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'Tacit Knowledge, Organisational Learning and Innovation: A Societal Perspective'

by
Alice Lam
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Alice Lam

University of Kent
Canterbury, Kent
CT2 7PE, UK

Tel: +44 1227 827731
Fax: +44 1227 761187
E-mail: A.C.L. Lam@ukc.ac.uk

Abstract
Knowledge and competence are increasingly regarded as the most critical resources of firms and economies. Much recent attention has focused, in particular, on the importance of 'tacit knowledge' for sustaining firms' competitiveness, and its role in technological innovation and organisational learning. This paper argues that the extent to which tacit knowledge constitutes the knowledge base of the firm, and how it is formed and used are powerfully shaped by the broader social and institutional context. It builds upon the premise that the knowledge of the firm is socially embedded. It is rooted in organisational coordination mechanisms and routines which, in turn, are heavily influenced by societal institutions. Societal level factors such as education and training systems, the structures of the labour market and social relationships between different occupational groups are important factors shaping organisational structures and processes within which the knowledge of the firm is embedded. The paper develops a four-fold typology, at the individual, organisational and societal levels, as an analytical framework to explain the links between knowledge types, patterns of work organisation and societal institutions. It shows how the three levels interact to shape the learning and innovative capabilities of firms. The theory developed in this paper represents the first attempt to integrate the diverse strands of literature and different levels of analysis into a single coherent framework. It holds promise for interpreting and understanding the sources of differences in learning and innovation practices between firms, industries and countries.

Keywords
Tacit knowledge, organisational learning, innovation, national innovation system, societal effect.

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D23, L21, O31, O33

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Contents

INTRODUCTION

Knowledge and competence are increasingly regarded as the most critical resources of firms and economies (Drucker, 1993; Quinn, 1992; Reich, 1992). Much recent attention has focused, in particular, on the importance of 'tacit knowledge' for sustaining firms' competitiveness, and its role in technological innovation and organisational learning. Tacit knowledge refers to knowledge that cannot be easily articulated or transferred because it is uncodified and context specific. Arguably, it represents the principal source of sustainable competitive advantage in an increasingly dynamic and turbulent business environment (Grant, 1996; Hall, 1993; Winter, 1987). The emphasis on the importance of developing distinctive core competence, intangible assets or firm-specific 'dynamic capabilities' has emerged as a central theme in the resource-based strategic management literature (Prahadlad and Hamel, 1990; Itami, 1987; Teece and Pisano, 1994). Interest in tacit knowledge has also grown rapidly as studies of technological innovation and diffusion have increasingly identified tacit knowledge as an important component of the knowledge used in innovation (Dosi, 1988; Rosenberg, 1976 and 1982; Pavitt, 1987; Senker, 1995; Howells, 1996). More recently, it has been argued that the growing complexity of technological systems and rapid change in the knowledge and scientific base has made tacit knowledge ever more important in the process of learning and knowledge accumulation (Lundvall and Borras, 1997). Literature in the field of organisational learning emphasises the importance of tacit knowledge in collective learning and organisational knowledge creation (Nonaka and Takeuchi, 1995; Spender, 1996b).

Much of the existing literature in the field of management has sought to propose universal best practice with respect to the model of organisation and management most conducive to harnessing tacit knowledge (Quinn, 1992; Hedlund, 1994; Grant, 1996; Garvin, 1993). It is widely agreed that the traditional bureaucratic, hierarchical model of organisation is ill suited to this and hence detrimental to learning and innovation. In contrast, the organic model of organisation, based on decentralised problem solving, horizontal coordination and cross-functional team working, has been advocated as the most appropriate organisational form for the creation of tacit knowledge and learning. The debate thus far has focused primarily at the level of the firm and on internal organisational changes as a key strategy for promoting the learning and innovative capabilities of firms. The wider societal and institutional factors have been neglected in most of the literature.

This paper seeks to broaden the scope of the analysis by demonstrating the importance of

macro-level societal and institutional factors in shaping the knowledge base of the firm and its capability for learning and innovation. The perspective adopted in this paper builds upon the premise that the knowledge of the firm is socially embedded. It is rooted in organisational coordination mechanisms and routines which, in turn, are heavily influenced by societal institutions. Societal level factors such as education and training systems, the structures of the labour market and social relationships between different occupational groups are important factors shaping organisational structures and processes in which the knowledge of the firm is embedded.

Firms depend differentially on different knowledge types and adopt different approaches to learning. The relative importance of tacit vs. codified knowledge and their role in learning and innovation can vary greatly between firms in different societal contexts. For example, Nonaka's and Takeuchi's study (1995) shows that tacit knowledge plays a more important role in Japanese firms than in their Western counterparts. They point out that Western management displays a strong normative bias in favour of explicit and formal knowledge and a constant tendency to codify and formalise tacit knowledge. In contrast, Japanese companies favour tacit knowledge and organise firms in ways which deliberately take into account the important role of tacit knowledge. Boisot's (1995a; 1995b) study on the relationship between the codifiability of knowledge and societal culture and institutions also illustrates the marked preference within Western organisations for codified and abstract over uncodified and concrete forms of knowledge. My own comparative study, in British and Japanese firms, demonstrates concretely how these differences influence firms' approach to product innovation and learning strategies (Lam, 1996; 1997).

This paper argues that the extent to which tacit knowledge constitutes the knowledge base of the firm, and how it is formed and used are powerfully shaped by the broader social and institutional context. The nature of knowledge within the firm and the role of tacit knowledge in learning and innovation cannot be fully understood by focusing the analysis only at the organisational level. The broader societal and institutional context must be taken into account. The paper develops a four-fold typology as an analytical framework to explain the links between knowledge types, patterns of work organisation and societal institutions. It shows how these three dimensions interact to shape the learning and innovative capabilities of firms. It

focuses, in particular, on the role of tacit knowledge and how firms located in different institutional contexts differ in their capability in mobilising it.

THE SOCIAL EMBEDDEDNESS OF THE KNOWLEDGE OF THE FIRM: KNOWLEDGE, WORK ORGANISATION AND SOCIETAL INSTITUTIONS

The analytical framework developed in this paper builds on and integrates the following three major strands of literature. First, theory of knowledge and organisational learning, most notably, the work of Polanyi (1962, 1966), Nelson and Winter (1982), Spender (1996a, 1996b) and Nonaka (1994), which seeks to understand the nature of knowledge and organisational learning from a pluralistic epistemological perspective. It makes a distinction between explicit and tacit types of knowledge and argues that the interaction between these two modes of knowing is vital for the creation of new knowledge. Their emphasis on the importance of tacit knowing as the origin of human knowledge directs our attention to the social and interactive nature of knowledge and learning. Second, the paper also draws upon the theoretical insights of the resource- or knowledge-based theory of the firm. Following Penrose (1959), the knowledge-based theory sees the firm as a body of knowledge residing in its structures of coordination and organising principles, which in turn, defines the social context for cooperation, communication and learning (Nelson and Winter, 1982; Kogut and Zander, 1992; 1996; Fransman, 1995). At the heart of this theory is the idea that the primary role of the firm, and the essence of organisational capability is the integration and creation of knowledge (Spender, 1996a; Grant, 1996; Tsoukas, 1996). Differences in the organising principles of firms thus can be seen as reflecting their differing knowledge base and learning capabilities. This paper argues that there is a close connection between the relative importance of different knowledge types and organisational forms. And finally, the perspective adopted in this paper follows the 'societal effect approach' in industrial sociology, and builds on the theoretical foundations of the literature on the 'national systems of innovation'. The 'societal effect' approach, associated particularly with the work of the 'Aix group' (Maurice et. al., 1986; Sorge et. al., 1986; Maurice, 1995), demonstrates how external societal institutions interact with internal organisational structures and processes to generate societally distinctive organisational forms.

Literature on 'national innovation systems', most notably the work of Freeman (1987; 1995), Lundvall (1992) and Nelson (1993), seeks to understand the link between national institutions, primarily at the macro-level, to the innovative performance of firms and economies. These two

approaches both underline the 'specificity' and 'interconnectedness' of national institutions bearing on industrial innovation.

This paper represents the first attempt to integrate the above three intellectual developments to construct a systematic theoretical framework to explain how knowledge, organisational forms and societal institutions interact to shape learning and innovation. The concept of 'social embeddedness', referring to how behaviour and institutions are affected by networks of social relations (Granovetter, 1985), is used as an umbrella concept bridging the three different levels of analysis. At the *epistemological level*, the notion of social embeddedness underlines the 'tacit' nature of human knowledge and the dynamic relationship between individual and collective learning. It draws our attention to the fact that a large part of human knowledge is occupied by knowledge that cannot be easily articulated or communicated in codified forms e.g. skills, techniques and know-how, and 'routines' (Polanyi, 1962; 1966; Nelson and Winter, 1982). Knowledge of this kind is experience-based, it can only be revealed through practice in a particular context and transmitted through networks of human relations. Hence knowledge is socially embedded and the process of learning is predominantly interactive (Lundvall, 1992).

