Timo J. Hämäläinen & Gerd Schienstock

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Innovation Networks and Network Policies

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1. Globalisation and Innovation Competition

There is widespread agreement that industrialised countries are in a process of fundamental and rapid change. The globalisation of firms and markets is the driving force behind a radical transformation process which has gained momentum with the information technology revolution and the liberalisation and deregulation of markets. Globalisation can be seen as a new stage in the development of the world economy; while "internationalisation" refered to increasing border-crossing economic activities, "globalisation" implies the merging of national markets into one borderless world market. It results in a growing world-wide integration and interpenetration of economic activities.

Besides intensifying price and cost competition by eroding national monopolies or oligopolies, globalisation has also created new bases of competition such as quality and time. Nowadays all global players must be able to produce high-quality products on low costs, sell them at a reasonable price and deliver them quickly and in time (Stahl et al. 1993: 15). The same competition criteria are also pressured on local firms by their larger customers and the subsidiaries of multinational enterprises.

However, meeting the above competition criteria is not enough. They are necessary but not sufficient conditions for success in the rapidly changing environment. Today, firms' competitiveness depends increasingly on their capability to continuously innovate new products and processes that better meet the demands of customers. Innovative companies enjoy first-mover advantages in the product market and can charge premium prices as long as their competitors are struggling to catch up. Customised innovation is becoming an increasingly important competitive factor relative to productive efficiency and cost cutting as the demand patterns are becoming increasingly individualized and the life cycles of products are decreasing in many industries.

2. Towards a New Model of Innovation

2.1 Technology push and demand pull

Innovation research has for a long time been been dominated by a controversy between two different models of innovation. The "demand pull" model emphasizes the dynamics of market demand as the catalyst of technological change (Schmookler 1966). The changing market potential guides innovative activities to the most profitable areas. The demand pull approach is very appealing to social scientists as it stresses the social shaping of technological progress.

The "technology push" model underlines the inventive genius of innovators and scientists as the driving force behind technological development. In the short term, innovation opportunities are seen to be restricted by the limited set of technological trajectories (Salter 1960; Dosi 1988). Hence, it is not always possible to attribute an innovation to specific demands; in fact, it is often the case that demand has to be created after a new innovation has taken place. Furthermore, the demand pull model does not adequately deal with the problem of technological uncertainty within innovation processes, as it assumes a technical solution to emerge whenever there is market demand. And finally, the organizational problems of innovation processes are not touched upon (Kowol and Krohn 1994).

The technology push model is based on a Schumpeterian linear model of innovation. It assumes that new knowledge will always find its way into marketable products. Schumpeter gave the risks-taking entrepreneur a decisive role in innovation processes (Schumpeter 1934). He is assumed to press new products and process technologies to the market even if there is no guarantee of sufficient demand. Later, the entry of imitators will speed up the diffusion of the innovation to other industries. The technology push approach assumes that entrepreneurs will start innovating again once imitation becomes

less profitable and the process of diffusion slows down. According to Schumpeter, such waves of innovation lead to a process of "creative destruction" which inflicts serious damages to the existing economic structures (Schumpeter 1934).

The technology push approach has its own problems, too. It assumes some kind of a technological determinism. The innovation process, where technological inventions are transformed into marketable products, is not well analyzed. Nor is the commercial success and failure of different innovations explained. Finally, the technology push model ignores the mental, social, cultural and institutional factors that influence the development of new innovations.

The above discussion suggests that the simple demand pull and technology push models do not offer a very realistic model of modern innovation processes (Dosi 1988). Hence, a new and richer model of innovation has been called for. The innovation process must be seen as an open and socially-embedded process in which new scientific options, accumulated production knowledge and market demands interact with each other (Lovio 1985).

2.2 From linear to recursive model of innovation

There are many different ways of describing the innovation process. Traditionally, the process of technological change has been characterised with three consecutive stages: invention, innovation and diffusion. Invention is defined as the stage where new technological knowledge is produced, innovation as the stage where it is first applied to production, and diffusion as the widespread marketing and adoption of the new products and technologies in production and consumption.

This model can be characterised as a "cascade model" (Schienstock 1994); it implies that investments in basic research substantially influence the opportunities for technological innovations which, in turn, determine the growth

rate of the economy and thus employment. This model suggests that, at low levels of investment in basic research, the redistribution of resources towards this stage of the innovation process would speed up the process of economic growth and job creation. However, the cascade model can also be criticised from many different perspectives (Lundvall 1988, Schienstock 1994):

(1) Innovations are not exceptional events that take place only in very specific circumstances; they cannot be characterised as marginal phenomena. On the contrary, innovations can take place any time in any part of the economy. They must be conceptualised as ubiquituous phenomena. With such a conceptualisation, there is no need to associate innovations only with radical technological breakthroughs; incremental changes can also be included in the concept of innovation (Lundvall and Johnson 1994).

(2) Although improvements in scientific knowledge are generally expected to raise the innovation potential of a society, the utilisation of new knowledge is by no means guaranteed. Moreover, scientific research is not a necessary condition for innovations to occur. They can also be triggered by other causes: such learning processes in production (learning by doing), new demands of customers (learning by interacting), or new possibilities to apply existing knowledge in other contexts (knowledge transfer) only to give a few examples. Furthermore, there are no clear stages in the innovation process. We have to analyse innovation as a recursive or "chain-linked" process in which particular innovation activities can be both the cause and the effect; i.e. the innovation process has multiple feedback loops among interdependent activities (Kline and Rosenberg 1986).

(3) We must also recognize the fact that innovation processes are socially embedded and shaped. There is no dominant logic that drives innovatory activities. Instead, they are influenced by social factors such as a national culture, institutional setting and the interests of the dominant coalition of economic actors. Thus, innovations are born in an open, interactive and social process.

(4) The socially-embedded nature of innovation makes the innovation processes cumulative in nature. Thus, Dosi has introduced the term "technological trajectories" to describe the path-dependency of technology development processes (Dosi 1982).

Once we move from the linear model of innovation to the recursive one we can no longer assume, as Schumpeter did in his earlier writings (1934), that innovation depends primarily on exceptional personalities who push through the innovation process motivated by aims such as recognition and power. This "big man" or "hero" theory (Schienstock 1975; Freeman 1991) of innovation does not correspond to the realities of modern economies where incremental innovation is ubiquituous and innovation processes typically involve many different and closely cooperating actors. In this context, innovation depends *inter alia* on intra-organisational coordination, inter-organisational co-operation, rich communication flows along the value-adding chain and supportive institutions. This is also the context where "innovative networks" has come to the focus of innovation research and policy discussions.

There are many different types of networks in modern economies and their economic rationale may also vary considerably. The following section will review some of the most typical network structures. The subsequent section will analyse the economic rationale behind them.

3. Different types of networks

The concept of "network" has become so popular during the past ten years that critiques are already talking about its abuse (Grandori and Soda 1995). However, despite its widespread use, there is no concensus about the appropriate definition of networks. As we will see below, this reflects the numerous forms that networks can take.

Networks are often characterized with the concept of "loose coupling": various independent actors develop relatively loose relationships among each other to

pursue some common goals (Johannison 1987: 9). Network relationships usually take a relatively long period of time to develop but, once established, they tend to be characterized by mutual interdependence, intensive communication, reciprocity, and high levels of trust (Nahapiet and Ghoshal 1998). However, occasional conflict and power-asymmetry are not ruled out. The focus of networks analysis is more on the relationships and interactions between interdependent actors or organisations than on these actors or organisations themselves.

Networks have been analysed by researchers from many different disciplines with varied research interests and approaches. They have focused on different aspects and levels of network formation. Some researchers take an interpersonal perspective and emphasize the non-economic bases of social exchange and the importance of interpersonal relationships for productive cooperation, economic efficiency and innovativeness (Granovetter 1973,1995; Miettinen et al. 1999). Others emphasize the structural approach and focus on the configuration, number and quality of network ties (Nahapiet and Ghoshal 1998; Mattila and Uusikylä 1999). Still others focus on the institutional nature of networks and define them as a distinct organizational arrangement comparable to markets and corporate hierarchies (Powell 1990; Williamson 1991).

There are many different types of networks in modern economies. They can be divided into vertical and horizontal networks according to the value-adding chain (Porter 1985). Vertical networks connect firms or production activities along a particular value-adding chain or production process; whereas horizontal networks connect individuals and organizations in particular functional areas (such as research, production, logistics, marketing, etc.). In recent years, network type of arrangements have also been created between private and public sector organizations. For example, private-public partnerships and quasi-market arrangements have been used to improve the efficiency public service provision (Le Grand and bartlett 1993).

Networks can also be differentiated by their geographical scope. Thus, we can distinguish between local, regional, national, international and global networks.

The formality of network relationships may also vary considerably from highly informal, flexible and trust-based relations toward more formal and rigid connections (Lundvall and Borras 1997: 110f). The duration of networks can also differ: for example, project teams and virtual corporations can be formed to achieve a particular short term goal, whereas strategic alliances, joint-ventures and business associations typically have longer term objectives.

The new information and communication technologies have increasingly liberated networks from the need for physical proximity. As a result, traditional social networks with face-to-face communication have been supplemented by virtual networks and electronic interaction.

The boundary of a network can be more or less clear-cut. In most cases no clear boundaries between a network and its environment exist. It is not always easy to say whether a specific individual or organization belongs to a particular network or not. The membership of a network can also change over time. Old members can leave, while new members can joint it. This means that networks are open constructs and we can speak of blurred boundaries. However, access to networks is not always easy and the costs of leaving a network can be quite high. We can therefore differentiate networks according to their degree of openness or closeness.

Networks can also differ according to the dimension of centrality. In principle, networks are defined as an association of autonomous social actors having equal rights. However, the dependency among the members of a network can be more or less symmetric. In some cases, a number of small companies can form a network of partners with equal rights and mutual assistance while, in other cases, the network may be led by one or more "flagship" firms which more or less control the other network partners (Rugman and D'Cruz 1996).

Finally, the stability of networks may also vary considerably. In general, networks are seen as a structure of loosely coupled actors, which makes it easy for new members to join them and for established partners to leave if they want. This could mean that the membership of networks would change quite

rapidly and the relationships within them would be relatively unstable. However, networks are usually characterized by close interdependency and high-trust relationships among their members, both factors which contribute to the stability of networks. We can therefore characterise networks as stable and changeable at the same time.

4. Comparative advantage of networks

Networks are not always the best arrangement for particular organisational problems though their comparative advantage seems to have risen in recent years. Markets (small firms competing at arm's-length) and corporate hierarchies have their own organizational strengths and weaknesses which give them comparative advantage in some industry environments. This section will argue that the dominant theory of institutional economics, the transaction costs theory, cannot adequately explain the recent paradigm shift in economic organisation toward networks. Hence, we will develop a richer organisational framework which includes four key characteristics of value-adding systems, one of them being transaction costs. These characteristics shape the comparative advantage of markets, hierarchies and networks in organising particular value-adding activities. In the end of the section, we will dynamize our theoretical framework by discussing the impact of increasing specialization and uncertainty of economic activities on the five organisational determinants.

