier and supporter of the initiatives. The main challenge for cluster initiatives is to ensure that they make an economic impact at a local, as well as a national level. This will be dictated by the governance and professionalism of the cluster, as well as it's alignment with government policy.

To be successful, they claim that cluster initiatives must also consider:

- The link with academia must be underpinned by a business pull, and clusters must connect with people in academia who are passionate about engaging with industry.

- One of the largest constraints of a cluster is a skills mismatch, and this must be addressed by training and the development of a cluster ignition team.
- Building knowledge infrastructures and centres of excellence, such as incubators and accelerators, stimulates innovation and allows companies to build capabilities and access new ideas and inventions.
- Identify gaps, and then utilise the knowledge and technology brought by FDI (foreign direct investment) to address these gaps and increase competitiveness.
- Embrace new technologies to ensure the success of a cluster. The conference gave insight into the importance of spreading knowledge and building capability for cluster initiatives to succeed. For example, tacit knowledge, or knowhow, is becoming incredibly important to the success of a nation's economy. Collective or team knowhow is the key to driving production and diversity in a country – as people move within a country, the collective knowhow increases as the capability of the people builds and growth is accelerated.
- Set strategic policy to proactively assist clusters. Government policies and public inputs such as information and resources facilitate the growth of an economy and productivity. Policy should be based around the following:
    - Learning and reviewing, as policy should never be rigid.
    - The significance of a long-term perspective.
    - A collaboration between the public and private sector.
    - Close co-operation between the different government agencies.

FIAL is a cluster similar to Geoscience Ireland, with strong marketing elements. It sponsors international exhibitions, trade fairs, market research, innovation and industry awards. A successful SME trade cluster, its hallmarks are the perennially essential qualities - vibrancy, flexibility, business networking and social interaction.

Its powerful branding also acts as a proxy brand for its member companies, providing an implicit endorsement as well as exposure to potential clients globally.

This strong branding has the secondary effect of proactively creating a positive image for the industry, educating consumers and indeed the formal media and other influencers. As can be seen, staples such as milk, beef and eggs can lose their lustre overnight in the face of activism. Industries everywhere need to be socially conscious, and to be seen to be so, disseminating the right message, before the horse has bolted, so to speak.

11 Conclusion

All societies are subject to the inevitability of major economic shocks and the Schumpeterian cycle: it is not a question of “what will we do **if** there is another shock” but rather what will we do **when** the next shock occurs – indeed, what will we do **before** the next shock, in order to prepare for it. One way is through unity of common purpose, as can be achieved via effective clusters: developing economic strategies that suit our resource base by tightening the valence bonds of the Triple Helix of government, industry and educational institutions.

Societies only progress when they increase the effectiveness of the sophistication of their interactions: in other words, when they learn to overcome natural distrust, and human desire for autonomy, by “competing and cooperating” simultaneously, guided by strong cluster norms as well as the other human instinct – to be social creatures. This guidebook has attempted to show how that can be done, using examples from across the world, as well as some closer to home in clusters such as Geoscience Ireland, Animation Ireland, Foodwise and the Irish MedTech clusters, to name but some recent successes.

It has provided a 4-stage development ladder to show how clusters can progress from the initial stage to the fully functional mature stage, along with notes on the different cluster-management approaches needed.

Finally, it has brought into the light the wonderful (but sometimes unseen) work of pioneers in the area, such as Ifor Ffowcs-Williams and colleagues in ITC, Nicola Watts as well as the foundational work of eminent authorities such as Michel Porter.

Sincere thanks to those pioneers as well as all those who contributed their time and expertise to this Guidebook. We hope you find it useful.

Appendix A - Introducing Geoscience Ireland

Geoscience | The science and engineering of breaking ground.

Geoscience Ireland | The collaborative network connecting Irish experts to commercial projects and project partners in over 50 countries.

Geoscience Ireland (GI) operates under the following value proposition:

> *"*Geoscience Ireland is a business cluster of 42 companies, delivering integrated expertise in water, minerals, environmental and infrastructure development to clients in over 75 countries.
>
> The Geoscience Ireland companies provide design, consultancy and contracting services to multilateral agencies, governments and the private sector.
>
> Geoscience Ireland is supported by Geological Survey Ireland, Enterprise Ireland and the Department of Foreign Affairs."

