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The emerging shape and form of innovation networks and institutions

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The emerging shape and form of innovation networks and institutions

1. Introduction

The aim of this paper is to offer an account of the changing shape and form of innovation networks and institutions in developed industrial economies. To date this debate has been dominated by discussions of 'grand transitions' from Fordist mass-production to Post-Fordist batch production. Associated with this has been a concern with the social and economic contexts that are perceived to be necessary or sufficient to support, or promote, economic development. Researchers have highlighted the role of the institutional and network structures within which firms operate. A further dimension of the debate has had an epistemological character implicating either macro-structures (regulation theory) or micro-actors (flexible specialization) in explanations of the transition process.

This paper attempts to cut across these debates in an unorthodox fashion that is sceptical of the explanatory power, and extent of the applicability, of 'grand transition' theories. It accepts that networks and institutions have always been important in industrial development; it is their exact nature, form and effect that are in question. Specifically, this paper argues that the contemporary discussion about networks and institutions ignores the question of power. In order to understand the consequences and effects of different forms of economic arrangements for various actors and collectives analyses of the relations between power and institutions are clearly required.

The key points of the paper emerge through a review of different accounts of organizational networks and institutions. Accounts that rely upon, on the one hand top-down macro-scale arguments, and on the other micro-level actions are contrasted. The objective here is to resist the attractions of either position. Crucial to this aim is the concern with power; the paper avoids the twin pitfalls of using power in an absolute totalizing manner, or eliminating power from the analysis altogether. The argument pursued rests upon a formulation termed 'power/institutional'. This approach attempts to explore how social relations are made and re-made across different scales as well as how different actors are implicated in one another's strategies. The effect is a power differential between the agents involved. It is important that such analyses have a means of linking individual actions, work organization and institutional co-ordination without reductive recourse to any particular agent.

The paper is substantially concerned with the way in which innovation is accounted for, and configured in, organizations and the policy responses that have emerged to promote it. The paper resists an account of innovation as either a one-off event, or one that is simply contained in a workshop or laboratory: in effect it is concerned with the configuration of the whole of society. The paper begins with a consideration of individualistic accounts of innovation which draw upon the metaphors of chains and linkages. This is followed by a section concerned with explanations of innovation that draw upon notions of structural features of economies as mediated by institutions. The third section draws out the problems associated with fixed, or ostensive, characterizations of social relations that are embodied in the foregoing accounts of innovation. In their place a performative concept of social relations is suggested via the concept of 'power/institutions'. It is argued that such an account offers both a more satisfactory view of social relations and one that is sensitive to considerations of power.

2. From entrepreneurs to science parks.

Economic historians such as Kondratieff are often cited as discovering economic cycles, others such as Mensch have associated these cycles with different technologies (steam power, chemical and oil, electronics), notably Schumpeter suggested the importance of innovation 'swarms' in down swings (see Marshall 1987). This has led to policy debates in which commentators have been concerned to identify or encourage innovation. The question is how does innovation occur, and how - if at all - can it be encouraged ?

Writers on innovation, if coming from a positivist or/and a neo-classical economic perspective, begin with the firm and the product cycle (Vernon 1966) plotting the stages of product development. Subsequent work by Markusen (1985) has developed this model by focusing upon profitability rather than the volume of production or sales. However, it does not actually tell us much about why some firms bring products to market and others do not. It simply suggests that the market does - or does not; the policy implication points to the importance of the correcting such market failure. The usual responses by policy makers who share this view is to attempt to generate more new firms in the hope that they will generate more new innovations/products, some of which will be successful.

Focus on the market leads to an exclusive concern with exchange relations. Hence the importance of technology transfer between organisations, between universities

and industry, and between intermediate producers. The hope would seem to be that the firms developing these new products and processes will be able to exploit market advantage and increase production. This begs one further question; why is technology not already transferred ?

The standard response is to invoke the notion of the 'innovation chain' - like the product life cycle - monitoring the product from its initial inception as an idea through prototype, production, marketing and consumption. Some critics of such a conception of the 'innovation chain' conception have drawn attention to the presence of 'feedback loops' in the 'system' (see discussion in Rosenberg 1976; 1982). However, the overarching notion remains, it is linkages - or their lack - that are conceptually to the fore together with an implicit acceptance of the discreteness of the elements within the innovation process.

