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FLEXIBLE MANUFACTURING NETWORK CREATION. An alternative strategy to combat increased competition in the Single Market?

Abstract: In the recent years there has been (a) an increase in competition due to the creation of the Single Market, (b) a need for components instead of single sub-assemblies and (c) a dramatic economic success in the Third Italy. All three events have made the creation of flexible manufacturing networks an interesting alternative to improve competitiveness among small- and medium-sized companies in areas where such networks do not exist yet. This article looks at what is already known about the creation of flexible manufacturing networks. Besides some common aspects, like determinants, life-cycles, support organisations and network brokers, it gives a description of three empirical models. These are the industrial districts or Third Italy model, the Danish model and the Appalachian Center for Economic Networks model. Their functioning and pros and cons are explained to help areas willing to run a network creation scheme.

Key words: geography of manufacturing, industrial policy.

1. INTRODUCTION

Over the last few years there have been three main trends that have made the creation of flexible manufacturing networks worthwhile to consider as an alternative strategy to improve the competitiveness of small- and medium-sized companies[1] in the European Union. First of all, more and more small- and

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[1] A useful definition of small- and medium-sized companies is given by the Commission of the European Communities' recommendation as published in [1996] OJ L 107. It states that to qualify as a small- or medium-sized company a company has to meet all of the following criteria: less than 250 employees; a maximum annual turnover of 40.7 million ECU; a maximum annual balance sheet of 27.5 million ECU; and less than 25% of its control in hands of a large company or a group of large companies.

medium-sized companies experience increased competition after the creation of the Single Market.

Secondly, large companies and multinationals are increasingly realising that increased competition demands flexibility from their side as a consequence of the Single Market and globalisation in general. They often adopt a strategy of 'back-to-the-basics' to create this flexibility. This means that they do not want to buy single sub-assemblies anymore, but whole components. The production of these components asks for networking among subcontractors.

Lastly, the economic success in the Third Italy received a lot of attention at the end of the 1980s. One of the main explanations of its success is the existence of flexible manufacturing networks. In recent years the success has led to the development of programmes to create similar networks in areas of the European, American and Australian continents.

The aim of the research is to identify flexible manufacturing network creation models for areas where such do not exist yet. This article identifies three empirical models of flexible manufacturing network creation. It analyses the pros and cons for network creation models.

2. THE RESEARCH METHODS

There are two methods used in this research. First of all, secondary sources were consulted, like books, journals, internal documents, etc. A peculiar secondary source is the Internet. Besides snail-mail and faxes, e-mail discussion groups were used to identify secondary sources.

In the second place in-depth, open-ended semi-structured interviews were carried out. The in-depth nature allows themes and issues to be explored under the control of the interviewee. Moreover, open-ended interviews promote confidence. The interviewer's willingness to listen until all relevant issues have been dealt with gives the interviewee a sense of importance and centrality in the information gathering process. The semi-structured nature assures comparability between interviews (Midmore, Ray and Tregear, 1995: 13). The people interviewed can be divided into two groups. The main group consists of key--informants working in the different support organisations. The other group are the so-called 'network' experts.

3. COMMON ASPECTS OF FLEXIBLE MANUFACTURING NETWORK CREATION

Before going deeper into the three different models it is necessary to look at some common aspects of flexible manufacturing networks. In the first place it is

necessary to clarify the meaning of 'flexible manufacturing networks'. In the scientific literature the term 'network' is used in different ways (cf. e.g. Szarka, 1990: 11–12). In this research the term 'flexible manufacturing network' is confined to: "a wide range of efforts to increase the competitiveness of small- and medium-sized companies" (Ratner, 1995: 1). More specifically these efforts include marketing, production and training networks between at least three small- and medium-sized companies. They network to achieve together what no single company could achieve alone with the aim to increase profits (Hatch, 1995b: glance.html).

What makes the manufacturing networks flexible is their life cycle of birth, growth and death, that is repeated many times over. ACENet (*A market driven...*: markfmn.html) identifies six different phases in this life cycle, which are given in table 1. Life cycles are expected to be greatly varied in length. Some may last only a few days, other many years. New networks are usually formed from the excess capacity released, when successful ones cease operation. The resources and capacities gained during the growth phase of successful networks are the material of new networks (ACENet, *Creating flexible...*: fmncrea.html). Generally networks never meet as a whole group. Out of the entire pool of companies smaller clusters of action groups arise to design and implement collaborative projects. What the cluster learns from the project is shared freely throughout the network. Thus each new project builds on previous success and failure (ACENet, 1994: polrec.html).

