Cluster Theory and Practice: Advantages for the Small Business Locating in a Vibrant Cluster

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Abstract: This paper seeks to review the state of knowledge to this much talked-about paradigm, first made famous by Porter (1990). Clusters are a striking and common feature in today's economy. Nonetheless, this phenomenon is not exactly new and has been the object of attention from a wide variety of social scientists for much of this century. In the last ten years, this phenomenon has attracted renewed interest from academics, practitioners, and the British Government - who have become aware of its central importance in competitive strategy. An understanding of clusters adds an important dimension to the more commonly debated role of personal contact networks in the success of entrepreneurial small business.

INTRODUCTION

The marketing-entrepreneurship interface has rightly considered the role of personal contact networks to be fundamental to the successful survival and growth of the small business (see, for example: Carson et al, 2000; Chaston, 2000; Shaw, 2000; Hill and McGowan, 2001; Shaw, 2002). Equally some of these personal contact networks will be enacted within an industrial district, or to use the contemporary phrase as popularised by Porter (1990) – a cluster. There may well be substantial advantages for the new entrepreneur in setting up in an established cluster, and concomitant disadvantages in not locating in such an environment. In their role as sub contractors, small firms will find business within the cluster, whilst in their role as aggressive opportunity seekers the turbulence and dynamism in the cluster will throw up opportunities to be sought. Indeed the origin of a cluster may well be the initial location decision made by entrepreneur. In 1989, the garage on Adison Avenue, Palo Alto, in which Hewlett and Packard started their company fifty years earlier was dedicated as a historic landmark. Some would argue as does the dedication on the marker board that this was the start of 'Silicon Valley'.

Clusters are a striking and common feature in today's economy. Nonetheless, this phenomenon has been the object of attention from a wide variety of social scientists for much of the twentieth century. In the last ten years, this phenomenon has attracted renewed interest from academics and business practitioners (Saxenian, 1994; Porter, 1998: a-c; Swann, 1998; The Economist, 1999; Owen, 1999) as well as the Department of Trade and Industry in the UK (DTI White Paper, 1998). The latter seeing clusters as being of central importance in UK competitive strategy. Historically, clusters have been found in a wide variety of traditional industries (textiles in northern Italy, shipbuilding in Glasgow, steel in Pittsburgh, car manufacture in Detroit). In the British context, the clustering phenomenon was observed in the industrial revolution (cotton industry) and in earlier economies, for example, textiles in northern England and a financial cluster in the City of London

In 1998, the UK Department of Trade and Industry recognised the strategic importance of clusters in the British economy with clusters defined as a geographic *'concentration of competing, collaborating and interdependent companies and institutions which are connected by a system of market and non-market links'* (DTI, 1998:22). In November 1999, a countrywide study on U.K. business clusters was launched by the DTI and the first assessment was completed in early 2001. This has resulted in many U.K. regional development agencies seeking to identify and cultivate growth through 'high value added' embryonic clusters.

Today, with the Internet and a click of the mouse button, companies can source for goods, capital and technology globally. Technology has set a new frontier to the conventional wisdom about how companies and nations compete. With more open global market, easy access to information and faster transportation, the role of location in competition might be said to have diminished! But if location does not matter, why is today's economic map of the world is still being dominated by growing clusters of economic activities?

This paper is organised as follows: the first part comprises a general literature review of the concepts and theories on the clustering phenomenon put forth by the thinkers and practitioners in the last seventy years. This part is organised around the themes of Clusters, Innovation and Competitive Advantage (as observed by strategists from the late seventies); Clusters and Agglomeration Externalities (as observed by industrial and geographical economists since the nineteen twenties); Clusters and Linkages (mainly

concerning the views of the economists and strategists). This first part concludes by briefly reviewing the two main effects attributed to clusters – positive feedback, and, productivity and growth. The second part looks at contemporary research work and focuses on some famous clusters around the world. Finally relevant conclusions are drawn.

In this paper, clusters are defined as a geographical agglomeration of competing and related industries; and where there is evidence of improved performance such as a growth and profitability arising from the agglomeration of firms in a region.

CLUSTERS, INNOVATION & COMPETITIVE ADVANTAGE

Garelli (1997) argued that one of four forces that would dominate the competitiveness environment of any country was the 'economy of globality and proximity'. Globility assumes that production does not necessarily need to be close to the end-user. It benefits from the comparative markets worldwide, especially in operational costs. It is generally competitive and price efficient. On the other hand, the economy of proximity inherent in a cluster, provides value-added services close to the end user. With improvements in telecommunications and transportation infrastructures, the world is becoming more of a global village - where physical separation is no longer a barrier to international business relations, and multi-national corporations (MNCs) thrive on tapping international resources (such as cheaper labour, raw material and location) for added competitive advantage. However, Porter (1998c) noted that the enduring competitive advantage in a global economy lies increasingly in local things – knowledge, relationships, motivation- that distant rivals cannot match.

