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Organizational Innovation

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ABSTRACT

This paper examines the dynamic and multi-level relationship between organization and innovation from three different but interdependent perspectives: a) the relationship between organizational structural forms and innovativeness; b) innovation as a process of organizational learning and knowledge creation; and c) organizational capacity for change and adaptation. It provides a critical review of the literature, focusing especially on the question of whether organizations can change and adapt to major discontinuous technological change and environmental shifts, or whether radical transformation in organizational forms occurs principally at the population level through the process of selection. This is discussed with reference to organizational ecology theories, the punctuated equilibrium model and theories of strategic adaptation and continuous change. The paper argues that organizational innovation may be a necessary pre-condition for technological innovation, and thus it is important to take greater account of the role of endogenous organizational forces such as capacity for learning, values, interests and power in shaping organizational transformation and technological change.

Keywords: organization; innovation; learning and knowledge creation; organizational innovativeness; organizational change.

1. INTRODUCTION

Organizational creation is fundamental to the process of innovation (Van de Van et al 1999). Innovation constitutes part of the system that produces it. The system is itself 'organization' or 'organizing', to put it in Weick's (1979) term. The ability of an organization to innovate is a pre-condition for the successful utilization of inventive resources and new technologies. Conversely, the introduction of new technology often presents complex opportunities and challenges for organizations, leading to changes in managerial practices and the emergence of new organizational forms. Organizational and technological innovations are intertwined. Schumpeter (1950) saw organizational changes, alongside new products and processes, as well as new markets as factors of 'creative destruction'.

In a general sense, the term 'organizational innovation' refers to the creation or adoption of an idea or behaviour new to the organization (Daft 1978; Damanpour and Evan 1984; Damanpour 1996). The existing literature on organizational innovation is indeed very diverse and not well integrated into a coherent theoretical framework. The phenomenon of 'organizational innovation' is subject to different interpretations within the different strands of literature. The literature can be broadly classified into three different streams, each with a different focus and a set of different questions which it addresses. Organizational design theories focus predominantly on the link between structural forms and the propensity of an organization to innovate (Burns and Stalker 1961; Lawrence and Lorsch 1967; Mintzberg 1979). The unit of analysis is the organization and the main research aim is to identify the structural characteristics of an innovative organization, or to determine the effects of organizational structural variables on product and process innovation. This strand of literature has been most influential and well integrated into the literature on technological innovation (e.g. Teece 1998). Theories of organizational cognition and learning, by contrast, tend to focus on the micro-level process of how organizations develop new ideas for problem solving. They emphasise the cognitive foundations of organizational innovation which is seen to relate to the learning and organizational knowledge creation process (Agyris and Schon 1978; Nonaka 1994;

Nonaka and Takeuchi 1995). This camp of research provides a micro-lens for understanding the capacity of organizations to create and exploit new knowledge necessary for innovative activities. A third strand of research concerns organizational change and adaptation, and the processes underlying the creation of new organizational forms. Its main focus is to understand whether organizations can overcome inertia and adapt in the face of radical environmental shifts and technological changes, and whether organizational change occurs principally at the population level through selection (e.g. Hannan and Freeman 1977; 1984; Romanellie and Tushman 1994). In this context, innovation is considered as a capacity to respond to changes in the external environment, and to influence and shape it (Burgleman 1991; Child 1997).

While there are important empirical overlaps between these three different strands of research, they remain theoretically distinct. The separation of these research streams has prevented us from developing a clear view of 'organizational innovation', and of how its different dimensions are interrelated.[1] This chapter seeks to understand the interaction between organization and innovation from the three different but interdependent perspectives. Section 2 examines the relationship between organizational structures and innovation, drawing on the various strands of work in organizational design theories. Section 3 looks at organizational innovation from the micro-level perspective of learning and organizational knowledge creation. It argues that organizations with different structural forms vary in their patterns of learning and knowledge creation, engendering different types of innovative capabilities. Section 4 discusses organizational adaptation and change, focusing on whether and how organizations can overcome inertia in the face of discontinuous technological changes and radical shifts in environmental conditions. The chapter concludes by discussing the limitations and gaps in the existing literatures, and the areas for future research.

2. ORGANIZATIONAL STRUCTURE AND INNOVATION

Conventional research on organizational innovativeness has explored the determinants of an organization's propensity to innovate. Although researchers have analysed the

influence of individual, organizational and environmental variables (Kimberley and Evanisko 1981; Baldridge and Burnham 1975), most of the research has focused on organizational structure (Wolfe 1994). Within the field of organizational design theories, there has been a long tradition of investigating the links between environment, structures and organizational performance. Several studies have shown how certain organizational structures facilitate the creation of new products and processes, especially in relation to fast changing environments. The work of micro-economists in the field of strategy also emphasises the superiority of certain organizational forms within particular types of business strategies and product markets. (Teece 1998). More recently, there has been a significant shift in the focus of theoretical enquiry away from purely formal structures towards a greater interest in organizational processes, relationships and boundaries (Pettigrew and Fenton 2000). The growing influence of economic sociology and the introduction of 'network' concepts into the organizational design field denotes such a shift. The relationship between network structure and innovation is dealt with by Powell and Grodal (chapter 4, this volume).

2.1. Contingency Theory: context, structure and organizational innovativeness

The classical theory of organizational design was marked by a preoccupation with universal forms and the idea of 'one best way to organise'. The work of Weber (1947) on the bureaucracy and of Chandler (1962) on the multidivisional form, was most influential. The assumption of 'one best way' was, however, challenged by research carried out during the 1960s and 1970s under the rubric of contingency theory which explains the diversity of organizational forms and their variations with reference to the demands of context. Contingency theory argues that the most 'appropriate structure' for an organization is the one that best fits a given operating contingency, such as scale of operation (Pugh et al 1969; Blau 1970), technology (Woodward 1965; Perrow 1970) or environment (Burns and Stalker 1961; Lawrence and Lorsch 1967). This strand of research and theory underpins our understanding of the relationships between the nature of the task and technological environments, structure and performance. However, only

some of the studies deal specifically with the question of how structure is related to innovation.

Burns and Stalker's (1961) polar typologies of 'mechanistic' and 'organic' organizations (see Box 1) demonstrate how the differences in technological and market environment, in terms of their rate of change and complexity, affect organizational structures and innovation management. Their study found that firms could be grouped into one of the two main types: the former more rigid and hierarchical, suited to stable conditions; and the latter, a more fluid set of arrangements, adapting to conditions of rapid change and innovation. Neither type is inherently right or wrong, but the firm's environment is the contingency that prompts a structural response. Related is the work of Lawrence and Lorsch (1967) on principles of organizational differentiation and integration and how they adapt to different environmental conditions, including the market, technical-economic and the scientific sub-environments, of different industries. Whereas Burns and Stalker treat an organization as an undifferentiated whole that is either mechanistic or organic, Lawrence and Lorsch recognise that mechanistic and organic structures can co-exist in different parts of the same organization owing to the different demands of the functional sub-environments. The work of these earlier authors had a profound impact on organizational theory and provided useful design guidelines for innovation management. Burns and Stalker's model remains highly relevant for our understanding of the contemporary challenges facing many organizations in their attempts to move away from the mechanistic towards the organic form of organizing, as innovation becomes more important and the pace of environmental change accelerates. Lawrence and Lorsch's suggestion that mechanistic and organic structures can coexist is reflected in the contemporary debate about the importance of developing hybrid modes of organizations - 'ambidextrous organizations' - one that is capable of coping with both evolutionary and revolutionary technological changes (Tushman and O'Reilly 1996; see also sections 4.2 and 4.3)

Box 1 Burns and Stalker: Mechanistic and Organic Structures

Burns and Stalker (1961) set out to explore whether differences in the technological and market environments affect the structure and management processes in firms. They investigated twenty manufacturing firms in depth, and classified environments into 'stable and predictable' and 'unstable and unpredictable'. They found that firms could be grouped into one of the two main types, mechanistic and organic forms, with management practices and structures that Burns and Stalker considered to be logical responses to environmental conditions.

