



Innovation led policies for clusters and business networks

Globalization, ontological uncertainty and degeneracy¹

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¹. David A. Lane - University of Modena and Reggio Emilia



The subject of this session is “innovation led policies for clusters and business networks.” It should be evident that this is treacherous ground: there are some serious a priori grounds for suspecting that both “innovation” and “clusters”, popular rallying cries for policy though they both are, may resist efforts of policy makers to make them conform to the policy-makers’ best intentions.

Innovations, after all, are hard to program – and to forecast. We all remember Tom Watson’s grounds for initially refusing to enter the computer business: he couldn’t foresee that the demand for production versions of the Eniac prototype could exceed six or so systems, world-wide. And of course it goes the other way as well. In the mid-80’s, a distributed control technology was developed by a group of engineers personally selected by Apple CEO Mike Markkula, and then turned over to a company run by ex-ROLM CEO Ken Oshman; the company founders had no trouble raising the 26 million they believed adequate to make the company profitable, and they confidently projected a 25 billion dollar industry around the technology, in 5 years from its December 1990 launch. Fifteen years later, the company and its technology are alive and well – but the new market system that has emerged around it, featuring products and services provided by several thousand companies world-wide, is only a tenth the size of the original projections. And it still isn’t clear how big it will get, and what it will take to get it there; nor does the uncertainty surrounding the future development of this market system have much, if anything, to do with another popular rallying cry, often linked in these days with “innovation” – that is, “competitiveness.” We can all multiply examples of these phenomena: of “innovations” that generated developments – and hence growth (and perhaps also development) in various regions of the world -- well beyond anyone’s wildest imaginings; and of others whose evident promise mysteriously failed to materialize, at least according to anyone’s time- (and space-) tables. Popular though the term is now, “innovation policy” may be an oxymoron; at the least, it requires careful explication of just how intervention relates to effects.

As for “clusters,” from the earliest discovery of the Italian districts and their surprising success, theorists like Beccatini have emphasized that these are “organic” growths, dependent on the socio-cultural humus from which they arise, based on relations of trust and cooperation, and traditional competences inextricably entwined with the history of the territory and its people. From this point of view, it would be hard to imagine how districts could be implicated in a strategy of regional development. Moreover, Brusco described how the worker-entrepreneurs of the districts innovate with their hands as much as their heads, using their deep familiarity with their tools and materials and the functionality of the products they make from them to engage in a constant succession of incremental adjustments that keep them positioned ahead of competitors’ less personally and socially embedded in their productive activities. Such a view of innovation resists amplification by policy.

Of course, that was then (*if* it were so even then), and now is now. The third-generation district entrepreneurs don’t have the same level of immersion in the crafts of production, and the districts, after thirty years of relative prosperity and epochal social-demographic-political change seem much less the passive creation of their ancestors’ history than they once appeared. Something else was, or certainly is, going on, but what is it? What theories do we have of how districts work, what their structure is, how that structure accounts for their economic functionality, and, most important, how that structure and that functionality are, or must, change to face the challenges of the present and the near future? Well theorized or not, districts *have* stimulated quite a bit of social engineering; but, as Annalee Saxenian remarks, after more than a decade and a half of zealously pursuing efforts to “build” high technology districts around the world, she has yet to find any clear success stories, in which what transpired bears more than a vague resemblance to what policy makers attempted to construct – and in some cases, as in the science-park movement, the record is one of unadorned, dismal failure.

So we have to be cautious as we seek to identify “innovation led policies for clusters and business networks.” Perhaps it would be best to turn now to an investigation of some of the new challenges – and opportunities – that such policies would have to address. The most important of these are tied to what we abstractly label as “globalization,” but for district actors, at least here in Italy, is more concretely identified by the word “China.” “China” means many things to them, most of them frightening, but some distinctly appetizing. On the frightening side: new competitors, whose production costs are to a first approximation



negligible compared to theirs; and who operate in a political economic context characterized by “artificial” exchange rates tied to the ever-diminishing dollar, with unreliable and asymmetric (to say the least) attitudes towards such practices as dumping, or enforcing foreign-held patents. On the other hand, the same cheap labor and increasingly efficient production methods tempt some European producers, including district actors, to follow the American lead in delocalizing production, not only to China, but to their own Eastern back-yard. Even better, if American middle-class consumers fell under the spell of Italian design and German engineering years ago, maybe the same will be true of the new Chinese and Indian middle-class multitudes, who will soon outnumber (and outconsume) their American and European counterparts. (Though we must remember that the American elite has sought European inspiration for tasteful ways to dispose of their rising incomes for the last several centuries, while the Eastern elites have viewed Europeans as ignorant savages for the millennium or so that they have been aware of Europe’s existence.)