4.1 Critique of transaction cost theory

The comparative advantages of markets, hierarchies and networks have been analysed in New Institutional Economics. This relatively new branch of economics has applied the transaction cost theory (TCT) of Coase, Williamson and others to argue that economic activities are organised according to their transaction cost characteristics (Coase 1937; Williamson 1975, 1985). In particular, the TCT suggests that markets can efficiently organise economic activities characterised by low transaction costs, hierarchies are superior with

high transaction cost activities, and networks or "hybrids" have a comparative organisational advantage with activities characterised by intermediate levels of transaction costs (Williamson 1991). However, despite its considerable achievements, the TCT has met increasing criticism in recent years. The following arguments summarize this criticism.

First, the definitions of "transaction" and "transaction cost" have been very vague and all-encompassing. As Demsetz (1991) noted a while ago, the "recent writings..sometimes use transaction cost to refer indiscriminately to organizational costs whether these arise from within the firm or across the market" (see also Perrow 1981). Second, the TCT has paid disproportionate attention to transactions in comparison to production and coordination issues (Dunning 1988; Simon 1991; Demsetz 1991). As a result, the impact of firms' differential resources and organizational capabilities on organizational choices has not received sufficient attention (Conner 1991; Demsetz 1991). The organizational choices of firms are influenced by their value-adding and coordination capabilities, and the performance of different organizational forms along these two dimensions (Kaldor 1934; Robinson 1934; Penrose 1959; Richardson 1972; Peteraf 1993).[1]

Third, the unit of analysis in the TCT is an individual transaction. This neglects the costs and benefits that a particular transaction may cause in other parts of the interdependent production system (Stigler 1951; Chandler 1979; Porter 1985; Winter 1991; Simon 1991; Istvan 1992). In highly specialized and interdependent modern industries, coordination and joint-optimization of the whole value-adding system is likely to be a far more important organizational determinant than the transaction costs between any two activities (McManus 1972; Porter 1985).

Fourth, the static approach of the TCT has little to say about the dynamics of technological and organizational innovation (Kogut and Zander 1992; Nahapiet

[1] Richardson's (1972, p. 888) criticism of neoclassical economics applies well to the new institutional economics: "It abstracts totally from the roles of organization, knowledge, experience and skills, and thereby makes it more difficult to bring these back into the theoretical foreground in the way needed to construct a theory of industrial organization".

and Ghoshal 1998; Lazonick 1993:195). Having roots in neoclassical economics, the TCT focuses on cost minimization rather than value creation through innovations. Moreover, the TCT has problems in explaining the new network type of arrangements, or "hybrids" as it tends to call them. It argues that hybrid forms of organization, such as alliances, joint-ventures, long-term contracts, etc., coordinate activities of intermediate asset specificity. In other words, network arrangements are seen to fall somewhere between the "ideal" organizational forms of markets and hierarchies (Williamson 1991). However, as we will soon show, the asset specificity and transaction costs are not the only determinants of economic organization, and all other determinants suggest that networks are not a hybrid form between markets and hierarchies rather than a third and truly original form of organization.

Fifth, while emphasizing the behavioral uncertainties related to opportunism, the TCT disregards other types of economic uncertainty and their organizational implications (Vernon 1983; Contractor 1990; Ring and Van de Ven 1992). For example, scholars of multinational enterprises (MNE) emphasize the "global scanning" and learning advantages of MNEs stemming from their global network subsidiaries (Vernon 1979; Bartlett and Ghoshal 1989). These uncertainty reducing advantages are efficiently achieved through hierarchical organization which facilitates the close interaction and rich communication of interdependent value adding activities (Itami 1987; Nahapiet and Ghoshal 1998). Besides the transaction-related uncertainties, MNEs must consider i.a. competitive, technological, political, institutional, and exchange rate uncertainties in their organizational choices (Vernon 1983; North 1990; Casson 1990; Contractor 1990; Ozawa and Phillips 1991; Ring and Van de Ven 1992).

More generally, the technological, political, institutional framework of value-adding activities varies among different industries, geographical locations, and historical time periods in ways that influence the comparative advantage of different organisational arrangements. For example, the "high-trust culture" of Japan has tended to favor network arrangements, while the "low-trust culture" of the United States has emphasized the benefits of hierarchical organizations (Aoki 1990; Bierly and Hämäläinen 1995).

4.2 Four organisational determinants

The critics of the transaction cost theory have argued that firms make their organizational choices by comparing "all gains and losses" of alternative solutions (Chandler 1977; Dunning 1988; Contractor 1990; Demsetz 1991). Even if transaction costs are significant, organizational decisions may still turn on the similarity and synergies of firm's productive resources, its coordination costs, or the innovation consequences of organizational alternatives. Hence, we need to develop a richer theoretical framework.

This section will develop a systemic framework which includes the four organisational determinants presented above. We will attempt to show that different levels of these factors tend to favor different organisational arrangements. In other words, the comparative efficiency of markets, corporate hierarchies and networks is determined by the level of (a) resource (dis)similarity, (b) transaction and (c) coordination costs, and (d) innovation activity in a particular value-adding chain.[2] We will analyse each of these determinants below.

Similarity of resources. Many researchers have suggested that firms" resources and capabilities shape the organizational structure of value-adding systems (Richardson 1972; Miles and Snow 1986; Demsetz 1991; Kogut and Zander 1992; Quinn 1992). In their view, firms can only undertake activities and maintain organizational arrangements supported by superior firm-specific resources.

Following the seminal work of Edith Penrose (1959), the "resource based theory of the firm" (RBT) became popular among strategy scholars in the late 1980s and early 1990s (Rumelt 1984; Wernerfelt 1984; Barney 1986; Teece, Pisano and Shuen 1990; Peteraf 1993). The RBT looked at firms in terms of their unique bundle of resources. The resources that provide a firm's competitive advantage

[2] The focus of our framework will be on the economic determinants of organisation but we acknowledge that in some situations power motives may also play a role in organisational decisions. For a discussion of the relative merits of economic and power approaches to organizational analysis, see Perrow (1981), Williamson and Ouchi (1981), Francis, Turk and Willman (1983) and Williamson (1991).

can take several forms: favorable location, proprietary technology and knowhow, good reputation, superior organizational culture and routines, and so forth. In the early 1990s, the resource based approach was applied to explain the boundaries of firms, particularly the limits to their diversification (Teece et al. 1990; Prahalad and Hamel 1990; Peteraf 1993). However, it was G. B. Richardson (1972, p. 888) who first applied this approach to analyze the organization of value-adding systems:

> "It is convenient to think of industry as carrying out an indefinitely large number of *activities*..[T]hese activities have to be carried out by organizations with appropriate *capabilities*, or, in other words, with appropriate knowledge, experience and skills..[F]irms tend to specialize in activities for which their capabilities offer some competitive advantage; these activities..may nevertheless lead the firm into a variety of markets and a variety of product lines".

Richardson (1972) analyzed the organization of industry with the concepts of resource similarity and complementarity. He argued that a firms' resources and capabilities support closely-related, or similar, activities. In a specialized value-adding system, these activities must be coordinated with other, complemetary, activities. Due to specialization, the complementary activities are often undertaken by other firms possessing different kinds of resources.

Although insightful, the resource based theory neglects firms' transaction and coordination costs and the uncertainty-related aspects of different organisational arrangements. The RBT is also rather static: it emphasizes firms' existing value-adding capabilities and production costs rather than their innovative capabilities. The organisational determinants of innovation have been the focus of the more recent "knowledge-based theory of the firm" (see e.g. Cohen and Sproull 1995; SMJ 1996). This theory will be introduced below with innovation.

Transaction costs. Transaction costs are related to the: search of appropriate exchange partners, negotiation and enforcement of contracts with them, and the problems of opportunism (e.g. adverse selection, moral hazard and principal-agent problems) related to the "bounded rationality" of economic agents. The transaction cost theory argues that transaction costs tend to increase with the

"asset specificity" of value-adding activities (Williamson 1985). The more co-specialised the productive resources of a value-adding system, the higher will be the transaction costs of markets (Williamson 1985). After a certain threshold of asset specificity, increasing transaction costs will move transactions from markets to "hybrids" or network arrangements (Williamson 1991). However, at the highest levels of asset specificity, only hierarchies can efficiently overcome the behavioral uncertainties and transaction stemming from highly co-specialized resources.

Besides asset specificity, transaction costs are also affected by the political and institutional framework within which the transactions are embedded (North 1990). Transaction costs are increased e.g. by uncertain property rights and low trust among exchange partners. As we noted above, different industries and local cultures may have widely differing institutional environments and thus transaction costs (see e.g. Fukuyama 1995).

Coordination costs. The coordination mechanisms and costs of value-adding systems are determined by the nature of interdependence among their value-adding activities. This, in turn, is shaped by the "richness" of information links between the value-adding activities: i.e. the number of specific aspects that must be coordinated between the interdependent activities (Galbraith and Kay 1986; Daft and Lengel 1986; Simon 1991). A traditional market exchange involves only two quantitative links, price and quantity. However, value activities often have qualitative links which require the matching of specific operation plans (Richardson 1972; Simon 1991). For example, marketing, R&D and production functions may have to coordinate numerous aspects of their highly-interdependent plans during a product development project (Kline and Rosenberg 1986; Teece 1992). The richer the information links between value activities, the more powerful coordination mechanisms are needed to facilitate the information exchange (Thompson 1967; Richardson 1972; Galbraith and Kay 1986; Daft and Lengel 1986; Simon 1991).

Thompson provides a useful typology of interdependence for our purposes by differentiating between the pooled, sequential, and reciprocal relationships of hierarchically organised value-adding activities (Thompson 1967). In pooled

interdependence, the value activities are interrelated only in that each activity contributes to the overall goal of the firm (e.g. firm's cafeteria and marketing department). In sequential interdependence, one value activity must be performed before the other (components manufacturing before their assembly). In reciprocal interdependence, the value activities have feed-back loops - i.e. they relate to each other as both inputs and outputs (marketing and R & D activities in dynamic industries) (Kline and Rosenberg 1986; Scott 1987). Van de Ven, Delbecq and Koenig have added a fourth type of interdependence to Thompson's typology: team interdependence (Van de Ven, Delbecq and Koenig 1976; Grant 1996). This is a systemic interdependence which involves several reciprocal links within a group of economic agents.

Combining the organisational arguments of Richardson, Thompson, Van de Ven et al., and Williamson we can derive the following propositions about the organization and coordination of value-adding systems. First, firms will internalize those value-adding activities where their resources and capabilities provide a competitive advantage (Richardson 1972; Miles and Snow 1986; Itami 1987; Demsetz 1991; Kogut and Zander 1992; Quinn 1992).[3] Depending on the nature of their interdependence, the internalized value activities will be coordinated by different mechanisms. Pooled interdependence will be coordinated by rules and standards, sequential interdependence by planning, reciprocal interdependence by mutual adjustment (Thompson 1967), and team interdependence by group meetings (Grant 1996) and shared values and vision (Hämäläinen 1999).