At the *organisational level*, the concept of embeddedness focuses on how the organising principles of the firm shape the social structure of coordination, the behavioral routines and work roles of organisational members within which the knowledge of the firm is embedded. The structure of coordination determines the capacity of the organisation in mobilising and integrating different types of knowledge, and shapes the nature of the relationship between individual and collective learning. There is a corresponding relationship between the different types of knowledge used and organisational forms. The learning and innovative capability of the firm is thus embedded in its social structure of coordination and principles of work organisation.

At the *societal level*, the notion of embeddedness draws attention to the fact that organisational level routines and rules of coordination are, to a large extent, shaped by societal level institutional factors (Karnoe, 1996). Our analysis focuses, in particular, on the education and training system, and the types of labour markets and careers as key societal institutions in shaping the patterns of work organisation and the knowledge base of the firm. The education

and training system contributes to the social construction of 'knowledge', and determines the extent to which this is used as a basis of qualification, work status and job boundaries. As such, it shapes the relative status and importance of different types of knowledge, and the nature of their interaction within organisations. The types of labour market and careers determine the locus of learning, the incentives for developing different types of knowledge, and define the boundary and social framework within which individual learning interacts with collective learning. The education and labour market institutions are inextricably linked and there is an institutional logic defining their specific configurations in different societies. These institutional configurations interact with organisational structures and processes to generate different types of knowledge, patterns of learning and innovation. The knowledge of the firm is socially embedded: what firms can do, how their knowledge is configured, generated and developed is specific to the societal and institutional context within which they are located.

The rest of the paper explores the coherence between the three levels of analysis, and the implications for organisational learning and innovation.

KNOWLEDGE WITHIN THE FIRM: CHARACTERISTICS, ATTRIBUTES AND TYPES

The knowledge of the firm is multifaceted, complex and dynamic. An analysis of its characteristics and attributes inevitably raises a fundamental and highly contentious question: what constitutes knowledge? This question has intrigued and preoccupied some of the world's greatest thinkers. It underlies the debate in philosophy about the nature of the relationship between rationalism and empiricism and the origin of new knowledge. Drawing upon the work of Polanyi (1962; 1966) and contemporary theorists in industrial organisation (e.g. Nelson and Winter, Spencer, and Nonaka and Takeuchi), this paper assumes that there are many different types of knowledge that are relevant to the firm. The main purpose of this section is to give a micro-level analysis of the characteristics and attributes of different types of knowledge, to explore the nature of their relationships and to construct a typology of organisational knowledge.

The knowledge of the firm can be analysed along two dimensions: the epistemological and ontological. The former is concerned with the manifestation or modes of expression of

knowledge, namely, Polanyi's distinction between explicit and tacit knowledge. The latter is about the locus of knowledge or the knowing entity within the firm; knowledge can reside at the level of the individual or the collective. These two dimensions give rise to four different forms of organisational knowledge: 'embrained', 'embodied', 'encoded' and 'embedded' knowledge (see Figure 1).

The Epistemological Dimension: Explicit vs. Tacit Knowledge

Human knowledge exists in different forms; it can be articulated explicitly or manifested implicitly (tacit). The critical differences between these two forms lie in three major areas. First, its codifiability and mechanisms for transfer. Explicit knowledge is also codified knowledge. It is that part of human knowledge that can be specified or communicated verbally, or in symbolic forms such as written documents, blueprints or computer programmes. It belongs to Popper's (1972) 'World three' knowledge: it can be abstracted and stored in the 'objective world', and understood and shared without a 'knowing subject'. Ease of communication and transfer is its fundamental property. Tacit knowledge, in contrast, refers to knowledge that is intuitive, unarticulated and that cannot be easily codified and transferred. It resides in Popper's 'World two' where knowledge cannot be communicated, understood or used without the 'knowing subject'. Hence, tacit knowledge is also 'subjective knowledge'. The notion of 'tacit knowledge' was first expounded by Polanyi (1962). Based on the simple observation, 'We know more than we can tell', Polanyi argued that a large part of human knowledge is occupied by knowledge that cannot be articulated. This is particularly true in the case of operational skills or know-how acquired through practical experience. It is action oriented and has a personal quality that makes it difficult to formalise or communicate. Since tacit knowledge cannot be specified in detail and is revealed through practice, it cannot be transmitted by prescription. It can be transferred only by example or observation, such as from master to apprentice. This restricts the range of diffusion to personal contacts. Unlike explicit knowledge which can be formulated, abstracted and transferred across time and space independently of the knowing subjects, the transfer of tacit knowledge requires close interaction and the build up of shared understanding and trust among them.

Second, the main methods for the acquisition and accumulation of the above two knowledge forms also differ greatly. Explicit knowledge can be generated through logical deduction and

acquired by formal study. Tacit knowledge, because it is based on experience and bodily action, can only be acquired through practical experience in the relevant context, i.e. 'learning-by-doing'. Moreover, as noted by Nonaka (1994: 21-2), the 'variety' of experience and the individual's commitment and involvement in the 'context' are critical factors in determining the generation and accumulation of tacit knowledge.

Third, the two different forms of knowledge differ in their potential for aggregation and modes of appropriation. Since explicit knowledge can be easily codified, it can be aggregated at a single location, stored in objective forms and appropriated without the participation of the knowing subject. Tacit knowledge, in contrast, is personal and contextual. It is distributive knowledge that cannot be easily aggregated and stored in objective forms; it can only be appropriated through direct application. The realisation of its full potential requires the close involvement and cooperation of the knowing subject.

Although it is possible to make a conceptual distinction between explicit and tacit knowledge, they are not separate and discrete in practice. Explicit and tacit knowledge are mutually constituted. Nonaka and Takeuchi (1995) argue that new knowledge is generated through the dynamic interaction and combination of these two types of knowledge. In a similar vein, Nelson's and Winter's (1982) evolutionary theory of the firm assumes that the firm provides a special context in which the explicit and tacit modes of knowledge are selected by interaction with the external economic reality and then stored in organisational routines. Over time the quality of the interaction of the explicit and evolving tacit types of knowledge may lead to superior firm performance. However, firms can differ in their capacity for fostering the interaction between these two different knowledge types, and their relative importance and status may also differ.

Despite the contemporary trend towards knowledge codification and the growth in the body of 'scientific' knowledge, tacit knowledge will always remain an important component in all productive and innovation activities. The inherently tacit nature of a large part of human knowledge means that there are natural limits to codification. Knowledge that can be expressed in words and symbols represents only the tip of the iceberg of the entire body of possible knowledge. Codification inevitably involves a data sacrifice; some part of the knowledge will

always stay behind in the minds of the knowing subject. More importantly, the creation of new knowledge in itself will necessarily involve the use and generation of tacit knowledge. Polanyi (1962; 1966) sees the origin of all human knowledge in individual intuition. He argues that scientific creativity stems primarily from deep immersion in the phenomenon to be explained, for that alone gives rise to intuitions about how to begin the interaction. For Polanyi, science is a process of explicating the tacit intuitive understanding that underlies the subconscious learning of the focused scientist. In a similar vein, Nonaka and Takeuchi (1995) argue that the key to organisational knowledge creation lies in the mobilisation and conversion of individual tacit knowledge into collective knowledge. The learning and innovative capability of an organisation is thus critically dependent on its capacity to mobilise tacit knowledge and foster its interaction with explicit knowledge.

The Ontological Dimension: the Individual vs. Collective

Knowledge within the firm can reside at the level of the individual, or be shared among members of the organisation as a collective. Individual knowledge is that part of the organisation's knowledge that resides in the brains and bodily skills of the individual. It is acquired through formal education and practical experience. Individual knowledge is discrete and self-contained. It is a repertoire of knowledge 'owned' by the individual, which can be applied independently to specific types of tasks or problems. Autonomy in application is its key characteristic feature. Given the cognitive limits of the individual in storing and processing information – Simon's (1957) 'bounded rationality' problem – individual knowledge is inevitably specialised and domain-specific. Individual knowledge is also transferable, moving with the person, giving rise to potential problems of retention and accumulation.

Collective knowledge refers to the ways in which knowledge is distributed and shared among members of the organisation. It is the accumulated knowledge of the organisation stored in its rules, procedures, routines and shared norms which guide the behaviour, problem-solving activities and pattern of interaction among its members. In this respect, collective knowledge resembles the 'memory' or 'collective mind' of the organisation (Walsh & Ungson, 1991). It can either be a 'stock' of knowledge stored as hard data that is readily available for use by its members; or represent knowledge in a state of 'flow' which emerges from the interaction among its members. Collective knowledge exists between rather than within individuals. It can

either be centralised or dispersed throughout the organisation. It can be more, or less, than the summation of the individuals' knowledge, depending on the mechanisms that translate individual into collective knowledge (Glynn, 1996: 1093-4; also see, below).

