THE PATH DEPENDENCE OF MULTIMEDIA: EXPLAINING TORONTO'S CLUSTER

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The international literature on multimedia (aka new media) reveals a high degree of similarity in the way the industry is geographically localized at the metropolitan level of national urban systems. Furthermore, discussion of the places where multimedia concentrations have emerged suggests that this industry is closely identified with small firms that are the creative users of new software and hardware platforms that are themselves usually generic, globally available technology. These small, innovative multimedia producers have created locationally identifiable clusters that rely on a variety of clients that are largely drawn from the ranks of the major corporations and with whom they maintain face-to-face relationships.

This seemingly mismatched arrangement works because enterprising small firms back-up their relationships with corporate clients using networked production connections forged with other firms. While some of these involve collaborative initiatives, there are a number of other features common to multimedia concentrations, including the project-based organization of production and a reliance on freelance creative workers and consultants. Despite these similarities, however, there are differences between the client bases, product mix, institutional context and policy and planning regimes of the industry in places such as San Francisco and Toronto, that impinge on the ability of small firms to weather the turbulence of the 'new economy'.

By focusing on these differences, rather than superficial similarities, we can possibly understand how clusters evolve. The focus of this paper is on the process whereby we can understand how the contemporary structure, strengths and frailties of the Toronto multimedia cluster reflect an industrial and institutional experience, which contains elements of market processes and threads of distinctive policy initiatives and programs. In other words, Toronto's industry is examined in terms of its origins in the local industrial and institutional context, which itself is shaped by the city's position in the Canadian urban system and its cultural development and economic diversity.

Path dependence and its origin?

In the literature on industrial clusters, path dependence is the concept that injects the historical dimension into this strongly spatial field of economic inquiry (see for example Wolfe 2002; Wolfe and Gertler 2003). Its intellectual origins are found in evolutionary economics where a core idea is that the development of technologies can be traced along pathways of refinement and application that represent their industrial histories (Nelson and Winter 1982). The best-known elaboration of the concept is associated with discussions of technologies themselves, and David (1985) uses the term in a frequently cited paper on

[1] I would like to acknowledge the contribution of Gerry Legare who provided comments on a previous draft and undertook half of the interviews used as factual material in this paper.

the origin of the (QWERTY) layout of typewriter keys. More generally, he argued that a chance decision or event, through inertia, can lock-in an industry or technology on a particular path of subsequent development - whether or not that choice and that path are in any sense the most desirable from an aggregate standpoint. This is tied to positive feedback effects from the market, which point to the establishment of de facto standards or winning designs, and increasing returns to scale. Subsequent research stimulated by David's work has identified other examples of the importance of 'historical accident' and cumulative influences including the dominance of the VHS cassette over the Betamax system (Puffert 1999).

A second application of the core elements of the concept of path dependence explicitly involves clusters and location and is concerned with understanding how “places produce path dependence" (Martin 1999, 80). With Silicon Valley in mind, Arthur (1990, 1994) uses path dependence to craft an explanation of the establishment and growth of industrial agglomerations. Arthur models the agglomeration of firms in a new activity as a stochastic process so that the probability of each new firm selecting a location reflects the proportions of firms in individual places each time a locational selection is made. Even accidental origins can lead to spatial concentrations of industrial activity. Like other 'new economic geographers', however, he has been accused of abstracting the human dimensions out of his model (Garnsey 1998). Nevertheless, his interpretations are clearly within the evolutionary school arguing, for example, that "Settlement patterns are path-dependent;….with geographical attractiveness bestowing 'selectional advantage'…." (Arthur 1990, 249). Arthur seeks to show that larger urban regions have a greater likelihood of generating new economic successes as they will be sources of (potential) demand, while on the supply side, their locational concentrations of producers are likely to generate learning effects. His version of path dependency suggests that current choices of technologies, products and location by firms are heavily influenced, probably even constrained, by the cumulative effect of previous development.