Competitive advantage grows out of the value a firm is able to create for its buyer and this can be diagnosed through the value chain (Porter, 1985). Innovation is seen to be central in creating a competitive advantage by perceiving or discovering new and better ways to compete in an industry and bringing them to market (Porter, 1990). Competitive advantage grows fundamentally out of improvement, innovation and change. Firms in a cluster will gain advantage over international rivals if they could find new and better means to compete with better linkages, knowledge spillovers and innovation … and this will be discussed in the subsequent sections of this paper.

Competitive advantage involves managing the entire value system, encompassing the value chains of the firm, suppliers, channels and buyers. The importance of the entire value system to competitive advantage is manifested by the prevalence of clustering (Porter, 1990). The strongest competitive advantages, observed by Porter, often emerge from clusters that are geographically localised. In his earlier works on the Competitive Advantage of Nations, Porter (1990) introduced the concept of clusters being *"groups of interconnected firms, suppliers, related industries and specialised institutions in particular fields that are present in particular locations"*. He has acknowledged that the agglomeration of firms has long been recognised in economic geography and regional science literatures. However, the phenomenon was viewed narrowly in this early publication, propelling the concept of value chain and vertical integration in clusters. His emphasis was then on sustaining the nation's competitive position where he acknowledged that cluster activities increase productivity and the innovation of products. Not much was mentioned on globalisation or international competition where the inputs are widely accessible from many locations; Reduction in transport costs now reduce the need for the firm to be located near its input and output linkages such as the suppliers and customers respectively. The connection between agglomeration economies and a sophisticated view of competition and strategy was yet to be explored in this earlier work.

Porter (1990) noted that competitive advantage is sustained only through relentless improvements to the firm's product and organisation. Geographical concentration, indeed, is important for organisational improvement and technological innovation (Baptista and Swann, 1999). Concentration and accumulation of knowledge in the cluster will attract increased human capital to the cluster and, since the information exchange tends to be more informal, the spread of knowledge outside the region becomes limited. Baptista (1996) suggested that technological innovation is the heart of the dynamic process of cluster growth, accessed by new firm entry and incumbents' growth. Arthur (1990) noted that strong clusters tend to attract more firms, and regions with strong innovative record have an advantage in achieving more innovation; they are self-fulfilling and path-dependent. Innovative activity and output are positively correlated with new firm entry and productivity growth (Swann et al, 1998)

Porter (1998c) summed up that clusters broadly affect competition and create competitive advantage in three ways:

- By increasing the productivity of companies based in the cluster;

- By driving the direction and pace of innovation, which underpins future productivity growth; and

- By stimulating the formation of new businesses, which expands and strengthens the cluster, forming a virtuous circle or positive feedback.

CLUSTERS AND AGGLOMERATION EXTERNALITIES

Alfred Marshall, in his book Principles of Economics (1890), characterised 'concentration of specialised industries in particular localities' that he termed as industrial districts. This local concentration of specialised activities exhibited external economies in the ready availability of skilled labour; the growth of supporting and ancillary trade; and the specialisation of firms in different stages and branches of production. Such external economies are dependent upon the size of the industry, region or economy. Marshall argued that once localisation and specialisation processes had got under way, it became cumulative and socialised in the locality. Although he had described the phenomenon and acknowledged industrial districts as an integral feature to industrial organisation, he did not provide any explanation on how and why it started in certain places and not others.

Externalities are generally defined as impacts, side-effects or spillovers which are usually not reflected in the costs or prices of a particular good or service, i.e. not covered by a market mechanism. In the urban economics literature, agglomeration externalities are due to any economies or cost reductions that are possible if several firms locate near to each other (Evans 1985). By being located close to one other, potential customers can reduce their searching costs and compare prices with quality. Reputation of a cluster, be it in quality or innovation, will further draw customers to the location for their custom. Silicon Valley has become an international cluster reputed for its design and innovation ability (Saxenian, 1994). Whereas Harley Street and Saville Row in London are reputed for quality medical and tailoring services respectively (Pandit et al, 2001a).

Firms may sometime cluster in particular location to take advantage of close proximity to concentrations of their customers, which may of course be other firms. This can sometimes be imposed by the customers, such as Dell Computer, who to benefit from integration in the supply chain, demand that supply sources be located within a certain distance.

Most works on clusters and industrial districts have considered agglomeration externalities as the key force behind clustering. Externalities involve a diversity of supplier, information and knowledge spillovers on market conditions and technology transfer, which are more to add onto Marshall's model. Models of dynamic externalities argue that cities or clusters grow because they allow people to interact and learn from one another, and this is promoted by physical proximity.