The *Mechanistic Organization* has a more rigid structure and is typically found where the environment is stable and predictable. Its characteristics are:

a) tasks required by the organization are broken down into specialised, functionally differentiated duties and individual tasks are pursued in an abstract way, that is more or less distinct from the organization as a whole;
b) the precise definition of rights, obligations and technical methods is attached to roles, and these are translated into the responsibilities of a functional position, and there is a hierarchical structure of control, authority and communication;
c) Knowledge of the whole organization is located exclusively at the top of the hierarchy, with greater importance and prestige being attached to internal and local knowledge, experience and skill rather than that which is general to the whole organization;
d) a tendency for interactions between members of the organization to be vertical, i.e. between superior and subordinate.

The *Organic Organization* has a much more fluid set of arrangements and is an appropriate form to changing environmental conditions which require emergent and innovative responses. Its characteristics are:

a) individuals contribute to the common task of the organization and there is continual adjustment and re-definition of individual tasks through interaction with others;
b) the spread of commitment to the organization beyond any technical definition, a network structure of control authority and communication, and the direction of communication is lateral rather than vertical;
c) knowledge may be located anywhere in the network, with this ad hoc location becoming the centre of authority and communication;
d) importance and prestige attach to affiliations and expertise valid in industrial and technical and commercial milieu external to the firm.

Mechanistic and organic forms are polar types at the opposite ends of a continuum and, in some organizations, a mixture of both types could be found.

Source: Burns and Stalker (1961).

Another important early contribution is the work of Mintzberg (1979) who synthesised much of the work on organizational structure and proposed a series of archetypes that provide the basic structural configurations of firms operating in different environments. In line with contingency theory, he argues that the successful organization designs its structure to match its situation. Moreover, it develops a logical configuration of the design parameters. In other words, effective structuring requires consistency of design parameters and contingency factors. The 'configurational hypothesis' suggests that firms are likely to be dominated by one of the five pure archetypes identified by Mintzberg, each with different innovative potential: simple structure, machine bureaucracy, professional bureaucracy, divisionalised form and adhocracy. The characteristic features of the archetypes and their innovative implications are shown in Table 1. The main thrust of the argument is that bureaucratic structures work well in stable environments but they are not innovative and cannot cope with novelty or change. Adhocracies, by contrast, are highly organic and flexible forms of organization capable of radical innovation in a volatile environment (see also section 3.3).

Contingency theories account for the diversity of organizational forms in different technological and task environments. They assume that as technology and product markets become more complex and uncertain, and task activities more heterogeneous and unpredictable, organizations will adopt more adaptive and flexible structures, and they will do so by moving away from bureaucratic to organic forms of organising. The underlying difficulties in achieving the 'match', however, are not addressed in this strand of research. Contingency theories neglect the possibility that the factors identified as most important in this theory are susceptible to different interpretations by organizational actors (Daft and Weick 1984), and ignores the influence of other factors such as managerial choice (Child 1972; 1997) or institutional pressures (Powell and DiMaggio 1991). These aspects will be discussed in sections 3 and 4.

Table 1 Mintzberg's structural archetypes and their innovative potentials

Organization archetype	Key features	Innovative potential
Simple structure	An organic type centrally controlled by one person but can respond quickly to changes in the environment, e.g. small start-ups in high-technology.	Entrepreneurial and often highly innovative, continually searching for high-risk environments. Weaknesses are the vulnerability to individual misjudgement and resource limits on growth.
Machine bureaucracy	A mechanistic organization characterized by high level of specialization, standardization and centralized control. A continuous effort to routinize tasks through formalization of worker skills and experiences, e.g. mass production firms.	Designed for efficiency and stability. Good at dealing with routine problems, but highly rigid and unable to cope with novelty and change.
Professional bureaucracy	A decentralised mechanistic form which accords a high degree of autonomy to individual professionals. Characterized by individual and functional specialization, with a concentration of power and status in the 'authorized experts'. Universities, hospitals, law and accounting firms are typical examples.	The individual experts may be highly innovative within a specialist domain, but the difficulties of coordination across functions and disciplines impose severe limits on the innovative capability of the organization as a whole.
Divisionalized form	A decentralized organic form in which quasi-autonomous entities are loosely coupled together by a central administrative structure. Typically associated with larger organizations designed to meet local environmental challenges.	An ability to concentrate on developing competency in specific niches. Weaknesses include the 'centrifugal pull' away from central R&D towards local efforts, and competition between divisions which inhibit knowledge sharing.
Adhocracy	A highly flexible project-based organization designed to deal with instability and complexity. Problem-solving teams can be rapidly reconfigured in response to external changes and market demands. Typical examples are professional partnerships and software engineering firms.	Capable of fast learning and unlearning; highly adaptive and innovative. However, the unstable structure is prone to short life, and may be driven over time toward the bureaucracy (see also section 3.3).

Sources: Mintzberg (1979); Tidd et al (1997: 313-314); Lam (2000).

2.2 Industrial economics: strategy, structure and the innovative firm

The work of micro-economists in the field of strategy considers organizational structure as both cause and effect of managerial strategic choice in response to market opportunities. Organizational forms are constructed from the two variables of 'strategy' and 'structure'. The central argument is that certain organizational types or attributes are more likely to yield superior innovative performance in a given environment because they are more suited to reduce transaction costs and cope with alleged capital market failures. The multi-divisional, or M-form, for example, has emerged in response to increasing scale and complexity of enterprises and is associated with a strategy of diversification into related product and technological areas (Chandler 1962). It can be an efficient innovator within certain specific product markets, but may be limited in its ability to develop new competencies.

The theory of 'the innovative enterprise' developed by Lazonick and West (1998) is rooted in the Chandlerian framework, inasmuch as it focuses on how strategy and structure determine the competitive advantage of the business enterprise. It also builds on Lawrence and Lorsch's (1967) conceptualisation of organizational design problems as differentiation and integration. This theory postulates that, over time, business enterprises in the advanced economies have to achieve a higher degree of 'organizational integration' in order to sustain competitive advantage. Japanese firms are said to have gained a competitive advantage in industries such as electronics and automobiles over the USA because of their superior organizational capacity for integrating shop-floor workers and enterprise networks, enabling them to plan and coordinate specialised divisions of labour and innovative investment strategies. Lazonick and West also argue that those US firms (e.g. Motorola and IBM) that have been able to sustain their competitive advantage also benefit from a high degree of organizational integration. The 'organizational integration' hypothesis directs our attention to the social structure of the enterprise and its internal cohesiveness as a critical determinant of corporate strategy and innovative performance. But this interpretation itself is insufficiently attentive to the contingency

viewpoint - the Japanese model of organizational integration works well in established technological fields in which incremental innovation is important, but not necessarily in rapidly developing new fields where radical innovation is vital for competitiveness.