Its ambition is to assist Irish companies, in the 'geoscience' sector, in accessing overseas commercial tenders and opportunities.

Background

Geoscience Ireland was not borne from an overarching, top-down, Irish economic policy, instead it was borne as an industry response to the economic collapse post-2009 and its foundations were supported by the sectors most immediate department: Geological Survey Ireland, and the national export agency: Enterprise Ireland.

In 2010, Geological Survey Ireland and Enterprise Ireland, along with a reference group of five companies delivering geoscience advisory services to infrastructure and extractive industries, came together to arrest the resulting acute job losses in the sector.

In order to save and create valuable and skilled jobs, it was clear that geoscience skills developed in the Irish market needed to be sold into international markets. Growth of overseas markets allows for greater resilience and increased scale for Irish companies. Initial focus was on work flowing from International Financial Institutions, mainly in Sub Saharan Africa; this led to Geoscience Ireland's collaboration with the Department of Foreign Affairs and Trade. It was also clear that collaboration between Irish small- and medium-sized enterprises (SMEs) was essential in order to win large international contracts. In order to foster and develop this collaboration, Geoscience Ireland was placed on a more formal basis in 2012 with the appointment of a full time Business Development Director based in

Geological Survey Ireland. Geological Survey Ireland is a division of the Department of the Environment, Climate and Communications.

Since then, the target markets and sectors have widened considerably to include infrastructure development in the Gulf, the Balkans, the UK and Nordic Countries. Membership has expanded to include contractors and the Irish offices of large international consultants and Geoscience Ireland is now a network of 42 companies delivering integrated expertise in water, minerals, environmental, infrastructure in over 75 countries. The Geoscience Ireland network is founded on a belief in the value of shared effort, selective collaboration, industry leadership, client focus, innovation, combined resources and stakeholder support. The ambition is to assist each Member Company achieve greater business success, increase employment and make each company a “great place with which to do business”.

Chronological Growth

- 2009 | Sharp fall in Infrastructure spending in Ireland from 2009 left many companies facing cutbacks and losses.
- 2010-2011 | Geological Survey Ireland and Enterprise Ireland, plus 5 Reference Companies in the geoscience sector, identified opportunities for Irish companies in international markets; Geoscience Ireland was born.
- 2012 | Sean Finlay was appointed Business Development Director; Membership growth: 5 to 17
- 2013 | Membership: 22 Companies
- 2014 | Andrew Gaynor appointed Business Development support; DFA joins Geoscience Ireland Steering Committee; Membership: 24 Companies
- 2015 | Membership: 26 Companies
- 2016 | Membership: 31 Companies; Geoscience Ireland Members agree to attract larger companies to the cluster
- 2017 | Andrew Gaynor appointed Business Development Manager; Elizabeth Murphy and Stephen D Walsh appointed Market Advisors; DBEI joins Geoscience Ireland Steering Committee; Membership: 33
- 2018 | Membership: 36 Companies
- 2019 | Jessica Allen appointed Market Advisor; Membership: 40 Companies

- 2020 | Membership: 42 Companies

Geoscience Ireland has filled this remit beyond the most optimistic expectations, with Member Companies creating 1,346 net new jobs – 1,296 of which were created by the SME

cohort. This was aided by the overall economic recovery, of course, but Geoscience Ireland is acknowledged by the companies as having played a critical and highly proactive role in preserving these companies.

Geoscience Ireland has based its future strategy on the following three pillars:

Pillar 1:	**Maintaining the Core Focus on Members' Business Growth**
Goal:	To continue supporting its Members' ambitions and focus its activities toward end-clients and markets.

Pillar 2:	**Continued and Expanded Internationalisation of Members Business**
Goal:	To enhance market knowledge and market access opportunities.

Pillar 3:	**Promoting and Strengthening Geoscience Ireland, Growing its Influence and Visibility**
Goal:	To promote and invest in Ireland as being a centre of geoscience excellence and to attract graduates and apprentices.

The Geoscience Ireland Experience in Forming and Maintaining a Cluster

The reason for forming the Geoscience Ireland cluster are clear: to arrest job losses in a highly technical sector and to assist in stimulating economic growth and job creation in Irish companies. Today, Ireland has reached full employment and Geoscience Ireland is responding to more contemporary issues of addressing skill shortages, targeting overseas contracts in ever-competitive economic landscape and offering focussed, quality networking to its member companies.