Other forms of externalities in the context of the clustering phenomenon considered by urban economists include: location externalities resulting from geographical agglomeration within the same industry, and urbanisation externalities arising from the agglomeration of firms in different industries. Jacobs (1969, 1984) viewed the second type of externalities from the diversity of industries in a city or region as the main factor conducive to the growth of cities. The birth of great cities like Manchester and Glasgow in the United Kingdom originates from successful agglomeration economies. Consumers prefer to shop in big cities for the simple benefit of being able to obtain almost everything from one trip to the city centre.

Conversely, the success of the London region can be explained primarily in terms of urbanisation economies of scope and scale – the co-location of financial services firms created an effective demand for factors of production in finance, qualified labour and technology (Simmie and Sennett, 1999). Specialised and experienced personnel, from the clustered industries, are readily available from within the cluster. Infrastructure

benefits - motorway accessibility, airports & rail – will not only benefit firms in their supplies and distribution but also attract personnel to work in the cluster. Around 778,000 people commute into London to work – almost a fifth of the capital's total workforce (GLA, 2002).

Other types of externalities arising from industry specialisation have its origins in traditional economic theory. Within the clustering phenomenon, Romer (1986, 1990), building on the earlier works by Marshall (1920) and Arrow (1962), concluded that MAR externalities (Marshall-Arrow-Romer) have positive influences on firms' growth as knowledge accumulated by one firm would help the technology evolve in other firms. Industries that are regionally specialised would benefit from the within-cluster transmission of knowledge and therefore should grow faster on the whole of being together.

Central to the arguments about geographical clustering is a particular type of agglomeration externalities: the knowledge spillovers. These spillovers, resulting from contact with other firms or institutions, do not simply influence technological innovation and productivity. It also has a wider range of effects like altering the financing, marketing, managerial and organisational practices of the beneficiaries; and by affecting firm growth and changing the nature of market structure (Baptista, 1996). Knowledge spillovers arise from everyday contact, networking through geographical proximity, as well as from formal arrangements such as joint-ventures and joint research work with Universities. In short, spillovers are a broader concept than traditional agglomeration externalities, particularly because a spillover like that of information and knowledge is not necessarily spatially bound in the present globalisation context.

CLUSTERS AND LINKAGES

Porter (1998c) has similarly suggested that a cluster's boundaries are defined by the linkages and complementaries across industries and institutions that are most important to competition. Clusters may span across state or national borders although most would be contained within political boundaries. Porter (1998c) cites examples of *"a pharmaceutical cluster straddles through New Jersey and Pennsylvania in the US. Similarly, a chemical cluster in Germany crosses over into the German-speaking part of Switzerland"*. They rarely conform to standard industrial classification systems, which fail to capture many important players and relationships in competition and partnership as seen from above. Porter (1998c) has described clusters as a kind of new spatial organisation form in

between that of "arm's length markets" and "vertical integration" systems. Clusters encompass an array of linked industries and other entities important to competition. Besides the array of specialised supplier of components and machinery, the cluster also extends downstream to channels, customers and laterally to manufacturers of complementary products and other industries related via similar skills, technologies and inputs. Porter (1998c) describes the California's wine cluster … thus:

"The California wine cluster is a good example. It includes 680 commercial wineries as well as several thousand independent wine grape growers. (See the exhibit "Anatomy of the California Wine Cluster.") 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 enology 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."

Oakey (1985) had earlier emphasised the importance of input and output linkages in defining the boundaries of a cluster and the agglomeration advantage. In his study on the clustering phenomenon in Silicon Valley, he concluded that input and output linkages for the high technology cluster are relatively of high value and as such the transportation cost to customers (output linkage) are a small proportion of the total price to customer. Thus the linkage of local origins (where it is an important consideration in the past) is less significant in today's context. Finally, many clusters also include linkages to governmental and other institution – such as universities, think tanks, standards setting agencies, vocational training and trade association- that provide the essential training, education, information research, legal advice and technical support to the cluster.

CLUSTERS AND POSITIVE FEEDBACK

Positive feedback is seen to be playing a central role in clusters (Baptista and Swann, 1999; Beaudry *et al.*, 1998; Swann *et al.*, 1998; Swann and Prevezer, 1996). Agglomeration or external economies result in demand and supply conditions that are better in a cluster than in isolation and so promote the growth of incumbent firms and attract the entry of new firms. This growth and entry increases the intensity of agglomeration and so promotes further growth and entry which begins to accelerate once a cluster has reached a critical mass (Pandit *et al.*, 2001a). Porter (1998c) also acknowledged that the positive feedback loop within a cluster and that the

formation of new businesses amplifies the benefits of clustering. Other extraneous effects from this positive feedback include a higher rate of productivity growth (Henderson, 1986), more prolific innovation (Baptista and Swann, 1999) and significant information and knowledge spillovers (Oakey, 1985). However, the feedback will not remain positive indefinitely. Beyond some saturation point, congestion and competition might slowdown individual firms' growth and entry, and eventually possibly contributing to the decline of the cluster. This is suggested by Porter and is consistent with the argument on a cluster life cycle theory advanced by Swann et al. (1998).