Second, following Richardson (1972), interdependent value-activities requiring dissimilar resources and capabilities will be internalized by different firms. If this interdependence is of pooled nature, the activities will be coordinated by the market mechanism where price equates supply and demand quantities (Richardson 1972; Williamson 1985; Galbraith 1986). However, if the activities are more interdependent, firms will have to cooperate in order to achieve qualitative coordination (Richardson 1972; Simon 1991). Similar to hierarchical

[3] However, the competitive advantage does not necessarily relate to the activity undertaken. An activity may be undertaken solely for its contribution to the firm's overall competitive advantage.

organization, we can expect that sequential interdependence between firms will lead to cooperative planning, reciprocal interdependence to mutual adjustment, and team interdependence to cooperative networks and the development of shared understandings, values and visions among the cooperating organisations.

In a competitive economy, firms will attempt to economize in their use of different coordination mechanisms (Thompson 1967; Grant 1996). The coordination by rules and standards or the price mechanism requires least resources, particularly information (Hayek 1945; Simon 1991). Thus planning, mutual adjustment, and the development of shared values and visions, which require increasing amounts of resources, are likely to be used only at the higher levels of interdependence (Thompson 1967).

Finally, we must recognize that the costs of intensive communication, development of shared values and visions, mutual adjustment, and planning are likely to be higher between firms than within them. The cost differential is related to the heterogeneity of firms' organisational cultures which leads to larger differences in information, ideologies and goals between organizations than within them. As a result, the borderline between hierarchical and network organization, where the resources of two organizations differ only slightly, is a "grey area" where the benefits of more efficient intra-firm coordination, or "economies of common governance" (ECG), may overwhelm a small resource advantage of the related firm. This may extend hierarchical coordination beyond the limits suggested by the relative resource advantages.

The size of the grey area and the ECG are influenced by several factors. First, the ECG are likely to diminish as the interdependence of the value activities decreases and markets become more efficient. Indeed, in perfect markets, the ECG turn into diseconomies of common governance. Second, as have already noted, the ECG are negatively related to the amount of *trust* between the interdependent organizations. A "low trust society" such as the United States will have higher inter-firm coordination and transaction costs than a "high trust society" such as Japan. This has traditionally allowed the Japanese firms to rely more extensively on cooperative modes of organization (Casson 1990;

Williamson 1991). Third, the size of the ECG are also negatively related to the size of the organization because the costs of intra-firm coordination in larger hierarchies are likely to approach those of the inter-firm coordination as the differences in inter-functional information, ideologies and goals increase. Finally, the size of the grey area also depends on the set up or acquisition costs involved in undertaking an additional value activity. The larger these costs, the more unlikely it is that the ECG warrant an extension of the hierarchy.

Innovation. So far, our organisational analysis has been couched in rather static terms. However, organisational arrangements have important implications for firms' innovativeness which cannot be ignored in a world of increasing innovation competition and quickly-eroding resource and cost advantages. The importance of innovation for organisational arrangements is also likely to vary among industries. In particular, we would expect innovation to play a key role in the organisation of the new knowledge-based industries; while resource and cost considerations would receive more attention in mature and less innovative sectors.

The organisational determinants of innovation and learning have, in recent years, been studied by scholars developing the new "knowledge based theory of the firm" (KBT) (see e.g. Cohen and Sproull 1995; *Strategic Management Journal* 1996, Nahapiet and Ghoshal 1998). Kogut and Zander, two leading scholars in this area, define a firm as "a social community specializing in the speed and efficiency in the creation and transfer of knowledge" (Kogut and Zander 1996: 503).

The KBT has analysed the different types of knowledge very carefully. Particularly, the different implications of tacit (implicit) and codified (explicit) knowledge for competitiveness, communication, information systems and organisations have received a great deal of attention (see e.g. Kogut and Zander 1992; Nonaka and Takeuchi 1995; Spender 1996; Brown and Duguid 1999). For example, Spender has argued that sustainable competitive advantage can best be built on socially shared and tacit knowledge (Spender 1996). Nonaka and Takeuchi have emphasized the dynamic interaction between an organisation's

tacit and codified knowledge bases for the development of new knowledge (Nonaka and Takeuchi 1995). Daft and Lengel, in turn, have underlined the importance of informal face-to-face communication mechanisms in highly complex and uncertain situations where the established cognitive frames must be changed (Daft and Lengel 1986). According to them, simple and stable communication environments tend to favor more formal communication mechanisms such as memos, faxes and E-mail. The former type of communication is characteristic of innovation processes where different types of cognitive frames and tacit and codified knowledge must be combined to produce new insights (Bierly and Hämäläinen 1995).

The knowledge based theory of the firm emphasizes four organisational factors which influence the innovativeness of firms. These are the (a) diversity of knowledge, (b) intensity of communication, (c) social capital and (d) the availability of complementary assets. We will discuss each of these factors in turn.

New knowledge is typically created when different types of knowledge is exchanged and combined or when the same knowledge elements are combined in a new way (Grant 1996; Nahapiet and Ghoshal 1998). In the past, this combination often took place in the heads of single inventors such as Leonardo da Vinci, Thomas Edison and Albert Einstein. The inventiveness of such "hero inventors" was often facilitated by their varied background and training which gave them the required diversity of knowledge and cognitive frame as well as the mental flexibility to combine different types of knowledge or to create new combinations of old knowledge elements.[4] However, today, individual knowledge bases tend to be so specialised that the required diversity of knowledge for major innovations can only be reached when two or more experts combine their different specialised knowledge sets and create a partially shared knowledge base (Grant 1996).

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[4] Professor Rogers Hollingsworth pointed out recently that the "cultural diversity within one's head" was an important factor behind major scientific breakthroughs in his empirical studies (Hollingsworth 2000). Such diversity and mental flexibility could be facilitated by an education system which

The different knowledge sets of individuals cannot be combined and shared very easily. The combination requires the development of shared language, overlapping knowledge structures, and common cognitive frames together with a meta-level recognition of each other's knowledge domains. This involves highly tacit types of knowledge which are very difficult to communicate. However, once established, the shared knowledge base permits individuals to exchange and combine aspects of knowledge which are not common between them (Grant 1996). This provides new insights, perspectives and meanings which would not otherwise emerge.

The development of shared knowledge bases among individuals with different knowledge sets requires intensive and long-term communication between them. The more diverse the individuals' knowledge sets are initially, the more difficult such communication becomes. At one extreme, when the individuals' knowledge bases are totally different, communication, and hence the creation of shared knowledge, becomes impossible. On the other hand, when the knowledge sets are very similar both communication and the creation of shared knowledge are very easy. However, the low diversity of knowledge does not encourage learning and invention.

Hence, the relationship between knowledge diversity and invention (learning) seems to be an inverted U (Nahapiet and Ghoshal 1998; Hollingsworth 2000). The intermediate levels of knowledge diversity, where the combination of different knowledge sets is still possible, provide the most fertile ground for major inventions. Moreover, it is possible that the "radicality of innovations" tends to increase with the diversity of knowledge. In other words, radical innovations are likely to require the combination of more diverse sets of knowledge than incremental ones.

The third organisational determinant of innovation is social capital. Nahapiet and Ghoshal define social capital as:

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familiarised students with many different subjects, disciplines and perspectives.

> "[T]he sum of the actual and potential resources embedded within, available through, and derived from the network of relationships possessed by an individual or social unit. Social capital thus comprises both the network and the assets that may be mobilized through that network" (Nahapiet and Ghoshal 1998: 243).

In the context of innovation, Nahapiet and Ghoshal operationalise the social capital with three dimensions: the structural, cognitive and relational. The structural dimension involves the number and configuration of an individual's existing or old network ties ("weak ties"). These ties have an important influence on the available knowledge diversity. The cognitive dimension includes the shared language and frames discussed above. As we noted, these cognitive factors determine the efficiency and intensity of communication between the different knowledge sets. Finally, the relational dimension of social capital involves the trust, behavioral norms and social identities which influence the access to different sources of compelementary knowledge and the motivation of people to exchange knowledge. Hence, the social capital shapes the outcome of innovation processes through affecting the diversity of available knowledge and the agents' "combinative capabilities" (Kogut and Zander 1992).

Finally, inventions do not become successful innovations before they are combined with many different complementary assets and activities and brought to the market (Teece 1987). This will often require systemic innovation where the missing pieces of the idea-innovation chain are either acquired or created and the other value-adding activities are adjusted to the demands of the new invention. The initial invention could involve any part of the value-adding system (sourcing, technology, production, marketing, etc.) and the systemic innovation takes place in the other, complementary, parts the system.

Nahapiet and Ghoshal have argued that the intensive communication required for creating new innovations cannot take place through the market mechanism (Nahapiet and Ghoshal 1998). According to them, rich communication flows require hierarchical organisation. This is consistent with Brown and Duguid who note that new knowledge is typically created in closely interacting "communities of practise" which have a shared frame, professional code and knowledge base.

Small firms may only have one community of practise; whereas larger firms may have several functionally divided communities (Brown and Duguid 1991; 1999).

However, the diversity of knowledge may not be adequate for major innovations within highly specialised firms. Very often the appropriate specialised knowledge can only be found in other organisations. Here, the more diverse knowledge available in occupational "networks of practise" may become highly valuable (Brown and Duguid 1999). Such networks consist of experts who are engaged in similar activities in different organisations. As a result, their knowledge bases, frames and language may overlap to a larger or smaller extent. Indeed, networks of practise may provide an attractive continuum of knowledge diversity and combinative capability. Some participants may have quite similar knowledge and frames; while others' cognitive sets may just barely overlap. Hence, networks of practise often provide a very fertile ground for innovative new combinations of different knowledge sets.

4.3 Increasing specialization and uncertainty

In this section, we will argue that the four determinants of economic organisation introduced above have, in the past few decades, been influenced by two fundamental forces: the increasing specialisation and growing uncertainty of economic activities. These twin forces have increased the dissimilarity of productive resources, the transaction and coordination costs of economic activities, and the diversity of knowledge in value-adding systems. These changes tend to favor more poverful organisational arrangements and, hence, raise the comparative advantage of hierarchies and networks over the market mechanism. Moreover, only one of the organisational determinants, the increasing transaction costs, seems to favor hierarchical organisation over network arrangements. The other three - increasing resource dissimilarity, coordination costs and diversity of knowledge - favor network arrangements over hierarchies. Thus, our organisational framework seems to explain why networks have become so popular in recent years. But let us not hurry to the conclusions before the analysis.

As we argued in the beginning of this paper, the world economy is currently going through the third industrial revolution driven by the globalisation of markets and the rapid development of the new ICTs. The rapid growth of both national and international markets after the Second World War as well as the increasing competitive pressures that followed the integration of markets has led to an ever-increasing specialisation of economic activities (Hämäläinen 1993). Although there are no statistics available, the specialisation and complexity of production systems are likely to be at their historical highs today (see e.g. Hodgson 1999; Hämäläinen 1999).

At the same time, the uncertainty of economic activities has also increased. The increasing specialisation and globalisation of economic activities combined with the rapid structural change of modern economies has challenged the information processing capacities and cognitive frames of economic agents. They have become increasingly dependent on highly specialised and complex production systems without having full information, nor understanding, of their different parts and behavior. The uncertainty of producers about future demand patterns may also have risen due to longer production processes and the unpredictable behavior of wealthier and more individualised consumers (Hämäläinen 1999). The growing specialisation of value-adding activities has also led to growing indeterminacy in the production system by increasing the number of agents who can send "shock waves" throughout the system (Ranta 1998).