Four Types of Knowledge

The explicit-tacit and individual-collective dimensions of knowledge give rise to four categories of knowledge: 'embrained', 'embodied', 'encoded' and 'embedded' knowledge. These conceptual distinctions were first suggested by Collins (1993) to explain the psychological and behavioural aspects of knowledge. Blacker (1995) adapts them to describe the different 'images' of knowledge within organisations. The typology presented here focuses on the socio-cognitive structures of knowledge, integrating the individual and organisational dimensions. It provides a means for relating the characteristics of knowledge to its specific embodiment, linking the process of generation and utilisation of knowledge with its cognitive dimension.

Embrained Knowledge (individual-explicit) is knowledge that is dependent on conceptual skills and cognitive abilities of the individual. It is formal, abstract or theoretical knowledge. For example scientific knowledge, which focuses on the rational 'understanding' and 'knowing' of universal principles or laws of nature, belongs to this category. Nonaka's (1994) concept of 'knowledge of rationality' underpins the rationalism and deductive nature of such knowledge. Embrained knowledge is also general and transferable because it can be used and applied to different situations and a wide array of phenomena. It is 'homogeneous' and a priori knowledge which can be acquired primarily through formal education and training, in other words, 'learning-by-studying'. It can be standardised and applied in a logical and consistent manner. Embrained knowledge enjoys a privileged social status within Western culture. For example, the high occupational status of science compared with engineering reflects the social dominance of embrained knowledge. Moreover, the historical attempt on the part of engineers in the Anglo-American countries to emphasise the conceptual components of their activity represents a conscious attempt to seek status enhancement in society (Layton, 1974; 1976).

Embodied knowledge (tacit-individual) is action oriented; it is the practical, individual type of knowledge (know-how or technique) on which Polanyi (1962; 1966) has focused. Nonaka (1994) uses the term 'knowledge of experience' to denote the fact that it is created through

hands-on-experience or 'learning-by-doing'. In contrast with embrained knowledge which depends on abstract theoretical reasoning (‘knowing’), embodied knowledge builds upon 'bodily' or practical experience (‘doing’). It has a strong automatic and voluntaristic component; its generation and application does not need to be fitted into or processed through a conscious decision-making schema (Spender, 1996b: 67). Embodied knowledge is also context specific; it is 'particular knowledge' which becomes relevant in practice only 'in light of the problem at hand' (Barley, 1996). Its generation cannot be separated from application, and the close involvement of the actor in the relevant context. Embodied knowledge is emergent, fluid and person-specific knowledge.

Encoded knowledge (collective-explicit) is knowledge (or sometimes referred to as ‘information’) conveyed by signs and symbols. It is knowledge that has been codified and stored in blueprints, recipes, written rules and procedures. It is public knowledge accessible to the wider organisation and can be understood and used without a knowing subject. For example, the abstraction and codification of the knowledge of an accounting controller into a spreadsheet template on the computer for analysing the performance of client firms (Bonoar and Revang, 1993: 204). Once done, the knowledge can be shared and used by other controllers within the organisation. However, the outcome is that the knowledge becomes a standardised programme which can only deal with standardised problems or situations, leading to the potential danger of 'pigeon-holing' in problem-solving (Mintzberg, 1979). Encoded knowledge is thus 'mechanistic' knowledge that tends to generate a unified and predictable pattern of behaviour and output in organisations. Since encoded knowledge can be stored and retained within organisations without the knowing subject, it reduces their dependence on individuals. The abstraction of individuals' experience and knowledge into encoded knowledge facilitates centralisation and control in organisations. This is well-illustrated by the principles of Scientific Management which attempt to control and standardise work through formalisation of work roles and procedures, i.e. codification of worker experiences and skills into objective scientific knowledge. Encoded knowledge is inevitably simplified, selective and partial, for it fails to capture and preserve the tacit skills and judgement of individuals.

Embedded knowledge is the collective form of tacit knowledge residing in organisational routines, practices and shared norms. Badaracco (1991) develops this concept to refer

specifically to the kind of knowledge that resides in complex social or team relationships that cannot be fully articulated or easily transferred. Embedded knowledge is the Durkhemian type of tacit knowledge based on shared beliefs and understanding within an organisation which makes effective communication possible. It is rooted in an organisation's 'communities-of-practice', a concept used by Brown and Duguid (1991) to denote the socially constructed and interactive nature of learning within organisations. Nelson's and Winter's (1982) concept of 'routines' also refers to how a large part of an organisation's operational knowledge or 'skills' is rooted in its specific work practices and social structures. They emphasise the importance of communication, shared experience and implicit coordination in the generation of embedded knowledge. Embedded knowledge is relation-specific, contextual and dispersed. It is 'situated knowledge' organised around a set of rules and a myriad of relationships which enable the organisation to function in a coordinated way. It is the social knowledge of coordination, communication and learning generated through organisational identity (Kogut and Zander, 1996). Embedded knowledge is organic and dynamic; it is an emergent form of knowledge capable of supporting complex patterns of interaction in the absence of written rules. It is, however, also 'sticky' and ‘path dependent’: its generation and application can be constrained by the established organising principles and patterns of social relations.

KNOWLEDGE TYPES AND ORGANISATIONAL FORMS: FOUR CONTRASTING MODELS OF ORGANISATIONAL LEARNING

Organisations are social systems of coordination. They provide a social context in which different types of knowledge interact and combine to achieve collective productive purposes. What organisations can do, in particular, their capacity for learning and innovation are closely related to how their knowledge is constituted, utilised and generated. All organisations will potentially have a mixture of different knowledge types. However, their relative importance can differ. Organisations can be dominated by one knowledge type rather than another. There is a close correspondence between the dominant knowledge type and the structural configuration of the organisation, resulting in different dynamics of learning and innovation.

Organisations characterised by an explicit knowledge base tend to have formal structures of control and coordination, and exhibit a high degree of standardisation of tasks or work roles. This is because explicit knowledge can be standardised, codified and aggregated. It is possible

to specify and pre-determine the repertoire of knowledge and skills required for task performance. In contrast, organisations with a tacit knowledge base will exhibit a decentralised structure and use informal coordination mechanisms. This is due to the fact that tacit knowledge is dispersed, subjective and organic; it cannot be standardised, disembodied or pre-determined. The mobilisation of tacit knowledge requires autonomy and commitment on the part of the knowing subject. Without such conditions, tacit knowledge remains latent.

Organisations can also depend on different knowledge agents. Those which rely primarily on the contribution of key individuals will tend to accord them a high degree of control and autonomy. In contrast, those which draw their capability from the collective knowledge of their members will need to develop effective mechanisms for integration and coordination. This can be achieved either through formal hierarchical control, or informally, through socialisation and mutual adjustment.

This section examines the relationships between the different knowledge types and organisational forms, and discusses how the different patterns of coordination shape the learning and innovative capabilities of firms. Drawing upon Mintzberg's (1979) classic typology of organisational forms and the work of Aoki (1988) and Nonaka and Takeuchi (1995) on the 'Japanese model', the analysis presented below makes a distinction between four ideal typical organisational forms (see, Figure 2). It argues that each organisational form is associated with a dominant knowledge type, giving rise to four contrasting configurations: 'professional bureaucracy' and embrained knowledge; 'machine bureaucracy' and encoded knowledge; 'operating adhocracy' and embodied knowledge; and 'J-form' organisation and embedded knowledge. They differ along two key structural dimensions: the mechanisms for the coordination of operating tasks and the knowledge agents. These structural differences shape the patterns of knowledge distribution and dissemination within organisations - an important determinant of the occurrence and breadth of organisational learning (Huber, 1990; Dibella et al 1996); and the main methods of knowledge acquisition. They also affect the capacity of the organisation to deal with novel problems, respond to external changes and to create new knowledge.

‘Professional Bureaucracy’ and ‘Embrained Knowledge’

An organisation which derives its capability from the formal ‘embrained knowledge’ of its highly trained individual experts can be defined as a ‘professional bureaucracy’. Mintzberg (1979) describes a professional bureaucracy as complex, bureaucratic, and characterised by a high degree of autonomy for the individual professionals. Classic examples include universities, hospitals and craft production firms.

Within this organisational form, coordination is achieved primarily by the standardisation of knowledge and skills through the individual's formal education and training. The formal knowledge constitutes an important basis of internal work rules, standards, job boundaries and status. Although the professional bureaucracy accords a high degree of autonomy to the individual professionals, its structure is primarily ‘bureaucratic’: coordination is achieved ‘by design and by standards that pre-determine what is to be done’ (Mintzberg, 1979: 351). The source of standardisation originates outside the organisation. The external education institutions and professional bodies play an important role in defining the standards and boundaries of the knowledge in use.

The individual professionals are the key knowledge agents of the professional bureaucracy. They are the ‘authorised experts’ whose formal training and professional affiliations give them a source of authority and a repertoire of well-defined knowledge ready to apply and use. The approach to problem solving involves the application of an existing body of abstract knowledge in a logical and consistent way. This inevitably restricts the use of tacit knowledge and judgemental skills in dealing with uncertainty in problem-solving. Formal expert knowledge often entails 'perceptual filters' (Starbuck, 1992). Professional experts have a tendency to interpret specific situation in terms of the general concept and place new problems in old categories. Mintzberg (1979) uses the term 'pigeonholing' to describe how, in a professional bureaucracy, the uncertainty in problem solving is being contained in the jobs of single 'experts', and circumscribed within the boundary of conventional specialisation. This allows the organisation to uncouple the various specialist tasks and assign them to autonomous individuals, leading to a high degree of individual and functional specialisation.