In addition to the externalities associated with cluster strength, the dynamism of a cluster will be influenced by a number of regional fixed effects or attributes. These fixed effects are attributes, which influence the attractiveness of a cluster, but are not themselves changed as the cluster expands or contracts (Swann et al, 1998). A country could be competitive in numerous attributes that are important to businesses, such as the presence of a strong government, stable financial institutions and good transport infrastructure. However, only the right fixed effects or attributes can create a form of synergy or strategic fit between the cluster and region (Kuah, 1998); and this can further intensifies the dynamic feedback mechanism. The strategic fit model (see Exhibit Two), together with the positive feedback model, can serve to explain why certain countries/ regions can possess most of the competitive attributes but still could not catalyst the growth of a desired cluster.

CLUSTERS, PRODUCTIVITY AND GROWTH

If the positive feedback mechanism is said to enhance the cluster growth and attract new firm entry; the reverse is said to be true as well. Porter (1998c) pointed out that rapid firm growth and new firm entry are two signals of a successful cluster. The recent econometric work carried out by Baptista and Swann, 1999; Beaudry et al., 1998; Cook et al., 1999; Pandit et al., 2001: a-b, 1999; Swann et al., 1998; Swann and Prevezer, 1996 further supported this. These works investigated into the rate of growth of the firm as a function of the strength of the cluster in which it is located and whether strong clusters attract a disproportionate number of new start-up firms.

Swann's (1998) positive feedback model aptly sums up how the clustering phenomenon, felt through the entry of new firms and the growth of

incumbent firms, leads to a positive feedback loop, which will induce further growth within the cluster. The main findings being:

- Firms in clusters grow faster than average (if clustered with others in their own sub-sector of the industry);
- Clusters attract a disproportionate amount of new entry (but a cluster strong in sub-sector X will typically attract entry into another sub-sector Y – not into X itself);
- Firms in clusters are more innovative (whether we measure this by patent counts or innovation counts);
- Firms in clusters that are strong in sub-sectors other than the firm's own do not grow faster - and might sometimes grow slower. The same ambivalence applies to the propensity of firms in clusters to introduce innovations; and,
- In biotechnology, the strength of the science base in a cluster had a strong positive effect on new firm formation and growth of firms in that cluster.

Exhibit Two:
Strategic Fit Model
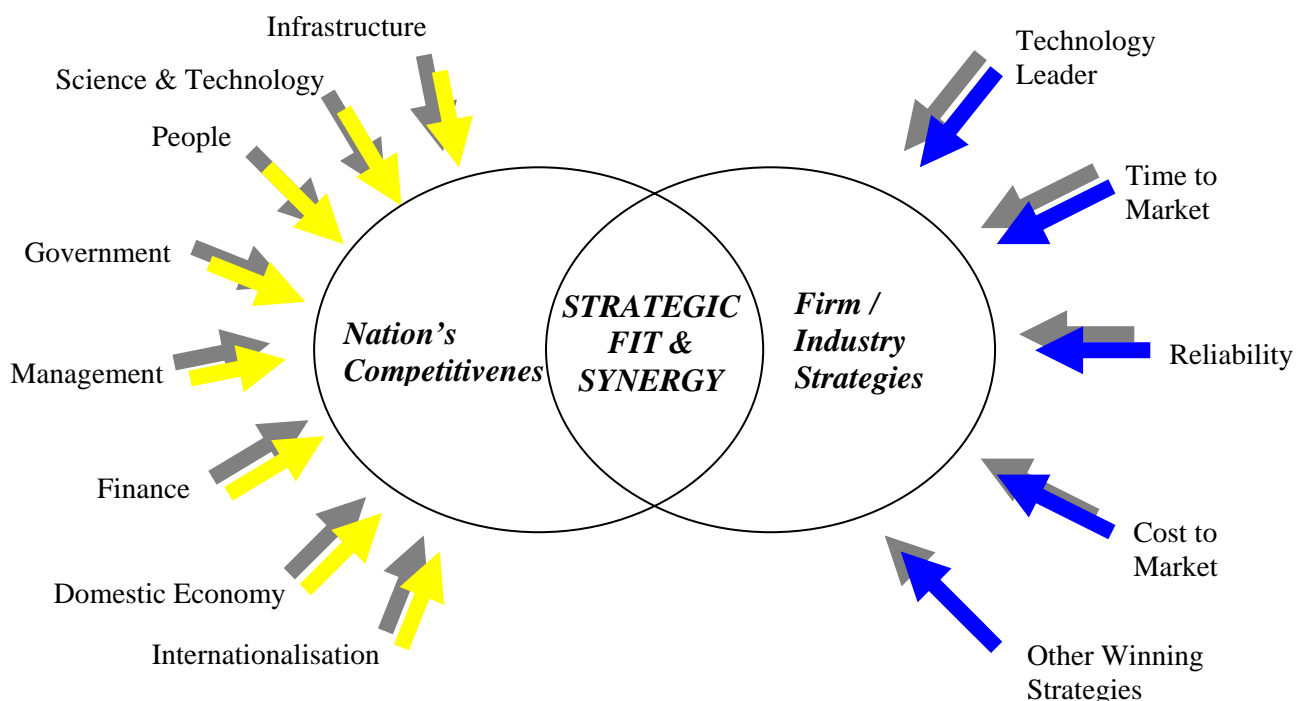
Source: Kuah, 1998, p.61, with slight modifications