Delivering on actions as agreed with members is a tangible method to develop and sustain and trusting relationships, while confidentiality and responsiveness allows Geoscience Ireland's secretariat of four staff to be considered trusted advisors.

Developing such a dynamic has witnessed a high level of social capital between Geoscience Ireland, its members and its stakeholders.

The benefits of membership to the cluster are substantial:

- By pooling market knowledge, sourced by Geoscience Ireland, and leveraging Team Ireland's support services, companies can expand their global reach and identify opportunities that would not otherwise be visible.
- Joining this networked community facilitates the growth of a geoscience cluster, concentrates power, accelerates technical development, deepens the talent pool, leverages research and promotes innovation.
- GI offer full-time tender tracking, market intel and support for joint bid activity.
- GI actively promotes Member Companies in a wide range of international exhibitions, conferences, trade shows, industry fairs and business networking.

Develop trust, years later proves that social capital is strong and new members are at ease quite quickly, demonstrate reciprocal nature of collaboration.

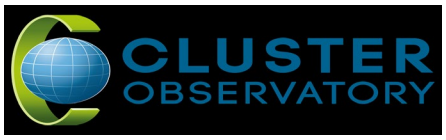
The Geoscience Ireland initiative now operates across government and includes continuous interaction between Geological Survey Ireland, a division of the Department of the Environment, Climate and Communications, Enterprise Ireland and the Departments of Foreign Affairs and Enterprise, Trade and Employment. Geoscience Ireland aligns very well with the evolution of a "Team Ireland" approach to developing international trade. In addition, Geoscience Ireland has established close links with trade and commercial bodies in Ireland

and abroad as outlined in the Government's 'Global Ireland 2025' Policy, thus enhancing promotion and connectivity.

Geoscience Ireland (GI) has achieved low cost Job Creation through developing the industry and its members

- GI has displayed excellent Trust Building capability: GI is a surprisingly cohesive association of members, who compete and simultaneously collaborate within the cluster
- GI has an effective Business Model
- GI has deep market knowledge, implicit and explicit
- GI has Privileged Access to Project Sponsors, Funders, Gateway Stakeholders
- GI has Unique Tendering & Bid Capabilities
- GI facilitates International Scaling Capability
- GI has strong Irish Government Support
- GI has Committed Leadership
- GI has strong links to industry and other networks

Appendix B - European Cluster Observatory In Brief



The European Cluster Observatory is a single access point for statistical information, analysis and mapping of clusters and cluster policy in Europe that is foremost aimed at European, national, regional and local policy-makers as well as cluster managers and representatives of SME intermediaries. It is an initiative of the "SMEs: Clusters and Emerging Industries" unit of the European Commission's Enterprise and Industry Directorate-General that aims at promoting the development of more world-class clusters in Europe, notably with a view to fostering competitiveness and entrepreneurship in emerging industries and facilitating SMEs' access to clusters and internationalisation activities through clusters.

The ultimate objective is to help Member States and regions in designing smart specialisation and cluster strategies to assist companies in developing new, globally competitive advantages in emerging industries through clusters, and in this way strengthen the role of cluster policies for the rejuvenation of Europe's industry as part of the Europe 2020 Strategy.

To support evidence-based policy-making and partnering, the European Cluster Observatory provides an EU-wide comparative cluster mapping with sectoral and cross-sectoral statistical analysis of the geographical concentration of economic activities and performance. The European Cluster Observatory provides the following services:

- a bi-annual "European Cluster Panorama" (cluster mapping) providing an update and enrichment of the statistical mapping of clusters in Europe, including for ten related sectors (i.e. cross-sectoral) and a correlation analysis with key competitiveness indicators;
- a "European Cluster Trends" report analysing cross-sectoral clustering trends, cluster internationalisation and global mega trends of industrial transformations; identifying common interaction spaces; and providing a foresight analysis of industrial and cluster opportunities;

- a “Regional Eco-system Scoreboard” setting out strengths and weaknesses of regional and national eco-systems for clusters, and identifying cluster-specific framework conditions for three cross-sectoral collaboration areas;
- a “European Stress Test for Cluster Policy”, including a self-assessment tool accompanied by policy guidance for developing cluster policies in support of emerging industries;
- showcase modern cluster policy practice through advisory support services to six selected model demonstrator regions, including expert analysis, regional survey & benchmarking report, peer-review meeting, and policy briefings in support of emerging industries. The policy advice builds also upon the policy lessons from related initiatives in the area of emerging industries;
- bring together Europe’s cluster policy-makers and stakeholders at the European Cluster Conferences 2014 and 2016 for a high-level cluster policy dialogue and policy learning, and facilitate exchange of information through these webpages, newsletters, videos, etc.