The knowledge structure of a professional bureaucracy is individualistic, functionally segmented and hierarchical. The individual experts have a high degree of autonomy and discretion in the application and acquisition of knowledge within their own specialist areas, but the sharing and dissemination of such knowledge across functional boundaries is limited. The lack of a shared perspective and the formal demarcation of job boundaries inhibit the transfer of non-routine tacit knowledge in day-to-day work. Moreover, the power and status of the 'authorised experts' inhibits interaction and sharing of knowledge with the 'non-experts'. The problem of coordination in a professional bureaucracy translates itself into problems of innovation. As noted by Mintzberg (1979: 375):

'Existing programs can be perfected by individual specialists. But new ones necessarily cut across existing specialties – in essence, they require a rearrangement of the pigeonholes – and so call for interdisciplinary efforts. As a result, the reluctance of the professionals to work cooperatively with each other translates itself into problems of innovation'.

The learning focus of a professional bureaucracy is narrow and constrained within the boundary of formal specialist knowledge. Tacit knowledge is circumscribed and contained; it plays a limited role in a professional bureaucracy.

'Machine Bureaucracy' and 'Encoded Knowledge'

An organisation which depends heavily on 'encoded knowledge' can be defined as a machine bureaucracy. The key organising principles are specialisation, standardisation and control. This is an organisational form designed to achieve efficiency and stability. Mass production firms operating on the principles of Scientific Management are classic examples.

Coordination of operating tasks in a machine bureaucracy is achieved via standardisation of work process, sharp division of labour and close supervision. Each single, routine task requires minimal formal knowledge from the individual. The organisation displays a continuous effort to formalise operating skills and experience into objective knowledge through codification and institutionalisation. The objective is to reduce and eliminate uncertainty in the operating tasks, or to put it in Mintzberg's words: 'the sealing off of the operating core from disruptive environmental influences' (Mintzberg, 1979: 315).

The knowledge agents of a machine bureaucracy are not the individuals directly engaged in operations, but the formal managerial hierarchy responsible for formulating the written rules, procedures and performance standards. There is a clear dichotomy between the 'application' and 'generation' of knowledge i.e. a clear separation of 'execution' from 'conception'. The rules and procedures store the operating knowledge of the organisation, ready to be applied by the individuals engaging in operating tasks. The managers are the key agents responsible for translating individual knowledge into rules and procedures and for filtering information up and down the organisational hierarchy. Knowledge within the machine bureaucracy is highly fragmented and only becomes integrated at the top of the managerial hierarchy. The organisation relies heavily on management information systems for knowledge aggregation. It is a structural form in which the organisation's dependence on the individual's knowledge is minimised. By forming the rules and standards for operation and by centralising knowledge through the formal hierarchy, the organisational structure and the management information system become knowledge itself (Bonora and Revang, 1993). The whole organisation operates on the basis of 'encoded knowledge' – knowledge that has been objectified and translated into hard data and information. A large part of tacit knowledge is naturally lost in the translation and aggregation process.

The knowledge structure of a machine bureaucracy is collective, functionally segmented and hierarchical. The structure operates to eliminate tacit knowledge. The organisation operates on a partial, incomplete and impoverished knowledge base. It learns by 'correction' through performance monitoring. It can only accumulate new knowledge through an extremely slow process of formalisation and institutionalisation. It is a structure designed to deal with routine problems but is unable to cope with novelty or change.

'Operating Adhocracy' and 'Embodied Knowledge'

An organisation which relies not only on the formal knowledge of its members, but draws its capability from the diverse know-how competencies and practical problem solving skills embodied in the individual experts, can be described as an 'operating adhocracy'. This is a highly organic form of organisation with little standardisation of knowledge or work process. The administrative function is fused with the operating task, giving the individual experts a high

degree of autonomy and discretion in their work. It also leads to a close integration of technical and managerial expertise.

Coordination in the operating adhocracy is achieved via the direct interaction and mutual adjustment of the individual experts operating in market-based organic project teams. Organisations engaged in providing non-standard, creative and problem-solving services directly to the clients, such as professional partnerships, advertising agencies, software engineering firms and management consultancies, are typical examples. In these organisations, formal professional knowledge may play only a limited role; a large part of the problem-solving activities has very little to do with the application of narrow standardised expertise and more to do with the experience and capacity to adapt to new situations. Hence, the importance of 'embodied skills' and 'know-how competencies'. The term ‘embodied’ illustrates the personal, action-oriented nature of this type of knowledge; its creation is inseparable from application. Starbuck's (1992) concept of 'knowledge intensive firms' which emphasises the significance of ‘esoteric expertise’ over commonplace standardised knowledge illustrates the idiosyncratic nature of the knowledge base underlying an operating adhocracy. Sveiby's and Lloyd's (1987) idea of 'know-how companies' in which technical and managerial expertise are integrated suggests the broad-based and varied nature of the knowledge required for creative problem-solving in such organisations.

The knowledge structure of an operating adhocracy is individualistic but collaborative. The individual experts deployed in market-based project teams are the key knowledge agents. This leads to a fusion and integration of specialised expertise in operating tasks and problem solving activities. Learning occurs as experts of diverse backgrounds jointly solve shared problems. Unlike in the professional bureaucracy, learning is not confined within the boundary of conventional specialisation; it is broad-based and draws upon the diverse experiences and know-how of different experts. Quinn (1992) stresses the importance of ‘inter-dependent professionalism’ in an operating adhocracy. Learning occurs on multiple levels as shifting teams of experts regroup in line with market-based problems and client demands. As a result, individuals are under continuous pressure to accumulate new know-how competencies which go far beyond the pursuit of formal credentials. The individual's performance is assessed in terms of its market-based outcomes; the ultimate judges of their expertise are their clients, and

not the professional bodies (Starbuck 1992). Hence, a strong incentive to engage in 'extended occupational learning', and the accumulation of tacit skills beyond the pursuit of formal knowledge.

The knowledge base of an operating adhocracy is diverse, varied and organic. A large part of the knowledge in use is 'organic' i.e. tacit knowledge generated through interaction, trial-and-error and experimentation in problem-solving. It is an organisation capable of divergent thinking, innovation and creative problem-solving. Its learning and innovative capabilities stem from: 1) the way its collaborative approach to problem-solving facilitates the distribution and dissemination of knowledge; 2) the high degree of autonomy given to individuals and entrepreneurial project teams leads to a diverse and varied knowledge base; and 3) its strong market-discipline exerts pressures on individuals to accumulate their knowledge and expertise in line with shifting market opportunities.

Operating adhocracies are fluid and fast moving organisations. The speed of learning and unlearning is critical for their survival in a complex and dynamic environment. This, however, creates potential problems in knowledge accumulation. The frequent re-structuring and shifting of individuals between project teams means that tacit knowledge may not be fully and adequately articulated before an individual moves on. An operating adhocracy is highly efficient in the utilisation and generation of tacit knowledge but is not well equipped to accumulate it. Another related problem is knowledge retention. The organisation's competence is embodied in its members' market-based know-how and skills which are potentially transferable. This makes the organisation vulnerable to the loss of its competencies to potential competitors. Starbuck (1992: 725), for instance, talks about the ‘porous boundaries’ of the ‘knowledge intensive firms’ and points out that these organisations often find it hard to keep unique expertise exclusive. The operating adhocracy is the most innovative and yet least stable form of organisation.

‘J-form’ Organisation and ‘Embedded Knowledge’

An organisation which derives its capability from knowledge that is 'embedded' in its operating routines, team relationships and shared culture can be described as a 'J-form' organisation. The term 'J-form' is used because its ideal-typical features are best illustrated by the Japanese type of

organisation, such as Nonaka's and Takeuchi's (1995) 'knowledge creating companies', and Aoki's (1986; 1988) model of the ‘J-firm’. The J-form organisation combines the stability and efficiency of a bureaucracy with the flexibility and team dynamics of an adhocracy. It allows an organic, non-hierarchical team structure to operate in parallel with its formal hierarchical managerial structure. These two structural layers are 'glued' together by a strong corporate culture and shared identity, which constitute the third layer - the knowledge base of the organisation. Coordination in the J-form organisation is achieved via horizontal coordination and mutual adjustment. This is reinforced by shared values and common understanding embedded in the organisational culture. The formal hierarchy serves an integrating, rather than a controlling function. Nonaka and Takeuchi (1995) use the term 'hypertext organisation', an analogy borrowed from computer science, to illustrate the dynamic interaction between the different layers of the organisation and the freedom of the members to switch among the different contexts. They argue that the dynamic interaction among the different contexts facilitates the interaction between tacit and explicit knowledge, which ultimately determines the capability of the organisation to create new knowledge. Aoki (1986; 1988) also emphasises the importance of the horizontal information structure and the role of semi-autonomous work groups in facilitating collective 'learning-by-doing' in the J-firm. In a similar vein, Hedlund (1986; 1993; 1994) uses the term 'heterarchy' to depict the operation of a horizontal, fluid knowledge structure within a formal hierarchy in Japanese organisations.