Earlier work within the urban economics field, Henderson (1986) found strong evidence that industry location raises factor productivity. Being part of a cluster allows companies to productively source for inputs; access information, technology and institutions; and coordinate with other firms both horizontally and vertically. Agglomeration is said to raise local endogenous innovation and productivity growth as it allows firm to benefit from forms of market and non-market spillovers (Martin and Sunley, 1998).

Porter (1990) suggested that a nation's most globally competitive industries are also likely to be 'geographically clustered' within the nation; and the interaction between four sets of factors constitute a competitive diamond, namely firm strategy, structure and rivalry; factor conditions; demand conditions; and related and supporting industries. The more developed and intense these interactions, the greater the productivity of the firms concerned. Martin and Sunley (2002) asserted that the competitive diamond is the driving force making for cluster development, and simultaneously the cluster is the spatial manifestation of the competitive diamond.

Companies in vibrant clusters can tap into an existing pool of specialised and experienced capital resources, thereby lowering their search costs and time wasted on the learning curve (Porter, 1998c). On the other hand, vibrant clusters like Silicon Valley are able to attract specialists to the cluster, who felt that they actually work for the cluster (via job hopping and cross sharing of resources) rather than for one firm alone (Saxenian, 1994). Clustering makes it earlier to benchmark against other players in the same industry; to measure and compare performances because local rivals share general circumstances. Companies within clusters have intimate knowledge of their suppliers' costs and managers are able to compare costs and employees' performance with other local firms - this is also a result of close working relationship with each other.

In Saxenian's (1994) study of Silicon Valley, cooperation amongst the firms took many forms – from cross-licensing and second sourcing arrangements to technology and patents agreements and joint-ventures. The presence of two universities on the West Coast (University of California Berkeley and Stanford) not only supplied the much-needed engineers, expert resources and joint research opportunities, but also tailored-made programmes for the industries, all these enhancing their productivity.

Proximity improves communications and relationships with the suppliers as well. It could induce instantaneous support from the supplier to the incumbent firm like debugging and installation even on short notices during night breakdowns. Saxenian (1994) noted that joint developments with the suppliers were common during the start-up phase of Silicon Valley. Porter (1998c) also observed that a well-developed cluster provides an efficient means of obtaining important input linkages such as a deep and specialised supplier base located within the proximity. Oakey (1985) noted that electronics suppliers, within such proximity, would lie within a 50-km radius encircling the firm, whilst May et al (2001) noted in the Hi-Fidelity cluster in U.K. suggested a 50-mile range for this proximity. The importance of input and output linkages in agglomeration could not be overemphasised in defining the effects and advantages of the clustering phenomenon.

CLUSTERS IN ACTION

In the 1970s, Northern California's Silicon Valley and Boston's Route 128 attracted international acclaim as the world's leading centres of innovation in electronics. They had common origins in university-based research and post-war military spending, as such, Silicon Valley and Route 128 quickly came to be viewed as industrial counterparts. A science-based support and the linkage to the proximity to governmental procurement activities were common to both areas (Oakey, 1985); and have been conducive to the growth of these clusters.

The enchantment waned during the early 1980s, when the leading producers in both regions experienced crises of their own. Silicon Valley chipmakers relinquished the market for semiconductors memory to the Japanese competitors who were very good "copiers" and managed to reproduce the similar technologies with a substantial price differences. Route 128 minicomputer companies, at the same time, saw a shift in interest from the minicomputer to the personal computers and workstations; and IBM look-alikes proliferated the market from the mid-eighties. Both regions were facing their worst downturn (Saxenian, 1994) coupled with the global recession in the mid-eighties. In the post-1980s, however, there were dramatic successful new start-ups and the revitalisation of existing firms in Silicon Valley. This has continued and Silicon Valley is now home to one-third of the 100 largest technology firms created in the United States since 1965.