Beyond these obvious and straightforward considerations, globalization, and in particular China, is important for the districts in deeper ways: recent changes in the structure of global markets are producing changes in the way in which district actors relate to one another, and these relations are the key to what makes a district an *organization*, albeit one characterized by distributed control, rather than a mere *agglomeration* of small and medium enterprises.

Let’s look at an example, which will also provide us some insight into what made the districts a success in the first place. The town of Sassuolo is home to several hundred small and medium firms involved in producing (or providing services to firms involved in the production of) tiles. Until a few years ago, Italy was the leading producer of tiles in the world, and the leading exporter as well, with a substantial share of total production and a larger share of total exports from Sassuolo and its environs. Sassuolo tile producers have maintained a high level of innovation, in production processes, in new applications for tiles and other ceramics, and new styles of decorative tiles. An important element in this innovative activity has been the close relations between tile producers and the (generally small and medium) companies that produced the machines used in tile production. Through these relationships, new ideas for tile forms, material and decoration have been brought quickly into production and thence to world markets. As Brusco emphasized, Sassuolo workers have an intimate understanding of their machinery and their materials, so the machine manufacturers have emphasized flexibility and reconfigurability over reliability in designs targeted for their Sassuolo clients. Moreover, these designs emerged on the Sassuolo shop floors, in extended discussions and joint action on the part of tile makers and machine producers. In the meantime, Sassuolo entrepreneurs have developed a particular way of looking at the world: as a collection of places and activities where tiles might be hung. As a result, they collectively engage in a parallel exploration that uncovers new applications and styles, which in turn create space for finding further applications and styles; and the ties between the entrepreneurs, their workers and the machine producers generate a rate of innovation and implementation that rivals elsewhere just cannot match.

The barriers to enter basic tile manufacture are not particularly high: you need earth, water, and ovens, and you are most of the way there. Not too long ago, Spain and Brazil surpassed Italian tile production, and Spanish producers have begun to develop innovative new decorative techniques different from those of Sassuolo. More recently, China began to ramp up tile production, and is now by far the world’s largest tile producer. Most of its production goes to its own domestic market, but China has begun to export as well, particularly to other Asian countries. While Sassuolo production and export figures have stabilized and even begun to decrease, in a certain sense these newer entries are not yet competing directly with Sassuolo tiles. In the US, for example, Sassuolo tiles sell for an average \$11 a square meter, while Chinese and Brazilian tiles sell for \$4 and Spanish tiles for a little more: that is, Sassuolo, which certainly has higher costs than these “competitors”, still owns the top end of the market, where, other things being equal (which of course they are not), the highest margins are.

But Sassuolo producers are worried. Something important has changed, which may erode their position by diminishing their level of innovation and the length of time that they can exploit new applications and styles: they are no longer so closely linked to the firms that supply them with machines. These firms have new customers, and these customers impose new design requirements: the customers are



the tile producers in Spain, Mexico, Brazil and especially China, and they don't want flexible, reconfigurable components, but reliable turn-key factories. They want their factories to reflect the latest state-of-the-art in tile manufacturing techniques, so naturally they go to the producers of machinery for Sassuolo manufacturers. These new customers provide a huge opportunity, but they also require new organizational structures: these customers need an integrated system, not a collection of separate machines they must integrate themselves; they require service contracts; their workers don't have the skill to tinker with the machinery themselves, and the firms don't want to wait for the next plane from Italy every time a machine malfunctions. To satisfy these new requirements, the tile machinery firms have consolidated into four organizations providing these system integration services, each with a distinctive form of control (from outright ownership of suppliers to buying on the open market). The effect of this reorganization on Sassuolo manufacturers is obvious: not only can they no longer count on tight and constant collaboration with machine producers (except for those unsuccessful in gaining entry to the privileged circle of the four system integrators), but they have also come to assume that any innovation they manage to generate that is instantiated in a machine will very soon find its way into a new Chinese factory, courtesy of a (relatively) local machinery manufacturer.