Globalisation, in turn, has expanded the stock of potentially important business information, exposed firms to unpredictable foreign competitors, and challenged the relevance of established cognitive frames (see Hämäläinen 1999). It is a well-known fact that international business activities involve more uncertainty than purely domestic ones (Johanson and Vahlne 1976; Luostarinen 1980).

The old cognitive frames of economic agents have also been challenged by the increasing specialisation of production and the current paradigm shift in the world economy. The dynamic processes of the "New Economy" cannot always be explained and understood with old theories and mental maps (see e.g. Arthur

1994). Moreover, the specialisation of cognitive frames in the value-adding system has increased the behavioral uncertainties related to information assymmetries among agents (Hämäläinen 1999).

In the following paragraphs, we will analyse the impact of increasing economic specialisation and uncertainty on resource similarity, transaction and coordination costs and the organisational determinants of innovation.

Similarity of resources. The growing specialisation of value-adding activities leads to increasingly specialised and dissimilar resources (high "asset specificity") in value-adding systems. As firms focus on their "core competences" (Prahalad and Hamel 1990), they develop closely-related (similar) resources and capabilities internally and rely on cooperative agreements for the acquisition of more distant (dissimilar) but co-specialised resources (Kogut and Zander 1992). Basic resources - such as raw materials or standard components - can usually be sourced from competitive markets.

Hence, the relative efficiency of markets, hierarchies and networks is shaped by the degree of specialisation in the value-adding system and the consequent (dis)similarity of productive resources. Markets can only function well be if the resources of firms are not too different. The growing asset specificity of value-adding systems tends to decrease the number of potential buyers and sellers in any particular product or service category.

Hierarchical organisation, in turn, is likely to be most efficient at intermediate levels of specialisation and resource similarity where markets tend to fail due to the above "small numbers" problem but firms may still have a resource advantage in several related activities. Finally, in highly specialised value-adding systems, most of the key resources can be quite dissimilar but highly co-specific. As a result, firms tend to focus on their core resources and build cooperative arrangements with other firms controlling co-specialised complementary resources.

Transaction costs. It has often been argued that the rapid development of ICTs has reduced the transaction costs of economic activities and thus made the market mechanism more efficient in recent years (e.g. Economist 1996). However, recent changes in market efficiency depend on the types of goods and markets analysed. The greatest beneficiaries of modern ICTs have been markets for simple and standardised goods, such as financial instruments, raw materials and commodities. These types of markets have clearly become more efficient with the new ICTs.

On the other hand, many service markets (such as personal services, financial services, training, etc.) and most markets for technology-intensive and highly-specialised intermediate products and services (tailor-made parts and other inputs, management consulting, advertising, etc.) involve rich information flows which are difficult to codify for the modern ICTs.

There are also dynamic forces which have increased the transaction costs of markets. First, the growing specialisation of economic activities has led to increasing asset specificity, knowledge diversity and information asymmetry among economic agents (Williamson 1985; Hodgson 1999). Second, the increasing division of labor has reduced the impact of shared ideologies and values on individual and firm behavior (Durkheim 1964). This undermines trust and other social constraints to opportunistic behavior (North 1981; Casson 1990). Third, the increasing specialisation and differentiation of buyers' preferences and firms' resources has led to a proliferation of new products and product attributes in the market place. This has increased the search, measurement and enforcement costs of boundedly rational economic agents (Piore and Sabel 1984; Willinger and Zuscovitch 1988; Eliasson 1990).

Fourth, the bounded rationality of economic agents has been further challenged by the information explotion related to the globalisation of markets. The firms' exposure to new types of customers, competitors, institutions, and cultures creates new types of information needs and uncertainties which cannot properly be dealt with in contractual exchange. It is well known that the transaction costs of international business activities are greater than those in purely domestic

markets (Buckley and Casson 1976; Hennart 1982). Finally, the rapidly growing markets for information and knowledge products involve more uncertainty and transaction costs than markets for more traditional goods and services (Arrow 1962).

To sum up, the transaction costs of value-adding activities have been influenced by two opposing forces: the new information technologies have reduced the transaction costs of markets for simple and standardised goods; whereas the increasing economic specialisation and uncertainty have increased the transaction costs of markets for more specialised, differentiated, complex and knowledge-intensive products. As a consequence, the markets for the former types of goods have become more efficient in recent years; while those for the latter types of goods have become less efficient. The growing transaction costs have increased the competitive advantage of networks and hierarchical organisations relative markets in highly specialised and uncertain industries (Hämäläinen 1993). In such industries, the value-adding activities associated with highest transaction costs tend to be internalised within corporate hierarchies; while those that involve intermediate levels of transaction costs can be coordinated in high-trust cooperative networks (Williamson 1991).

Coordination costs. The coordination problems and costs of value-adding systems have also been increased by the growing specialisation and uncertainty of economic activities. The growing specialization increases the firms' coordination costs by multiplying the number of activities that must be coordinated and increasing the specificity and richness of information links between them (Hämäläinen 1993). The coordination of highly co-specific activities requires large information flows and effective communications media between the interdependent activities (Daft and Lengel 1986). The costs of communication, in turn, are increased by the growing diversity of individual knowledge sets and frames. As a result, the increasing specialisation and interdependence of value-adding activities requires more effective and costly coordination mechanisms than markets: such as planning, mutual adjustment, group meetings, meetings as well as shared values and visions.

As we have noted above, the more powerful coordination mechanisms can be used in both hierarchies and networks. However, hierarchical coordination becomes problematic at the highest levels economic specialisation. The coordination tasks of top management can exceed their coordination capabilities which rapidly increases the coordination costs. As Kaldor (1934) and Robinson (1934) have noted, the increasing coordination costs reflect the limited mental capabilities of top managers and the indivisibility of the coordination task (Robinson 1934:248):

> "So far as the purely supervisory tasks of management are conserned,...a multiplication of supervision is possible by purchasing more units of supervision or employing them in parallel. But the task of co-ordination cannot be multiplied in parallel. It is of its essence that its is single. Even if the task of co-ordination is exercised by a group, the decision of the group must be the decision also of each member of the group...If there is division of labor in the co-ordinating group there is no coordination".

Robinson (1934:253) has argued that hierarchical organisation can be extended indefinitely without a loss of efficiency only on two assuptions: first, that the necessary knowledge for decisions is small, and second, that the maximum amount of coordination is achieved at each level of the organisation, and the knowledge required for coordination at the next higher level need not decend into the lower levels. In managerial practice, neither of these assumptions are likely to hold (Robinson 1934:254):

> "In almost every instance knowledge of the detail of a problem is an essential condition for its solution. In few cases,...is it true that the act of co-ordinating two units can effectively be achieved without knowledge of the internal effects on the units co-ordinated of the methods of co-ordination adopted...The larger the field in which co-ordination is being attempted the greater must be the knowledge which ought to be in the minds of the co-ordinators. But a man’s mind and man’s memory is essentially a limited factor. It cannot absorb, understand and retain material without end".

Over time, innovations in information technology, organisation and accounting systems have alleviated the managerial coordination task by improving the quality and increasing the amount of available information, creating special organisational units to process part of the information (staff, consultants),

developing new organisational forms (functional and multi-divisional structure), and by introducing new accounting concepts to synthesize information (stockturn, operating ratio, rate of return, current ratio) (Kaldor 1934; Chandler 1977, 1979).

The nature of the coordination task is also influenced by the amount of environmental change. Kaldor (1934) has argued that organisations can become larger in "quiet" periods when environmental change is less rapid. One such period of relative environmental "quietness" was experienced during the decades immediately following the Second World War (Piore and Sabel 1984). The seemingly unstoppable growth of large hierarchies during this period led some researchers to doubt the practical effectiveness of the coordination cost limit to the growth of hierachical organisations (Penrose 1959:18). However, the growing specialisation and uncertainty of modern value-adding systems has re-emphasized the "managerial limit" to organizational growth during the past two decades.

The increasing coordination costs tend to favor decentralised organisational solutions which economize in the scarce coordination capability of individuals by dividing the overall coordination task into more manageable parts. To a certain extent, this decentralisation can take place within hierarchical organisations through divisionalised structures and improved accounting procedures (Chandler 1979). The divisionalised structure divides the coordination and supervisory tasks of management into semi-decomposable units which maximizes the coordination capability of the top management team. However, the hierarchical solutions to coordination problems are limited.

At some point, the further growth of hierarchical organisation will become limited by the increasing coordination costs related to the bounded rationality of the management (Kaldor 1934; Robinson 1934; Simon 1991). The growing size of the hierarchy also magnifies the agency problems, organisational politics, splintering of ideologies, bureaucratic alienation, and loss of information, which increase the monitoring and supervision costs (Williamson 1975). This is where the benefits of decentralised information processing and coordination within

networks of closely cooperating firms overwhelm the additional costs of inter-firm communication and coordination (Hämäläinen and Laitamäki 1993).

Innovation. The increasing specialisation and uncertainty of economic activities shapes the comparative efficiency of organisational arrangements also through their impact on the innovation processes. In the following paragraphs, we will focus on their impact on the four determinants of innovation: diversity of knowledge, communication, social capital and complementary assets.

We have argued above that inventions tend to take place when different types of knowledge is exchanged and combined. We have also proposed that radical inventions would involve the combination of more diverse knowledge sets than incremental innovations. The globalisation of economic activities and the new ICTs have increased the possiblities for innovatory combinations of different knowledge sets. However, at the same time, firms tend to specialise on their core resources and capabilities and leave the coordination of complementary but dissimilar resources to other organisations. Such specialisation reduces the diversity of knowledge within organisations. As a result, all complementary pieces of specialised knowledge required for inventions may not lay within the boundaries of any particular firm.[5] Thus innovation may require inter-firm cooperation.

The appropriate complementary pieces of knowledge for a highly specialised firm are also likely to be highly specialised. Such highly specialised complementary knowledge cannot always be found in the innovating firm's home location but needs to be searched from other locations in the same region, country or even from abroad.[6] The geographical location of potential network partners has

[5] The number of potential combinations of different elements of knowledge grows very rapidly when the number of elements is increased. As a result, networks which involve more diverse elements of knowledge have a substantially wider potential for innovative combinations.

[6] Narula and Dunning (1999) note the rapid growth of international strategic technology partnerships (STPs) during the past two decades. They explain this growth primarily with the firms' innovation needs: STPs are an efficient way of combining the firms' different knowledge bases.

important implications for network facilitating policies. Local networking initiatives may not be able to reach the best potential partners for highly specialised firms.[7]

We have also noted that the exchange and combination of different knowledge sets requires intensive long-term communications, shared language, as well as overlapping cognitive frames. The increasing specialisation of value-adding activities leads to increasingly diverse experiences of individuals, splintering of their cognive frames and differentiation of language. Nahapiet and Ghohal suggest that these trends can be better resisted within corporate hierarchies than in firms coordinating their activities through arm's length markets (Nahapiet and Ghoshal 1998). However, high-trust networks of closely cooperating partners may also be able to create the rich communication flows needed for exchanging and combining diverse knowledge sets. Such networks may even have an equal amount of social capital as corporate hierarchies.[8]

Brown and Duguid's "networks of practise" combine the diversity knowledge and ease of communication in a way which provides a fertile ground for invention (Brown and Duguid 1999). In highly specialised and uncertain industries, the most innovative combination of these two factors is not likely to be found within single firms, no matter how big they are. Instead, the best environment for invention involves a large network of economic agents who can engage in intensive communication to build a shared knowledge base.