Policy responses here seek to engineer more technology transfer via linkages between pure and applied scientists, and between applied scientists and innovating firms. In Britain the practice has been rather lacklustre with a range of rather ineffectual and unco-ordinated technology transfer programmes (see Miliband 1990). Ironically, it has been a private sector initiative, the UK Science Park Association (UKSPA), that has internalized an understanding of the notion of technology transfer and have attempted to codify it in an attempt to facilitate implementation. For the UKSPA (1990) a science park is: a development that has formal operational links with a higher education or research institution; that is designed to encourage the formation and growth of knowledge-based businesses and other organisations normally resident on site; and, the management of transfer of technology and business skills to the organisations on site.

3. From institutions to learning regions

An alternative starting point is with the work of Schumpeter (1943) who outlined a conception of the innovation process as one of creative destruction, a process which would constantly undermine the very basis of economic activity through the development of new products, technologies and sources of supply. In their discussion of Schumpeter's contributions to this question Freeman et al. (1982) highlight a shift in Schumpeter's writing over time with regard to the main agent of innovation from the small firm entrepreneur to the routinized research and development department of the large firm. Dosi (1983; 1988) argues that innovation

is an evolutionary process that is specific to particular sectors of industry, and linked to particular technologies: the macro- context of innovation. Dosi uses the term 'trajectory' to express the notion of continuous incremental innovation allowing firms to evolve within a technology. Using the idea of paradigms from the history of science Dosi suggests that 'revolutions' are rare, but that new innovations - for example, semi-conductors or bio-technology - simply open up new trajectories.

Dunford (1993) argues that these approaches of Dosi and Freeman and his colleagues, termed Neo-Schumpeterian, generally avoid the reductionism inherent in explanations that draw upon the work of Kondratieff or Schumpeter. In contrast, these arguments focus upon an inter-related set of institutional factors rather than singular spatial, organisational or technological ones. Thus, technological changes may have widespread effects on economic life; these may entail, by consequence, substantial and radical reorganisation, re-skilling, and retooling of production processes. Dosi calls such a process a techno-economic paradigm shift.

Massey et al. (1992) have drawn upon Dosi's work on innovation to offer an account of why science park development in the UK has been ill-conceived and ineffective. Their argument begins with the observation that the dominant mode of industrial organization in the twentieth century has been large scale mass-production; this production process is characterised by a rigid technical division of labour that has facilitated a functional separation of elements of the production process (termed Taylorism). They argue that over time this functional separation has been extended by firms to create spatial divisions in an attempt to exploit possibilities of lower labour costs in some localities. Specifically, science parks are a logical extension of this process; representing a finer technical division of labour amongst scientists and researchers.

Massey and her colleagues suggest that Taylorism re-inforces a conception of innovation as a sequential, linear, process. They consider science parks to be weakened by the fact that they are tied into a very hierarchical and fractured production and innovation process. Whilst Fordism has many benefits, flexibility and innovation are not amongst them. This argument suggests that science parks are a child of the Fordist organization of production. This corresponds with Schumpeter's view (see above). Science parks are the hiving-off, the sub-contracting out, of research and development activities. The social overhead costs of research and development are thus effectively transferred from the individual firm to the

promoting organization (invariably the (local) state, or the state by proxy: a university).

Massey et als. account, although sensitive to spatial variation, does rely heavily upon a structuralist account of the labour process in which technology and control of wielded unambiguously by capital, or the state. Other analyses have sought to avoid such problems by drawing upon meso-level concepts such as institutions. Dunford (1993: 40) follows such a line of argument in a call for the consideration of technopoles in the light of the broader 'institutional conditions in which inventions and research and development occur', and the 'different institutional conditions in stimulating the diffusion of technologies'.

Discussion of 'institutional conditions' requires some clarification. Taken at face value Dunford's article might simply be read as a call for an approach informed by institutional economics (c.f. Williamson 1975; 1985). Indeed, such an approach might fit conveniently with the discussion of post-Fordism and new industrial districts by well known institutional economists Piore and Sabel (1984). Whilst the empirical validity or otherwise of the post-Fordist hypothesis has been subject to near saturation debate the epistemological assumptions of the institutional economics that underpins it has not. Institutional economics attempts to respond to the under-socialised and atomistic concept of economic action inherent in neo-classical economics, stressing instead the importance of the analysis of social institutional and transactional factors (such as decision making, rationality and trust).

It is important here to note the critique of institutional economics (see Granovetter 1985; Powell 1990; Hodgson 1988, 1993). Granovetter, in particular, argues that institutional economics tends to under-socialize economic action, for which it compensates with an oversocialized notion of society; this is underpinned by a functionalism that implies that institutions arise as efficient solutions to economic problems. In the place of institutional economics Granovetter stresses the importance of understanding the social embeddedness of economic action. Recently, this approach has informed work into the social context of industrial development (see Amin and Thrift 1994; Grabher 1993). In particular writers such as Lorenz (1990; 1992) have stressed the importance of relations of trust, or what Storper (1993) more generally has referred to as 'untraded dependencies'.