Table 1. The different life cycle phases of networks

1. An emerging market niche and/or production idea is identified.
2. A set of companies form a flexible manufacturing network quickly to design and produce this product.
3. Network participants communicate frequently and clearly during the process.
4. The network determines when the product is no longer profitable.
5. The network disbands when this is the case.
6. The companies in the disbanded network use what they learn about partners and processes to form new, even more successful flexible manufacturing networks.

Source: ACENet, *A market driven...*: markfmn.html.

Networks by themselves are not a miracle solution for the competitiveness problems of companies. Networking in no way makes inefficient, non-innovative companies efficient and innovative by somehow bringing them together (Bosworth and Rosenfeld, 1992: 31). However, there are some major benefits derived from networking. These are given in table 2.

Table 2. Theoretical benefits of flexible manufacturing networks

Joint solutions to common problems. Critical resources, which one single, small company cannot afford by itself, can be financed by groups of companies jointly, thus giving them access to knowledge, information, functions or equipment which would otherwise be the right of the large company.
Development and exploitation of mutual complementarity. Networks are often formed on the basis of complementarity of the participants in terms of products, skills, equipment or market. One of the important dynamics of their development will often be a strengthening of this complementarity.
Developing the quality of subcontracting links. Groups of companies might qualify as subcontractors on terms where any of them would fail, just as they as a group might be able to attract the very best subcontractors to their own product line. In networks very small companies are able to imitate the behaviour of the best of the large companies.
Individual access to end-markets. The strength of networks lies in the flexibility and reactivity of the small company. Therefore, successful networks emphasise and develop company behaviour in which many of the participating companies bring some of their products to end markets and end users. This gives the network hypersensitivity to market needs, superior to what is usually seen in large companies.

Source: Internal document, Danish Technological Institute.

Networks can be divided into four basic types as given in figure 1. The first is the 'star' network. In this network a lead company plays a central role. This company stands out in terms of experience and strength of personality. A 'star' network works well for beginning networks, but is less suitable for heterogeneous networks (CEC, 1996: 7).

The second is the 'nodal linkage' network. In this network there are no special, privileged relationships. It is well suited for companies of equal footing. However, it is not suitable for companies with different levels of experience (CEC, 1996: 7).

The third is the 'ad hoc' network. In this case there are no formal structures. The companies know each other well. They intensify communication and collaboration when required. This network is a natural shape for mature networks. However, it does not work well for heterogeneous networks or those with little commonality between companies (CEC, 1996: 8).

The last is the network of regional networks. This is the most complex type of network. It consists of a multi-tiered structure linking local networks through an international backbone. Because of its complexity, it is only suited to support specific, limited duration projects with heterogeneous members. It does not really work for any other type of network (CEC, 1996: 8).

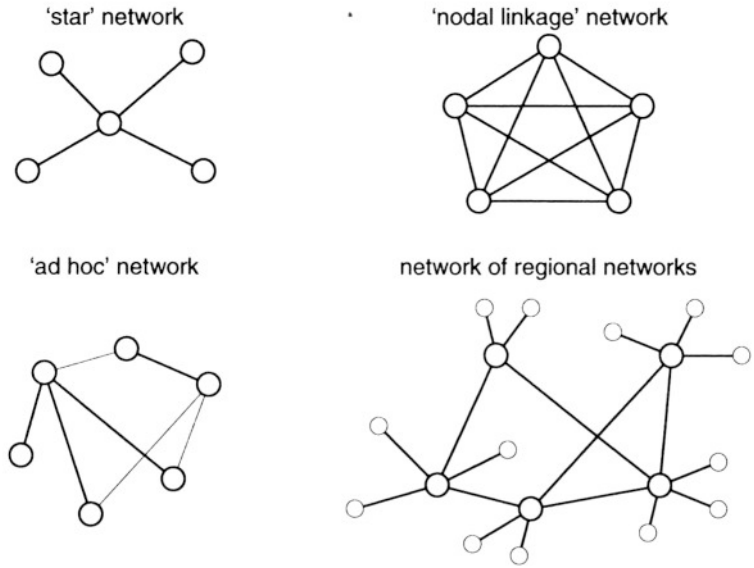

Fig. 1. The four basic types of networks
Source: CEC (1996: 7–8)

These four types of networks are rarely found in their pure form. Most networks will need to adapt to changing internal and external circumstances. Through a process of controlled and well-managed evaluation a network will develop from one type into another over time.

4. DETERMINANT FACTORS OF NETWORK CREATION

The first type of factors that determine the creation of networks are the barriers to network. Table 3 gives the most common barriers to networking. One of them, the lack of trust, is considered to be crucial in this respect. Theorists argue that the lack of trust can be overcome through experience. According to them trust is built up over a period of time, through (Harrison, 1992: 477):

– continual contracting and re-contracting;
– informal deal making;
– one company or group offering assistance to another in moments of stress; and
– mutual reinforcement in responding to contingency.

