Cluster Lifecycle: A Case Study of the Glasgow-Edinburgh Corridor

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Abstract—**Tremendous changes in technology, political and social frameworks as well as the impacts of globalization have put pressure on countries to become competitive. One strategy for creating an engine of economic growth is the creation of clusters. These clusters, be they naturally or artificially conceived hold the promise of becoming the economic weapons of a country. This paper explores the question of cluster lifecycles. This was done through a case study of a Scottish cluster, namely, the Glasgow-Edinburgh Corridor.**

Keywords-cluste; ,lifecycle; corridor.

I. INTRODUCTION

Clusters is a concept made popular by Michael Porter through his Cluster Diamond Framework (CDF) as a management tool for creating and sustaining competitive advantage [1]. The cluster concept argues for a synergy created by geographically linked actors leading to enhanced productivity which is attractive to both firm managers and governments.

There is no single unified definition existed that can be adopted. However, it can be seen that there are groups of definitions that share similarities – spatial-based, industrial sector-based, and measured variables-based definitions. Furthermore, it can be seen that there are a number of recurring or common themes – link to performance, geographical concentration and/or proximity, cluster actors, and linkages and interrelationships – which might be suggesting towards a convergence among the experts on how clusters are being viewed [2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17 & 18].

The convergence seems to centre on the ideas that clusters are sets of actors that gravitate around a particular location i.e. geographically proximate, where knowledge intensive activities occur in a knowledge rich environment and ultimately impacts the larger economy.

II. CLUSTER LIFECYCLE

There are a number of models that have been proposed to represent the lifecycles of clusters. The Department of Trade and Industries (DTI) [19] proposed a four stages cyclical model - Embryonic Clusters, Established Clusters, Mature Clusters, and Declining Clusters. At each stage, different sets of interventions are suitable or needed. In embryonic clusters government and intermediary brokers can be important in encouraging collaboration and acting as information brokers,

a role that may not be needed at a later stage. For mature or declining clusters, it is essential to encourage openness and innovation so to prevent regional lock-in. Thus, this can promote the creation of new industries. Furthermore, certain strategic intervention is needed at every stage of the lifecycle but at different intensities and implementation method.

Williams [20] reported a project funded by the Canadian Social Sciences and Humanities Research Council (SSHRC) that examines the impact and importance of a cluster driven innovation in Canada. The study investigated how local networks of firms and supporting infrastructure of institutions, business and people in communities across Canada interact to spark economic growth. The project defines cluster lifecycle using the 'S' curve with the four stages being "Latent", "Developing", "Established" and "Transformational".

Andersson et al's [21] discussion on the process of "clustering" can help provide further insights to the lifecycle of clusters. The standard clustering process is seen as a model of four phases that ran parallel to each other once each phase is reached. The four phases are; i) create trust or in other words building social capital, ii) forming linkages (as linkages are develop, visions will also be formulated), iii) formulation of vision or strategic direction(s) – when the linkages are solidified, a collective vision and strategic aim will be forged, and iv) undertake action – actions to realise the vision and aim will be taken as well as action to strengthen the cluster (common types of actions include those for improving; technology development; start-ups formation and firm growth; networking among the actors; the market factors; cluster dynamics; etc.). There should be a constant feedback loop between the third and fourth phases as the cluster develops. However, a closer look at the clustering process of numerous clusters around the globe have led them, [21], to further define the clustering process into three categories, namely; engineered, organic and re-engineered.

To conclude, four key points can be deduced from this discussion on cluster lifecycles:

- The stage before the emergence of a cluster is important. Understanding this stage will enable us to identify the basic building blocks that made the cluster possible. Also study of this stage will highlight what spurs the creation/formation/emergence of the cluster, for example, policy actions, natural resources, etc

- The early stage of clustering is critical as recognition of the signs can help trigger policy efforts that can strengthen the process and quicken the formation of the critical mass
- If the early stages have been successful, there would be a full fledge cluster. At this stage is when the dynamics are going at full cylinders and the economic impacts start to be significant
- After passing of time, due to industry/technology/product lifecycles as well as resources nearing/reaching physical and/or natural limits, the cluster will show signs of maturity. This is a crucial point as the possibility for the next progression includes, levelling off of performance (stagnant), decline and failure, or rehashing/reinvent itself and start the cycle all over again.