The key knowledge agent in the J-form organisation is neither the autonomous individual expert nor the controlling managerial hierarchy, but the semi-autonomous project team, comprising members from different functions and units of the organisation. The cross-functional team integrates and synthesises knowledge across different areas of functional expertise and serves as a bridge between the individual and the organisation. It is at the level of the team, positioning at the intersection of horizontal and vertical flows of knowledge within the organisation, where the greatest intensity of interaction, learning and knowledge diffusion takes place within the J-form organisation. Similar to the operating adhocracy, a great deal of the learning occurs through shared work experiences and joint problem-solving in project teams. The cross-functional nature of the team in a J-form organisation, however, facilitates a much more broad-based learning. It helps to develop a diversity of knowledge within the individual and knowledge overlap across individuals and functional units. Nonaka (1994:28) points out that such

knowledge overlap or 'redundancy of information', to put it in his words, brings about 'learning by intrusion', generates trust and promotes the sharing and transmission of tacit knowledge within the organisation.

Unlike the operating adhocracy where the temporary nature of the project team inhibits the transfer of the knowledge generated beyond the level of the team, the J-firm organisation is capable of diffusing the knowledge widely throughout the entire organisation. This occurs as members rotate across functional units and as they return from their temporary assignments to their routine formal positions. The formal structure in the J-form organisation constitutes an important integrating mechanism. It captures the tacit knowledge generated and stores it at the level of the organisation for future use. While the operating team is the focal point for the acquisition and generation of knowledge, the dissemination and diffusion of knowledge in the J-form organisation is organisation-wide. Knowledge stored in the formal hierarchy in the form of operating procedures and rules constitutes, however, only a small part of the knowledge base of the J-form organisation. A large part of the knowledge in use is stored organically in the operating routines, networks of human relations, shared values and beliefs developed through common experience. It is the socially embedded nature of knowledge which constitutes the most important source of learning and innovation in the J-form organisation.

The J-form organisation is an adaptive and innovative organisation. It is marked by a tremendous capacity to generate, diffuse and accumulate tacit knowledge continuously through ‘learning-by-doing’ and interaction. New knowledge is generated through fusion, synthesis and combination of the existing knowledge base. It has a unique capability to generate innovation continuously and incrementally. However, learning in the J-form organisation is also potentially conservative. Its stable social structure and shared knowledge base can reduce the capabilities of the organisation to learn from individual deviance and the discovery of contrary experience (Levinthal and March 1993: 108; Dodgson 1993: 383). The J-form organisation may find it difficult to innovate radically.

The Role of Tacit Knowledge

The four contrasting organisational forms differ in their ability to harness and mobilise tacit knowledge. The machine bureaucracy seeks to eliminate and control tacit knowledge. It

operates on an 'impoverished' knowledge base. The professional bureaucracy contains and circumscribes tacit knowledge within the boundary of individual specialisation. Tacit knowledge plays only a limited role in the problem-solving activities of the individuals. The operating adhocracy generates a large quantity of tacit knowledge through experimentation and interactive problem-solving, but has a limited capacity to accumulate the tacit knowledge created because of the shifting market-based project teams. The J-form organisation has a superior capacity for mobilising and accumulating tacit knowledge. It allows an organic team structure to operate in tandem with a formal hierarchy and stable social organisation.

THE INSTITUTIONAL FRAMEWORK OF KNOWLEDGE, LEARNING AND INNOVATION

Patterns of work organisation and knowledge configurations do not develop in a social vacuum. The relative dominance of the different knowledge types, and the capability of an organisation in harnessing tacit knowledge as a source of learning and innovation are powerfully shaped by the broader societal and institutional factors. There is a large body of research in comparative management and organisational studies which has established how social institutions influence patterns of work organisation in a systematic way, with the result that organisational structures and processes reflect distinctive national patterns (Maurice et. al., 1986; Sorge et. al., 1987; Lane, 1989; Whitley, 1990). The 'societal effect' approach, in particular, demonstrates an interactive relationship between patterns of work organisation with the education and training system, types of labour markets and careers, and argues that 'societally significant organisational types' exist (Sorge, 1991). Maurice et. al. (1986) in their comparative studies of organisational structures in France, Britain and Germany, emphasise how the different ways and degrees to which workers and staff are qualified and promoted shape the patterns of coordination and work structuring in the three countries. They speak about the degree of ‘professionality’ with which tasks are accomplished by the different categories of the workforce. By this they mean the relative importance of formal knowledge versus mastery of practical skills, and the formal recognition of qualifications. Their study underlines the importance of education and training as a key societal factor shaping the knowledge and competence criteria underlying different types of expertise, and the nature of the relationship between different categories of the workforce.

The role of the formal education and qualification system in defining the knowledge and

competence criteria within organisations is closely related to the nature of employment relationships and labour market organisation: the extent to which organisation of skills and careers are governed by markets or firms. This broad distinction draws attention to the major differences between an occupation-based labour market (OLM) and a firm-based internal labour market (ILM), and how they operate to structure the knowledge base of the firm, and influence the processes and incentives for developing and accumulating different types of knowledge.

The nature of the employment relationship also defines the social framework and boundary for the diffusion of knowledge and interaction between individual and collective learning. The organisation of the labour market and careers is thus another major institutional factor shaping the knowledge configuration of the firm and its learning and innovative capability.

The education and labour market dimensions are inextricably linked and there is an institutional logic defining their specific configurations in different societies (see, Figure 3). This section examines how these institutional configurations interact with organisational structures and processes to generate different types of knowledge, patterns of learning and innovation.

Education and Training Systems

The education and training system, both formal and informal, is an important component of national innovation systems (Lundvall ,1992; Nelson, 1993; Patel and Pavitt, 1994). It affects the innovative capabilities of firms not only in terms of its quantitative dimension (e.g. the adequacy in the supply of highly trained people or enrolment in science and engineering), but more importantly, its qualitative dimension. Two aspects are of particular importance here.

The first is the degree of formalisation of high-level expertise. This refers to the extent to which the formation of high-level expertise is based on abstract theoretical knowledge or concrete practical problems. This is a critical factor shaping the knowledge base of the firm, its approach to problem-solving and the nature of relationships between different knowledge types. The second is the degree of elitism or egalitarianism of the education system. This determines the specific mix and distribution of skills among the workforce and hence the pattern of coordination and interactive learning within firms.

Degree of formalisation of high-level expertise: theory vs. practice

The degree of formalisation of high-level expertise has three inter-related aspects (Whitley, 1995). First, it concerns the extent to which training programmes and skill competence criteria

are dominated by abstract theoretical knowledge and organised around intellectual boundaries and concepts rather than around practical problem-solving activities. An education system characterised by a high degree of abstraction of knowledge and academic orientation tends to generate a narrow conception of 'knowledge' and recognition of only the theoretical component of it as a basis of expertise and qualification. Expertise acquired through this kind of education system tends to be highly specialised and distant from problem-solving practices. It leads to a dominance of explicit over tacit knowledge, and the adoption of a deductive approach to problem-solving. Holders of such academic credentials will also seek to legitimate their positions in organisations by drawing a clear boundary between 'theory' and 'practice', and by distancing themselves from those engaged in practical problem-solving. In contrast, a system that combines formal education with practical experience and emphasises the importance of 'learning-by-doing' tends to give rise to a broad conception of 'knowledge'. Knowledge, in such a context, is defined to include not only the formal theory acquired through study, but also the practical skills, experience and know-how accumulated in work-related contexts. In other words, the system sees both formal knowledge and practical skills as of equal importance for the competent performance of tasks. Such a broad conception of knowledge reinforces a close working relationship between different categories of the workforce and promotes cooperative team working.

The second aspect of formalisation is associated with the extent to which formal education institutions and professional bodies have control over the definition and constitution of high-level expertise. Generally speaking, increasing levels of control by formal education and professional institutions are associated with increasing formalisation and abstraction of knowledge in training programmes. This is because the training programmes become structured around academic conceptions of expertise derived from intellectual and scientific objectives rather than problem-based techniques, and a large part of it is constructed outside the work context. Hence, the knowledge acquired is more standardised and codified; it can be bundled into specific occupations with clearly defined knowledge and role set. This aspect is related to the structure of the labour market and nature of employment relations. A market-based employment system (OLM) implies a higher degree of academic and professional control over skills formation and hence a greater degree of formalisation and abstraction of knowledge. In contrast, a firm-based system (ILM) implies a greater degree of control by the employers over

the definition of expertise and lesser academic control, leading to a lower level of standardisation of expertise around formal knowledge.