Arthur's models are directly influenced by self-reinforcing (cumulative) processes in which local and system-wide economic, social and institutional structures and patterns of choice facilitate new rounds of innovation, investment and development (Myrdal 1957 and Kaldor 1970). To that extent, Arthur's work signals important relationships that we need to explore in the context of real histories and real places (see also, Boschma and Lambooy 1999, Turok 2003). Economic geographers have focused on this task in order to understand the performance of regional industrial systems the lasting significance of unanticipated contingent events (Steed and DeGenova 1983); the way that new technologies renew local or regional industrial environments (Aydalot and Keeble 1988); and the influence of industrial inertia[2].

In order to explore the mechanisms at work in the way clusters emerge, develop, or regress, the research focus must be on local environments, which have proved successful in creating or adopting innovations. To follow this lead means we have to resolve what past and present local conditions have encouraged the clustering of new firms and the adoption of new ideas by existing companies. The research question becomes, 'How is an industrial cluster a product of its local environment?', while recognizing that national influences also have a role. The latter may be worked out over time through framework policies - which might assist innovation (Lipsey 1998) - and public investments.

[2] Similarly, economic historians and geographers have explored the persistence of spatial economic inefficiencies that derive from different railway gauges Puffert 2002).

Meanwhile, global influences are always at play as new technologies in the developmental phase elsewhere are adapted quickly to local markets.

To discover how the local environment has assisted the emergence of a cluster, we need a finer grained set of ideas. These include the following:

1. Producers exploiting new technologies establish an interdependent relationship with their clients and engage in a learning process of "trial, feedback and evaluation" (Teece and Pisano 1998). Clusters reveal that this process has a local collective dimension, as new technologies generate increasing returns with the expansion of their market and there is learning-by-using among clients and producers (Storper 1992).

2. As locational concentrations of new activities develop, small firms attempt to overcome their limited internal resources and information by means of a variety of behaviours, which reinforce clustering. These include imitating apparently successful choices by firms in the same or similar line of business, by participating in the circulation of tacit knowledge through inter-firm networking, and by responding to clients and through social contact (gossip). Equally important is labour market mobility and dynamism. Not only is this a major means for the diffusion of ideas, but clusters are identified as the sites where knowledge relevant to an activity is accumulated and firms find workers with particular sets of skills. These untraded interdependencies go a long way towards establishing common practices within a cluster or nascent cluster (Maskell 2001).

3. Places evolve in terms of their institutional identity, which at any one time is composed of formal organizations, as well as practices and customs that firms, consultants, workers and public officials employ. Braczyk and Heidenreich (1998) argue that the way (technological) knowledge is generated, circulated and used is very much a product of the educational and financial systems and industrial relations of particular places. Thus, we should recognize a local temporal pattern or sequence of changes that they term institutional path dependence.

Path Dependence of Toronto's Multimedia cluster:

Path dependency might appear to have limited value in analyzing multimedia since it is a very young industry. Even this component of the new digital economy, however, has substantial connections with developmental paths initiated decades ago. At the outset it is necessary to appreciate that multimedia is an industry, which attaches limited direct importance to its access to leading scientific institutes. It is largely a new technology user or adopter. This is demonstrated in its innovations, which are the outcome of the early adoption of and experimentation with internationally available software and hardware platforms, and learning-by-using, rather than the design of ‘new’ software. The process of innovation is manifest by the development of novel applications of software, especially the development of new animated, interactive creative content and the design of digital tools.

Since its emergence, firms in the multimedia industry have produced two sets of digital products – business services and specialized content and services for film and television productions. In both cases, the industry replaces activities that used traditional methods and substitutes new services and capabilities. Despite different development paths, the two product segments have continued to converge as is made evident in the use of animation and visual effects in business, informational, educational, and other products delivered through CD-ROMs, kiosks, DVDs, and increasingly the Internet. In establishing the timeline for Internet-based multimedia, it is useful to remember that the web browser *Netscape* became available in 1995, as did *Java* and *RealAudio,* which

allowed users access to audio over the Internet in near-real time. The now widely used search engine *Google* was introduced only in 1998.