A particular articulation of this idea has been suggested by Powell and Dimaggio (1991) which they term 'institutional thickness'. Amin and Thrift (1992; 1994)

elaborate this as 'a simultaneous collectivisation and corporatisation of economic life'; but they go on to stress the importance of the consideration of the dynamic process of institutionalisation rather than the static presence of institutions. Kevin Morgan (1995) draws upon this line of argument and relates it back to the innovation process via the concept of the 'learning region'. Morgan draws upon the work of Lundvall (1994) in order to highlight the role of knowledge and learning in economic development. Morgan's substantive concern is with the role of the Welsh Development Agency (WDA) in regional economic development. He charts the development of the WDA from a glorified property developer to an agency supportive of aftercare, supplier development, technology support and skills formation. The WDA has, for example, used branch plant firms as 'tutors' in the creation of business support programmes. Morgan stresses the interactive process of innovation, and its contextual setting which is shaped by a variety of institutional routines and social conventions, he then develops the concept of a learning region. The learning region is, in this context, a particular structured combination of institutions strategically focused on technological support, learning and economic development that may be able to embed branch plants in the regional economy and hence cause firms to upgrade in situ rather than to relocate away from the region.

4. From networks and institutions to 'power/institutions'

How practical is Kevin Morgan's argument? Can the promotion of networks, or the existence of an institutionally rich locale, account for the form of economic development? It will be clear from the above that considerable emphasis has been switched from the individual entrepreneur to the individual firm in an institutional context. The flow of knowledge and ideas now takes place in two, or more, directions: Morgan (after Schoenberger 1994) suggests the possibility of such an institutional embeddedness changing the organizational position of the branch plant from a subservient one to an active innovator. In a sense the institutional context is about reversing the flows of skills and control out of the region, and creating an embedded economic structure. There is a key weakness: the analysis of power that underpins this account. This section focuses upon the character of the conceptual problems inherent in conventional network and institutionalist analyses and develops an alternative approach that is more sensitive to power.

The recognition of the weaknesses inherent in institutional approaches to the study of contemporary organizations has led a group of writers to propose an alternative: a 'power/institutions' approach (see Clegg 1990; Clegg and Wilson 1991). They argue

that materialist approaches link power and technology, but their characterization of technology is one in which technology conceals power, and hence protects capital's interests. On the other hand 'engineering' views of technology conceptualize it as a neutral agent. From the former view power is all pervasive, from the latter it is non-existent. Clegg's (1989) alternative is to draw upon post-structuralist arguments such as those developed by Foucault, in particular his work on disciplinary practice and governmentality (see Burchell et al. 1991). The concept of disciplinary practice highlights the ways in which the practices of individuals and organizations are defined and regulated by particular modes of rationality. In this context a mode of rationality may correspond to scientific management as embodied in Tayloristic work organization.

The very concept of Taylorism carries with it the notion of delimitation and control of a process. Within a defined process 'jobs' are created as the smallest possible unit of process activity, moreover these tasks have to be co-ordinated: hence the need for 'managers' (see du Gay 1994). Workers, managers and the organization are all governed via this mode of rationality, different decisions are justified or rejected according to its code (see Rose 1989). Most obviously, the modes of rationality of managers and their identities are created through the discourse of 'management science' (see Hoskin 1995). It is important to note several points here. First, that power is conceived as a practice rather than a position within a bureaucracy. Second, that there is no a priori presumption of the direction, or mode of exercise, of power. Third, institutions and structures do not precede agents, and agents do not arrive pre-formed either. In short, power is an effect, or an outcome; as such it cannot be ascribed in the abstract or generalized, it will be particular to, and occasioned by, specific situations.

A similar argument to that developed from Foucault's later work on governmentality has developed through research into the nature of scientific work (known as the sociology of scientific knowledge). A highly influential and clearly argued exposition of the process of innovation, and the relationship between science and technology from such a perspective, is provided by Bruno Latour (1987). Latour argues in favour of two key principles concerning the analysis of scientific work: first, the imperative of not focusing on the final products of science and technology but rather to follow them through the process of their creation. This study of science and technology in the making leads us, he argues, back from cold, stable, objects toward warm, unstable, objects. Thus, Latour argues that the process of science is centrally one of getting others to corroborate one's own findings to make unstable

facts stable. To make them stable these findings must be reproduced or disseminated by others. This leads to Latour's second point that the process of the reproduction of ideas and findings is not a simple copying process, but rather one of translation and transformation.