Appendix C - Related European Cluster Resources:

The European Strategic Cluster Partnerships for Going International (ESCP-4i) aim to develop and implement joint internationalisation strategies to support SME internationalisation towards third countries.

They contribute to develop common actions (i.e. business missions, cooperation agreements, gateway services, export consortia, etc.) strengthening European SMEs access to specific third markets and initiating a long-term cooperation agenda with strategic partners in third countries.

The European Cluster Collaboration Platform **is a service facility aiming to provide cluster organisations with modern tools**;

These tools help to:

- make efficient use of networking instruments (search/find potential partners and opportunities)
- develop collaboration trans-nationally (within Europe) and internationally (beyond Europe)
- support the emergence of new value chains through cross-sectorial cooperation
- access the latest quality information on cluster development
- improve their performance and increase their – as well as their members' - competitiveness.

The services include:

- a dynamic **mapping** of over 1000 profiled cluster organisations worldwide
- the largest **information hub** for clusters offering latest **news**/**events**/**open calls** to a broad community via the ECCP Weekly Digest
- **matchmaking events** supporting the development of cooperation between clusters **in Europe and beyond**
- a unique database on regional, national, international and sectoral **cluster networks**
- detailed information on the **European Strategic Cluster Partnerships**
- a **partner search** facility, where cluster organisations can exchange their offers and demands

- dedicated pages supporting **international cooperation** including profiles of selected countries of strategic interest and related European international support services
- a unique database of profiled **cluster-related projects** developed under **various European programmes**.

The ECCP addresses primarily the needs of **cluster managements**, but its rich content is useful for both the SME **cluster members** and for the **cluster policy makers at regional, national or international level**. Although the European cluster organisations, by their number and long history of development, make an important part of the platform, ECCP is open and connected to the whole world, with a special focus on certain specific third countries of strategic interest.

Being at the service of cluster organisations, with a unique offer of facilities and tools to create a favourable environment for collaboration to emerge and develop, ECCP aims to become **the leading European hub for international cluster cooperation, building cluster bridges between Europe and the world**.

The European Cluster Observatory and the web site was launched in July **2007**. In addition to cluster mapping data the web site also offered data on cluster organizations and cluster-related reports. In **2012** the Cluster Observatory was separated from the European Cluster Observatory and is run by the Centre for Strategy and Competitiveness at the Stockholm School of Economics.

Appendix D - Practical Activities to Develop an Irish Cluster for International Growth

Geoscience Ireland has helped cluster members grow their businesses in practical ways:

- ✓ Preparing succession plans for firms
  - Rarely done in any depth by most domestic-only companies
- ✓ Practical help in making firms internationalise
  - Enterprise Ireland, the Departments of Foreign Affairs and Enterprise, Trade and Employment and associations such as Chambers of Commerce, exporting agencies and diaspora are invaluable.
- ✓ Joint initiatives to adopt leading-edge technology
  - Collaborations that are sensitively managed, and can be very fruitful.
  - International forums held in Ireland for potential clients
  - Conferences can help establish reputations and thought-leadership positions: good examples are Mining Ireland; IFI Conference; EI MSVs/TMs
- ✓ Introduction of world-class methods from abroad
  - Intelligence-gathering should be continuous, not episodic, with conscious efforts to glean international expertise. The MNCs can be useful sources of such intelligence., as can Study tours to world-class firms, such as Toyota UK, often organised by Enterprise Ireland.
- ✓ Invitations to leading gurus to make presentations in Ireland
  - Can be arranged with some Tier 1 organisations such as PMG, Mace; also, self-organised with Geological Survey Ireland.
- ✓ Holding a conference on tech clustering so as to position Ireland well
  - Follow, for example, the Cork IT model.
- ✓ More vibrant links with researchers in Universities.
  - iCRAG, UCD, TCD, and Geological Survey Ireland Research for example
- ✓ Achieving synergy through closer collaboration.
  - Joint purchasing, talent sharing, intelligence gathering/ sub-contracting can be useful.