Teece (1998) explains the links between firm strategy, structure and the nature of innovation by specifying the underlying properties of technological innovation and then proposing a related set of organizational requirements of the innovation process. His framework suggests that both the formal (governance modes) and informal (cultures and values) structures, as well as firms' external networks, powerfully influence the rate and direction of their innovative activities. Based on four classes of variables including firm boundaries, internal formal structure, internal informal structure (culture), and external linkages, the author identifies four archetypal corporate governance modes: multiproduct integrated hierarchy, high-flex silicon valley type, virtual corporation and conglomerate. He argues that different organizational arrangements are suited to different types of competitive environments and differing types of innovation. Teece (1998: 156-7) illustrates the argument by distinguishing between two main types of innovation, namely 'autonomous' and 'systemic' innovation, and matching them with different organizational structures. An autonomous innovation is one that can be introduced to the market without massive modification of related products and processes. An example is the introduction of power steering which did not initially require any significant alternatives to the design of cars or engines. This can often be advanced rapidly by smaller autonomous structures, such as 'virtual' firms, accomplishing necessary coordination through arm's-length arrangements in the open market. By contrast, the move to front-wheel drive required the complete redesign of many automobiles in the 1980s. This type of change is systemic innovation which favours integrated enterprises because it requires complex coordination amongst various subsystems, and hence is usually accomplished under one 'roof'. These propositions, however, have yet to be empirically verified (Teece 1998: 146-7).

The work by micro-economists highlights the interaction between market and organizational factors in shaping innovative performance, although it devotes little attention to the internal dynamics and social processes within organizations. Many of the

empirical predictions within this literature on the relationship between firm strategy and structure, and innovative performance have yet to be verified, and pose intriguing opportunities for future research.

3. ORGANIZATIONAL COGNITION, LEARNING AND INNOVATION

3.1. The cognitive foundations of organizational innovation

The 'structural perspectives' discussed above treats innovation as an output of certain structural features, some organizational researchers regard innovation as 'a process of bringing new, problem-solving, ideas into use' (Amabile 1988; Kanter 1983). Mexias and Glynn (1993: 78) define innovation as 'nonroutine, significant, and discontinuous organizational change that embodies a new idea that is not consistent with the current concept of the organization's business'. This approach defines an innovative organization as one that is intelligent and creative (Glynn 1996; Woodman et al 1993), capable of learning effectively (Senge 1990; Agyris and Schon 1978) and creating new knowledge (Nonaka 1994; Nonaka and Takeuchi 1995). Cohen and Levinthal (1990) argue that innovative outputs depend on the prior accumulation of knowledge that enables innovators to assimilate and exploit new knowledge. From this perspective, understanding the role of cognition and organizational learning in fostering or inhibiting innovation becomes crucially important.

The cognitively oriented literature in organization and management research is rooted in cognitive psychology and analyses the various intervening mental processes that mediate responses to the environment (see, Hodgkinson 2003) . The terms 'cognition' or 'cognitive' refer to the idea that individuals develop mental models, belief systems and knowledge structures that they use to perceive, construct and make sense of their worlds and to make decisions about what actions to take (Weick 1979;1995; Walsh 1995). Individuals are limited in their ability to process the complex variety of stimuli contained in the external environment (Simon's 'bounded rationality' problem), and hence they develop 'mental representations' to filter, interpret and reconstruct incoming information

which, under certain circumstances may form basis of creative ideas and new insights, but may also lead to biases and inertia. The psychological literature has focused predominately on the information processing consequences of mental models. Organization and management researchers have extended the analysis to the group and organizational levels. Their analysis suggests that organizations develop collective mental models and interpretive schemes which affect managerial decision making and organizational action. Organizational cognition differs from individual cognition because it encompasses a social dimension. Thus much of the research has focused on the socio-cognitive connectedness, and seeks to account for the social processes in the formation of collective cognition and knowledge structures.

The idea that organizations can think and act collectively, and serve as a repository of organised knowledge has stimulated much research on organizational learning and knowledge creation. This work has sought to understand how social interaction and group dynamics within organizations shape collective intelligence, learning and knowledge generation, and yields important insights into the micro-dynamics underpinning the innovative capability of organizations. It has also examined how shared mental models or interpretive schemes affect organizational adaptiveness. On the positive side, some argue that shared interpretive schemes facilitate an organization's capacity to process and interpret information in a purposeful manner, promote organizational learning and collective problem solving and thus enhance its adaptive potential (Fiol 1993; Brown and Duguid 1991). Other studies suggest that organizational interpretive schemes can create 'blind spots' in organizational decision-making and block organizational change (Shrivasta and Schneider1984; Shrivastava et al 1987). The paradox seems to be that organizational cognition can be at once enabling and crippling, like two sides of the same coin.

Viewing organizational innovation from the cognitive perspective shifts our analysis from organizational structures and systems to the processes of organizational learning and knowledge creation. The analysis below suggests that organizations with different structural forms vary in their patterns of learning and knowledge creation, giving rise to

different types of innovative capabilities. Organizational boundaries and the social context of learning influence an organization's cognitive vision and its capacity for radical change and innovation.

3.2. Organizational learning and knowledge creation: shared context and collective learning

Innovation can be understood as a process of learning and knowledge creation through which new problems are defined and new knowledge is developed to solve them. Central to theories of organizational learning and knowledge creation is the question of how organizations translate individual insights and knowledge into collective knowledge and organizational capability. While some researchers argue that learning is essentially an individual activity (Simon 1991; Grant 1996), most theories of organizational learning stress the importance of collective knowledge as a source of organizational capability. Collective knowledge is the accumulated knowledge of the organization stored in its rules, procedures, routines and shared norms which guide the problem-solving activities and patterns of interaction among its members. Collective knowledge resembles the 'memory' or 'collective mind' of the organization (Walsh and Ungson 1991). It can either be a 'stock' of knowledge stored as hard data; or represent knowledge in a state of 'flow' emerging from interaction. Collective knowledge exists between rather than within individuals. It can be more, or less than the sum of the individuals' knowledge, depending on the mechanisms that translate individual into collective knowledge (Glynn 1996). Both individuals and organizations are learning entities. All learning activities, however, take place in a social context, and it is the nature and boundaries of the context that make a difference to learning outcomes.

Much of the literature on organizational learning points to the importance of social interaction, context and shared cognitive schemes for learning and knowledge creation (Nonaka 1994; Agyris and Schon 1978; Lave and Wenger 1991; Brown and Duguid 1991; 1998). This builds on Polanyi's (1966) idea that a large part of human knowledge is subjective and tacit, and cannot be easily codified and transmitted independent of the

knowing subject. Hence its transfer requires social interaction and the development of shared understanding and common interpretive schemes.