Finally, we have emphasised above that inventions do not become innovations before they are combined with appropriate complementary resources and brought to the market. In highly specialised and uncertain value-adding systems, such complementary resources often lie outside of the innovating firm's boundaries. If the complementary resources are not very similar to the innovating firm's core resources it is likely to engage in cooperative arrangements to get access to them. However, sometimes important complementary assets do not exist and have to be created. This requires

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[7] On the other hand, since communication is likely to become more difficult with increasing geographical distance, local and domestic partners may be easier to work with, all other things being the same.

[8] In fact, the amount of structural social capital in networks may even exceed that of hierarchies due to

“systemic innovation”: i.e. large parts of the value system may have to change in order to support the adoption of a new technological or other innovation. Such systemic innovation may be quite problematic since value-adding activities are often deeply embedded in local institutions and routines which are difficult to change (Brown and Duguid 1999).

In conclusion, the increasing specialisation and uncertainty production processes seem to favour network arrangements in the organisation of innovative activities. These types of activities require intensive communication and rich knowledge flows which markets cannot provide; and they flourish in diverse knowledge bases where open networks can offer more than even the largest of hierarchies. Like hierarchies, cooperative networks can be characterised by high inter-personal trust, shared professional language and overlapping cognitive frames which facilitate intensive knowledge exchange and combination. Moreover, the commercialisation of inventions often requires highly specialised complementary resources which cannot be found in the innovating organisation nor in the market. Again, a network solution can be superior.

We can summarise the previous analysis with following table. It shows how the four determinants of economic organisation influence the comparative advantage of markets, corporate hierarchies and network arrangements. Moreover, the table suggests how the increasing specialisation and uncertainty of economic activities has shaped the overall comparative advantage of these organisational alternatives.

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the higher diversity of inter-personal links within networks.

Industry characteristics	**Market mechanism**	**Corporate hierarchy**	**Cooperative network**
Dissimilarity of resources	Low	Intermediate	High
Transaction costs	Low	High	Intermediate
Coordination costs	Low	Intermediate	High
Innovation	Low	Intermediate	High
Specialisation	**Low**	**Intermediate**	**High**
Uncertainty	**Low**	**Intermediate**	**High**

First, the high dissimilarity of productive resources (including knowledge) tends to favour network solutions where different firms undertake interdependent value activities. On the other hand, if the productive resources are quite similar among firms there will be many similar product offerings in the market which is likely to be quite efficient. Hierarchical solutions have a comparative advantage where a group of specialised resources are rather similar but, at the same time, different from (dissimilar) other related resources. This represents an intermediate level of resource similarity in the value-adding system. As a result, the growing specialisation of economic activities has tended to push the organisation of value-adding activities from markets toward hierarchies and networks.

Second, the new information and communications technologies have lowered the transaction costs of markets for simple and standardised goods and, hence, made them more efficient. However, at the same time, the growing specialisation of value-adding activities has led to increasing asset specificity, knowledge diversity and information asymmetry among economic agents and, hence, to higher transactions costs in markets for more specialised, differentiated, complex and knowledge-intensive products. In terms of organisational efficiency, low degrees of economic specialisation and uncertainty are associated with low transaction costs and tend to favour market solutions; intermediate levels of specialisation, uncertainty and asset specificity

involve somewhat higher transaction costs which increases the comparative advantage of network arrangements; and, at the highest levels of economic specialisation and uncertainty when transaction costs are considerable, value-adding activities tend to be internalised in corporate hierarchies (Williamson 1991).

Third, the coordination costs of firms and value systems have also been growing with the increasing specialisation and uncertainty of economic activities. Markets can only coordinate value systems which involve relatively homogenous products and multiple buyers and sellers in each stage of the production chain. Somewhat more specialised value systems can be efficiently coordinated by hierarchical organisation if the production environment does not change too rapidly and overburden the top decision makers (Hämäläinen 1993). However, at the highest levels of economic specialisation, complexity and uncertainty, hierarchical solutions cannot anymore manage all the detailed information and knowledge required for efficient coordination (Hämäläinen and Laitamäki 1993; Hodgson 1999). Instead, the overall coordination task needs to be decentralised from hierarchies to wider networks which have the necessary knowledge of the “particular circumstances of time and place” (Hayek 1945). The overall network coordination, in turn, takes place through shared visions, values and rules.

Finally, the market mechanism is not a very efficient organisational arrangement for creating innovations which require the exchange and combination of knowledge from two or more different individuals. Since the specialisation of knowledge demands such combinations hierarchies and networks tend to be superior to markets in the organisation of innovative activities. The easier communication of individuals within hierarchies suggests that this organisational arrangement may have a comparative advantage in the creation of incremental innovations. These types of innovations involve the exchange and combination of relatively similar knowledge sets. However, if new inventions require the combination of more diverse knowledge sets, networks may be superior arrangements. Besides more diverse knowledge

than hierarchies, they may also have better complementary assets for the commercialisation of innovations.

In conclusion, our organisational analysis suggests that the traditional transaction cost theory is too “narrow” because it neglects important organisational determinants and the dynamic forces that shape organisational arrangements over time. Moreover, it suggests that highly co-specific value-adding activities (involving high asset specificity) would be internalised in corporate hierarchies. However, there is increasing evidence that such activities tend to be coordinated by cooperative inter-firm arrangements. Clearly, the other organisational determinants have overwhelmed the transaction cost considerations in such situations.

We have suggested a richer organisational framework which can explain the rapidly increasing popularity of cooperative arrangements and networks among firms. Such arrangements have been favoured by the increasing specialisation and uncertainty of value-adding systems which have led to the growing dissimilarity of productive resources, increasing coordination costs of hierarchical corporations and the increasing importance of innovative networks. In this environment, cooperative networks increase the productivity of value-adding systems by allowing firms to focus on their core resources and activities, reduce their coordination costs by decentralising the overall coordination task into more manageable parts, and provide a fertile ground for new innovations in highly specialised and dynamic industries.

5. Network facilitating policies

The growing importance of cooperative networks has also been recognised by governments in recent years. They have developed many different types of policy measures to facilitate the creation and efficient functioning of inter-firm networks. However, these government interventions have not been based on a sound theoretical framework of government role in network facilitation. Indeed, there is not, yet, a well-developed theory of network policies available.

5.1 Market failures, governance failures and network policies

The traditional theories of government intervention were not developed with network facilitation in mind[9], and the research on networks has paid very little attention to policy questions. The scholars of innovation systems and processes have recently moved toward a new policy paradigm that is more relevant to network facilitation but they are not very clear about the key problems that governments should adress and, more importantly, about the division of labour among government, third sector organisations and firms in addressing such problems (see Lunvall and Borras 1997; OECD 1998, 1999).

It is not enough to emphasise new types of "failures" in learning economies and argue that governments should do something about them. As institutional economists have shown, the existence of a governance problem does not automatically call for government intervention (Coase 1960). Other organisational solutions - such as markets, corporate hierarchies and third sector organisations - should also be examined. In particular, problems in networking can sometimes be solved more efficiently by large firms (hierarchies) and business associations (third sector) than by government intervention. Since all organisational arrangements involve their own strengths and weaknesses economic efficiency requires that different types of governance problems should be addressed by those organisational arrangements which have a comparative advantage in solving them in a particular social context (Hämäläinen 1999). Later in this paper we will propose a simple decision making model which helps policy makers to move the role of government in their economies toward its comparative advantage.

Due to the scarcity of research on network facilitating policies, policy makers know very little about the (a) conditions in which network arrangements are more efficient than alternative organisational solutions, (b) types of problems or "failures" that are typical in setting up and operating networks, and (c) which of

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[9] These theories come from multiple subdisciplines of economics such as neoclassical, development,

these problems could most efficiently be overcome by governments. We analysed the first question in the previous section. We will address the latter two below.

Some authors have rejected the traditional market failure approach of welfare and institutional economics as being outdated in a time of knowledge-intensive learning economies. Since market failures are pervasive in modern economies they argue that the concept of market failure is not useful anymore (Lundvall and Borras 1997: 49). We would not go quite as far. The fact that the market mechanism is less efficient in highly specialised, uncertain and knowledge-intensive economies does not mean that the basic idea behind the market failure approach has become irrelevant: i.e. that there are problems in *laissez faire* economy which prevent private action from maximising social welfare.

In fact, similar governance problems can also be found with other organisational arrangements, such as corporate hierarchies, third sector organisations and the government itself.[10] Since the government is the only organisation that has an economy- and society-wide responsibility for social welfare it should be concerned about the efficiency all types of organisational arrangements, not just markets. For example, the tax and regulatory systems, which are shaped by public policy makers, have a great influence on firms' incentives to maximise their organisational efficiency and, hence, the comparative efficiency of hierarchical arrangements. In a similar vein, government policies can also shape the efficiency of third sector organisations and inter-firm networks. Dunning and Hämäläinen have called this wider efficiency-enhancing approach as the macro-organisational role of government (Dunning 1992; Hämäläinen 1999).

The wide responsibilities of government in the macro-organisational approach do not mean that it should intervene more actively in the economy. The government role is limited by the comparative advantages of private and third

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welfare, and new institutional economics. For a comprehensive review, see Hämäläinen (1999).

[10] There is a vast literature on the "bureaucratic dysfunctions" in large hierarchical firms, incentive problems in non-profit organisations, and "government failures" in public sector organisations (see

sector organisational alternatives. In the present context, governments should worry about the problems in networking but only to the extent that they can provide superior solutions to those of the private and third sectors. In other words, the practical network policies of governments should depend on their organisational capabilities vis-a-vis the private and third sector alternatives in solving specific networking problems in particular contexts. Unfortunately, there are no rules of thumb for deciding the efficient division of organisational labour among different organisational alternatives (Coase 1990).

5.2 Matching policies to stages of networking

We will now turn to analyse practical problems in networking and the role of government in solving them at different stages of the networking process. These stages are the following: (a) awareness of networking possibility, (b) search for partners, (c) building trust and shared knowledge base, (d) organising the network, (e) adding complementary resources, and (f) active cooperation. We will pay particular attention to problems which create a wedge between the private and social benefits of networking.

Creating awareness. Despite wide media coverage and active promotion by different policy makers, the nature and potential benefits of network cooperation are not always very well known and internalised among small firms. They are often too busy to consider and test new business models and may even be afraid of losing their competitive advantages to prospective partners. This *information problem* may slow down organisational adjustments among firms that could benefit from active network cooperation. Governments and third sector organisations can promote firms' awareness about networking e.g. by arranging seminars and distributing information about it and by trying to get the media to cover successful examples of networking. The fact that networ cooperation is not a panacea to all organisational problems should be borne in mind in all network promotion.