- ✓ Developing firms meet the challenge of digital disruption
    - Advance education in Construction tech, Mining automation, for example.
- ✓ Produce more e-leaders in this digital age
- ✓ Continue streamlining tender processes
    - Use early market intelligence; bid collaboration; GIPH system

Develop a scheme whereby approved Irish firms don't submit the same info over and over on tenders

- Rationalise the system and avoid duplication as far as practicable

Practical help + guides on gaining working abroad (taxes, laws, contracts)

- Produce these in association with Chambers, for example.

Facilitating obtaining EU grants, especially in Marketing and in R&D

- Focus on industry-specific grants

Helping firms systemise their R&D efforts.

- Issue guidelines and follow-up on the specialist advice given

Joint brand (under the cluster umbrella brand)

- Promote dual-branding over time

Hold Award Ceremonies and Testimonials

- Geoscience Ireland have awards to boost the industry, with Engineers Ireland and others.

Appendix E - Zurich ETH Innovation Cluster Research Interview

Why are companies in a business cluster more innovative? And what makes a business cluster particularly successful? These questions were addressed by Professor Georg von Krogh, Professor for Strategic Management and Innovation at *ETH Zurich*, and Nina Geilinger, his doctoral student, in collaboration with the Business and Economic Development Division of the Office for Economy and Labour in the Canton of Zurich. The team studied business clusters in the biotech, cleantech and ICT (information and communications technologies) sectors in Canton of Zurich.

Innovation is important for all companies. Why did you choose the biotech, cleantech and ICT sectors?

Von Krogh: The pace and expansion of technological innovation has increased significantly – particularly in knowledge-intensive fields such as biotech, cleantech and ICT. For example, it took 84 years until 50% of the US population owned a car; it took only ten years for half of them to get an internet connection. This development means that technology-intensive companies must continue to work faster to create new products – and they must do this with the global market and their competitors in mind. Firms like Apple or IBM are driving this trend, but small businesses and company founders from anywhere in the world can suddenly revolutionise the market with an innovative idea.

What role do business clusters play in this process?

Von Krogh: Expertise from a limited field of knowledge is often insufficient to develop a new product in technology-intensive sectors. A business cluster facilitates rapid and direct knowledge exchange. Having a good local network supports a global presence.

Geilinger: In the high-tech sector in particular, business clusters frequently emerge from start-up activities out of universities and are therefore concentrated in a geographical area. In a business cluster, employees from various firms know each other personally, either from working for the same past employers or from their university studies. People meet spontaneously in an informal environment where they swap experiences or bounce around ideas – something that happens rarely in relationships on a global scale. This is where the true value of a business cluster lies.

Generally, companies are reluctant to share their knowledge. How is it that those in a business cluster are willing to open up and exchange ideas?

Von Krogh: That's what makes a business cluster special. In a business cluster, companies tackle similar problems, making them more inclined to share their knowledge. Physical

proximity is also an enabling factor. Proximity engenders trust, which is not so easy to forge over video-conferences or occasional meetings. Collaboration on projects and regular meetings also lead to informal, personal relationships. It's often in random conversations that relevant knowledge is shared.

Geilinger: Of course, nearly all firms possess knowledge that needs to remain confidential. On the other hand, many companies are aware that they can't survive in a vacuum. That's why they pass on their knowledge to others, so that in turn they may profit from the others' experience and expertise. Our study also showed that business clusters are more successful when product and research spheres are similar.

Can you give some examples?

Geilinger: Up to now, firms in the biotech and ICT clusters in the Canton of Zurich have learned more from each other than those in the cleantech cluster. In the latter cluster, the products and objectives are more diverse: one company is developing a system to recover energy from waste while another is developing solar panels. There is little overlap in these two areas. In addition, the ICT cluster has the advantage of having grown organically over the years. A successful and dynamic business cluster needs time to develop.

How did you arrive at your findings?