Table 3. Barriers to the creation of flexible manufacturing networks

Lack of familiarity. Most small companies are not experienced in networking. Introducing this concept takes time and requires careful explanation and lots of examples.
Lack of knowledge. Small- and medium-sized companies tend to work in isolation from each other. They have little information about the capabilities and opportunities for collaboration, often even with companies just down the street from them.
Lack of recognition of opportunities. Most companies look to see what they alone can do. They often cannot spot opportunities that require co-operation with others.
Lack of trust. Owner-managers who do not know or trust each other are usually unwilling to put their business at risk by depending on each other or by sharing knowledge or resources they regard as proprietary. The culture of manufacturing is highly individualistic and developing trust is very difficult.
Lack of time. Networking takes time and commitment of owner-managers, time they can ill afford.
Lack of resources. Firms may feel that they cannot take staff, money or equipment away from primary activities.

Source: USNet brochure *Short guide to inter-firm collaboration.*

Harrison (1992: 480), however, argues, that there is no necessary relation between experience and trust. Experience can lead to trust as well as distrust according to one of his referees. He suggests, that experience can create trust, when re-engagements lead to mutually profitable economic growth.

Two other factors that determine network creation are the capacity and willingness to undertake co-operative ventures. However, there are once again some critical remarks to this (Szarka, 1990: 18). First of all, co-operation is not an issue in controlled networks. These are networks where a single company dominates. Moreover, the relationships between companies are of the traditional subcontracting kind. In addition, the prices are imposed by the dominant company.

Secondly, although optimal networking is an effective strategy to reduce risk, sub-optimal networking may increase risk. The latter happens due to an increase in dependency on a potentially unreliable supplier. To avoid such dependency companies may have to implement traditional risk reduction strategies, like multiple sourcing and client diversification.

Thirdly, even in networks based on co-operation, price-quality-delivery trade-offs have their role in the initial decision to trade (Szarka, 1990: 18). In the last place, co-operation can be negative as in the form of collusion and corruption (Bonaduce and Miller, 1996: 10).

There exists a co-operation paradox. Actors realise that they need each other to pursue their objectives. However, at the same time they do not want to become dependent on others. They are fearful, that a partner benefits more from the relationship, or is taking unfair advantages of information. This paradox

causes co-operative agreements, which are rather unstable. They last until there is a change in the conditions that favoured co-operation (Kamann, 1991: 47).

Lastly, according to Felsenstein (1992: 105) networks are likely to be differentiated across industrial sectors on the basis of the following factors:

– the geographical proximity of the network;

– the intensity of the network; for example the level of companies' reliance on subcontractors and the frequency with which companies acquire certain physical inputs or services in the production process; and

– the type of network, that companies utilise; like for example production networks, service networks or marketing networks.

It would be premature to identify successful networking with geographical proximity. However, the trend away from vertical integration of production seems, to some extent, to have favoured regional agglomeration of sectoral specialisation. Networking and regional concentration of sectorally related companies seem to go together, even if one can arise without the other (Szarka, 1990: 17).

On the other hand this relation should not be over-estimated. First of all, it depends to a considerable degree on the level of sophistication of the company. This is likely to work against the creation of local networks. Sophisticated companies need specialised production inputs that are not always available locally (Felsenstein, 1992: 105–106). An Irish example of this is an engineering company in Killarney. This company networks with companies in a particular area in France, since only there it can find the training and tools necessary for its specialised and sophisticated production. In the second place, for networking to occur, a company's siting within a geographical and/or sectoral cluster is neither a necessary nor a sufficient condition for the formation of sustainable networks (Szarka, 1990: 17).

Company size is also said to determine the level of local networking. Small companies are likely to be more locally oriented than large companies (Taylor, 1975: 318). Moreover, companies in urban areas are likely to utilise local subcontractors more than companies located in more peripheral, less-urbanised areas.

The success of networks depends on the proficiency of the companies involved. Only companies, that share similar high levels of proficiency will be willing and able to collaborate. In addition, these companies must be committed to continuous innovation. There seems to be a natural selection process at work, that weeds out companies of lesser proficiency, when it comes to joint marketing or production (Ratner, 1995: 4–5).

5. THE ROLE OF SUPPORT ORGANISATIONS AND NETWORK BROKERS

The choice of the actual network segment is a strategic choice. In spite of its importance, this choice is very rarely made with full information about the potential network. The resulting incompleteness is caused by geographical and informational limitation, which could be improved with government aid as part of an industrial policy. This stage of network selection process is largely determined by the personality of the actor, their business routines, and goals. For a multiple-actor organisation with actors in different functions and tasks, each actor has his own personality, while groups of actors show subcultures and coalition behaviour (Kamann, 1991: 48).