The generative relationship between tile manufacturers and machine producers has been ruptured, and the two groups of firms are now going through a period of hostility and mutual recriminations. The machine producers feel that the Sassuolo tile producers could have kept their special relationship with them, had they also "gone global," by investing in production in the emerging countries, or at least delocalizing some of their production there to take advantage of reduced labor costs and laxer environmental regulations. The Sassuolo producers, on the other hand, feel abandoned and betrayed by their ex-allies. What is clear is that if no new relationships arise, between the Sassuolo producers and either some of the firms involved in the system integrator networks or other firms from the machinery districts in Emilia and Lombardia, both tile producers (first) and tile machinery manufacturers (not long afterwards) will lose their innovative advantage and become vulnerable to lower cost competition, particularly from China, and will not be able long to sustain their currently valuable market niches.

Sassuolo faces a challenge that cannot be resolved at the level of individual firms. It is a system problem, and to address it and determine its policy implications, we have to think at the system level. A district is not just a "cluster", or agglomeration, of firms, geographically collocated, engaging in a set of activities around some related family of artifacts, with "information spillovers" somehow providing a kind of cognitive infrastructure that makes the whole greater than its parts.

A district system can be viewed as a collection of transformation processes: for example, producing, integrating, designing, selling artifacts in the family around which the system is organized. In the course of carrying out these processes, other processes are enacted by agents in the system – gathering and interpreting information, setting standards, establishing new entities like strategic alliances or trade associations. All these processes are achieved through interactions among agents – individuals, working groups, divisions, firms, groups. Since these interactions taken together deliver the functionality that permit the system to endure over time, they tend to be organized into recurring patterns, with each pattern identifiable by its set of participants, interaction modes, and frequency and duration of interactions. Each recurring pattern of interaction defines a network; each network may be said to carry a system competence; as they are enacted, these competences generate the transformation processes that deliver the system's functionalities. At least four kinds of competence networks are particularly important for districts: networks of *information*, through which agents learn about new developments in the organization of agents and artifacts in their market system throughout the world; networks of *interpretation*, through which agents make sense out of the information they obtain to determine the directedness of the interactions in which they will engage; networks of *production*, in which they collaborate with other district agents to generate new artifact types and produce artifacts for the market; and networks of *marketing*, through which their products find buyers in markets around the world.

Over time, of course, the transformation processes, the competences that enact them, and the networks that carry these competences change. But in the relatively short term, we may describe the system's



organization as the cross-cutting network of these competence networks. If we view a district system from a somewhat longer time perspective, we notice that it is always undergoing perturbations, which may be generated from processes taking place within the system itself or may come from outside the system, as for example from large-scale macroeconomic shifts. In response, new networks are constructed and others change their structure, either by replacing or adding nodes or by altering the modes, duration or frequency of the linking interactions. Some of these changes may seem to happen “spontaneously,” but for most of them we can identify structures that have provided the opportunity and the means for them to happen. Thus, the fluid network organization of a district system is constructed, renewed, and extended by a longer-lasting set of structures that serves to keep the system functioning. We call these structures *scaffolds*, since they shape and support the competence network structure of the system as it undergoes construction and reconstruction. Two kinds of scaffolds are particularly important for creating and maintaining these sorts of networks. The first are scaffolds that promote social cohesion within the district, while at the same time mixing heterogeneous identities among district agents. Such scaffolds range from the informal but coherent set of practices described so well by Saxenian through which Silicon Valley engineers cross firm boundaries to “talk shop” in local bars and seminars, through the intricate and overlapping set of associations that bring together Modena entrepreneurs, from CNA (Confederazione Nazionale dell’ Artigianato) or API (Associazione delle Piccole Imprese) through industry-specific organizations like ACIMAC (for the tile machine manufacturers) or AssoPiastrille (for Sassuolo tile producers), through district-level “think tanks”. The second kind of scaffold provides for the delivery of local services which make it easy to start up a new firm and enable entrepreneurs to concentrate their resources on honing their particular design or production competences. In Modena, both local and provincial governments and CNA provide such services, from arranging financing to outsourcing book-keeping and legal assistance, to supporting trade fairs at which local firms may display their products to potential buyers recruited from around the world, to providing space for new firms to establish their operations, to research and educational projects like PROMO, designed to introduce local firms to best international practice. In Silicon Valley, many of the same scaffolding services have emerged privately, with little government or district-level organization. For example, venture capitalists, concentrated in several blocks of Sand Hill Road, provide not only seed financing but networking and recruiting services to prospective entrepreneurs. Local law firms specialize in legal services for start-up companies; some of them now offer start-up packages for as little as \$5,000 per year (or shares in the new companies), handling all the legal problems new firms encounter in their first two or three years of business. Real estate developers build industrial parks where start-up or expanding firms can locate. The architectural design of many of these parks provide open space, inside and out, that facilitate the formation of discursive relationships within and between firms located in the parks. Probably the most important scaffold for Silicon Valley, at least in its formative years, was Stanford University, whose engineering graduates were encouraged to start companies in the area and whose professors were permitted to engage actively in consulting and entrepreneurial activities of their own. Stanford, San Jose State, and Santa Clara now all play important roles in promoting knowledge development and exchange, through seminars, research programs, and teaching (often with instructors recruited from local businesses) for Silicon Valley firms and professionals. While local governments around Modena were often in the forefront in providing infrastructural support to local districts, this was not the case in Silicon Valley, until some of the “senior citizens” from successful firms in the district established a lobbying group, the Santa Clara County Manufacturing Group, which became an important scaffolding institution for the mature district.