Nonaka's theory of organizational knowledge creation is rooted in the idea that shared cognition and collective learning constitute the foundation of organizational knowledge creation (Nonaka 1994; Nonaka and Takeuchi 1995). At the heart of the theory is the idea that tacit knowing constitutes the origin of all human knowledge, and organizational knowledge creation is a process of mobilising individual tacit knowledge and fostering its interaction with the explicit knowledge base of the firm. Nonaka argues that knowledge needs a context to be created. He uses the Japanese word 'ba', which literally means 'place', to describe such a context. *'Ba'* provides a shared social and mental space for the interpretation of information, interaction and emerging relationships that serves as a foundation for knowledge creation. Participating in a *'ba'* means transcending one's limited cognitive perspective or social boundary to engage in a dynamic process of knowledge sharing and creation. In a similar vein, the notion of 'community of practice' developed in the work of Lave and Wenger (1991), Wenger (1998) and Brown and Duguid (1991; 1998), suggests that organizational members construct their shared identities and perspectives through 'practice', that is shared work experiences. Practice provides a social activity in which shared perspectives and cognitive repertoires develop to facilitate knowledge sharing and transfer. Hence, the work group provides an important site where intense learning and knowledge creation may develop. The group, placed at the intersection of horizontal and vertical flows of knowledge within the organization, serves as a bridge between the individual and organization in the knowledge creation process. Nonaka's theory stresses the critical role of the semi-autonomous project teams in knowledge creation. Much of the recent literature on new and innovative forms of organization also focuses on the use of decentralised, group-based structure as a key organizing principle.

Many organizational and management researchers regard the firm as a critical social context where collective learning and knowledge creation takes place. Nonaka and Takeuchi (1995) talk about the 'knowledge creating company'. Argyris and Schon (1978)

suggest that an organization is, at its root, a cognitive enterprise that learns and develops knowledge. 'Organizational knowledge' essentially refers to the shared cognitive schemes and distributed common understanding within the firm that facilitate knowledge sharing and transfer. It is similar to Nelson and Winter's (1982) concept of 'organizational routines': a kind of collective knowledge rooted in shared norms and beliefs that aids joint-problem solving and capable of supporting complex patterns of action in the absence of written rules. The notion of 'core competence' (Prahalad and Hamel 1990) implies that the learning and knowledge creation activities of firms tend to be cumulative and path-dependent. Firms tend to persist in what they do because learning and knowledge are embedded in social relationships, shared cognition and existing ways of doing things (Kogut and Zander 1992). Several authors have analysed how collective learning in technology depends on firms' cumulative competences and evolves along specific trajectories (Dosi 1988; Pavitt 1991). Thus, the shared context and social identity associated with strong group-level learning and knowledge accumulation processes may constrain the evolution of collective knowledge. Firms may find it difficult to unlearn past practices and explore alternative ways of doing things. Levinthal and March (1993) argue that organizations often suffer from 'learning myopia', and have a tendency to sustain their current focus and accentuate their distinctive competence, what they call falling into a 'competency trap'. The empirical research by Leonardo-Barton (1992) illustrates how firms' 'core capabilities' can turn into 'core rigidities' in new product development.

An inherent difficulty in organizational learning is the need to maintain an external boundary and identity while at the same time keeping the boundary sufficiently open to allow the flow of new knowledge and ideas from outside. March (1991) points out that a fundamental tension in organizational learning is balancing the competing goals of 'the exploitation of old certainties' and the 'exploration of new possibilities'. Whereas knowledge creation is often a product of an organization's capability to recombine existing knowledge and generate new applications from its existing knowledge base, radically new learning tends to arise from contacts with those outside the organization who are in a better position to challenge existing perspectives and paradigms. Empirical

research has suggested that sources of innovation often lie outside an organization (von Hippel 1988; Lundvall 1992). External business alliances and network relationships, as well as using new personnel to graft new knowledge onto the existing learning systems, are important mechanisms for organizational learning and knowledge renewal in an environment characterised by rapid technological development and disruptive changes. The 'dynamic capability' perspective argues that the long-term competitive performance of the firm lies in its ability to build and develop firm-specific capability and, simultaneously, to renew and re-configure its competences in response to an environment marked by 'creative destruction' (Teece and Pisano 1994). Thus, a fundamental organizational challenge in innovation is not simply to maintain a static balance between exploitation and exploration, or stability and change, but a continuous need to balance and coordinate the two dynamically throughout the organization.

3.3. Two alternative models of learning and innovative organizations: 'J-form' vs. 'Adhocracy'

All organizations can learn and create knowledge, their learning patterns and innovative capabilities vary. During the past decade, a large literature has discussed new organizational models and concepts designed to support organizational learning and innovation. These models include 'high performance work systems' or 'lean production' (Womack et al 1990), pioneered by Japanese firms in the automobile industry; and the 'N-form corporation' (Hedlund 1994) and 'hypertext organization' (Nonaka and Takeuchi 1995). More recent, concepts such as 'cellular forms' (Miles et al 1997); 'modular forms' (Galunic and Eisenhardt 2001) and 'project-based networks' (DeFillippi 2002) reflect the growth of flexible and adaptive forms of organization with a strategic focus on entrepreneurship and radical innovation in knowledge-intensive sectors of the economy. These studies highlight the different ways in which firms seek to create learning organizations capable of continuous problem solving and innovation. Very few studies explain the nature of the learning processes underpinning these structural forms, the types of innovative competences generated and the wider institutional context within which this organizational learning is embedded.

A closer examination of the literature on new forms suggests that the various models of innovative organizations can be broadly classified into two polar ideal types, namely, the 'J-form' and 'adhocracy'. The former refers to an organization which is good at cumulative learning and derives its innovative capabilities from the development of organization-specific collective competences and problem solving routines. The term J-form is used because its archetypal features are best illustrated by the 'Japanese type' of organizations, such as Aoki's (1988) model of the 'J-firm', and Nonaka and Takeuchi's (1995) 'knowledge creating companies'. Adhocracy (Mintzberg, 1979), by contrast, tends to rely more upon individual specialist expertise organized in flexible market-based project teams capable of speedy responses to changes in knowledge and skills, and integrating new kinds of expertise to generate radical new products and processes. Mintzberg's term is used here to capture the dynamic, entrepreneurial and adaptive character of the kind of organization typified by Silicon Valley type companies (Bahrami and Evans 2000). Both the 'J-form' and 'adhocracy' are learning organizations with strong innovative capabilities, but they differ markedly in their structural forms, patterns of learning and the type of innovative competences generated.

The J-form organization relies on knowledge that is embedded in its operating routines, team relationships and shared culture. Learning and knowledge creation within the J-form takes place within an 'organizational community' that incorporates shopfloor skills in problem solving, and intensive interaction and knowledge sharing across different functional units. The existence of stable organizational careers rooted in an internal labour market provide an incentive for organizational members to commit to organizational goals and to develop firm-specific problem solving knowledge for continuous product and process improvement. New knowledge is generated through the fusion, synthesis and combination of the existing knowledge base. The J-form tends to develop a strong orientation towards pursuing an incremental innovation strategy and do well in relatively mature technological fields characterised by rich possibilities of combinations and incremental improvements of existing components and products (e.g. machine based industries, electronics components and automobiles). But the J-form's

focus on nurturing organizationally embedded, tacit knowledge and its emphasis on continuous improvement in such knowledge can inhibit learning radically new knowledge from external sources. The disappointing performance of Japanese firms in such fields as software and biotechnology during the 1990s may constitute evidence of the difficulties faced by 'J-form firms' in entering and innovating in rapidly developing new technological fields (Lam 2002; Whitely 2003; see also box 2).