An analogy can be made with the parlour game of 'Chinese whispers' where by a story is passed around a circle via whispers the cumulative mishearing and mis-interpretation produces a new story by the time it returns to its origin. However, in contradistinction to chance mishearing in the game, Latour views transformations as active and purposeful. Moreover, the circle of people, the network, does not pre-exist and has to be created. So, the interests of a group of people at a dinner party have to be co-opted and co-ordinated before the game can be played in the first place. To be effective the initiator has to enroll the interests of her guests into her plan; she has to make the guests believe that their objectives (having a good time) can only be achieved by playing this game. If they agree, they will submit to the rules and play. They will only continue to play as long as they believe their interests to be satisfied in this way. For example, the game might be disrupted by a guest encouraging others to stop playing Chinese whispers and to begin a game of charades.

This last point is echoed rather more formally by Clegg and Wilson (1991: 243) who argue that "[a]gencies interested in maximizing their strategicality must attempt to transform their point of connection with some other agency or agencies into a necessary 'nodal point': a channel through which traffic between them occurs on terms which privilege the putative strategic agency." In Latour's work a significant 'nodal point' is the laboratory. Laboratories are, for Latour, the places where warm, unstable science is made stable and cold technology: after which it can be let out into the world to be used. After the title of an earlier paper (Latour 1983): '[g]ive me a laboratory and I will raise the world". But, the process of translation and fixing is not final, it does not stop at the laboratory door or the factory gate, different agencies and users will be constantly in the game of translating the technology into their own interests, this may again create further transformations.

Miller and O'Leary (1995) have drawn together these two strands of argument, from Foucault and the sociology of scientific knowledge, and used them to account for the transformation of work practices in a factory producing Caterpillar tractors. They see the factory, like Latour did the laboratory, as a crucial site of transforming and fixing technologies via instruments, ideas and calculations. In many ways the idea

that factories are about production and construction is easy for us to grasp, however, they argue that factories are just as much about the construction of social practices as they are about constructing technical practices and products. In their study they stress how the introduction of new work practices - which would be commonly considered under the label of flexible specialization - should be viewed as an attempt to create a new modality, one which is concerned with the construction of a new form of identity, or economic citizenship, as well as new factory layouts, production arrangements and products. They term this new modality, this new entity, an assemblage. They stress that as such it is always fragile or unstable as the outside world keeps 'intruding'. 'As soon as one element in this complex of interrelated practices and locales was altered or removed, then there was a possibility that the assemblage itself would be modified or transformed" (Miller and O'Leary 1994: 32).

5. Innovation networks and institution building: making science and technology more durable

I think that we can now re-consider Morgan's discussion of the learning region. Drawing upon the 'power/institutions' approach outlined above we should become cautious of two elements of his story. First, the apparent lack of acknowledgement of power. Second, the focus on meso-level bodies such as institutions. A 'power/institutions' account would highlight the role of inward investing companies and their attempts to create a new modality of economic organization, to stabilize their production techniques and technologies, and their workers. Such a modality could be created in a variety of contexts; at the beginning it is simply the idea of a market, and an idea of a factory. The practical establishment of a factory involves a huge range of complex tasks that imply coordination as well as a particular definition of the nature of work and management. The managers of the firm seek to enroll the potential workers, the local sub-contractors, and existing government agencies into their particular task. Aside from the necessity of convincing all of the agents that they should want to be enrolled - perhaps not so difficult in this case - enrollment has to take place.

Agents will have their own interests, they will naturally also seek to achieve them at the same time, in fact the inward investing firm's objectives will only be achieved if they can. In this context it is not surprising to find that the WDA - which clearly has an agenda - attempts to mobilize itself and others to capture the inward investing firm to further its aims: regional development. At each turn the interests get transformed, agencies like the WDA were created, and we learn from Morgan,

actively transformed - from property developer to 'animateur' - in the process of attracting inward investment . Likewise, pace Miller and O'Leary, the system of production developed by the company if established in South Wales will be different to the one established at plants elsewhere in the world.

This brief comment on Morgan's work serves to highlight what sociologists term the 'performative' nature of social relations and the active nature of power. Different entities or assemblages (firms, development agencies, locales, regions, individuals) are constantly re-making themselves, attempting to enroll and being enrolled. Those agencies that succeed in getting others to perform for them - through delegated tasks - create for themselves most power; power that increasingly allows the coercion of others. Delegation in this context does not have to be seen as happening within an organization, if a set of rules and norms are set by an agency and tasks denoted by such rules and norms are performed by others of their own accord, then clearly this is a subtle and effective exercise of power.