Over the past decade, many corporate clients have switched to the Internet for secure internal distribution of information for a variety of management and communication purposes, to allow public on-line searching of data and other information files, and for e-business. Most recently, broadband Internet service in private use has made a growing residential market accessible to retailers of goods and services and for on-line entertainment products such as games, which have proven to be a growth area. Broadband service raises expectations of high quality graphic design and artistic creativity and an increased variety of services available through the web. As the e-economy expands, there is a direct increase in demand for multimedia services. Ironically, as Internet-based services have been developed, links between the business core of Toronto and multimedia firms located nearby have remained strong because face-to-face contact with key client personnel through most phases of project development has retained its importance.

1 Origins: start-up, initial conditions, corporate resource endowment

Multimedia in a general way fits the agglomeration driven theory outlined above. Toronto is Canada's major metropolitan centre in terms of population but also it is the premier corporate head office concentration, and with that has come its first rank in Canadian financial services. This is paralleled by its strong national hold on the head offices of media corporations including newspapers and radio and television networks. Spatial concentrations of market leaders have proved important internationally in the emergence of the multimedia industry and in that sense it would be surprising if in the Canadian context, Toronto was not the major multimedia concentration. This, however, should not be taken to suggest that all metropolitan corporate concentrations have been as successful in multimedia as San Francisco, London, and New York.

Toronto's large Canadian share of corporate decision centres, especially the head offices of the major Canadian banks and other financial services, has been an important influence on the development of **business-oriented** multimedia firms. The localization of Canadian corporate offices (Semple 1996) is an outcome of long-term processes of corporate and metropolitan concentration. In recent decades, the process of consolidation in the financial sector, a result of deregulation (Dobilas 1996), has meant that the substantial scale of Canadian banks has supported their interest in new managerial and service opportunities. These grew with the expansion of the digital economy and were manifested in the banks' early investments in the development of electronic cheque processing, inter-bank transfer facilities and ATM networks all operated on a multi-time-zone basis. The banks have been leaders in introducing new technologies and have maintained large in-house IT departments. The national and increasingly international geographic scope of their operations probably had much to do with their being attuned to the potential of the Internet. By the late 1990s, for example, they had switched their corporate training and coursework programmes from CD-ROMs and other computer-based formats to the use of intranets, thus advancing from one generation of multimedia products to another (Newman-Provost 1998). The continuity of their appetite for digital services has meant that Toronto's multimedia firms benefited enormously from the co-location of these and other demanding corporate clients.

Advertising agencies, also dependent on the large business client base of Toronto, have been another major sources of business demand for multimedia firms, especially as their initial choice was to outsource their television and on-line content from multimedia

specialists rather than to develop in-house capability. Like the banks, the engagement of these firms with the Internet through the services of multimedia firms led firms in other markets into information dissemination, on-line catalogues, e-commerce, branding, and various other promotional activities.

The evolution of the **entertainment segment** of the multimedia industry is more complex, though no less path dependent in the sense that market and institutional choices have coincided to favour Toronto. It has long been the major centre for the Anglo-Canadian cultural industry sector - visual arts, live theatre, music, and publishing - and over the past 20 years it has experienced substantial growth in film production. This has generated increasing demand for visual effects, animation and post-production work, which constitute an important output segment of the multimedia cluster. The film production industry emerged from the conjunction of Toronto's theatrical environment, 40 years of public sector support for the industry nationally and provincially, and the ever-increasing demand for content for Canadian television networks. This was reinforced by the centralization of the CBC and other major television networks in Toronto, especially their programme scheduling activities, which stimulated the demand by advertisers and other forms of programme content for broadly defined multimedia outputs.

After 1979, but especially since the mid-1980s, various subsidy and tax credit programs stimulated growth in the film and television industry. These applied to both Canadian content and international productions using Canadian labour. At the same time, the definition of a Canadian content rule that applied as a condition of retaining a television-broadcasting license from the CRTC stimulated the domestic industry, especially firms producing dramatic series and made-for-television films[3]. The expanded use of Toronto as a location for filmmaking even prompted the then City of Toronto to appoint a Film Liaison officer.