Box 2 Japan: an example of organizational community model of learning

The Japanese economy is characterised by a high level of cooperation and organizational integration. This occurs through extensive long-term collaboration between firms in business groups and networks. Additionally, integration within large firms is particularly strong. Japanese social institutions and employment practices foster the close involvement of shopfloor workers in the development of organizational capability. The successful state education system and large-company driven networks equip the majority of workers with a high level of skills that employers respect and so can rely on them to contribute usefully to innovation activities. The internal labour market system is characterised not only by long-term attachment but also by well-organised training and job rotation schemes. These practices promote continuous skills formation through learning-by-doing and systematic career progression (Lam 1996; 1997). Hence, a strong organizational capacity to accumulate knowledge and learn incrementally. Over the past three decades, Japanese firms have gained international competitive advantage in those industries such as transport equipment, office machines, consumer electronics, electronic components for computing equipment and telecommunication hardware. The strength of Japan in these sectors stems from the capability of firms to develop highly flexible production systems through the close integration of shop-floor skills and experience, the tight linkages between R&D, production and marketing, and a unique innovation strategy based on continual modification and upgrading of existing components and products (Womack et al 1991). Conversely, organization-specific and path-dependent learning have constrained Japan's success in a number of leading-edge technological fields. Japan finds it harder to excel in sectors which do not exclusively rely on incremental upgrading of system components (e.g. aerospace; supercomputers) and those in which fast-paced radical innovation are crucial for success (e.g. pharmaceuticals and biotechnology). The human-network-based interaction and internal tacit knowledge transfer appear to be less effective in coordinating systems involving complex interactions among components. The organizational community model of learning limits the development of highly specialised scientific expertise, and makes it difficult to adopt radically new skills and knowledge needed for radical learning in emerging new technological fields.

The adhocracy is a organic and adaptive form of organization that is able to fuse professional experts with varied skills and knowledge into adhoc project teams for solving complex and often highly uncertain problems. Learning and knowledge creation in an adhocracy occurs within professional teams that often are composed of employees from

different organizatons. Careers are usually structured around a series of discrete projects rather than advancing within an intra-firm hierarchy. The resulting project-based career system is rooted in a relatively fluid occupational labour market which permits the rapid reconfiguration of human resources to align with shifting market requirements and technological changes. The adhocracy has a much more permeable organizational boundary that allows the insertion of new ideas and knowledge from outside. This occurs through the recruitment of new staff, and the open professional networks of the organizational members that span organizational boundaries. The adhocracy derives its competitive strength from its ability to reconfigure the knowledge base rapidly to deal with high levels of technical uncertainty, and to create new knowledge to produce novel innovations in emerging new industries. It is a very adaptive form of organization capable of dynamic learning and radical innovation. However, the fluid structure and speed of change may create problems in knowledge accumulation, since the organization's competence is embodied in its members' professional expertise and market-based know-how which are potentially transferable. The adhocracy is subject to knowledge loss when individuals leave the organization. Starbuck (1992: 725), for instance, talks about the 'porous boundaries' of this type of organizations and points out that they often find it hard to keep unique expertise exclusive.

The long-term survival of this loose, permeable organizational form requires the support of a stable social infrastructure rooted in a wider occupational community or localised firm networks. The example of high technology firms in Silicon Valley highlights the importance for the 'adhocracy' of supportive local labour markets and other external institutions typically included in analyses of national, sectoral and regional innovation systems (Saxenian 1996; Bahrami and Evans 2000; Angels 2000; see also the chapters in this volume by Edquist, Asheim and Gerlter, and Malerba, as well as box 3).

Box 3 Silicon Valley: an example of professional team model of learning

Silicon Valley has been an enormously successful and dynamic region characterised by rapid innovation and commercalisation in the fast growing technological fields. The core industries of the region include microelectronics, semiconductors, computer networking, both hardware and software, and more recently biotechnology. Firms operating in these industries undergo frequent reconfiguration and realignment in order to survive in a constantly changing environment marked by incessant innovation. The availability of a large pool of professional experts with known reputations in particular fields enables firms to quickly reconstitute their knowledge and skill base in the course of their innovative endeavours. The rapid creation of new start-up firms focusing on novel innovative projects, and the ease with which project-based firms are able to assemble and reassemble their teams of highly-skilled scientists and engineers to engage in new innovative activities are central to the technological and organizational dynamism of the region. The high rate of labour mobility and extensive hiring and firing creates a permissive environment for entrepreneurial start-ups and flexible reconfiguration of project teams and knowledge sources. Labour mobility within the context of a region plays a critical role in the generation of professional networks and facilities the rapid transmission of evolving new knowledge, a large part of which may be tacit. Such a regionally based occupational labour market provides a stable social context and shared industrial culture needed to ensure the efficient transfer of tacit knowledge in an inter-firm career framework. The shared context and industry-specific values within the regional community ensure that tacit knowledge will not be wasted when one changes employers, and this gives the individual a positive incentive to engage in tacit 'know-how' learning (Deffillipi and Arthur 1996). A regionally-based labour market and networks of firms create a stable social structure to sustain collective learning and knowledge creation within and across firm boundaries. The creation of a wider social learning system amplifies the learning and innovative capability of the individual firms locating within the system. It provides an anchor of stability for fostering and sustaining the innovative capability of the adhocracy.

Although firms in the high-technology sectors are under intense pressure to learn faster and organize more flexibly, evidence thus far suggests that complete adhocracies remain rare. Adhoracies are usually confined to organizational subunits engaged in creative work (e.g. 'skunk work' adhocracies) (Quinn 1992: 294-5), or knowledge-intensive professional service fields (e.g. law, management consultancies, software engineering design) where the size of the firm is generally relatively small, enabling the whole organization to function as an interdependent networks of project teams (DeFillippi 2002). Attempts by large corporations to adopt the adhocracy mode have proved to be difficult to sustain in the long-run. An illustration is the case of Oticon, the Danish manufacturer of hearing aids, which adopted a radical form of project-based organization (described as the

'spaghetti organization') to stimulate entrepreneurship and innovation but only to find itself giving way to a more traditional matrix organization a decade later (Foss 2003) (see, Box 4). Elsewhere, the most successful examples of adhocracies are found in regionally based industrial communities, as in the case of Silicon Valley, and other high-technology clusters. There, the agglomeration of firms creates a stable social context and shared cognitive framework to sustain collective learning and reduce uncertainty associated with swift formation of project teams and organizational changes. An important item for future research is a clear identification of the population of 'adhocracies' in different industries and regions of the global 'knowledge-based economy'. Current work on this organizational type consists largely of case studies and anecdotes.

Box 4 Oticon: the Rise and Decline of the 'Spaghetti Organization'

Oticon, a Danish electronics producer, is one of the world market leaders in hearing aids. The company became world famous for radical organizational transformation in the early 1990s, and has been treated as an outstanding example of the innovative benefits that a radical project-based organization may generate (Verona and Ravasi 2003). The 'spaghetti organization', as it has come to be known, refers to a flat, loosely coupled project-based organization characterised by ambiguous job boundaries and extensive delegation of task and project responsibilities to autonomous teams. The adoption of the radical structure in 1990 represented a dramatic break from the traditional hierarchical, functional-based organization that the company had relied upon in the past.