Hämäläinen 1999).

Besides the awareness, there are many other problems that need to be solved before a network can successfully be established. The costs of setting up a network tend to fall primarily on the organisation that actively promotes it. These costs stem from the process of finding the right partners, negotiating with them, creating behavioural rules for cooperation, and building the necessary shared resources. However, the benefits of a well functioning network tend to diffuse to all members of the network. Thus, the formation of networks tends to suffer from a *public good or externality problem*: the private benefits from network formation may not cover the private costs, though social benefits might well do so.

Only when the private benefits of setting up a network exceed the private costs will a firm engage in network formation. If this is not the case, and a market solution fails, there may be room for efficiency enhancing government intervention. However, even then business associations or other third sector organisations (chambers of commerce, centers of excellence, etc.) may provide more efficient solutions to the externality problem.

Searching for partners. Governments can support firms' own search for network partners with information, brokerage and matching services (Lundvall and Borras 1997; Narula and Dunning 1999). Such services can be arranged with trade fairs and business seminars or they can be provided with modern information technologies. For example, the European Union has web-based matching services that cover the whole EU-area. Policy makers can also subsidise small firms' travel expenses to foreign fairs and seminars where new partners can be found (Miettinen *et al*. 1999). Besides firms, successful networks often involve other types of organisations such as universities, research institutes, government agencies, etc. These organisations can be direct participants or provide important complementary resources for the network.

The above policy measures assume that firms actively participate in government programs. This might not always be so. Especially small firms are

often too busy with their daily business or simply lack the financial or human resources to find out and participate in different networking initiatives. As a result, many potentially beneficial networks are not created without more active policies and encouragement.

Finding out potential networks and partners is not easy, however. It requires deep knowledge about firms' specific strengths and weaknesses and how they could complement each other (Lundvall and Borras 1997: 112). This suggests that the search for potential network partners should take place very close to firms at local and sectoral levels. Besides the firms themselves, local authorities and business associations could play a key role in this process. Moreover, practical experience suggests that network policies should not aim to create new networks from scratch: network promotion could be focused on emerging and fragile networks which require further encouragement and support. This would minimise the potential for government failure.

Building trust and shared knowledge base. Once the appropriate partners have been found there may still be many mental barriers to effective cooperation. In fact, the mental rigidities and old behavioral routines of entrepreneurs are often the biggest hurdle to effective networking. Potential partners need to learn more about each others' world view (cognitive frame), beliefs and attitudes, values, business strategies and operating methods. This can only be done through a intensive and open discussions where the participants gradually build trust and a shared knowledge base. Being a neutral and trusted "third party", governments can often reduce the suspicions and reservations that firms have toward closer inter-firm cooperation.

Building shared understandings and trust takes time. As a result, governments should favor policies which provide firms adequate incentives to continue participating in the networking process long enough to build the necessary shared knowledge base and social capital. Setting up long-term network facilitation programs and building inter-firm meeting arenas may be more productive than trying to more directly match potential partners who have not had enough time to learn to know each other well nor build the shared

understandings and trust. One example of such a long-term process is the British technology forecast program which has resulted in active network formation among the participating firms and other organisations (see www.foresight.uk.gov).

Taking into account the time and resource constraints of small firms government programs should preferably offer them some additional benefits beyond the uncertain advantages of networking. For example, the Finnish authorities are currently considering the use of a "strategy foresight process" to encourage potential network partners to come together, analyse and discuss common development challenges, and create new networks. Besides the potential benefits of networking, the firms will get an easy access to well-analysed information about major changes in their business environment.

The intensive inter-firm communication required for trust-building can also be facilitated with shared information infrastructures, such as network-specific extranets or internet pages. The provision of such public goods could initially be supported by governments if the benefits of networking can only be expected in the longer term.

Organising the network. Once firms understand and trust each other enough, they can start to build a *shared vision, strategy, structure* and *behavioral rules* for the network. A shared vision of the future and a common strategy are important coordinating mechanisms in highly specialised and interdependent networks where the market mechanism or hierarchical coordination cannot be relied on. However, these coordination mechanisms do not emerge automatically; someone has to provide the leadership in their development. This role is often played by a strong "flagship firm" which has a keen interest in the success of the network (Rugman and D'Cruz 1996). Indeed, in the search stage of network formation, government activities could focus primarily on finding such flagship firms. The other partners could then be sought in cooperation with these firms.

Even in the absence of a flagship firm, governments can support inter-firm coordination by providing institutional arenas, such as the Japanese "deliberation councils" (World Bank 1993) or the Finnish cluster programs, for intensive inter-firm communication. The task of building a shared strategy for the network could also be explicitly included into public networking programs. Lacking detailed business knowledge, governments should try to avoid undertaking the coordination task themselves.

Governments can also support the actual organisation of the network and its business processes by providing information about potential problems and best practices in network cooperation. It can also develop contract models and arrange consulting services to help structuring the network. However, governments should be very careful in expanding their subsidised consulting services because there are well-functioning markets in organisational consulting.

Adding complementary resources. Emerging new networks do not often have all the key resources and capabilities required for competitive success. For example, a key technology or other input may not be available from the existing network partners, or the network could lack access to important foreign markets. More generally, such "systemic failures" could relate to any part of the network's value-adding system and its socio-institutional environment (OECD 1999), such as *resources* (e.g. human, financial, infrastructure), *technologies* (ICTs, specific technologies), *organisation* (intra-firm organisation, incentive systems, etc.), *product markets* (sophisticated demand, product market regulation, competition, etc.), *international business activities* (access to foreign markets, technologies, business systems, etc.), *institutions* (laws, regulations, norms, customs) and *policy framework* (public sector organisations and their activities). We will discuss the government role in reducing systemic failures related to networking later in this section.

The problem of missing complementary resources is familiar from development economics. Many development economists have emphasised the problem of building a mutually-reinforcing business system in developing countries

(Rosenstein-Rodan 1943; Hirschman 1958). Missing key resources can create negative external effects through "forward and backward linkages" in the interdependent business system. This calls for explicit coordination of development investments, or a "big push", throughout the system (Rosenstein-Rodan 1943; Richardson 1960). On the other hand, fixing the systemic failures may release the positive externalities of a network and lead to increasing returns and sustained competitiveness (Arthur 1994; Hämäläinen 1999).

Depending on the nature of the systemic failure, policy measures could be needed in any part of the network's value-adding system and its immediate socio-economic environment. However, since systemic failures could theoretically be found anywhere in the system policy makers have to be very careful of not becoming too active in their interventions. The systemic interdependencies within and around the network should be carefully evaluated before any intervention. Moreover, governments should not intervene if private or third sector organisational alternatives could provide the complementary resources more efficiently. We will next discuss some of the most common systemic failures that may affect networks. These are related to the: availability of financial capital, ICT infrastructure, intra-firm organisation

Availability of financial capital. Although networks of firms can spread risks among their members, some activities are so uncertain that not even networks can undertake them without government help. Basic research, development of major new technologies or entry into foreign markets are typical examples. In such cases, the uncertainty and costs of particular key activities may exceed the combined resources of the network though the potential benefits for the society at large could warrant undertaking these activities. This may call for government intervention and partial socialisation of the activity’s risk (Thurow 1983; Narula and Dunning 1999).

The cooperation of public research institutes, universities and firms in basic research is a good example of such risk sharing. Governments may also develop new financial instruments to support networks which undertake

activities that are too risky to be financed from the private markets. Public orders for specific new technologies may also be used to reduce firms' risks.

ICT infrastructure. The rapid diffusion of cooperative networks has been facilitated by a complementary paradigm shift in the nature and use of information and communication technologies. Traditionally, ICTs were used to automate human operations; they made it possible and economically attractive to process large amounts of information and perform simple value-adding activities more precisely and rapidly than before. As a labour-saving device, modern ICTs do not differ in any way from traditional machines.

Zuboff (1988) notes that modern ICTs not only automate activities and work processes but also translate them into information. Once modern ICTs are used in production they generate information about the underlying production and administration processes. This information can be used to improve the monitoring and control of work processes.

While Zuboff stresses the control aspect of modern ICTs, Castells associates the reflexive character of modern ICTs with processes of innovation and learning. He points out that these new technologies produce new work-related information which workers can use in their daily learning and innovation activities. Information technology creates a feedback loop between the generation and the application of new knowledge (Castells 1997: 32).

The real revolutionary feature of modern ICTs, however, is their development into a global communication system. They are now conceived of as media which connects people with each other as well as with machines. Hence, modern ICTs have become important infrastructure for intra- and inter-firm information flows as more and more communication has become technically mediated. While the use of new ICTs led to restructuring of corporate hierarchies in the 1980s and early 1990s, the present ICT applications tend to produce structural changes in inter-company relationships and create a new networked business architecture (Tapscott 1995: 97).

The paradigm shift in information and communication technologies and organisational forms are complementary and mutually reinforcing phenomena. The full benefits of the one cannot be reached without the other (OECD 1996). Geographically dispersed parts of a network can be linked with powerful information and communication networks. Massive flows of codified coordination information can be easily communicated, processed and storaged with modern ICTs.

The communication through the ICTs requires a shared language as well as overlapping knowledge base and cognitive frames at both ends of the communication flows. Thus, more demanding use of ICTs tends to require previous face-to-face interaction. Such informal and rich communication is more effective in the transfer of tacit knowledge. However, the modern ICTs can support the creation and mobilisation of tacit knowledge by reinforcing human interaction and interactive learning (Ernst and Lundvall 1997: 28). E-mails, file transfers and network technologies are effective communication mechanisms for researchers with shared understandings and knowledge bases.

The new ICT paradigm has recently shifted from mere linkages between computers to "co-operative computing" where the interacting partners could be located anywhere in the world (Castells 1998: 170). In decentralised work group computing, several geographically dispersed partners can jointly work on a complex task, such as the development of a new product or strategy, and simultaneously co-ordinate reciprocal sub-processes. "Qualitative advances in ICTs...nowadays allow the emergence of fully interactive, computer-based, flexible processes of management, production, and distribution, involving simultaneously co-operation between different firms and units of such firms (Castells 1998: 170).

The latest trend is the integration of firm’s internal information systems into a public information infrastructure. Two technological developments are important here: interactive multimedia telecommunication applications and the use of the Internet for commercial purposes. We can expect that, in the future,

interactive multimedia applications will be developed which will support tele-co-operation within and among firms, and between them and other organisations.

Finally, there is the risk that, under the pressure from large internationally-oriented companies, telecommunication operators are not sufficiently interested in extending the local network infrastructures which benefit small firms and households as they focus on increasing the bandwidth of information highways. However, an important part of information exchange takes place among local partners even if firms are also connected with foreign partners in transnational business networks. Moreover, the social benefits of information networks depend on the number of active participants. For example, the selection of goods and services available through electronic commerce depends on the number of consumers that can be reached with the new ICTs. These *network economies* provide a clear rationale for government policies aimed at increasing the coverage of new information infrastructures and the use of modern ICTs among firms.