The presence of a local industry meant that there was a ready-made basic infrastructure of film crews, equipment, and laboratories for location or studio work. Increasingly, too, Toronto was valued for its skilled post-production, visual effects and animation firms. Initially traditional animation and visual and special effects techniques led to the development of a substantial production of cartoons and other products and services directed at the North American television market. With the advent of broadband Internet service, these firms obtained more direct (on-line) access to the Hollywood market for their services. The local media market, the film and television production industry, the development of skills, and policy support were crucial in stimulating the emergence of the entertainment segment of the multimedia industry. Nevertheless, Hollywood and U.S. television networks were always the bigger market, and a major boost to the access of Toronto's firms to U.S. markets was the decline in the CDN $ from the late 1970s onward. This made all forms of production in Canada a highly advantageous financial proposition for U.S. companies.

2 Talent pool

This highly condensed institutional account conveys a strong sense that there were various sources of opportunity that led to the emergence of Toronto's multimedia cluster. Certainly, the networks' decisions to centralize in Toronto and the emergence of film production out of a thriving live theatre and broadly constituted arts environment reflects Toronto's metropolitan functions and status. Film and television production is one manifestation of that environment and it spawned firms that could apply traditional graphic-arts expertise and creativity to visual and special effects, post-production work, and

[3] The definition of 'qualifying Canadian content' has continued to change over time.

animation. From the late-1960s Sheridan College enhanced Toronto's capabilities in the latter field through its classical animation programme.

In the early-1980s, however, an unanticipated convergence of traditional skills and new technology was forged and the skills and reputation of workers and firms in animation, post-production and visual special effects were transferred to a digital technology base and became part of the emergent multimedia cluster. Toronto had a significant first-mover position in establishing animated computer graphics as a field of innovation. Omnibus Computer Graphics, one of the first digital animation and post-production companies in North America was started in Toronto (1982) to produce graphic logos for CBC and CTV television, and animations for the advertising industry. Its life as a company was brought to a fairly quick end by its over-ambitious acquisitions in US[4].

Multimedia realized the potential that came from computer graphics programmers with creative interests and self-trained hackers interacting with database programmers and conventional graphics arts specialists. Together, they generated the beginnings of a new industry though, as early as 1980, Sheridan College began offering training in computer animation (Eberts 2002). As software and hardware moved towards the status of relatively standardized platforms[5], imitation became easier. So did learning-on-the-job, which was the most influential career experience for most of the established individuals in the industry. Many of our interviewees were emphatic about the virtues of on-the-job-training and the initial depth of the talent pool in Toronto. They stressed that much of the innovative output from firms, in both the programming and creative spheres of multimedia, was a result of the convergence of a variety of traditional skills in the context of 'learning' and 'experimenting' with a new technology 'on the job'. Of course, the variety of work that could be generated in Toronto was itself yet another aspect of metropolitan advantage.

No doubt the experimental record of older members of the talent pool contrasts sharply with the lack of 'production experience' of recently trained graduates from the substantial number of college new media programs or university computer science departments. Moreover, the tight economic conditions for multimedia today mean that it is much more difficult for educated job-applicants to obtain internships or to obtain hands-on experience. There is a dearth of co-op or internship placements that is reflective of the thin revenue margins of firms and the expense of workstation time and program licenses. Nevertheless, some managers we interviewed look forward more strongly than back, and see clear advantages for the future of multimedia in the institutions that provide training and regard these as a clear source of institutional and public support. Despite this positive view, the connection of multimedia firms with educational institutions is largely a one-way relationship, though some senior people are involved in college curriculum committees and make occasional classroom appearances.