The capacity of district systems to maintain generative relationships among local firms and the networks through which they attach to world markets is itself maintained through its scaffolding structures. The biologist Gerald Edelman has introduced an important concept that helps to understand how these structures enact their functionality: degeneracy. According to Edelman, the key difference between an evolved and a designed system lies in how the system maintains its identity in response to perturbations, either internally or externally generated: designers try to assign each component functionality to just one kind of structure, and to each structure one functionality, and achieve system robustness through redundancy – that is, providing multiple copies of the structures that carry system-critical functionality; evolved systems, in contrast, are characterized by many-to-many structure-function mappings, which



Edelman calls degeneracy. Districts are evolved systems, and they are characterized by degeneracy rather than redundancy.

The problem that our Sassuolo example illustrates is that globalization and delocalization are generating perturbations to the districts' environment to which existing scaffolding structures may not be able to respond in a timely way. Some are: if Saxenian's story of Silicon Valley's "exportation" of its system structuring to Taiwan and now to China, via the bridging roles of its Chinese entrepreneurs and their associations, is right, then a new, higher-level, system of district systems is under construction, which will continue to maintain generativity not only in the Valley and the Taiwanese districts, but *between* these districts and the emerging districts in China. But Sassuolo's are not: AssoPiastrelle and ACIMAC are just generating a set of reciprocal attributions that serve to harden rather than resolve through new organizational forms the emerging gap between the two sets of entrepreneurs they represent.

So here is a clear policy challenge: how can a region develop a system capable of providing a higher-level monitoring of the capacity of its districts' scaffolding structures to continue to maintain the generative potential of the relationships among its firms and between these firms and the networks and groups through which they are tied into world markets? And at what point, and which with policy measures, can regional entities intervene, when this higher-level monitoring reveals the emergence of the kind of situation that is already evident in Sassuolo?

It would be wonderful to be in position to provide clear answers to these questions. Unfortunately, I cannot; but at least I can underline two principles that I think any such answers would have to respect, and with these I conclude my presentation:

Ontological uncertainty: innovation processes are characterized by the construction of new entities, both physical (agents and artifacts) and cognitive (categories and attributions of identity), which mediate the effects that present actions will have in the future. As a result, it is usually fruitless to try to choose these actions on the basis of an evaluation of their possible effects. This applies to *district* actors in their innovative activities and to *regional* actors seeking to formulate policies that will help district actors to innovate. What is important is to monitor changes in the generative potential of relationships among actors engaged in these processes, to invest time and resources in those relationships whose generative potential is highest, and to seek to enhance this potential. Such monitoring activities will include the kind of processes of benchmarking, error detection, analysis and correction about which Chuck Sabel writes, not just to productive and commercial activities, but to the networks of relationships through which these activities are enacted, as Bob Maxfield and I describe in our work on generative relationships. And of course monitoring isn't enough: there must be in place scaffolding structures that construct and maintain the information and interpretation networks through which the results of this monitoring activity circulate through the district and provide the basis for changes in relationship patterns.

Degeneracy and distributed control: multiple, overlapping scaffolding structures need to be engaged in these monitoring and network-forming and -maintaining activities, and the way in which these district scaffolding structures interact among themselves and with their constituencies must be monitored by yet other regional scaffolding structures, to maintain the set of functionalities that allows the district competence networks to reconfigure as the environment in which they operate changes. Determining just what this set of functionalities are, in what ways they might be changing, and how they are currently enacted by the various scaffolding structures in a region, should be a primary focus of an innovation led policy for clusters and business networks.