Intra-firm organisation. The full benefits of modern ICTs and inter-firm networks cannot be reached without restructuring the firms' internal organisations. Although such restructuring can take many forms, a new organisational paradigm seems to be emerging in industrialised countries (OECD 1996; Lundvall and Borras 1997). This paradigm emphasises i.a. horisontal communication between firms' different functions (multifunctional teams, rotation of personnel among functions, etc.), flat hierarchies, individual responsibility, initiative and flexibility, and good social, communication and language skills.

Firms are not always aware of the benefits of the new organisational forms and mechanisms. Hence, there may sometimes be a need for government to promote the new organisational solutions, especially among the smaller firms. Governments also need to continuously develop the public education systems so that they can keep up with the rapidly changing needs of the working life. New types of skills and curricula are needed and the role of on-the-job learning becoming increasingly important. The ability of firms to adopt new

organisational forms depends to a large extent on the quality and skills of the labour force.

Product market. Innovative inter-firm networks may sometimes suffer from poorly developed product markets. There could be problems with *demand patterns, institutional framework* and *competitive incentives*. The local demand conditions can be too unsophisticated to spur innovative activities (Porter 1990). For example, the market could consist of numerous small firms which are unable to demand innovative new products or services. Alternatively, there could be a government monopsony with little incentives to push the supplying firms to improve their product offerings. In these and other types of situations, governments may be able to use public procurement and close cooperation with private producers (private-public partnerships) to encourage more innovative solutions. Moreover, by defining tasks that cannot be addressed by existing constellations of firms, governments can use their procurement programs more directly to encourage the formation of new inter-firm networks (Lundvall and Borras 1997: 130).

Besides the systemic failure argument, there are also more traditional market failure rationales for government intervention on the demand side. Government procurement can be used to reduce the risks of firms in long-term and high-risk R&D projects. Public procurement may also be warranted if there is under-investment in socially-desirable technologies (military, environmental, etc.) or if the early buyers and users of new technologies face considerable risks. Government procurement is a particularly interesting policy option in situations where the society needs to break out from the established paths of innovation (Lundvall and Borras 1997: 125, 130).

Governments also influence the product market structure through legislation, regulation, standardisation, and competition policies (Porter 1990; Hämäläinen 1999). Tough environmental regulation, for example, may provide effective incentives for firms' technology development efforts (OECD 1996b). Open standards, deregulation (e.g. in telecommucication, transportation, airline industries) and competition policies, in turn, can be used to encourage

competition among suppliers. Intensive rivalry in the product market not only provides good incentives for innovation (Porter 1990) but also encourage firms to try new organisational solutions, such as inter-firm cooperation and network arrangements, in other parts of the value-adding chain. Indeed, the cooperative forms of organisation pose a major challenge to traditional competition policy which views all inter-firm cooperation with suspicion. In the context of increasing innovation competition and inter-firm cooperation, the competition policy makers have to draw a very sophisticated line between efficiency-enhancing inter-firm cooperation and socially harmful collusive practices (Teece 1992). This is an area where more research is clearly needed. In general, national policy makers have become more permissive to inter-firm cooperation as its innovative benefits have become better understood (see Lundvall and Borras 1997)

Internationalisation. Networks of small firms often run into the problem of getting access to foreign markets. Even the pooled resources of the network may be inadequate for establishing a presence in the leading international markets. At the same time, the domestic markets may be too small to support the development of the network's highly specialised products.

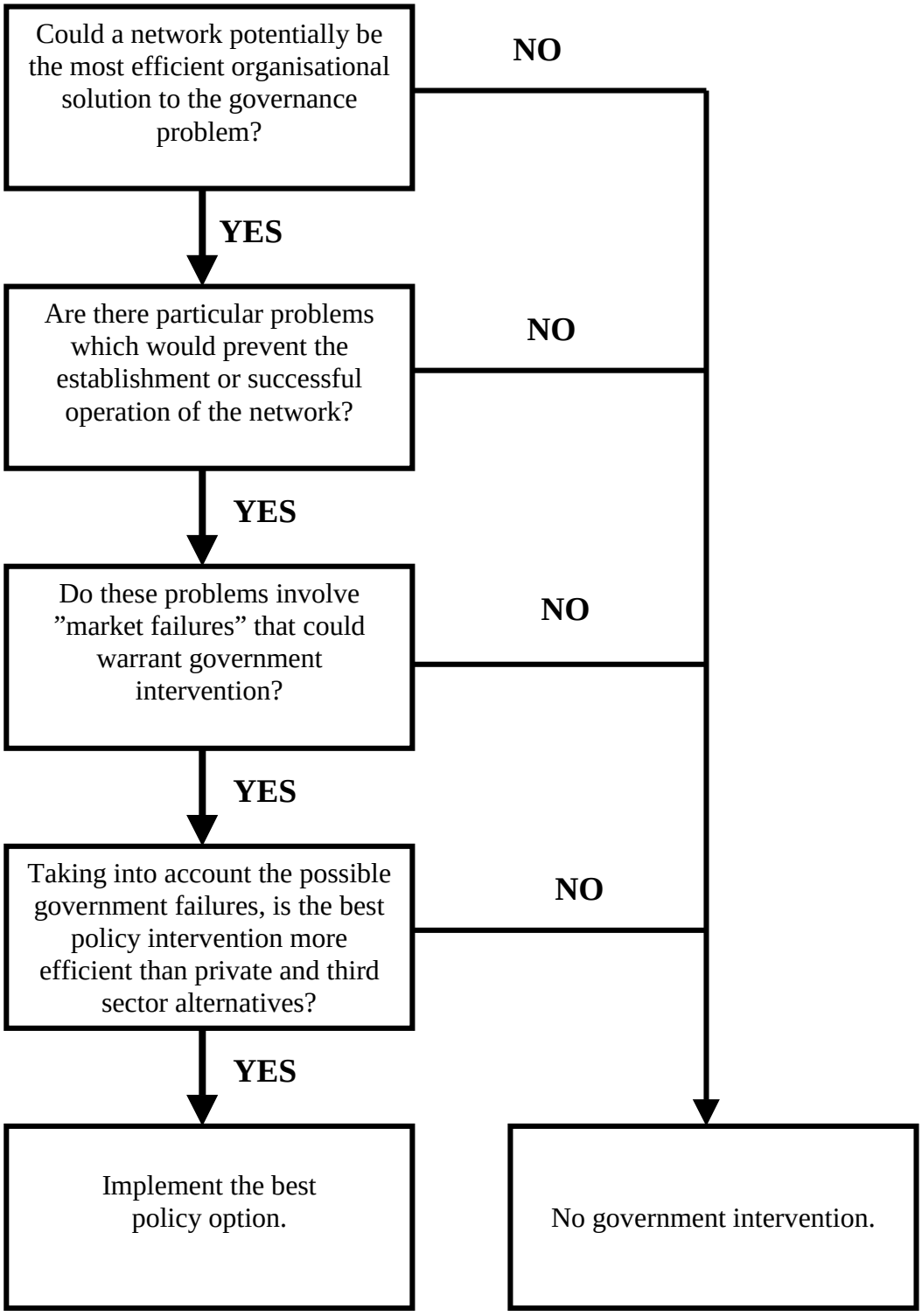
Governments may be able to help the internationalisation of such networks by helping in the search of suitable local partners in target markets. Governments can also partially cover the expenses of joint market research and export initiatives. Government sponsored business trips to international fairs and conferences are also common.

We will conclude our analysis of the different stages of networking and network policy making by arguing that governments should not continue to support networks once they have become established and their benefits have become obvious to participants. At this stage, the members of the network should begin to contribute their own fair share of its operating costs. The government to step back and move on to support new networks.

5.3 Deciding on network policies

Our analysis of network facilitating policy suggest that the traditional market failure approach of welfare economics must be modified in the context of networks. The failure of markets and potential efficiency of networks is not a sufficient rationale for government intervention. There must be particular governance failures in setting up or operating networks which governments are best able to overcome. Moreover, the potential efficiency-enhancing role of government is much wider than that of overcoming the failures of the market mechanism. As we have suggested, governments can, and should, also try to improve the efficiency of other types of organisational arrangements such as networks. Indeed, there is no reason to limit such “macro-organisational” government role to markets and networks, governments are the only economic agents that can take responsibility of the efficiency of the whole socio-economic system, including private and public hierarchies (Dunning 1992; Hämäläinen 1999).

All private, public and third sector organisational arrangements involve their own specific strengths and weaknesses and governments should aim to facilitate an efficient division of labour among them. This does not, of course, mean that the government should overemphasise its role in the economy. The large literature on government failures suggests that policy makers should be sensitive to their own limited capabilities (see Wolf 1988; Stiglitz 1989).


Could a network potentially be the most efficient organisational solution to the governance problem?
NO
YES
Are there particular problems which would prevent the establishment or successful operation of the network?
NO
YES
Do these problems involve ”market failures” that could warrant government intervention?
NO
YES
Taking into account the possible government failures, is the best policy intervention more efficient than private and third sector alternatives?
NO
YES
Implement the best policy option.
No government intervention.

There are no rules of thumb in deciding on the appropriate role of government vis-a-vis networks (Hämäläinen 1999). Instead, policy makers should carefully evaluate the networking potential of their economies, the problems that prevent socially beneficial networks from emerging and growing, and the alternative private, third and public sector solutions to them. The following flow chart may help to structure the decision making process in particular contexts.

5.4 Matching geographical scope of networks and policies

So far, we have not discussed the geographical scope of networking and network policy making. This section will make a simple but strong argument about the division of labour among different levels of government in network policy making. Borrowing from the theory of *Fiscal federalism* developed by Buchanan, Olson and others (Buchanan 1965; Olson 1969), we will argue that the geographical levels of government intervention should correspond to the geographical dimensions of networks involved. In other words, purely local or regional networks should be facilitated by local and regioinal governments, national networks would require both local/regional and national government policies, and transnational networks would add the need for international policy coordination. In the first part of this section, we will discuss recent geographical trends in the location of related value-adding activities; the latter part of the section will analyse their implications for the geographical scope of government in network facilitation.

It is often argued that modern ICTs make spatial barriers insignificant and signal the "death of distance" (Cairncross 1997). This implies some kind of "levelling effect" where local production structures would become increasingly similar over time. The fact that firms have become increasingly “footloose” in their locational choices is consistent with this scenario (Dunnin 1993). However, the increasing international mobility of firms has not led to the homogenisation of production environments around the world, quite the contrary.

International firms and production networks have more freedom to move their productive activities around the globe than perhaps ever before. However, at the same time, their freedom of locational choice is limited by the nature of modern production processes which favors the geographical concentration of interdependent value-adding activities. In a growing number of industries, the geographical proximity of interdependent firms as well as related public and third sector organizations has become an important competitiveness factor. The geographical concentration of economic activities in “industrial districts” or “industry clusters” has a strong effect on many determinants of firms' competitiveness: it improves the availability of specialized created resources, facilitates technology development and diffusion processes, increases the efficiency of organizational arrangements and provides a close contact with a large and sophisticated market.