Geilinger: We approached managing directors and executives from the three studied clusters in Canton of Zurich and carried out a total of 87 interviews. We supplemented the interviews with a standardised survey and assessment of the literature. We wanted to get to the heart of the matter instead of analysing superficial, quantitative data.

What did the study reveal with regard to the business clusters in Canton of Zurich?

Geilinger: The exchange of ideas with universities is just as important for business clusters as is the exchange with mentors, private investors, customers and competitors. This exchange is a key advantage of the cluster eco-system in Canton of Zurich.

And how do they compare on a global level?

Von Krogh: In the ICT sector, Silicon Valley is clearly unbeatable in terms of size and diversity, even though Canton of Zurich is the centre of the Swiss ICT industry. The advantage of a domestic business cluster is companies and their employees often know each other very well, which eases the flow of information, thus speeding up the innovation process.

Geilinger: In Canton of Zurich, universities and firms are also in close proximity, and the business clusters are well connected to the academic world.

How can firms further harness the power of business clusters in terms of process and product innovation?

Geilinger: Public authorities can assume a greater role here. Important considerations include the establishment of more financing opportunities for start-ups, a shared brand identity for the cluster eco-system and more international conferences and trade fairs in Zurich. In addition, knowledge sharing and collaborations between universities and firms should be intensified further. The Innovation Park in Dübendorf will lay the right foundations for such developments.

Von Krogh: When top ICT companies such as Google set up offices around the world, smaller firms learn a lot from them in a short span of time. At the same time, these companies only tend to put down roots in places where there is already a significant knowledge-base. Furthermore, large companies are suitable partners for small businesses.

How will markets develop going forward? Can product innovation advance yet further?

Von Krogh: Each market has its own unique trends, and not all markets are open to more and more technological changes. This can be due to a lack of customer resources or because people are no longer inclined to invest in new concepts. Fundamentally, I expect that consumers in many sectors will change their habits, buying more products as a one-off and then share these products more often. Cars are the prime example. The concept of the sharing economy will likely affect companies' investment behaviour, which may have a knock-on effect for innovation activities. Innovation through intensive knowledge-sharing between companies will be inevitable.

Geilinger: Firms in the cluster eco-system in the Canton of Zurich can use their full innovation potential by adopting new business models and management practices.

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Acronyms

AfDB African Development Bank

AICC Arab Irish Chamber of Commerce

BICC British Irish Chamber of Commerce.

COSME The EU programme for the Competitiveness of Small and Medium-Sized Enterprises. This is within the mandate of **EASME**: Executive Agency for SMEs

DETE Department of Enterprise, Trade and Employment, formerly DBEI

DECC Department of the Environment, Climate and Communications

DFA Department of Foreign Affairs

EBRD European Bank for Reconstruction and Development

EI Enterprise Ireland

EIB European Investment Bank

FICC French Irish Chamber of Commerce

GCC shorthand for Arabian Gulf: the Gulf Cooperation Council

GEE Geo-Energy Europe (GI's COSME project)

GI Geoscience Ireland

GIPH Geoscience Ireland Procurement Hub

ICBA Irish Canada Business Association

iCRAG Irish Centre for Research in Applied Geosciences

IBV Inward Buyers Visit

IEA Irish Exporters Association

IFI International Financial Institutions

IMQS Irish Mining and Quarrying Society

ITC Institution of Technology Carlow

MSV Market Study Visit

TCD Trinity College Dublin

TCI The Cluster Institute

TM Trade Mission

WB World Bank

Bibliography

Andersson, T., Schwaag Serger, S., Sörvik, J. and Wise Hansson, E. (2004), The Cluster Policies Whitebook, Malmö: IKED

Christensen, Thomas Alslev/Lämmer-Gamp, Thomas/Meier zu Köcker, Gerd, 2012: Let's make a perfect cluster policy and cluster programme. Smart recommendations for policy makers, Berlin/Copenhagen, pp. 32-34 C

Etzkowitz (2008), *The Triple Helix: University-Industry-Government Innovation In Action* London: Routledge

European Commission, *Smart Guide to Cluster Policy*, Guidebook Series, 2016

Geological Survey Ireland (2020) *"The Formation and Maintenance of a Successful Business Cluster"*

Hansen, Eric Rolf (2015), quoted in TCI Proceedings, ETG, New York.

