2010 International Conference on E-business, Management and Economics
IPEDR vol.3 (2011) © (2011) IACSIT Press, Hong Kong

Universities as Key Actors for Cluster Development: 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. Many studies have been done to understand the factors behind the success and failures of clusters. Often having the set of actors was identified as being one of key factor, where emphasis was given on the business and government actors. This paper explores the roles of universities as key actors for cluster development. This was done through a case study of a Scottish cluster, namely, the Glasgow-Edinburgh Corridor.**

Keywords-cluster, universities, 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. 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. The CDF provided a simple and yet seemingly comprehensive method to monitor and manage the various dynamics of a cluster. Porter [26] pointed out that contrary to global development trend of globalisation; location is becoming more important especially in organisation's efforts to secure competitive advantage. Porter here can be seen as echoing Marshall's [24] discussion on "the concentration of specialized industries in particular localities." Economic geographers like Scott [30]; Amin and Thrift [3]; Harrison [15]; Harrison, Kelly and Grant [16]; Markusen [23]; and Asheim [5] also discuss the subject. They came up with concepts such as Local Industrial Specialisation, Spatial Economic Agglomeration, and Regional Development to discuss the trend. Furthermore, numerous terminologies have been suggested to define the concept – "Industrial Districts", "New Industrial Spaces", "Territorial Production Complexes", "Neo-Marshallian Nodes", "Regional Innovation Milieux", "Network Regions", and "Learning Regions." However, these concepts were received with less wide spread acceptance and application than when compared with those offered by the business managers.

The most popular concept to date is the "Cluster" concept proposed by Porter [26]. He defined cluster as "..geographic concentrations of interconnected companies, specialised suppliers, service providers, firms in related industries, and associated institutions (for example, universities, standards agencies, and trade associations) in particular fields that compete but also co-operate" and "a form of network that occurs within a geographic location, in which the proximity of firms and institutions ensures certain forms of commonality and increases the frequency and impact of interactions."

Rosenfeld [29] highlighted the importance of the ability to produce synergy by and among the organizations. Feser [14] suggested that what define a cluster are not only the firms but also the "supporting institutions". Roelandt and den Hertog [28] described cluster as a value-adding production chain. Simmie and Sennett [32] proposed that clusters could better be analysed by looking at the supply chains. Enright [9] defines clusters based on proximity between the organizations. To sum it up, according to Van der Berg, Braun and van Winden [35] - "The popular term cluster is most closely related to this local or regional dimension of networks … Most definitions share the notion of clusters as localised networks of specialised organisations, whose production processes are closely linked through the exchange of goods, services and/or knowledge."

The number of definitions reviewed clearly demonstrated that 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, 6, 7, 8, 9, 10, 11, 12, 13, 14, 22, 26, 27, 28, 29, 32 & 35]. The convergence seems to centre on the ideas that clusters are sets of actors that gravitate around particular location i.e. geographically proximate, where knowledge intensive activities occur in a knowledge rich environment and ultimately impacts the

larger economy. Ab. Aziz and Norhashim [1] proposed a holistic framework designed to understand key cluster dynamics that drives cluster performance which then will enable policymakers to work towards ensuring sustainable cluster development. The holistic framework was used as the cluster analysis framework for this study.

II. 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 [34]. Zonabend [37] 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 [25]. Yin [36] 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 [33] and Yin [36], namely; documents, archival records, interviews, direct observation, and participant observation.

III. THE GLASGOW- EDINBURGH CORRIDOR (GEC)

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 [18].

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)." [19]. 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 [4, 18 & 21]. 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 [4, 18 & 21].

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 [31], 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 number of businesses within the corridor, as in Table I.

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 transformation with the emergence of a number of key sectors. Glasgow – Edinburgh corridor is showing signs of transformation from the Silicon Glen legacy with growth areas including software development, nanotechnology, green energy, biotechnology, life sciences and creative industries.

IV. Universities and The GEC

Scotland's universities in general had been recognised for their excellence. There are 14 Scottish universities, some of which are amongst the oldest in the world. The following universities are located within the corridor; University of Glasgow, University of Edinburgh, Strathclyde University, Glasgow Caledonian University, Edinburgh Napier University, Queen Margaret University and Heriot-Watt University. Two of the corridor's universities, (University of Edinburgh (23rd) and University of Glasgow (83rd)) were ranked among the top one hundred universities in the world [20]. The other five universities also consistently performed well; Heriot-Watt University was ranked 22nd among UK universities [17]. Table II shows the number of students enrolled in the universities surveyed between the years 1999 to 2009. Most of the universities, showed increasing trend in student enrolment. More importantly, the universities consistently represent more than 50% of the enrolled students in the Scottish universities.

A. Knowledge and Innovation Hubs

The universities' strengths not only attract students but also industry wanting to access the knowledge base, talent pools, technologies and innovations from the universities. Research awards secured by the two top universities from industry between the years 2004 to 2009 is illustrated by Table III. The University of Edinburgh's centre for research and innovation – Edinburgh Research and Innovation (ERI) celebrated its 40th anniversary in 2009 (the university itself was founded in 1583). Over the 40 years ERI and the researchers of University of Edinburgh, have produced a number of innovations. Table IV further illustrates University of Edinburgh innovativeness. Another major university in corridor is the University of Glasgow (founded in 1451). Table V highlights the university's innovation between the years 2004 – 2009.