III. METHODOLOGY

Case study methodology usage can be traced back to the early 1900's when it was popularly used by the University of Chicago, Department of Sociology [22]. Zonabend [23] stated that case study is done by giving special attention to completeness in observation, reconstruction, and analysis of the cases under study. Case study is done in a way that incorporates the views of the "actors" in the case under study. A case study is a research strategy used when attempting to understand complex organization problems; in essence allowing one to focus on something which is sufficiently manageable and can be understood in all its complexity [24]. Yin [25] also highlighted that the reasons for conducting case studies includes explaining linkages between causes and effects, to describe a phenomenon in its own context, to explore an issue or a question, etc. Triangulation for this study is achieved via methodological triangulation where multiple sources of data are used. This is done via the usage of several common types of case study sources of evidence as recognized by Stake [26] and Yin [25], namely; documents, archival records, interviews, direct observation, and participant observation.

IV. RESEARCH FRAMEWORK

The research framework developed for this study, is an enhancement of the various cluster lifecycle models reviewed. The model has six stages – Antecedence, Embryonic Cluster, Developing Cluster, Mature Cluster and Declining Cluster or Transformation.

- **Antecedence** is the early aspect that shows or helps to provide the impetus for clustering. It could be organic development (what was happening on the ground were showing natural tendencies for clustering) or engineered (decisions to cluster were made to derive the benefits and led through policy implementations).
- **Embryonic Cluster**, the cluster shows signs of agglomeration economies and the actors are benefiting from it as well as beginning to actively form linkages and networks.

- **Developing Cluster**, critical mass has been reached and linkages are active within the cluster as well as links with external parties are being developed.
- **Mature Cluster**, the cluster has peaked and its key denominator industry or technology has matured. Growth and performance are showing a marked slow down.
- **Declining Cluster**, the cluster has peaked and starting to experience slowdown in growth and performance. Such cluster has trouble finding new focus to generate new growth and to attract new entrants to reenergize the cluster mix. Failure to formulate new strategy means that eventually the agglomeration will disintegrate with actors finding new emerging clusters or locations providing them better economies of scale. A cluster that manages to identify ways and methods that can help it reenergize itself has a possibility of taking itself out of this stage into the "Transformation" stage.

Or,

- **Transformation** is when the mature cluster is showing signs of new growth. This could involve most of the actors or grouping around several new growth factors – new entrants to the cluster, new technology, new market segment, new methods of delivery of goods, etc. The locus for new growth could be identified through policy intervention, R&D activities (cluster-based or individual in-house investments leading to spillovers) or the impacts of major new entrants, etc. Some actors might leave but the critical mass threshold is maintained (with addition of new firms). The cluster is re-entering the early stages of its lifecycle – depending on how different the new focus is, will determine at which stage the cluster will re-enter the lifecycle.

V. CLUSTERS POLICIES IN SCOTLAND

The Scottish Development Agency (SDA) was established by the UK government in 1975. The imperatives for the agency were; i) to address the declining Scottish economy, ii) to address the rising unemployment rate in Scotland, iii) to address fragmented development initiatives, and iv) to address the growing sense of dissatisfaction with the issues of North Sea oil revenue. Part of their strategy, the SDA identified a number of focus industrial sectors; electronics, health-care, offshore engineering and advanced engineering. In 1991, SDA were given the additional role of Scotland's training agency and renamed the Scottish Enterprise (SE). A year before, in 1990, Porter's book "The Competitive Advantage of Nations" came out. SE must have taken note of it because they later implemented the cluster approach for economic development policies in Scotland. The same was also noted by [27] (p. 1); "The research of Harvard's Michael Porter on the importance of clusters to economic development has proved of value to policymakers, not least in Scotland, because it purports to offer more specific operational insights into the growth process." According to [28] the selection of the cluster concept were due to; i) the agency identify it as useful for economic development, ii) the alignment with existing policies, and iii)

promise for better policy framework to enhance Scotland's competitiveness. In 1993 SE commissioned a study on the Scottish economy using Porter's cluster framework and resulted in the identification of 30 clusters. In the next three years SE went through a change process in order to be in line with the cluster approach. In 1996 SE's board approved the cluster based development policies and identified 4 priority clusters in 1997; semiconductors, energy, food and biotechnology. The policies were characterised by a focus on stimulating engagement with key external partners, stakeholders, and stronger industry leadership in the development process. The plan was accompanied by a GBP 25 million allocation for incentives. In 1999, another set of clusters were announced, namely, opto-electronics, forest products, tourism and creative industries. In SE the Cluster Development Directorate was established to oversee the initiatives [28 & 29].