3 Spatial concentration and self-recognition as a cluster

The modal employer in this industry is quite small - between 5 and 10 employees - though establishments of firms headquartered elsewhere in Canada and USA tend to be

[4] Though its acquisition of two US companies led to its financial collapse (1987), highly skilled personnel became available to other ventures, including Alias (started in Toronto in 1983) and Side Effects Software, both of which continue as sources of animation and post-production software. The particular local initial advantage represented by Omnibus seems to have provided a modest stimulation to software development but not necessarily to multimedia service firms.

[5] IBM (U.S.), for example, participated in this process by establishing a multimedia division in 1990, which opened multimedia customer centres to market multimedia hardware products and services (Szuprowicz 1991)

larger than this. The recent history of this field reinforces this intensive competition among even the smallest firms because they are primarily single-proprietor firms that seek their own jobs and work on projects secured by larger firms. Many are really freelancers/consultants. The popular impression is that multimedia is spatially concentrated within the metropolitan region. This is true, but it is only part of the story. There has been dispersion, and this is primarily associated with simple web-site design, which has become a lower-order multimedia product. As margins have declined, lower rents have been sought, and freelancers -- often working from home -- have assumed an important share of the market.

Within this locational matrix, the major multimedia firms are concentrated into spatial pockets on the fringe of the downtown area. Close proximity to major clients and good transit access makes it easy to weave contract workers, especially freelancers, into new projects. Central locations are characterized by former warehouse and manufacturing buildings dating back to the mid-nineteenth century with a brick and beam style of architecture whose relatively low rents during the 1990s enabled firms to secure spacious accommodation. An informal work atmosphere was conducive to hiring young workers, as was the club scene in some central precincts. All these features contributed to a sense of identity for firms, labour and clients located in the cluster. Contacts between key personnel of firms proved easy enough to establish and in the growth-period of the 1990s in particular, these relationships, plus the churning of employees and freelancers, allowed a substantial flow of company gossip and the informal passage of technical and creative knowledge. Co-location of firms certainly generated opportunities for firms to monitor advances by competitors and to imitate and innovate within this learning environment (Maskell 2001).

As indicated, the major clients for the business segment of multimedia are led by the banks but are increasingly distributed across all sectors. In interviews, firms claim that business expertise developed in the Toronto market allows them to export their services. This relationship is clearly in evidence also among firms that focus on the entertainment market. These fall into two groups. Producers of computer games and related products for the educational market that are linked to (mainly local) publishers/ distributors, though international sales are the goal. Animators, producers of visual effects, and post-production firms function within film/television production systems that are directed from Toronto or Hollywood. Our interview data indicates that the U.S. connection is more important to firms both in terms of the value of output and stronger impact on innovation. This is clearly linked in a developmental sense to the seemingly unrelated set of circumstances that attracted Hollywood producers to the streets of Toronto and its inexpensive studio space.

4 Reality shock: clustering incentives intensified

The path dependency literature is strongly focused on continuity and on the influence of inertia in (regional) industrial systems. Though innovations can eclipse old products, and new technologies and new industrial spaces have repeatedly replaced the old, users of the concept focus on the irreversibility of choices made in the past and favour the study of accumulation at the expense of shocks or cleavages. Nevertheless, it is necessary to dwell also on discontinuities whose origins may be primarily technological, market-based or political (Bathelt 2003).

The issue in question is the response of the multimedia industry to the 'dot-com bust' of early 2001, which was a rapid deflation in the share prices of public companies attempting to sell goods and services on-line. This was followed by the failure of those

multimedia companies whose incomes, revenue expectations and hiring practices were too-closely associated with dot-coms. Closely linked to the analytical need to acknowledge discontinuities, is the more general issue of how resilient clusters are over time and whether their paths of development can withstand shocks such as the dot-com bust (Wolfe and Gertler 2003). The key question is whether firms and institutions that connect and respond in useful ways during a growth phase are flexible enough to establish their adaptability and longer-term strength when subject to substantial and perhaps unexpected pressures. Adaptability implies the capacity of firms to learn, and to do so while shocks reduce or eliminate whatever degrees of freedom were available to them and their infrastructural supports.