The background to the implementation of the spaghetti organization was the loss of competitive advantage that Oticon increasingly realised during the 1980s. Although for decades the company had played a leading role in the hearing aids industry, at the end of the eighties its products largely depended on a mature and declining technology. The advent of digital technology had gradually led to a shift in the technological paradigm during the eighties and Oticon was losing ground to its major competitors. In 1990, the company underwent extensive restructuring in response to the crisis. The spaghetti organization was introduced aiming at developing a more creative and entrepreneurial organization. The radical reorganization had immediate and strong performance effects, resulting in a series of remarkable innovations during the 1990s.
Despite this success, the spaghetti organization was partially abandoned from about 1996 and it was gradually superseded by a more stable, traditional matrix organization.

The study by Foss (2003) suggests that the Oticon spaghetti organization had encountered severe problems of coordination and knowledge sharing between projects because of the fluid and adhocratic nature of project assignments, and difficulties in ensuring employee commitments to projects. More notably, Foss argues that the spaghetti organization, as an 'internal hybrid' (i.e. the infusion of elements of market autonomy and flexibility into a hierarchy), was inherently unstable partly because of the motivational problems caused by 'selective intervention'. Attempts by management selectively to intervene in project selection and coordination became increasingly at odds with the official rhetoric that stresses self-organization. The mounting frustration among employees eventually led to the retreat from the radical spaghetti organization.

Although the Oticon experiment is widely considered as a success story of organizational innovation, the partial retreat from the spaghetti organization illustrates the inherent difficulties of sustaining a complete adhocracy.

Sources: Foss (2003); Verona and Ravasi (2003)

3.4. The social embeddedness of organizations and their innovative capabilities

Although competitive pressures are felt by nearly all organizations in the advanced economies, the emergence and structure of new organizational forms are affected by their particular institutional contexts. A large literature contrasts the patterns of innovation and technological change in different countries and attributes these differences to national institutional frameworks and the ways in which they shape organizational forms and innovative competences (Whitley 2000; 2003; Hollingsworth 2000). The 'varieties of capitalism' framework, for example, makes a stylised contrast between coordinated (CME) and liberal market economies (LME), and highlights how differences in labour market organization, training systems, and societal norms and values governing business and economic relationships encourage firms to organize and coordinate their skills and knowledge resources differently to pursue distinctive innovation strategies (Soskice 1999; Hall and Soskice 2001).

Much of the work argues that 'coordinated market economies' such as Japan and Germany have developed institutions that encourage long-term employment and business relationships, facilitating the development of distinctive organizational competences conducive to continuous but incremental innovation. The J-form organization is facilitated by this type of institutional context. Conversely, 'liberal market economies' like the US and UK are better able to foster adhocracies in rapidly emerging new industries through radical innovation. The more permissive institutional environment associated with the U.S. and U.K. facilitates high labour mobility between firms, and reconfiguration of new knowledge and skills within flexible forms of organization to support risky entrepreneurial activities. In addition to labour markets, other institutional features such as education systems and financial markets also shape the development of skills and innovative competences of firms (Lam 2000; Casper 2000; see also O'Sullivan, this volume). The linkages among institutions, organizations and innovation are more complex than the simplified stylised contrast between J-form and adhocracy suggests[2]. What the polar type contrast suggests is that the ability of firms to develop different patterns of learning and innovative competences is contingent upon the wider social

context, and that institutional frameworks affect how firms develop and organize their innovative activities in different societies. Societal institutions create constraints on and possibilities for firms to develop different types of organizations and innovative competences, giving rise to distinctive national innovative trajectories .

4. ORGANIZATIONAL CHANGE AND INNOVATION

Organizational theories have long considered the ways in which organizations evolve and adapt to their environments, including the influence of technological change on the evolution of organizations (see, Tushman and Nelson 1990). A core debate concerns whether organizations can change and adapt to major discontinuous technological change and environmental shifts, or whether radical change in organizational forms occurs principally at the population level through the process of selection (Lewin and Volberda 1999). This literature includes at least three broad views on the nature of organizational adaptation and change. Organizational ecology and institutional theories, as well as evolutionary theories of the firm, emphasise the powerful forces of organizational inertia and argue that organizations respond only slowly and incrementally to environmental changes. This strand of work focuses on the way environments select organizations, and how this selection process creates change in organizational forms. A second view, the punctuated equilibrium model, proposes that oganizations evolve through long periods of incremental and evolutionary change punctuated by discontinuous or revolutionary change. It sees organizational evolution as closely linked to the cyclical pattern of technological change. The punctuated model regards organizational transformation as a discontinuous event occurring over a short period of time. The third perspective, which might be described as strategic adaptation, argues that organizations are not always passive recipients of environmental forces but also have the power to influence and shape the environment. The strategic adaptation perspective stresses the role of managerial action and organizational learning, and the importance of continuous change and adaptation in coping with environmental turbulence and uncertainty.

The following sections examine their main arguments and relevance to our understanding of the relationships between organizational change and innovation.

4.1. Incremental/evolutionary view of organizational change

Organization population ecologists (e.g. Hannan and Freeman 1977; 1984) argue that individual organizations seldom succeed in making radical changes in strategy and structure in the face of environmental turbulence because they are subject to strong inertial forces. Such forces are inherent in the established structures of the organization which represent relatively fixed repertoires of highly reproducible routines. While giving organizations reliability and stability, these routines also make them resistant to change. As a result, organizations respond relatively slowly to threats and opportunities in the environment. Organizational ecology theories posit that adaptation of organizational structures within an industry occur principally at the population level, with new organizations replacing the old ones that fail to adapt.

The institutional perspective on organizations also emphasises the stability and persistence of organizational forms in a given population or field of organizations (DiMaggio and Powell 1983; Zucker 1987). A major source of resistance to change arises from the normative embeddedness of an organization within its institutional context. Organizations are socially defined and operate within a web of values, norms, rules and beliefs and taken-for-granted assumptions that they represent values, interests and cognitive schemas of organizational and institutional actors which are hard to change (Hinings et al 1996). In this view, organizational change consists largely of constant reproduction and reinforcing of existing modes of thought and organization (Greenwood and Hinings 1996). In other words, organizational change is usually convergent change that occurs within the parameter of an existing archetype, rather than revolutionary change which involves moving from one archetype to another.[3]

Evolutionary theories of the firm (Nelson and Winter 1982) also argue that organizations are subject to inertial forces. Organizations accumulate know-how and tacit knowledge in the course of their development, and the resulting organizational routines and skills

become core competences and are difficult to change. Evolutionary theories regard organizational change as a product of the search for new practices in the neighbourhood of an organization's existing practices, that is, 'local search', and thus organizational routines and skills change only slowly and incrementally.