Next, in 2002 the "Smart, Successful Scotland" (SSS) initiative was implemented with a focus on promotion of enterprise. The programme concentrated on business growth and entrepreneur skills development. This was later reviewed and updated in 2004 with the addition of the three main themes; i) growing businesses, ii) learning and skills, and ii) global connections. Then in 2006, the "Enterprise Strategy for Scotland" was added to the SSS initiative where partnership and spatial dimensions were the main focus. The partnership aspect included the investment strategy implemented to realise the desired economic development. The "Investment Alliance" concept outlined the strategy for delivering economic development via partnership where majority investment would come from the private sectors. SE on the other hand will also invest to catalyse the development process but decision was made for the investment to not exceed 5% of the total investment. SE also unveiled two more initiatives; i) Metro regions – where programmes were designed around major cities in order to achieve scale economies and cascade the benefits to the wider regions, and ii) Priority industries – industrial sectors were identified and categorised into either "National" and "Regional" priorities. The national priority sectors were defined as those identified with significant growth potential, strength, and potential to develop local major players. These industries were tourism, food and drink, financial services, life sciences, energy and electronics market. Then, the regional priorities sectors were textiles, aerospace, Shipbuilding and marine, chemicals, construction, and forest industries. It was also recognized that both of the priority areas benefit from the enabling advanced engineering and technologies sectors.

It was also learned through the interview with representative of SE, that the industry focus of SE and the lists of both national as well as regional priorities sectors/cluster were all relatively similar as in 2006 with a number of changes. The terms "National Priority" and "Regional Priority" were replaced with "Key Sector" and "Other Growth Industries" respectively. The "Electronics Markets" sector was replaced by "Creative Industries – Digital Markets", the "Aerospace" and "Shipbuilding and

Marine" sectors were combined into one category – "Aerospace, Defence and Marine".

Scotland's cluster policies targeted specific industrial sectors [28 & 29]. According to [30] (p.4) the cluster approach in Scotland "target industries and seed technologies designated, universities, science parks, incubators, public agencies encouraged to join and link together, and partnership and project development strongly promoted." According to [31] Scotland's cluster policies can be summarised into the following four categories; i) Broker Policies, ii) Demand Side Policies, iii) Training Policies, and iv) Measures for special promotion of international linkages.

VI. THE GLASGOW- EDINBURGH CORRIDOR (GEC)

This case study focuses on the Glasgow – Edinburgh corridor, which includes the local authority areas of West Lothian, North Lanarkshire, Falkirk, East Dunbartonshire, City of Edinburgh and City of Glasgow. The area is where most of Scotland's 5.2 million population is concentrated. The population concentration means that the area is also the hub for most of the industrial, commercial, financial and administrative activities in Scotland. Between 2004 and 2006, the six regions included in the corridor had 35% of Scotland's population and 36% of the working age population. The area contributed 45% of Scotland's GDP and 32% of the manufacturing GVA. The area was home to 29% of the registered businesses in Scotland where both Glasgow and Edinburgh each had 10% of the total number for the year. The area had an average of GBP 417.3 median gross weekly earnings, which was more than the Scotland's figure by GBP 5.6. The two main cities Glasgow and Edinburgh are located here. Glasgow is Scotland's largest city and Edinburgh is the capital. According to [32], for the year 2006, the two cities contributed 31% of Scotland's total GVA, combined export sales was GBP 4.8 billion – 23% of Scotland's total, had increased productivity levels by 19% which was 4% more than the UK figure. Seven out of the fourteen universities in Scotland are located in the Glasgow – Edinburgh corridor and a further six are located within or around the Central Belt area. This suggests that the area had a larger share of high paying jobs, suggesting a high concentration of knowledge workers and clustering. Finally, indication of the clustering can also be seen from the concentration of businesses within the corridor.

VII. THE GEC LIFECYCLE

The central belt of Scotland has been an area of industrial focus (iron manufacturing industry, engineering products, steel making and shipbuilding) since the 1800s. One of the main factors was the supply of raw materials – iron and coal. By 1889 Scotland-made ships were being exported across the globe. The shipyards and shipbuilding industry faced decline by the late 1950s due to the emergence of shipbuilding sectors in places like Korea and Japan. By the year 1972, there were only two active yards left [33].