This leads to a third related aspect: the extent to which academically developed and certified expertise monopolises high-status and well-rewarded jobs. This is closely connected with the degree of 'professionalisation' of expertise and the extent to which professional control is linked to task and occupational boundaries. The Anglo-Saxon model of 'professionalism' depicts a close connection between theoretical knowledge and elite status (Glover, 1978). It is characterised by the organisation of occupational expertise around academic specialisation, assuming a one-to-one connection between a body of abstract knowledge and an occupation. The body of formal knowledge becomes a basis of competence and jurisdictional control over task boundaries. This has resulted in a proliferation of occupations based on narrow academic specialisation. Formal knowledge thus becomes a tool for status differentiation and a basis of claims for control (Gerpott and Domsch, 1985). The professional model of skill formation de-emphasises the practical and tacit components of knowledge (Kerr and Von Glinow, 1977). It is associated with the development of a hierarchical pattern of work organisation within firms. For example, Child et. al. (1983) argue that the notion of 'professionalism' in Britain has led to the low status of production. The tacit and contextual nature of the skills underlying production makes it difficult for the job-holders to demonstrate that their work has a clearly defined 'knowledge base'.

Degree of elitism vs. egalitarianism

An education system characterised by a strong academic orientation but which attaches little importance to the general education and vocational training of the majority of the workforce can be described as 'elitist'. An elitist system is characterised by a highly uneven, two-tier structure of competence distribution: a well-developed higher education system for the elite while the majority of the workforce is poorly educated. For example, the system in the UK and USA belongs to this category. It displays a strong bias towards academic education and attaches little social status and economic credibility to practical skills which acts as a disincentive for investment in this area. As a result, there is a widespread lack of formal intermediate skills and qualifications among the general workforce in these two countries (Buechtemann and Verdier, 1998; Lynch, 1993; Finegold and Soskice, 1988; Prais, 1993). Such an elitist system creates a

bias in the use of human capital and labour market polarisation (Foray and Lundvall, 1996; Lundvall, 1997). It is associated with a bureaucratic form of work organisation and knowledge configurations within firms. The wide disparity in the educational backgrounds and skill levels between the different categories of the workforce generates knowledge discontinuities and social distance within firms. This reinforces the concentration of knowledge among the highly educated 'experts' and their monopoly of high-status positions. It reinforces the domination of formal knowledge over tacit skills and generates a hierarchical pattern of work organisation.

In contrast, an egalitarian education system is characterised by a widespread and rigorous general and vocational education for a wide spectrum of the workforce. It generates a decentralised mode of work organisation and provides a strong basis for interactive learning and the cultivation of tacit knowledge as a source of organisational capability. Germany and Japan are good examples (Soskice, 1996; Aoki, 1988; Koike, 1986 and 1995). In these two countries, the availability of a large supply of middle-level workers with good general education and training enables firms to organise work in a more cooperative and decentralised manner, conducive to the transmission and mobilisation of tacit knowledge.

Labour Markets: Careers, Identity and Learning

Skilled labour markets are typically classified into occupational (external)labour markets and internal labour markets (Marsden, 1986). The types of labour market and nature of employment relationship influence the knowledge base and learning capabilities of the firm in three respects. First, it determines the extent to which expertise is developed outside or within the firm, and hence the relative importance of formal education and training institutions vis-a-vis employers in defining the skills requirements and knowledge base of the firm. Second, it determines the degree of career mobility and stability of personnel which, in turn, influences the incentives of the individual and the capability of the firm in acquiring and accumulating different types of knowledge. And third, the nature of the employment relationship shapes the individual's career and social identity. It defines the incentives for and boundaries of learning, and influences the interaction between individual and collective learning.

Occupational Labour Market (OLM)

An occupational labour market (OLM) offers a relatively high scope for job mobility.

Knowledge and learning are embedded in an inter-firm rather than intra-firm career. A large part of the knowledge and skills required are developed outside the firm, or within the firm but according to inter-firm occupational standards. Formal education and training plays a much greater role in generating directly relevant occupational competence, and hence exerts a direct influence on the knowledge base and learning capabilities of firms. The type of qualifications generated can be highly task-specific based on standardised, advanced 'packaging' of knowledge and skills (e.g. craft-oriented training or professional education). Alternatively, it can be a broad-based general education giving the individual a high-level of 'meta-competences' that can be adapted and applied across a wide variety of work settings and tasks (Nordhaug, 1993). The former approach is based on the assumption that the task environment is relatively stable and the knowledge required can be codified and pre-packaged in initial training programmes. The latter, in contrast, rests on the notion that the task environment is uncertain and the knowledge required is fluid, emergent and constantly shifting. It cannot be easily bundled into occupations or codified in advance, and hence requires a broad-based initial qualification to enable individuals to pursue a more varied and flexible approach to continuous learning.

In an OLM, knowledge and skills are owned by and embodied in the individuals; they are personal properties for career advancement. The transparency and transferability of the knowledge acquired is of paramount importance for the efficient allocation of human resources. Career mobility in an OLM relies on effective signals: dependable information about the type and quality of skills and knowledge that individuals have. This can be based either on public certification (institutional signals), or peer group recognition (information signals) (Marsden, 1986: 2). The former approach works well provided that the knowledge and skills required can be easily identified and codified, i.e. bundled into specific occupations with a distinctive set of tasks or problems to which these skills and knowledge are applied (Tolbert, 1996: 336-7). In situations where the tasks are highly fluid and unpredictable, and the knowledge used constitutes a large tacit component (e.g. personal know-how), institutional signals become insufficient and unreliable. This is because tacit skills cannot be easily codified; they can only be revealed through practice and work performance. Their transfer will have to rely heavily on social and professional networks based on shared industrial or occupational norms. In other words, the efficient transfer and accumulation of tacit knowledge in an OLM requires the

support of a ‘containing social structure’, for example, the formation of a community-based OLM based on localised firm networks and industry clusters (Defillippi and Arthur, 1996; Saxenian, 1996). Social networks facilitate the ‘marketability’ of cumulative personal tacit skills.

Learning within an OLM tends to be person-centred and market-oriented. It is rooted in the individual’s professional and career strategy, and characterised by a greater degree of autonomy and latitude in the boundary and domains of learning. Learning may occur not only within the confines of the firm and the groups and networks attached to the firm, but also within the individual’s professional and social networks which extend beyond the firm (Bird, 1996). This can potentially enlarge the knowledge base of the individual and generates diverse cognitive maps and values in the organisation. According to Huber (1991), such diversity is a source of organisational learning as it helps the organisation to develop a more varied interpretation of the knowledge acquired and can potentially change the range of the organisation's behaviour, leading to the possibility of radical learning. Moreover, firms operating in an OLM can add variety and diversity to their knowledge base through external recruitment. They can transform and renew their knowledge base by acquiring and ‘grafting’ new members who possess knowledge not previously available internally (Huber, 1991: 97). The greater degree of mobility in the labour market allows firms to closely align their knowledge base with shifting market requirements and technological changes. Firms in an OLM will display a greater tendency to develop new knowledge by external acquisition and exploration. However, the costs for the firms are twofold: the difficulties in integrating and coordinating the diverse knowledge base and perspectives generated; and their limited capacity to develop a distinctive core competence through internal knowledge accumulation and exploitation.

Internal Labour Market (ILM)

An internal labour market is characterised by long-term stable employment with a single employer and career progression through a series of interconnected jobs within a hierarchy. Knowledge and learning are embedded in an intra-firm career; a large part of the knowledge and work-related skills is generated through firm-specific on-the-job training (OJT). Formal knowledge acquired through education serves only as an entry qualification and provides the basis upon which work-related skills are built within the firm. The nature of OJT thus plays a critical role in defining the knowledge base and learning capabilities of firms operating in an

ILM. The characteristics of OJT and its effectiveness as a mechanism of learning are closely connected with the pattern of work organisation and the extent to which practical experience is valued and constitutes a basis for career progression. There are two alternative ILM models: narrow jobs and stratified careers vs. broad-based jobs and continuous careers. The former is associated with an elitist education system, and the latter, an egalitarian one.

Where jobs are narrowly defined and careers are organised around hierarchies of jobs with tiered boundaries based on formal entry qualifications (e.g. upper-tier work associated with formal knowledge learned through higher education, as in the case of France), OJT will tend to be narrow and job-specific, and the opportunities for career progression based on OJT will be limited. Narrow OJT limits the variety of the individual's experience and hence impedes creative thinking and the generation of tacit knowledge (Nonaka, 1994: 21). The containment of learning within a single job prevents the creation of common understanding, shared experience and knowledge integration. Moreover, the association of formal knowledge with higher positions implies that tacit skills accumulated through practical experience will be under-valued and not recognised as a basis for promotion. The incentive for the individual to accumulate such knowledge is weakened and the organisation fails to exploit the potential of 'learning-by-doing'. An ILM based on narrow job specialisation and a career structure characterised by clear tier boundaries generates a fragmented and hierarchical knowledge base.