Innovation requires context, but context - as if a backdrop - is insufficient. Innovation is a practice that requires co-ordination. Entities created by innovation are unstable: they can only be created under heavily controlled conditions, and with much effort and expense made stable under such conditions. Entities (products, networks, or institutions) can only move out into the world if other agents and interests can be enrolled to reproduce the laboratory or factory in the world. To make any of these entities operative requires the building of networks it also requires the exercise of power. Networks should not be seen as neutral, neither should they be seen as unproblematic conduits of power. Clegg and Wilson (1991:266) highlight this paradox, such that no power is absolute: there is always a space for discretion. "What is crucial is the subordinates' preparedness to bend managerial control and management's success in securing the kind of power circuitry which enables them to do so". Clegg and Wilson (1991: 267) argue that this is not a zero-sum power relation, rather that positive sum outcomes can occur, when they do they may offer fruitful contingencies and create a place for real politics.

So, institutions or networks must be seen as constantly under construction, not ready made; they are unstable but can be made more stable. Moreover, they have a power effect, they are not neutral. The effect is the creation of an identity of a production line worker or manager, the production of a new product, the organization of a factory, or the configuration of a region. Effects cannot be determined a priori, rather they are outcomes of an ongoing progress of struggle to redefine agents interests and

co-operation. The building of locality based networks is an attempt to enroll actors into that locality, in the words of institutionalists, to embed them. However, embeddedness is at best temporary, and it is never total. As scientists build their laboratories, managers build their factories, and regional development agencies build their regions: the trick is to make networks and alliances more stable.

We can also reflect upon the account of science park development outlined by Massey et al (1992) and referred to earlier in this paper. In this account institutions and technology have a role, but one that is subservient to capital/power. So, science parks became an extension of the spatial and technical division of labour. A re-reading from a power/institutionalist perspective might suggest that science parks were an example of a proto-agent, or an assemblage, that sought to mobilize resources to build new products. The network builders in this case were predominantly universities, property developers, local authorities and agents of central government. Science park promoters were most successful in getting property related concerns to pass through their 'nodal point' and to collaborate with them. For local authorities the potential advantage was job creation and technology transfer to promote other firms. For property developers the interest was a return on investment. These agencies were less successful in getting firms to locate there who wanted to engage in technology transfer; many just wanted nice property in a good location with a prestigious address. Like the factory described by Miller and O'Leary (1995) the science parks were unstable assemblages.

Many science parks were unable to recruit sufficient firms or they recruited the wrong firms (non-innovators). Moreover, there is evidence of the instability of science parks manifest in an identity crisis through the concern with potential confusion with business parks; this accounts for the attempt by park managers to create their own network (UKSPA) central to which is a 'membership criterion' of certain the shared characteristics of the science park (see UKSPA 1990). Moreover, there are some further interesting dimensions that have emerged from Massey's (1995) work which focuses upon the intersection of gender relations, identity and work culture on (and off) science parks and highlights the significance of the regulation of identity and masculinity of male workers in high-tech firms.

The arguments developed above are suggestive of the similarities between the development of science parks and the construction of institutions and networks. What is different is the effect. The science park builders were perhaps less ambitious in their attempts to enroll actors by physically limiting their domain of action, they

sought to bring together all of their resources at one (physical as well as organizational) point. The network builders of South Wales were less limited in their spatial scope. They spun their webs more effectively, by enrolling agents at all levels from individuals, to firms, to organizations; they then sought to articulate them together in order to achieve their ends. This is not to suggest that there has been a unitary agent in control, or that all objectives have been achieved. What is particularly interesting in the WDA case is, as Morgan notes, that the WDA has itself been changed, been reconfigured, in this process.

6. Conclusion

This paper has stressed the importance of a concern with networks and institutions. However, it has been very critical of their conception. The 'power/institution' argument counters the idea of institution as 'context' or as a meso-level intermediary; it also resists the representation of networks as neutral or 'cloaks' of power. It does not presume that agents (which may be individuals, firms, or regions) come pre-formed, or ready made, rather its central concern is with the ways in which agents are constructed and translated in practice; it is also concerned with what the effects of such translations are in terms of power.

This paper has suggested that the 'grand transition' debate can be side-stepped, what is important is the analysis of the processes by which stabilization of objects and agents happens, and what power effects they have (see also Murdoch 1995). This approach implies a rather different perspective on innovation, economic and technological change. It encourages researchers to follow policy makers, and firms, and products through their networks into society. Agents that seek to achieve a position of stategicality within networks would do well to pay attention to the processes and techniques of network building and the translation of ideas and technologies. Building a network, a science park, or a better mouse trap, is not sufficient unless others can be convinced of its value and be enrolled into its promotion and use.

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