A survey of the Toronto multimedia cluster in 1997 showed that most firms were independent, small, creative and operated with both a core group of employees and freelance consultants, while secondary employees were hired on an as-needed basis. Firms were competitive, and there was little evidence of trust-based relationships between comparably sized firms with similar or complementary assets, and little collaboration or information sharing between them (Brail1998). The effective connections that did exist were formed between individuals. Venture capital was in evidence for some larger firms, whose client lists implied more economic strength than was true for those who produced customized products (Brail and Gertler 1999).

In the years immediately before the crash, the cluster experienced significant growth in the number of firms and in the scale of businesses, with the largest reaching 250 employees. According to a consultant's report (PWC 2000), the industry had grown without developing cooperation within the cluster and was identified as less collaborative than other major locations. Some of the larger firms went public with the assistance of venture finance (never a Toronto strength), and this was the period when some foreign firms, and domestic firms headquartered in other cities established branches in Toronto. Many firms expanded by hiring employees in anticipation of a continuing growth trajectory as the variety of activities in the market for multimedia products expanded and public sector agencies and educational establishments joined the ranks of business users. Hiring in expectation of market growth was a dangerous practice and collective growth expectations made a tight labour supply even worse and a rapid rise in wages ensued. The situation was made more treacherous by the practice of firms to accept shares in lieu of payment for Internet based design services.

The basic business revenue model for multimedia relies on a project-basis of production and the fee-for-service revenue component forces firms to contend with an actual income flow that may be highly episodic. The established firms have sought, therefore, to implement ways of acquiring long-term relationships with clients. One means they have used to generate a more predictable flow of revenue in the form of maintenance and licensing fees for proprietary parts of the solutions they provide for clients. In the slower growth environment since 2001, firms have placed even greater importance on these relationships. For business market firms this means finding a position akin to that of advertising agencies; for example, producing interactive Internet based branding strategies for clients and building on-line communities. Firms in the entertainment segment also have on-going relationships with their clients.

Current directories reveal that many firms have disappeared, though the total is still more than twice that of the 1997 count, having risen until late 2000. Survivors have also shrunk in terms of the scale of their employment since 2001, and an even larger part of the talent-pool of the industry is found among freelance/consultants. In this recent period, firms have retreated to their core competencies. Most of their assets are in the form of

permanently employed human talent. For this reason, firms expect to self-finance any future growth, as there is minimal interest by equity investors in multimedia firms, just as in all other producer service industries[6]. Unlike the software industry, there are few innovative world-firsts in multimedia, and the creative output of firms gives rise to limited intellectual property rights. The prospects of market growth for the multimedia cluster require a return of general business confidence, which would reduce the current tendency of client firms to stretch the time between projects. Similarly, there is potential for e-business and other multimedia products and services to penetrate more deeply than is currently the case among small firms.

In contrast with the profile of the industry 7 years ago, firms no longer ignore the potential value of **vertical linkages,** and operate more like theory suggests we should expect in a cluster. Today, when responding to formal Requests for Proposals from potential clients or to other informal invitations with the same intent, small firms in the industry often collaborate through co-bidding arrangements. In vertical terms, they form consortia so that combinations of specialist firms can compete against larger more diversified firms. There is effective development of production networks in the Toronto cluster. In interviews firms indicated that a definite component of their strategy is to cope with their small scale through the development of connections with other firms with whom they could maintain compatible co-bidding and production arrangements. Small- and medium-sized firms have also developed subcontracting arrangements to obtain specialized inputs, and maintain proprietary lists of preferred freelancers/consultants. In some cases, these are employees dating back to before the dot-com bust. Larger firms are also involved in the network process as they seek production inputs from small firms in order to avoid the more costly option of an expanded in-house team to meet bulges in production.