In contrast, an ILM can also be organised around broadly defined jobs and a continuous career hierarchy based on a common ranking system (e.g. the case of Japan). Progression to upper level positions is achieved, in this case, through accumulation of a wide range of skills and organisational experience. Formal knowledge plays only a limited role in defining competence criteria and entry to senior positions; the key emphasis is on the long-term accumulation of firm-specific skills and practical experience, i.e. 'learning-in-breadth'. Within such a system, OJT is broad-based and linked systemically with career progression. Individuals undertake a wide range of duties through job rotation. This gives them the opportunity to develop a broad range of knowledge and skills outside their own functions and expertise. It increases the variety of experience and facilitates the generation of tacit knowledge. Job rotation also serves an important socialisation function. It encourages individuals to accumulate a broad range of organisational experience and contextual knowledge,

and helps to reduce social distance between different categories of the workforce. Through such broad-based OJT, individuals not only acquire a diverse range of technical skills but also simultaneously learn to become members of the organisation, develop shared understanding and common values. To use Nonaka's terms, job rotation creates 'common perspectives' and 'information redundancy' within the organisation (Nonaka, 1994: 24-5). These facilitate the generation of trust, 'learning-by intrusion' and the formation of a social organisation within which the transmission of tacit knowledge takes place. The close integration of OJT with career progression also gives individuals a strong incentive to accumulate knowledge through practical experience. The career hierarchy becomes a device for tacit knowledge creation and learning.

Learning within an ILM is collective and organisation-oriented. It evolves along the internal requirements of the firm, and is rooted in a firm-based career and organisational identity. Individual learning merges with that of the collective. The firm's learning and innovative capability, however, may either be enhanced or hampered by its collective knowledge base, depending on the process and mechanisms through which such knowledge is generated. Firms may rely on different mechanisms for linking individual with collective learning. This is closely connected with the degree of trust and cooperation present in the firm. Collective knowledge generated through a top-down process of institutionalisation and codification is superficial and partial. It fails to incorporate tacit knowledge generated at the operational level. Firms operating on such an explicit knowledge base can only learn very slowly through internal adaptation, and their innovative capability is limited (Eliasson, 1996). In contrast, collective knowledge emerging through interaction and shared learning is dynamic and organic. Social interaction facilitates the transmission and accumulation of tacit knowledge and amplifies individual learning. In this context, collective knowledge is more than the summation of individual knowledge. It has the capacity to generate new knowledge through synthesis and combination, enabling the firm to learn and innovate on a cumulative basis.

Learning within an ILM tends to be internally oriented, self-reinforcing and path-dependent. The stability of personnel within an ILM facilitates the retention and accumulation of knowledge. Organisational memory becomes an important source of learning (Huber, 1991: 105). It allows firms to exploit its knowledge base on a continuous basis, linking their past and present activities and extend to future possibilities (Hamel and Heene, 1994). Firms may display

a strong capacity in incremental innovation and focus on developing a distinctive core competence (Prahalad and Hamel, 1990; Leonard-Barton, 1992). However, the learning and innovative capability of firms within an ILM may also be constrained by its existing ways of doing things and the established networks of social relations. The career structures that encourage social identification and close integration of individual with collective learning reduce the firm's capability to learn from individual deviance and pursue a radical transformation of its knowledge base through insertion of radical skills (March et. al., 1991: 6; Soskice, 1996: 20). As a result, the distinctive competence of the firm is accentuated. The firm may become increasingly removed from other bases of knowledge and experience and vulnerable to radical change in its environment (Levinthal and March, 1993: 102).

FOUR CONTRASTING SOCIETAL MODLES OF KNOWLEDGE AND LEARNING: THE ROLE OF TACIT KNOWLEDGE AND INNOVATION

The interaction between education and labour market institutions gives rise to four contrasting institutional configurations underpinning the different organisational forms and knowledge types discussed in the earlier part of the paper. These institutional configurations can be taken to represent different societal models of organising knowledge and learning: the 'professional', 'bureaucratic', 'occupational community' and 'organisational community' models (see, Figures 3, 4). Their implications for the innovative capabilities of firms are mediated through the different organisational forms and patterns of learning. Hence, one can argue that there are dominant societal patterns of learning and innovation.

The Professional Model: Professional Bureaucracy

The professional model is characterised by a narrow, elitist education based on a high degree of formalisation of knowledge. It is rooted in an open labour market based on a high level of occupational codfication and specialisation. The system is geared to the generation of explicit knowledge and favours an individual approach to learning; the incentives and social structure required for the diffusion and accumulation of tacit knowledge are relatively weak. The professional model gives rise to the dominance of the 'professional bureaucracy' and 'embrained knowledge' within firms. It prevails in the Anglo-American countries e.g. Britain and the USA, where the notion of 'professionalism' is deeply rooted in the fabric of societal institutions. The professional model generates a narrow approach to learning and inhibits

innovation.

The Bureaucratic Model: Machine Bureaucracy

The bureaucratic model shares many common characteristics with the professional model on the formal education and training dimension. However, it is rooted in an internal labour market organised around narrowly defined jobs and a tiered career hierarchy. These institutional features underpin the 'machine bureaucracy' dominated by 'encoded knowledge'. Crozier's (1964) portrayal of the French type of organisation epitomises this category. The bureaucratic model seeks to control and eliminate tacit knowledge. It generates a superficial approach to learning and has little capacity to innovate.

The Occupational Community Model: Operating Adhocracy

The occupational community model is rooted in a region-based OLM surrounding a cluster of interdependent occupations and firms. It is characterised by a high rate of inter-firm mobility which fosters the formation of social networks and transmission of knowledge and skills within the community. The education system also constitutes an important part of the local network. This brings about a more permeable boundary between the 'learning' and 'working' communities, and helps to create a responsive education system capable of meeting the competence and skills requirements of firms. The occupational community provides an institutional framework and social infrastructure for tacit learning to emerge. It reduces the pressure towards knowledge standardisation and occupational codification inherent in an open occupational labour market. The occupational community is an institutional prerequisite for fostering and sustaining the innovative capability of the 'operating adhocracy'.

The operating adhocracy is an organisational form regarded by many authors as the most appropriate structure for firms engaging in an innovative, dynamic and unpredictable environment (Mintzberg, 1979; Quinn, 1992). However, it is potentially unstable and hard to sustain, unless supported by an occupational community. In a 'boundaryless' open labour market, the operating adhocracy will be under pressure to bureaucratise because of the difficulties in accumulating and transferring tacit knowledge. The tacit knowledge creating capability of the operating adhocracy can only be sustained provided that it operates as a member of localised firm network. An archetypical example is Silicon Valley where a fluid,

occupational labour market is embedded in a rich fabric of regional and professional networks (Rogers and Larsen, 1984). Such networks of social relationships provide the 'social capital' and 'information signals' needed to ensure the efficient transfer of tacit knowledge in an inter-firm career framework (Saxenian, 1996: 36). The shared industry-specific values within the regional community ensure that tacit knowledge will not become wasted knowledge when one changes employers, and thus gives the individual a positive incentive to engage in tacit 'know-how' learning (Defillipi and Arthur, 1996: 123). The occupational community also fosters the 'know-who' network that supports high rates of job mobility. Tacit knowledge is made visible through social reputation in a community-based OLM. As Reich notes, 'The local gossip serves as a highly efficient and highly specialised job grapevine. It alerts everyone in the area to who is good at doing what and where skills can be best utilised' (Reich, 1992: 236).

A community-based OLM supports and reinforces the dynamic learning capability of the operating adhocracy. It creates a stable social structure within an open labour market. This fosters tacit knowledge creation and interactive learning. The inter-firm career mobility and social networks provide multiple learning opportunities which can have amplifying effects on the learning and innovative capability of the firm. Learning is not confined within the boundaries of individual firms; it draws from the knowledge base of the community as a whole. The community's social and technical networks operate as a kind of superorganisation, through which individuals and firms, in shifting combinations, engage in experimentation, entrepreneurship and interactive learning. (Saxenian, 1996: 30).

The Organisational Community Model: J-form Organisation

The organisational community model is characterised by a broad-based, egalitarian education system and an ILM based on broadly defined jobs and a continuous career hierarchy. It favours the J-form organisation typically found in Japan. The organisational community model generates a decentralised and cooperative approach to problem-solving. It facilitates the transmission and accumulation of tacit knowledge through collective learning within a stable career hierarchy. It is the socially embedded nature of knowledge that constitutes the important source of learning and innovation in the J-form organisation. It has a unique capability to generate innovation continuously and incrementally. Learning within the organisational community, however, is bounded within the firm-based ILM. This can generate conservatism

and inhibit radical innovation.