In the face of environmental change, new entrants within the industry may displace the established organizations that cannot adapt fast enough; new organizational forms thus tend to evolve and develop from the entrepreneurial activities of new firms. This viewpoint is consistent with the widespread argument in the literature on technological innovation that it is usually new firms which pioneer novel forms of organization to take full advantage of radical changes in technology (Schumpeter 1950; Aldrich and Mueller 1982). However, the relative importance of new entrants versus established organizations in developing new forms of organizing is partly shaped by the scale and pace of environmental change. Some evidence suggests that the effects of technological change on organizational evolution depend on whether the new technology destroys or enhances the competences of existing organizations (Tushman and Anderson 1986; Henderson and Clark 1990). The general observation is that new entrants play a much more significant role in organizational evolution in the face of 'competence-destroying' technological innovations; while established organizations are in a better position to initiate changes to adapt to 'competence-enhancing' technological changes.

The ability of an organization to adapt to technological change thus is influenced by the speed at which new competences and skills can be developed to match the demands of the new technologies. This is another reason to expect the institutional context to play an important role in shaping the dynamics of organizatonal change, for reasons noted above. New firms have played a much more prominent role in capitalizing on the new opportunities opened by radical technological changes in the United States than in other industrial economies because of the flexibility of professional labour markets and venture capital markets. In coordinated market economies such as Japan or Germany, new firms are not created as quickly because of the inflexibility of the labour market and relative absence of venture capital. As a result, established organizations may have more time to

create new organizational structures and competences to adapt to technological changes. The relative importance of selection versus adaptation as a mechanism underlying the creation of new organizational forms thus may vary between different contexts. Ecology and evolutionary theories of organizational change have tended not to take these contextual factors into account.

4.2. Punctuated equilibrium and discontinuous organizational transformation

In contrast, the punctuated equilibrium model proposes that organizations are capable of initiating revolutionary structural change during periods of environmental turbulence. It depicts organizations as evolving through relatively long periods of stability (equilibrium periods) in their basic patterns of activity that are punctuated by relatively short bursts of fundamental change (revolutionary periods) (Gersick 1991; Romanelli and Tushman 1994). It argues that organizations will typically accomplish fundamental transformations in short, discontinuous bursts of change involving most or all key domains of organizational activity. These include changes in strategy, structure, power distribution and control systems. Punctuated equilibrium theorists argue that the common state of organizations is one of stability and inertia, and as a result, these 'revolutionary periods' provide rare opportunities for organizations to break the grip of structural and cultural inertia. In this view, organizations are most likely to introduce radical changes in times of performance crisis or when they are confronted with disruptive environmental conditions such as radical competence destroying new technologies (Anderson and Tushman 1990). A number of empirical studies based on company histories (e.g. Tushman, Newman and Romanelli 1986; Romanelli and Tushman 1994) show that in many organizations fundamental organizational transformations occur according to the patterns predicted by the punctuated model. Other studies (e.g. Miller and Friesen 1982; Virany, Tshman and Ronamnelli 1992) show that organizations that were able to drastically transform themselves perform better than those that changed incrementally. However, most of the empirical evidence supporting the radical transformative mode of organizational change was based on retrospective archival studies of surviving companies. This approach does not permit analysis of the dynamics of the change process, and fails to account for unsuccessful transitions.

The punctuated model also suggests that the underlying dynamics of technological change influence patterns of organizational evolution. This argument builds on the technology cycle model developed by Anderson and Tushman (1990) which proposes that technological progress is characterised by relatively long periods of incremental, competence-enhancing innovation devoted to elaboration and improvement in dominant design. These periods of increasing consolidation and organizational alignment are punctuated by radical, competence-destroying technological discontinuities which pose fundamental challenges and strategic opportunities for organizations. The implication of the technology cycle concept is that the competitive environment repeatedly changes over time, and successful organizations accordingly have to initiate periodic discontinuous or revolutionary change to accommodate changing environmental conditions. A fundamental challenge facing organizations is to develop diverse competences and capabilities to shape and deal with the technology cycle. Tushman and O'Reilly (1996; 1999) argue that firms operating in the turbulent technological environment need to become 'ambidextrous', that is, capable of simultaneously pursuing both incremental and discontinuous technological changes[4].

The punctuated model provides important insights into patterns of organizational evolution and their relationship to the underlying dynamics of technological change, but it is largely descriptive. This model assumes that new organizational forms would emerge during periods of radical, discontinuous change; but fails to address the crucial question of how organizational actors create new forms during the revolutionary period. The model also does not address the long-term prospects for survival of the new organizational forms that emerge during the revolutionary period.

4.3. Strategic adaptation and continuous change

Theories of strategic organizational adaptation and change focus on the role of managerial action and strategic choice in shaping organizational change (Child 1972; 1997; Burgleman 1991). They view the evolution of organizations as a product of actor's

decisions and learning, rather than the outcome of a passive environmental selection process. Organizational agents are seen as enjoying a kind of 'bounded autonomy'. According to Child (1997: 60), organizational action is bounded by the cognitive, material and relational structures internal and external to the organization, but at the same time it impacts upon those structures. Organizational actors, through their actions and 'enactment' (Weick 1979), are capable of redefining and modifying structures in ways that will open up new possibilities for future action. As such, the strategic choice perspective projects the possibility of creativity and innovative change within the organization.

Many strategic adaptation theorists view organizational change as a continuous process encompassing the paradoxical forces of continuity and change, rather than an abrupt, discontinuous, episodic event described by the punctuated equilibrium model. Continuity maintains a sense of identity for organizational learning (Weick 1996; Kodama 2003), and provides political legitimacy and increase the acceptability of change among those who have to live with it (Child and Smith 1987). Burgleman's (1983; 1991) study of Intel corporation illustrates how the company successfully evolved from a memory to a microprocessor company by combining the twin elements of continuity and change for strategic renewal. Burgleman argues that consistently successful organizations use a combination of 'induced' and 'autonomous' processes in strategy making to bring about organizational renewal. According to the author, the induced process develops initiatives that are within the scope of the organizations current strategy and build on existing organizational learning (i.e. continuity). In contrast, the autonomous process concerns initiatives that emerge outside of the organization and provide the opportunities for new organizational learning (i.e. change). These twin processes are considered vital for successful organizational transformation. In a similar vein, Brown and Eisenhardt (1997) note that continuous organizational change for rapid product innovation is becoming a crucial capability for firms operating in high-velocity industries with short product cycles. Based on detailed case studies of multi-product innovations in six firms in the computer industry, the authors conclude that continuous change and product innovations are supported by organizational structures that can be described as 'semi-structures', a

combination of 'mechanistic' and 'organic' features, that balance order and chaos. More notably, the authors identify 'links in time' that force simultaneous attention and linkages among past, present and future projects as essential to change processes. The key argument is that links in time create the direction, continuity and tempo of change to support fast pace adaptation in an uncertain and volatile environment.

Most strategic adaptation theories assume that organizational adaptation can occur through incremental and frequent shifts, and that new organizational forms and discontinuous transformation can be brought about by such processes. This strand of research highlights the importance of firm-level adaptation and internal organizational processes in the creation of new organizational forms. Once again, however, most studies of strategic adaptation present retrospective studies of successful organizational adaptation. They tend to focus on organizational restructuring and transformation within prevailing organizational forms and are not specifically concerned with the creation of new organizational forms (Lewin and Volberda 1999). We remain in need of a theory to account for how and under what conditions managerial action and organizational learning is connected to the emergence of new organizational forms.