Responses to the depleted euphoria of the growth regime include fast learning by firms of the art of collaboration and intensified higher level networking, especially by the principals of firms whose business practices had not left them exposed to the dot-coms. The inference should be that Toronto's multimedia firms have been adaptive and have learnt to take advantage of cluster characteristics that include inter-firm interdependence and the informal acquisition of knowledge, usually in tacit form, about superior design ideas, software tools, and market openings. These untraded cluster interdependencies, which have become more important and probably better developed as time passes, are the outcome of the personal networks that parallel inter-firm relationships and percolate through the boundaries of firms, as freelancers leave trails of their expertise and other workers change employers (Britton and Legare 2004).

If this intensification of untraded relationships post-2001 is a sign of the stronger development of cluster characteristics, Toronto still has ground to cover before it establishes a cogent institutional framework for **business and professional associations**. Since 2001, organizations catering to the needs of individual multimedia workers have become even more important than previously. When employment was expanding prior to the crash, technical and creative employees easily gained access to information about new job opportunities from within their workplaces and through personal networks. Now, the proportion of freelance workers is much higher, generating personal networking needs, which associations such as *DigitalEve* try to meet. Civic associations have emerged to represent the interests of firms and workers and they have attempted to

[6] Teece (2003, 901) repeats the respected adage that professional service firms must face the reality that "the capital goes down the elevator every night" and that it is a managerial challenge to retain core workers. This was also voiced by a Toronto-based venture capitalist in an interview.

construct a recognizable voice and greater visibility for the Toronto cluster. Provincial initiatives have been supportive but unfocused. Too many different options have been tried, with the end result that the principal organization (*Smart Toronto*) absorbed a number of other local initiatives (into *Smart Toronto Technology Alliance*). This was itself absorbed by a national high-tech lobbying association (CATA), relegated to branch status and relocated out of an area of multimedia concentration.

Professional associations serving the business market are better developed than for firms with an entertainment focus. In this segment clients in the film/television market are fairly well defined. Business service firms face the challenge of acquiring new clients and need visibility and have developed cooperative initiatives that help them achieve collective identity, provide peer assessment of best- practice, and access to potential clients. Organizations such as AIMS receive praise from firms but associations with broader agendas receive mixed reviews.

Conclusion

The focus of much cluster research is directed to unraveling the currently operating forces, which act to bind producers, clients, and other participants through various webs of interdependence. Heavy data requirements have meant that the style of research has been strongly static. The irony of this is the reliance of many industrial clusters on processes of change in their underlying technologies, products and processes. An explicitly temporal perspective favouring a dynamic view of the way clusters evolve is provided by the concept of path dependence. With its origin in evolutionary economics, path dependence, when applied in a spatial context where agglomeration dominates, brings the recognition that members of clusters are in a constant state of flux. Our work on Toronto confirms that there are no certainties, especially in new technology fields.

The dot-com crash clearly had the potential to dislodge the relationship that had been exploited between market growth and product development, particularly because heavy reliance had been placed by the cluster on increasing returns to scale. In that sense, market generated crises like these challenge the applicability of a path dependent interpretation of cluster growth and change. In Toronto's case, however, we have seen the cluster demonstrate substantial resilience. Many firms have survived by downscaling. They have trimmed excess capacity and moved to stress the merits of specialization, and cluster interdependence has been intensified. Reliance of the cluster on a path of expansion and product innovation has been jolted, but it has emerged with a superior sense of the advantages of collaborative and cooperative business choices. In time, these aspects of cluster learning may influence Toronto's experiments with civic and professional associations. It is still striving to define goals for an organization to help establish the Toronto brand name, while coping with provincial policy initiatives, which do not meet the tests of coherence and continuity.

Path dependence can prove to be a rocky road, but Toronto has demonstrated more evolutionary forms of change that have stronger elements of continuity. This is illustrated by the convergence of the entertainment and business segments, as animation on the Internet has become commonplace with the availability of broadband service. Examples like this provide good evidence of the creative adaptability of firms in the Toronto cluster as they participate in the continuing transformation of the industry which is an outcome of the interrelationship between innovations in infrastructure, the developing needs of clients, and the talent of multimedia firms.

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