TWO ALTERNATIVE MODELS FOR LEARNING AND INNOVATION: THE OCCUPATIONAL COMMUNITY VS. ORGANISATIONAL COMMUNITY MODELS

The above analysis shows that there are two alternative models for learning and innovation: the occupational community and the organisational community models. The former supports the operating adhocracy, and the latter, the J-form organisation. These two organisational forms share many similar structural characteristics: they are both organic, non-hierarchical organisations based on decentralised problem-solving and multi-disciplinary team working. However, the nature of the relationship between the individual and the organisation differs. The individuals enjoy a much greater degree of autonomy in the operating adhocracy; their careers and social identity are rooted in the wider occupational community. In contrast, the J-form organisation emphasises the close integration of the individuals into the organisational community through intensive socialisation. The identity of the individual becomes firmly rooted within the organisation. These differences are reflected in their dominant knowledge types and learning strategies. The operating adhocracy derives its capability from the knowledge and skills embodied in the individual experts. The accumulation of knowledge occurs at the level of the individual and the organisation adopts an external approach to learning. It is a 'knowledge-intensive', market-based organisation focusing on the strategic advantage of continuous change, adaptation and entrepreneurship. In contrast, the J-form organisation draws its capability from the collective knowledge 'embedded' in the organisation’s routines and shared values. It adopts an internal and firm-centred approach to learning. It is a 'knowledge distributing' organisation, depending on the collective competence of its employees. It derives its competitive strength from the cultivation of firm-specific core competence. The contrasting strategies adopted by the two models generate different types of organisational capabilities and innovation patterns. The occupational community model facilitates the diffusion of tacit knowledge within a broader boundary and varied contexts. It encourages experimentation and entrepreneurial behaviour and has the potential to achieve radical innovation in leading edge technological fields. The organisational community model, however, allows the accumulation of tacit knowledge within the boundary of the firm. It has the capacity to enhance its knowledge base through internalisation and

absorption. It is geared to incremental product and process innovation in established areas.

Despite these differences, the two models share an important common feature: the role of tacit knowledge in generating learning and innovation within 'communities-of-practice' (Brown and Duguid, 1991), albeit on a different scale. They suggest that learning and innovation cannot be separated from social interaction and practical experience, both of which are vital processes for tacit knowledge creation. The 'community' concept underlines the 'socially embedded' nature of knowledge, learning and innovation.

CONCLUSIONS

This paper has illustrated the coherence and inter-locking relationships between the three levels of analysis: the individual, organisational and societal, in an attempt to construct a theoretical framework for understanding how they interact to shape the learning and innovative capabilities of firms. The 'societal perspective' adopted in this paper demonstrates how macro-level institutions shape the incentives and constraints for the actors in their learning and innovation activities. This, by no means, implies crude societal determinism. The incorporation of the epistemological dimension in the analysis suggests that individuals are both actors and agents in the social construction of knowledge. Organisations are key mechanisms in mediating the influence of societal institutions on the individuals' socio-cognitive structures and their learning and innovative potentials.

The theory developed in this paper represents the first attempt to integrate the diverse strands of literature and different levels of analysis into a single coherent framework. It holds promise for interpreting and understanding the sources of differences in learning and innovation practices between firms, industries and countries, and for suggesting the main focus of policy intervention in the creation of, what Lundvall (1997) has called, a 'learning economy'.

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Figure 1 Cognitive Level: Knowledge Types

Ontological dimension

Epistemological Dimension	Individual	Collective
Explicit	Embrained Knowledge	Encoded Knowledge
Tacit	Embodied Knowledge	Embedded Knowledge

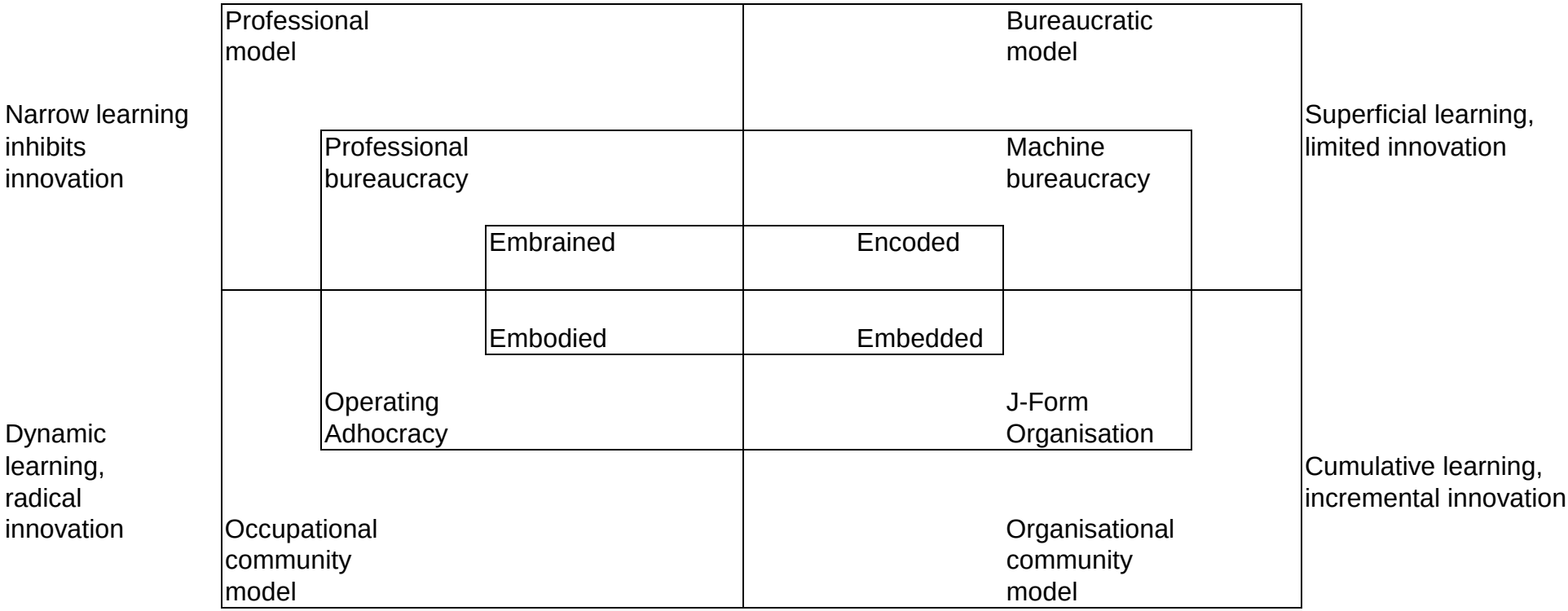
Figure 2 Organisational Level : Coordination and Learning

Standardization of knowledge and Work	Knowledge agent (Autonomy and control)	
	Individual	Organisation
High	Professional Bureaucracy	Machine Bureaucracy
Low	Operating Adhocracy	J-Form Organisation

Figure 3 Societal Level: Education and Labour Markets

Education & training	Labour markets (careers and mobility): OLM (Market)	ILM (Firm)
Narrow elitist	Professional Model	Bureaucratic Model
Broad egalitarian	Occupational community Model	Organisational community Model

Figure 4 Knowledge, Learning & Innovation: Three Inter-Locking Levels



Danish **R**esearch **U**nit for **I**ndustrial **D**ynamics

The Research Programme

The DRUID-research programme is organised in 3 different research themes:

- The firm as a learning organisation

- Competence building and inter-firm dynamics

- The learning economy and the competitiveness of systems of innovation

In each of the three areas there is one strategic theoretical and one central empirical and policy oriented orientation.

Theme A: The firm as a learning organisation

The theoretical perspective confronts and combines the ressource-based view (Penrose, 1959) with recent approaches where the focus is on learning and the dynamic capabilities of the firm (Dosi, Teece and Winter, 1992). The aim of this theoretical work is to develop an analytical understanding of the firm as a learning organisation.

The empirical and policy issues relate to the nexus technology, productivity, organisational change and human ressources. More insight in the dynamic interplay between these factors at the level of the firm is crucial to understand international differences in performance at the macro level in terms of economic growth and employment.

Theme B: Competence building and inter-firm dynamics

The theoretical perspective relates to the dynamics of the inter-firm division of labour and the formation of network relationships between firms. An attempt will be made to develop evolutionary models with Schumpeterian innovations as the motor driving a Marshallian evolution of the division of labour.

The empirical and policy issues relate the formation of knowledge-intensive regional and sectoral networks of firms to competitiveness and structural change. Data on the structure of production will be combined with indicators of knowledge and learning. IO-matrixes which include flows of knowledge and new technologies will be developed and supplemented by data from case-studies and questionnaires.

Theme C: The learning economy and the competitiveness of systems of innovation.

The third theme aims at a stronger conceptual and theoretical base for new concepts such as 'systems of innovation' and 'the learning economy' and to link these concepts to the ecological dimension. The focus is on the interaction between institutional and technical change in a specified geographical space. An attempt will be made to synthesise theories of economic development emphasising the role of science based-sectors with those emphasising learning-by-producing and the growing knowledge-intensity of all economic activities.

The main empirical and policy issues are related to changes in the local dimensions of innovation and learning. What remains of the relative autonomy of national systems of innovation? Is there a tendency towards convergence or divergence in the specialisation in trade, production, innovation and in the knowledge base itself when we compare regions and nations?

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Pernille Wittrup
Fibigerstræde 4
DK-9220 Aalborg OE
Tel. 45 96 35 82 65
Fax. 45 98 15 60 13
E-mail: druid-wp@business.auc.dk