Ingstrup, M. B. (2013). *The role of cluster facilitators in facilitating clusters: empirical and theoretical investigations*. (1. ed.). Syddansk Universitet. Det Samfundsvidenskabelige Fakultet.

Hardin G (1968) *The tragedy of the commons*. The population problem has no technical solution; it requires a fundamental extension in morality. Science 162(3859):1243–1248..

Johnston**,** Ron (1991) *A Question of Place. Exploring the Practice of Human Geography.* Blackwell

Ketels, C., Lindqvist, G., Sölvell, Ö. (2012). *Strengthening Clusters and Competitiveness in Europe* – The Role of Cluster Organizations. Stockholm: Center for Strategy and Competitiveness

Malmberg, A. and Maskell. P. (1999), *The Competitiveness of Firms and Regions*: 'Ubiquitification' and the Importance of Localized Learning, European Urban and Regional Studies, 6 (1), p. 9–25.

Marceau, J., *'Clusters, Chains and Complexes'*, in Dodgson, M. and Rothwell, R., eds., *The Handbook of Industrial Innovation*, Edward Elgar, Aldershot, 1994.

Osarenkhoe, A. and D. Fjellstrom (2017) Clusters vital role in promoting competitive Advantage. Investigaciones Regionales

Ostrom E (1990) Governing the Commons: The Evolution of Institutions for Collective Action (Cambridge Univ Press, Cambridge, UK)..Google Scholar

Marshall, A. (1890), *Principles of Economics*, Macmillan, London.

Marshall, A. (1920) *Industry and Trade* (London: Macmillan).

Mesquita, L. F. (2007) *Starting over when the bickering never ends*: Rebuilding aggregate trust among clustered

Millar G (2016) *Creating clusters will act as an engine for growth* (broadcast)

O'Connor, Gina.C., Corbett, A.C., Peters, L.S. (2018). *Beyond the Champion: Institutionalizing Innovation through People.* Page: 344 pages. Stanford University Press.

OECD, *Boosting Innovation: The Cluster Approach*, Paris, 1999, p.7

Ostrom E (1990) *Governing the Commons: The Evolution of Institutions for Collective Action* (Cambridge Univ Press, Cambridge, UK)..Google Scholar

Porter, M. E. (1990, 2008b), *Competitive Advantage of Nations*, in Porter (2008b)

Porter, M.E. (2008b) *On Competition,* Updated and Expanded Edition, Harvard Business School Press.

Reve, Torger. "*The firm as a nexus of internal and external contracts*." The Theory of the Firm: Critical Perspectives on Business and Management (1990): 310-334.

Roelandt, T., and den Hertog, P., *'Cluster Analysis and Cluster-based Policy Making in OECD Countries,* Chapter 1, p.9, in OECD, 1999, op cit, ref 1.

Schumpeter, Joseph A.; Opie, Redvers (1983) [1934]. *The theory of economic development: an inquiry into profits, capital, credit, interest, and the business cycle*. New Brunswick, New Jersey: Transaction Books. ISBN 9780878556984. Translated from the 1911 original German, Theorie der wirtschaftlichen Entwicklung.

Schumpeter, J.A., *The Theory of Economic Development*, Harvard University Press, 1934.

Slaper, Timothy (2015) *Industry Clusters and Economic Development*, Indiana Business Research Center, Indiana University Kelley School of Business Paper

Sölvell, Ö., Lindqvist, G. and Ketels, C. (20023), *The Cluster Initiative Greenbook*, Ivory Tower Publishers

Sölvell, Ö. (2009) Clusters - *Balancing Evolutionary and Constructive Forces*. Stockholm: Ivory Tower Publishers

Stoerring, D. (2007) Emergence and Growth of High Technology Clusters (Aalborg**:** Aalborg University Press, Denmark).

Tang S (1994) in *Rules, Games, & Common-Pool Resources*, eds Ostrom E, Gardner R, Walker J (Univ of Michigan Press, Ann Arbor, MI), pp 225–246..Google Scholar

Varmland Karlstad **–** Manickam, Anu and Karel van Berkel (2011) in *Clusters and how to make it work: Cluster Strategy Toolkit* extracted from **h**ttp://www.varmland.se/sites/default/files/kcfinder/

Williams, Ifor Ffowcs (2018) *Cluster Development Handbook,* Cluster Navigators, New Zealand