Silicon Valley has quite a different culture, organisational form and linkages amongst the firms in the cluster compared to Route 128. Being smaller firms with close working relationships, yet being mutually exclusive in business decisions; the firms in Silicon Valley are quick to react to changing business needs yet they are able to tap on mutual resources and successful business ideas. This has led to their superior flexibility and resilience to recover quickly after the downturn. Silicon Valley has a regional network based industrial system, comprising small firms that collaborate and promote collective learning. The region's dense social networks and open labour markets encouraged experimentation and entrepreneurship.

Most of the early pioneers and self-starters have developed their experiences from a common parent company and bonding was strong (Saxenian, 1994). There has been plentiful informal communication and collaborative practices amongst the players upstream and downstream in the linkages, as well as amongst those in related technologies (even amongst the competitors).

Route 128, in contrast, has been dominated by a small number of integrated corporations that internalised a whole range of productive activities. Practices of secrecy and corporate loyalty govern the relationship between firms and their customers, suppliers and competitors. Although initially most firms were small, they have emulated the corporate hierarchies common in the US, which reinforced a centralised authority and a vertical flow of information. Network systems, such as that found in Silicon Valley, flourished in regional agglomerations where repeated interaction builds shared identities and mutual trust.

Swann's (1998) study of 650 firms in the US computing industries indicated that over a half of computer firms in the US are located mainly in three states (California, Massachusetts and New York). While some new clusters may be forming and playing an increasingly important role, the earliest clusters like Silicon Valley (California) and Route 128 (Massachusetts) still dominate today's economic map.

Across the Atlantic in the UK, the British financial services cluster date back at least to the late seventeenth century when, in the City of London, goldsmith-bankers began to provide monarchs and merchants with the money they needed to fund their ventures around the world. These merchants became Britain's first bankers. Over time, the services offered by

such businesses increased in volume and scope until by the 1890s there were some one-hundred British private banking businesses offering a range of financial services. With the liberalisation of the UK Financial Services and Building Societies Acts of 1986, the range of activities in which financial institutions could engage radically innovated, leading to greater competition and the increasing internationalisation of financial markets (Pandit *et al.*, 2001a). In most countries financial services cluster together with merchant and investment banks almost exclusively based in financial centres like New York and Frankfurt. The global financial industry has grown rapidly over the past fifteen years but has grown fastest in Britain (Davis, 1996). Today, there are about 2500 financial institutions and intermediaries located in Central London.

Pandit et al.(2001) found significant and positive clustering effects in the British financial services industry. Companies co-located with others in the same sub-sector show a strong tendency to grow faster than average. The regional fixed effects on growth in financial services appear to be weaker in the traditional cluster of London suggesting the cluster is reaching saturation because of high congestion costs.

Oakey (1985) has observed the clustering phenomenon of high-technology industries in Silicon Glen (Scotland) and South East England. Two regional areas in the South East - Cambridgeshire-Hertfordshire and Berkshire - have become major technology-oriented complexes. The Cambridge region has seen the boom of small and medium research-oriented firms since the sixties, with nearly one firm per month added to the stock over the subsequent twenty years. (Segal Quince & Partners, 1985)

Over at the Asia Pacific Rim, Singapore has developed a bustling electronics industry since the mid seventies and today, this is one of the twin pillars in terms of growth and GDP output. Singapore's electronics industry comprises large and small original equipment manufacturers (OEMs), vendors and suppliers who manufacture a comprehensive range of final products, subassemblies, components and parts for both industrial and consumer markets. By 1994 the output in electronics manufacturing had grown to about S$49.35 billion.

The single largest sectoral contributor being the disk drive manufacturing cluster, contributing some S$10 billion and making an impact on the global market by becoming the major producer, and exporter, of 46% of the

world's disk drive output (Kuah, 1998). This does not come as a surprise as the disk drive cluster in Singapore has a strong , almost twenty years old, foundation. The US disk drive maker Computer Memory, now defunct, set up the first disk drive plant in Singapore in 1980; with Tandom and Seagate quickly following. By 1988, there were already about ten disk drive manufacturers in Singapore. Although some of the players have since become defunct and new entrants have come into the market. Currently there are about thirty disk drive manufacturers in the world today, out of which about ten of the big manufacturers produce their drives in Singapore (Kuah, 1995).