The advantages of geographically concentrated industries were first recognized by Alfred Marshall when he made his seminal observations about “the concentration of special industries in particular localities” (Marshall 1890, reprinted 1968). In recent years, the geographical concentration of industries has attracted the attention of a group of economists who criticize the nationally-aggregated analysis of mainstream macroeconomics (e.g. Jacobs 1984; Scott and Storper 1989; Porter 1990; Krugman 1993). Following Marshall, they argue that firms gain several advantages by concentrating their activities in relatively small geographical areas, such as cities or industrial districts:

1. Better availability of scarce natural and human resources,
2. Proximity of specialized supplier and related industries,
3. Information and knowledge spillovers,
4. Increased inter-firm rivalry,
5. Improved inter-organizational coordination, and
6. Proximity to large and often sophisticated markets,

Marshall was probably one of the first to observe that “physical conditions”, such as the “character of the climate and the soil, the existence of mines and

quarries in the neighbourhood", may attract firms to locations where scarce natural resources are readily available (Marshall 1890, reprinted 1968, 268). He also noted that industrial districts may provide an efficient market for specialized human capital (p. 271):

> "Employers are apt to resort to any place where they are likely to find a good choice of workers with the special skill which they require; while men seeking employment naturally go to places where there are many employers who need such skill as theirs and where therefore it is likely to find a good market" (Marshall 1890, reprinted 1968, 271).[11]

Furthermore, Marshall observed that "subsidiary trades" tend to grow up in the neighborhood of geographically concentrated industries to supply specialized inputs and services. The growth of specialized supplier industries is facilitated by the large volume of demand that such an industry can create (Marshall 1890, reprinted 1968, 271). On the other hand, Porter has argued that specialized supplier industries create advantages for "downstream" producers by offering an efficient, early, rapid and sometimes preferential access to cost-effective inputs. In addition, the geographical concentration may provide similar benefits in the form of production or marketing synergies (Porter 1990, 101-105).

Marshall was also the first to note that geographical concentration of industries facilitates information and knowledge exchange among interdependent organizations:

> "When an industry has...chosen a locality for itself, it is likely to stay there long: so great are the advantages which people following the same skilled trade get from near neighbourhood to one another. The mysteries of the trade become no mysteries; but are as it were in the air...Good work is rightly appreciated, inventions and improvements in machinery, in processes and general organization of the business have their merits promptly discussed: if one man starts a new idea, it is taken up by others and combined with suggestions of

[11] Krugman provides a modern analysis of Marshall's arguments relating to the benefits of industrial districts (Krugman 1993, ch. 2).

> their own; and thus it becomes a source of further new ideas" (Marshall 1890, reprinted 1968, 271).[12]

Within a geographical concentration of industries, technological spillovers are influenced by the composition and characteristics of the industries represented. For example, an emprical study by Glaeser, Kallal, Scheinkman and Shleifer (1992) found that industries located in 170 U.S. cities benefited more from technological spillovers: (a) the less dominant they were in the city, (b) the more competitive the city-industry was, and (c) the more diversified industrial base the city had. These results underline the importance of competitive pressures for innovation, and suggest that technology spillovers may be larger among concentrated industries than within them. This is consistent with the arguments of Porter (1990) and Jacobs (1984), respectively.

The geographical concentration of industries also tends to increase the intra-organisational (technical) and coordination efficiencies of value-adding systems. Porter has noted that the geographical proximity often makes firms "jealous and emotional" competitors. According to him, "proximity raises the visibility of competitor behavior, the perceived stakes of matching improvements, and the likelihood that local pride will mix with purely economic motivations in energizing firm behavior" (Porter 1990, 157). Moreover, in geographically concentrated "industry clusters", competitive pressures are also increased by frequent entry of new rivals from supplier, user, or related industries. As a result, the geographical concentration firms increases their technical efficiency.

Information and knowledge spillovers are not the only benefit from the easier communication in geographically concentrated industries. As we have argued before, rich inter-firm communication flows are a prerequisite for high levels of coordination efficiency and innovativeness in advanced industries. Intensive information exchange builds trust among individuals and organizations and

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12 More recently, the technological spillovers in geographically concentrated industries have been studied by Porter (1990) and Krugman (1993).

helps to make the goals of interdependent organizations more congruent (Porter 1990, 153).

Finally, some scholars have argued that the geographical concentration of industries is encouraged by the pull of large markets, particularly in cities (Henderson 1986; Krugman 1993). These “urbanization externalities” initially stem from the increasing income of workers in a successful local industry. The higher income of workers then increases the demand for income-elastic consumer goods and services. As a result, the enlarged market may attract a concentration of seemingly unrelated industries (Glaeser, Kallal, Scheinkman and Shleifer 1992).

We would like to add another, and perhaps more fundamental, link between large markets and the geographical concentration of economic activities. As Adam Smith noted long ago, the division of labor is limited by the extent of market (Smith 1776, reprinted 1964). A large and concentrated market offers a perfect environment for increasing economic specialization and division of labor (Stigler 1951). The growing specialization makes value-adding activities increasingly interdependent and complex, which raises the transaction, transportation and coordination costs of firms (Hämäläinen 1993). The geographical concentration of industries can reduce all of these costs.

Krugman has argued that geographically concentrated industries involve “a kind of product cycle, in which emergent new industries initially flourish in localized industrial districts, and then disperse as they mature” (Krugman 1993, 63). This observation is supported by the fact that “emergent new industries”, especially when they involve rapidly evolving technologies, seem to benefit most from the advantages of concentration discussed above.

Such industries typically emerge to serve an increasing local demand and involve a limited supply of specialized inputs (Vernon 1966; Piore and Sabel 1984; Womack, Jones and Roos 1990). The rapid evolution of product and production technologies creates positive externalities that can best be captured in geographically concentrated industries (Porter 1990, 151). Since competition

is based on product design and development in the early stages of industry development, rival firms can better monitor the evolution of customers' preferences and competitors' strategies near markets and each other (Porter 1980, 159). Finally, rapid technological development that spans many interdependent value-adding activities cannot be efficiently coordinated by the market mechanism (Kline and Rosenberg 1986; Teece 1992). The close inter-organizational relationships that develop in concentrated industries facilitate the use of more effective coordination mechanisms, such as cooperative planning, mutual adjustment and group meetings (Richardson 1972; Thompson 1967; Simon 1991; Grant 1996).

Over time, the market growth and technological spillovers tend to slow down as the industry becomes more mature (Porter 1980). A maturing industry is characterized by emerging technological standards and the entry of new competitors which reduce the technological uncertainties and improve markets in important inputs and intermediate products. At same time, firms enter new geographical markets to avoid the increasing competition in the original market. As a result, the benefits of geographical concentration are likely to diminish in the later stages of the industry life cycle.[13]

The high specialisation, dynamism and local embeddedness of networks makes network facilitation a demanding challenge for policy makers. Sophisticated interventions require deep knowledge about the relative efficiency of different organisational alternatives, specific strengths and weaknesses of potential partner firms and peculiarities of the local socio-institutional framework. Local and regional governments and industry associations have a clear information and knowledge advantage over national and higher levels of government (such as EU) in this respect. Moreover, since the feasibility of carrying out complex inter-firm cooperation declines with

[13] The industry life cycle argument of geographical concentration is supported by Krugman's data which suggests that the high-water mark of geographical concentration in the U.S. manufacturing industries was reached somewhere in the 1920's (Krugman 1993, 80). At that time, many currently mature American industries were still young and characterized by rapid technological and organizational innovation (Chandler 1973, 1977). Similar concentration takes place in today's new industries such as the information and communications technologies (see Ollus, Ranta and Ylä-Anttila 1998).

geographical distance and increasing knowledge diversity the preconditions for successful networking are also best at these levels (Scott and Storper 1986: 26).

Despite the importance of geographically concentrated production networks, we cannot neglect that networking also takes place at the national and international levels. For example, cross-border technology alliances have grown very rapidly since the 1980s as firms are seeking firm-specific complementary knowledge from all around the world (Dunning and Narula 1999). Therefore no single actor can take the full responsibility for network facilitation policies since the different levels of government and types of third sector associations are often involved with different parts of the same inter-firm networks.

National policies can focus on creating the right framework conditions for the network facilitation activities of local/regional governments and industry associations. This could involve e.g. changes in the regulatory framework or financial support of local networking programs. Many important complementary resources of networks - such university research infrastructure, internationalisation services, etc., are also most efficiently provided by national governments. National governments could also coordinate the various local/regional policies, activities of industry associations and the programs of different government agencies and connect national networks to foreign markets and networks.

The local/regional governments and industry associations are not always aware of the potential benefits and risks of networking and the emerging best practices in network policy making. They may also lack the appropriate knowledge and training for conducting effective network policies. Hence, national governments could set up programs that transfer the necessary knowledge and skills about networking to these organisations.

National governments can also support the network facilitation policies of local/regional governments and industry associations by undertaking future

oriented programs, such as technology foresight and assessment, which provide local policy makers and industry associations with useful tools in their networking activities. As we have noted above, foresight processes and materials can be used to attract busy entrepreneurs to participate in networking processes. Such future oriented processes will also help the local policy makers to build realistic and anticipatory policy visions.

Finally, when inter-firm networks cross national borders, as they increasingly do today, national governments can use their international networks to facilitate effective international cooperation. They can e.g. search foreign partners to complement the knowledge and resources of domestic networks, distribute information about potential foreign markets, and arrange access to multinational research networks and programs. These foreign activities need to be closely coordinated with the network policies pursued at the national, local/regional and industry levels.

6. Conclusions

The research on inter-firm networks has not paid much attention to policy; and the scholars of government role have not been interested in network facilitating policies. This paper has made a preliminary attempt to analyse the various policy questions that arise from the increasing importance of inter-firm networks, particularly innovative networks.

In the beginning, we argued that the current paradigm shift in the world economy has also transformed our model of the innovation process. The new recursive model of innovation requires the coordination of multiple complementary knowledge sets and intensive communication and interaction among the different stages of a value-adding chain. Network arrangements are particularly well-suited to coordinate modern innovation processes.

We then analysed the comparative organisational advantage of cooperative networks vis-a-vis markets, corporate hierarchies and governments and found

the traditional transaction cost model of economic organisation too narrow. As a result, we developed a broader framework that includes the similarity of firm's productive resources, transaction costs, coordination costs and the organisational implications of modern innovation processes. We also argued that the increasing specialisation and growing uncertainty of value-adding activities has, in recent years, favored the network arrangements relative to the market mechanism and corporate hierarchies.

In the end of the paper, we focused on the economic rationale, nature and organisation of network facilitation policies. In particular, we examined the different types of governance failures that could warrant government intervention if better organisational alternatives (e.g. industry associations9 could not be found. We also analysed how the nature of practical network facilitating policies changes during different stages of the networking process. Our analysis suggests a more sophisticated role for government in economic organisation. Governments should not only worry about market failures but the inefficiencies of economic organisation more generally, including those of corporate hierarchies, networks, third sector organisations and the government itself. We also proposed a decision making model to help governments define this macro-organisational role in practical situations. Finally, we discussed the appropriate division of labour among the different levels of government and third sector organisations in network facilitation. Most practical networking policies should be conducted at the local/regional and industry levels where the necessary detailed knowledge about potential partners and local conditions exist.

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