B. Business Creation

Universities not only act as sources of knowledge, talent, technologies and innovations, but also as centres for business creation. University of Edinburgh reported that it had produced nearly 200 companies between the years 1969 to 2009. The same was also seen from the University of Glasgow as illustrated by Table V.

C. Networking

Networking is a key driver for cluster development and universities in the cluster were found to be actively involved in various networks. Examples are:

- Connect Scotland, designed to generate academia – industry links by facilitating flow of information between academia and the industries.
- The network of seven science and technology parks in Edinburgh – the Edinburgh Science Triangle (EST)[1]. EST was established by SE in 2004 with the aim to capitalise on the collective resources, capabilities and capacities of the seven parks.
- The online platform designed to bring forth Scottish universities innovations; www.university-technology.com. The site served as a showcase for technological innovations from Scottish universities.
- The Edinburgh – Stanford Link[2] was established in 2002, when the SE awarded University of Edinburgh GBP 6 million to develop a collaborative research and commercialisation programme with Stanford University, California.

D. Knowledge Movement

Knowledge movement is another major success factor for clusters as a healthy flow of knowledge among the actors in a cluster would lead to more innovations. Knowledge often is embodied by the workers and thus, human capital mobility within the cluster indicates the level of knowledge movement. The universities were found to be a major source for human capital mobility; for example, the move of human capital from the education sector to the industries via the creation of spin-out and start-up companies from the universities.

E. Infrastructure

The universities also provided infrastructure for R&D, business and industry. The University of Edinburgh and the City of Edinburgh Council jointly established the Edinburgh Technology Transfer Centre (ETTC), a business incubator facilities for spin-out and start-up companies emerging from the university. Furthermore, there exists a number of science and technology parks within the GEC corridor and the adjacent areas providing space for industry and facilities for R&D that are linked to the universities and their pool of researchers as well as innovations. The parks also provide spaces for the spin-out and start-up companies that come out from the universities. Main example is the seven parks that make up the Edinburgh Science Triangle (EST). An example from Glasgow is the Digital Media Quarter, Pacific Quay[3], a project by the SE to drive the digital media industry.

[1] www.edinburghsciencetriangle.com
[2] www.eslink.org
[3] www.pacificquaydmq.com

TABLE I. NUMBER OF REGISTERED ENTREPRISES IN SCOTLAND BY LOCAL AUTHORITY AREA (2005-2009) (SOURCE: SCOTTISH ENTREPRISE)

Local Authority	2005	2006	2007	2008	2009
East Dunbartonshire	2,500	2,510	2,555	2,650	2,700
Edinburgh, City of	15,400	15,360	15,570	15,975	15,870
Falkirk	3,405	3,440	3,480	3,635	3,625
Glasgow, City of	15,760	15,750	16,015	16,265	16,245
North Lanarkshire	6,265	6,370	6,545	6,790	6,745
West Lothian	4,020	4,110	4,210	4,400	4,400
Corridor Total	47,350	47,540	48,375	49,715	49,585
Scotland Total	146,890	147,490	150,745	154,635	154,370
Corridor/Scotland Total	32%	32%	32%	32%	32%

TABLE II. NUMBER OF STUDENTS IN UNIVERSITIES IN THE CORRIDOR (SOURCE: SCOTTISH ENTREPRISE)

Year	1999-00	2007-08	2008-09
Glasgow Caledonian University	14,935	16,770	18,410
Heriot-Watt University	6,610	10,065	10,430
Edinburgh Napier University	11,405	12,995	13,645
Queen Margaret University, Edinburgh	3,875	5,330	5,045
Edinburgh, The University of	22,220	23,555	24,525
Glasgow, The University of	22,745	23,735	24,240
Strathclyde, The University of	22,130	21,740	21,300
Corridor Universities Total	103,920	114,190	117,595
Scotland Total	188,845	224,855	231,260
Corridor/Scotland Total	**55%**	**51%**	**51%**

TABLE III. RESEARCH AWARDS FROM BUSINESS AND INDUSTRY (2004-2009)

Year	2004-05	2005-06	2006-07	2007-08	2008-09
University of Edinburgh	£4.5m	£8.4m	£14.2m	£8.1m	£11.2m
University of Glasgow	£8.4m	£5.1m	£11.8m	£12.0m	£12.0m

TABLE IV. UNIVERSITY OF EDINBURGH INNOVATION STATISTICS (2004-2009)

Year	2004-05	2005-06	2006-07	2007-08	2008-09
Technology disclosures	105	103	120	121	215
Patent filed	49	80	77	82	89
License agreements	33	31	66	47	38

TABLE V. UNIVERSITY OF GLASGOW INNOVATION STATISTICS (2004-2009)

Year	2004-05	2005-06	2006-07	2007-08	2008-09
Number of new patents filed	49	36	36	10	11
Total number of patents granted	60	21	6	2	2
Cumulative number of patents in force	183	405	441	221	250
Number of new licences	24	31	20	12	12
Number of new spin-out/start-up companies	7	1	9	8	10

V. CONCLUSION

Many studies have been done to understand the factors behind the success and failures of clusters. Often having the set of actors was identified as being one of key factor. Commonly, emphasis was placed on the roles of the business and government actors. This paper explores the roles of universities as key actors for the GEC cluster development. It was found that the universities played a central role in driving and sustaining the cluster; as knowledge and innovation hubs, generating new businesses, driving networking and knowledge sharing, as well as providing infrastructure for R&D, business and industry.

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