As the traditional heavy industries were experiencing decline in 1950s a number of companies – Ferranti, NCR, Honeyman, Burroughs and IBM, were setting up operations in the area. By 1980s there was a significant concentration of

semiconductor chip design and manufacturing companies in the region (most significantly in the Glasgow – Edinburgh corridor that it was nicknamed the Silicon Glen. "At its manufacturing peak in the 1980s Silicon Glen produced about 30 percent of Europe's PCs, 80 percent of its workstations and 65 percent of its ATMs (automated teller machines)" [34]. The Silicon Glen was a result of aggressive marketing of Scotland (as a destination for foreign high-tech investment) by the government. The factors used to attract the companies were low business costs, spare local industrial capacity, and financial incentives. Motorola received more than GBP 50 million via the regional selective assistance programme, NEC received an incentive of GBP 13 million, and Chunghwa Picture Tubes received GBP 15 million [33, 35 &36]. The focus was; l) attracting the big players such as NEC, Motorola, IBM, etc, ll) setting up of manufacturing and assembly facilities which were seen as generators of job opportunities, lll) the facilities as branch plants for the global companies. The UK in general and thus Scotland had always been high cost country, so the cost advantage factor had a significant flaw. This was seen as early as in 1993 when Conner Peripherals, Timex and GEC Marconi took actions towards moving away from Scotland. In 2001 Motorola closed its Bathgate factory. In 2002 Hewlett-Packard downsized its workforce. Also, Chunghwa Picture Tubes closed its plant in Mossend and took their operations to China. Inventec Servers took their operations to the Czech Republic and Lexmark chose Mexico and the Phillippines. The Silicon Glen was reported to have shrunk around 70% between 1998 and 2006. However, it was not all bleak; the Silicon Glen brought major players to Scotland and established the ICT sector. This, in effect, created pools of skilled local workforce, creations of local firms which initially was part of the MNCs local supply chain. Examples of the local high-tech firms included Wolfson Microelectronics and Semefab. It was noted that the original Silicon Glen had disappeared and replaced by a new one that was higher on the value chain, no longer manufacturing centric but higher value R&D and innovation [33, 35 & 36].

Silicon Glen from clustering point of view was a mature cluster showing clear signs of decline. However, now with the adoption of cluster oriented policies by the authorities, the corridor as a cluster had been showing of signs of being at the "Transformation" stage with the emergence of a number of key sectors - software development, nanotechnology, green energy, biotechnology, life sciences and creative industries.

The transformation continued and affected from the initiative launched in 2009, namely the Glasgow Edinburgh Collaboration Initiative (GECI). The initiative was a collaborative project between the councils of the two cities and Scottish Enterprise. GECI was initiated due to the belief that major cities can make a significant impact on the country's growth and performance: combined cities are better able to provide needed critical mass and scale. Furthermore, the combined factors position the corridor as a more attractive investment destination. The collaboration may improve efficiency of the region as duplication of resources and efforts can be reduced. This actually can be linked back to SE's Metro Regions policies. GECI's focus was on; i) improving connectivity between the two cities (both physical and ICT) – part of the GBP 1 billion Edinburgh-Glasgow Improvement Programme (EGIP), ii) industry collaboration in key sectors, iii) improving the two cities international profile and attract investment, talent and commerce, and iv) lobbying for national investments to further develop the cities.

Collaboration was also evident in the governance of the initiative, the three organizations seconded staff for the management of the project. Furthermore, in the governance structure there are "Task Groups" and "Reference Groups" comprised of representatives from the three organisations as well as from key stakeholders – community, government, industries, etc. The programmes implemented as part of GECI include; i) building of a high speed rail link between Glasgow and Edinburgh (35 minutes journey time) as well as London, ii) wireless and mobile network on the high speed rail link, (The rail link was identified as crucial because it was believed that this would enable the important face-to-face contact for the businesses in the corridor.) iii) GECI organised entrepreneur development programmes such as the "Innovation EG" programme, iv) GECI commissioned studies to help improve the stature of the cities globally such as the study used to help win Glasgow's UNESCO City of Music status[1]. The aim of GECI was to help raise the Scottish economic growth rate to the UK level by 2011. Thus, arguably GECI will affect further transformation of the cluster.

VIII. CONCLUSION

The GEC was showing signs of transformation from the Silicon Glen legacy with growth areas including software development, nanotechnology, green energy, biotechnology, life sciences and creative industries. GEC's success and evolution provide both best practice insights as well as cautionary lessons for clusters managers to learn. The study also showed that clusters are dynamic entities that evolve and change. Thus, it is important to match interventions with the lifecycle stage a cluster is at.

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