The global disk drive industry was a typical oligopoly market containing a few big and dominant players like Seagate (36%), Quantum (21%), Maxtor (11%) and Western Digital (11%) locating their plants in Singapore, with these top players all controlling about 80% of the global output. This booming cluster in Singapore for the last ten years has also resulted in the growth of numerous support industries, with the local universities working closely and setting up research centres such as the Magnetics Research Institute to complement developments of the disk drive. Kuah (1998) has suggested that there is a synergy between the cluster and Singapore, which can be explained through the strategic fit model (Exhibit Two), where the country has provided fixed and important attributes to these MNCs such as a stable infrastructure (utilities, transportation and communications); and a supportive and stable government who has provided tax incentives, skilled technologists and management capabilities.

DEFINITION REVISITED

Whilst this paper has employed a robust and defendable definition of a cluster it is worth noting some of the recent debate into the definition of clusters as it adds understanding to this complex phenomenon.

Martin and Sunley (2002) refuted the vague characterisation and concept of clusters, although a myriad of theoretical and empirical studies, as well as methodological investigations have been carried out. A source of such ambiguity is that of definition. Clusters, according to Porter (1998c), are critical masses in one place of unusual economic success in particular fields. He further defined them as 'geographic concentration of interconnected companies, specialised suppliers, service providers, firms in related industries and associated institutions in particular fields that competes but also cooperates' (Porter, 1998a:197).

Rosenfield (1997:4) has defined clusters simply as 'concentration of firms that are able to produce synergy because of their geographical proximity and interdependence' whilst Roelandt and den Hertog (1999:9) characterised clustering as networks of producers of strongly interdependent firms linked to each other in a value-adding production chain. Swann (1998:1) has defined clusters, in geographical and technological sense, as a large group of firms in related industries at a particular location. Swann has also taken the definition a little further in his empirical investigations by defining two main cluster strengths as the agglomeration sizes of similar-firms and related-firms in the region for a particular industry. Taking the number of definitions further, Feser (1998:26) said that 'economic clusters are not just related and supporting industries, but rather related and supporting institutions that are more competitive by virtue of their relationships'.

Clearly from this myriad of definitions, there are three main elements. Firstly, a cluster must consist of groups of associated and interconnected firms that are linked vertically and/or horizontally through their commonalities and complementariness in products, services, inputs, technologies or outputs activities. Secondly, clusters are physical proximate groups of interlinked companies which can encourage the formation of, and enhances value creating benefits via their interaction. Lastly, co-location itself does not imply clustering when these associated clustering benefits like innovation, productivity, growth or other superior competitiveness cannot be shown or described.

Thus the justification for the definition of clusters used in this paper, namely, that clusters are a geographical agglomeration of competing and related industries; and where there is evidence of improved performance such as a growth and profitability arising from the agglomeration of firms in a region.

CLUSTER LIFE CYCLE THEORY

Whilst one tenet of cluster theory is path dependency, the examples cited in this paper demonstrate that clusters go through stages of relative success and decline, albeit some are more robust than others. Thus this section discusses the extent to which business cycle and growth theory add to our understanding of the operation of clusters. Business cycles are advances and declines in aggregate economic activity, which cannot be defined not by any single variable, and are pervasive and persistent. Growth rate cycle

downturns are pronounced, pervasive and persistent declines in the growth rate of aggregate economic activity (Bry et al, 1971).

The economic literature distinguishes four main types of cycles: Kitchin or inventory cycles (3-5 years); Juglar or investment cycle (7-11 years); Kuznet or building cycle (15-25 years) and the long wave or Kondratieff cycle (45-60 years) named after their discoverers. Van Duijn (1983:8) relates the shorter inventory investment cycle to the concept of business cycle, as such cycles are caused by turning points in inventory investment. In the case of business cycles, the dates of the peaks and troughs in the growth rates of output, income, employment and sales... etc tend to coincide, showing the cyclical co-movement.

Growth is first seen as an S-shaped curve by French sociologist Gabriel Tarde in 1890 in his *Les lois de l'imitation* (cited in Van Duijn, 1983). Tarde described how growth in a concept or invention, once initial barriers were overcome, will spread rapidly until it became established. The growth will then taper off and might even become negative, if the original novelty is replaced by another.

Like business cycles, growth rate cycles are identified in the same way for each country. The only difference is that business cycles refer to alternating periods of expansion and contraction, while growth rate cycles refer to alternating periods of rising and declining growth rates in the industry. The S-shaped growth curve evolved in the field of marketing, where it has become known as the product life cycle, coined by Joel Dean in 1950 (cited in Van Duijn, 1983) and there are now four and five stage model found on the product life cycle. The S-shaped growth curve is also used in technology literature, where S-shaped correspond to individual technologies and succession of new technologies. Another area which the S-shaped cycle is also found contributes to theories of international trade, advanced by the Vernon school (1966, cited in Van Duijn, 1983) where Net Export versus Net Import determine the 5 phases to internationalisation. Here the implications of the product life cycle are explored with respect to the national and international development of industries and firms.