5. CONCLUSION

The relationship between organization and innovation is complex, dynamic and multi-level. The existing literature is voluminous and diverse. This chapter has sought to understand the nature of the relationship from three different but interdependent perspectives: a) the relationship between organizational structural forms and innovativeness; b) innovation as a process of organizational learning and knowledge creation; and c) organizational capacity for change and adaptation. Although there are potentially important overlaps and interconnections between these different aspects of the relationships, the different strands of research have remained separate and there is no single coherent conceptual framework for understanding the phenomenon of 'organizational innovation'. This is partly due to the great conceptual ambiguity and confusion surrounding the term 'organizational innovation'. Our review of the existing

literature reveals no consensus definition of the term 'organizational innovation'. Different researchers have used the term to describe different aspects of the relationships between organization and innovation. Indeed, the concept has been used in a rather loose and slippery manner in many writings and some authors are coy about stating definitions. Perhaps this conceptual indeterminacy reflects the fact that 'organizational innovation' embraces a very wide range of phenomena. Much work remains to be done if we are to understand how the different dimensions fit together.

This large literature has advanced our understanding of the effects of organizational structure on the ability of organizations to learn, create knowledge and generate technological innovation. We know relatively less, however, about how internal organizational dynamics and actor learning interact with technological and environmental forces to shape organizational evolution. It remains unclear how and under what conditions organizations shift from one structural archetype to another, and the role of technological innovation in driving the process of organizational change is also obscure. Progress in these areas will require greater efforts to bridge the different levels of analysis and multidisciplinary research to add insight and depth beyond one narrow perspective.

At present, research on organizational change and adaptation is fragmented: the different levels of analysis are disconnected and often rooted in different theoretical paradigms that use different research methods. While ecology and evolutionary theorists have sought to understand the dynamic relationship between innovation and organizational evolution at the population or industry levels using retrospective historical data, organizational and management researchers tend to examine the process of adaptation at the level of individual organizations, mostly based on cross-sectional case studies. The former is rooted in a structuralist deterministic paradigm whereas the latter takes into account actor choice and intentionality. The disconnection between these two different levels of analysis has meant that we continue to treat selection and adaptation as two separate processes in organizational evolution, whereas in reality new forms of organization emerge from the dynamic interaction between the two processes (Lewin and Volberda 1999). The biggest challenge for researchers is to bridge the wide gulf between

ecology/evolutionary theories which deal with organizational evolution and external forces of change, as contrasted with strategic choice and learning theories that focus on actor choice, interpretation and group dynamics within organizations. A useful avenue for future research would consider how organizational choice and evolutionary processes interact to facilitate organizational change and innovation. This will require longitudinal research on organizational adaptation in 'real time', as distinct from retrospective historical case studies (Lewin et al 1999).

Another factor that inhibits major theoretical progress in the field is the failure of researchers in the fields of innovation and organizational studies to work more closely together. Although innovation scholars have long recognized the importance of the organizational dimension of innovation, many innovation studies continue to be dominated by an economic approach that allows little room for the analysis of creative change and innovation within the organization itself. By contrast, researchers in the field of organizational studies who have developed a rich literature on organizational cognition, learning and creativity rarely relate their work explicitly to innovation. As a result, this stream of work which offers great potential for understanding the micro-dynamics of organizational change and innovation remains outside the main arena of innovation studies. The bulk of the existing research on the relationship between organization and innovation continues to focus on how technology and market forces shape organizational outcomes and treat organization primarily as a vehicle or facilitator of innovation, rather than as innovation itself. For example, we tend to assume that technological innovation triggers organizational change because it shifts the competitive environment and forces organizations to adapt to the new set of demands. This deterministic view neglects the possibility that differences in organizational interpretations of, and responses to external stimuli can affect the outcomes of organizational change. The literature in organizational cognition argues that the environment is equivocal and changes in the environment creates ambiguity and uncertainty which prompts the organization to embark on a cycle of environmental scanning, interpretation and learning (Daft and Weick 1984; Greve and Taylor 2000). The scanning and search process may lead to new interpretive schemata and

organizational action which could be an important source of innovative organizational change. Treating the organization as an interpretation and learning system directs our attention to the important role of internal organizational dynamics, actor cognition and behaviour in shaping the external environment and outcomes of organizational change.

Another promising direction for future research recognizes that organizational innovation may be a necessary precondition for technological innovation, rather than treating this process uniformly as a response to external forces, and focuses on the processes of internal organizational reform and transformation that are necessary to create such preconditions. This requires that scholars take greater account of the role of endogenous organizational forces such as capacity for learning, values, interests and power in shaping organizational evolution and technological change. This is an area where organization and management researchers could make a significant contribution by placing a greater emphasis on rigorous empirical research and theory building.

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Endnotes

[1] The term 'organizational innovation' is ambiguous. Some authors use it to refer to the broad meaning of 'innovation or innovative behaviour in organizations (Slappendel 1996; Sorensen and Stuart 2000), or 'organizational adoption of innovations' (Kimberley and Evanisko 1981; Damanpour and Evan 1984; Damanpour 1996). Within these broad meanings, the dependent variable 'innovation' is defined to encompass a range of types, including new products or process technologies, new organizational arrangements or administrative systems. The main aim of these studies has been to identify a range of individual, organizational and environmental variables that affect an organization's propensity to adopt an innovation. Others (e.g. Pettigrew and Fenton 2000) use the term in a more restrictive way simply to refer to innovation in organizational arrangements. Here the dependent variable is new organizational practices or organizational forms. Innovation may refer to the widespread adoption by organizational population of an organizational innovation, or merely some novel combination of organizational processes or structures not previously associated. There is a tendency for authors in this camp to equate organizational innovation to organizational change or development, assuming that change in itself is necessarily innovative, without making an explicit link between organizational change and technological innovation.

[2] For a detailed analysis of the interaction between institutions and organizations in innovation systems, see Edquist and Johnson (1992) and Hollingsworth (2000).

[3] Institutional theorists accept that radical, innovative change would be possible in newly emerging sectors (e.g. biotechology) where the organizational fields are 'illformed' and there is no stipulated template for organizing (Greenwood and Hinings 1996).

[4] According to Tushman and O'Reilly (1996; 1999), ambidextrous organizations are ones that can sustain their competitive advantage by operating in multiple modes simultaneously - managing for short-term efficiency by emphasizing stability and control, and for long-term innovation by taking risks. Organizations that operate in this way develop multiple, internally inconsistent architectures, competences and cultures, with built-in capabilities for efficiency, consistency and reliability on the one hand, and experimentation and improvisation on the other. During periods of incremental change, organizations require units with relatively formalized roles, responsibilities, functional structures and efficiency-oriented cultures that emphasize teamwork and continuous improvement. By contrast, during periods of ferment - times that can generate architectural and discontinuous innovation - organizations require entrepreneurial 'skunkworks' types of units. These units are relatively small, have loose decentralized product structures, experimental cultures, loose work processes, strong entrepreneurial and technical competences. Examples of companies that have successfully developed ambidextrous organizations include Hewlett-Packard, Johnson and Johnson, and ABB (Asea Brown Boveri), as well as such large Japanese companies as Canon and Honda.