Kuznet (1930) has observed that long-term national economic development is characterised by a succession of leading industries. An industry rapid growth during one point in time, would not continue indefinitely and would eventually slacken in pace and finally overtaken by another industry. Is

there then a life cycle in cluster, that is, is there a critical mass where incumbents no longer enjoy the benefits of clustering in a regional or national context, and starts to depart? Pouder and St John (1996) suggest that economies of agglomeration, that initially draws firms together into clusters, could eventually erode. Martin and Sunley (2002) believe that this is perhaps the first documented theory of life cycle in clusters where cluster formation, growth and decline are set against the background of industry life cycle.

The competitiveness of firms in clusters, through their synergies, innovation and strategies tend to converge with firms that are not clustered, over time. This may be due to clustered firms' restricted collective behaviour as they define their own field of competition from within, resulting in competitive blind spots which limit their innovation, strategic positioning to the extent of reducing their ability to react to industry-wide shock like governmental policy changes. Non-clustered firms, on the other hand, tend to be less constrained and more adaptable to sudden industry-wide changes.

The clustering network of interdependence firms, is a source of competitive advantage in the early phases of cluster formation and growth, are hypothesized to create inertia and inflexibility for the firms in the cluster by Pouder and St John (1996).

Porter (2000) recognizes that participation in an established cluster may not always help a firm adapt to new circumstances. When a cluster shares a uniform approach to competing, a sort of groupthink often reinforces old behaviours, suppresses new ideas, and creates rigidities that prevent adoption of improvements. Clusters also might not support truly radical innovation, which tends to invalidate the existing pools of talent, information, suppliers, and infrastructure. In these circumstances, a cluster participant….might suffer from greater barriers to perceiving the need to change…. (Porter 2000:24, emphasis added.)

Swann and Prevezer (1998) suggest that clusters have a life cycle, related to the life cycle of the technologies developed. This meant that the "growth and entry of new firms depended not only on the life cycle of technologies, but also on the life cycle of the cluster". Each industry contain several technologies, if new technology is introduced and the old become obsolete, there will be major changes in the industry. If the new technology for some reason is excluded from the cluster, it could have major implications for the

cluster's competitiveness. The level of technology relates directly to the health of the hi-tech cluster in that the cluster with diversified technology survive better than the single technology cluster.

Swann et al (1998) describes three stages of a cluster's life cycle. Critical mass or take off stage where the number of new entries starts increasing and the cluster grows in size. The growth plateaus at peak entry stage; and more or less stop growing at saturation stage. The level of entries is linked to the change in technology and also congestion on either the demand or supply side causes the cluster to mature.

CONCLUSION

While the phenomenon of clusters in one form or another has been recognised and explored in a wide range of literature, Porter, Swann and others have only recently provided some valuable insights on how clusters enhance the value chain and promote innovation. Clusters, being critical masses of unusual competitive success in particular business areas are a striking feature of virtually every regional, state and metropolitan economy, especially in the economically advanced nations like the UK or US. The presence of clusters suggests that much of competitive advantage lies outside a given company or even outside its industry, residing instead in the locations of its business units in the form of externalities and linkages reveals that gaps exist in location and cluster theory!

In management literature, attention to geography or location has been minimal. If treated at all, consideration of location has often been reduced to assessment in cultural and other differences in the international business environment. The narrow preoccupation with globalisation, sadly, has created a tendency to regard location as of diminishing importance. However, this paper has suggested that relationships and linkages are still vital in managing the value chain and competitive success.

The possibility of a positive feedback in enhancing the clustering mechanism has been suggested in numerous literatures; but Swann's (1998) model has advanced the concept and aptly sums up how the clustering phenomenon, felt through the entry of new firms and the growth of incumbent firms, would lead to a positive feedback loop and induce growth and other extraneous effects to the clustering phenomenon.

Cluster theory bridges network theory and competition as suggested by Porter (1998c). A cluster is also a form of network that occurs within a geographical location, where the proximity of firms and institutions ensures certain commonality, increases the impact and frequency of communications and interactions. Well functioning clusters, like Silicon Valley, move beyond hierarchical networks to establish a "fluidity" in connection to becoming more effective and productive - adding a relatively new and undefined facet to the cluster theory - on *who* needs to be in the network, *for what* relationships, and *why* - an interesting area to explore further.

Finally, all of these conclusions have implications for the small entrepreneurial business and the marketing entrepreneurship interface. The latter traditionally has shown a research strength in the understanding of the immense value of personal contact networks whilst this paper has discussed the contextual landscape in which many of these personal contact networks will be enacted.

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