For the potential of inter-firm collaboration to be realised there should be pro-active support by the public and semi-public support organisations (Greenwood, 1992: 8). The link between networking companies and support organisations can be created through flexible support networks. These are designed to assist in the formation and expansion of inter-firm collaboration. They can facilitate the networking process by supplying information. Thus, there may be many important partners in this support network, like for example (Schaefer and Roy, 1993: 18):

- educational institutions;
- financial institutions;
- government agencies;
- scientific and technical research institutes; trade associations; and
- trade unions.

The actual way to create flexible support networks is the same as for flexible manufacturing networks.[2] Figure 2 gives an outline for this.

Most network creation programmes on the European, American and Australian continent[3] use network brokers as facilitators and catalysts for network creation (Liston, 1996: 7). Brokers help companies form strategic partnerships, organise network activities and identify new business opportunities. Brokers spread network (Liston, 1996: 7). Brokers help companies form strategic partnerships organise network activities and identify new business opportunities. Brokers spread network concepts, promote co-operation, organise groups of companies and connect them to the product designers, marketing, specialists, training providers and industry services programs they need to compete successfully. For brokers a network means increased effectiveness and a broader client base (Hatch, 1995a: glance.html).

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[2] Bennett and McCoshan (1993) explain in depth how to create flexible support networks.

[3] In the Netherlands the programmes are sometimes broker-focused and in the United States this is the case in some places (Liston, 1996: 7).

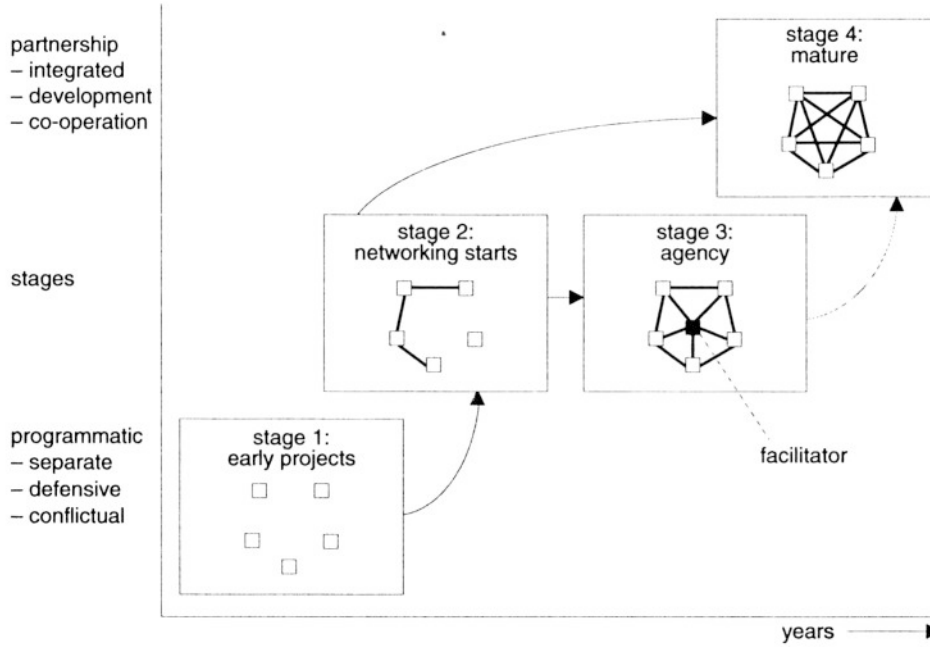

Fig. 2. Stages of integration and development of support networks
Source: Bennett and McCoshan (1993: 217)

Effective network brokers have similar characteristics (Hatch, 1995b: section1.html). First of all, they are committed. They accept the fact that business culture change is a slow process. They are aware of what will happen if companies fail to modernise. Secondly, they are entrepreneurial. They see new ways of adding value by combining the capabilities of complementary companies with those of research, training, marketing and other organisations. Lastly, they are knowledgeable. They understand their target companies and the environment in which they do business.

Table 4 gives the general role of a network broker. Within this he has five major tasks (ACENet, *Network theory. . .* : nettheory.html), namely:

– to introduce new perspectives or new ways of operating as a company, especially the notion of meeting needs through networks and collaborative action;

– to train groups in new rules of interaction involved in networking and collaborative action;

– to set up situations that will enable people in companies to map the network and build relationships with others in the network, including people in other companies and people in other relevant organisations;

– to guide groups of companies and people in other entities through the processes required to act and then learn from that action; and

– to built leadership that will distribute facilitative ability throughout the network.

Table 4. The role of network brokers in building networks

The network broker's task in network building is to:
function as a shared manager, enabling small companies in groups to take on new challenges;
identify critical competitiveness problems and common solutions through constant contact with companies and their markets;
establish regular communication among companies, and between companies and those with whom they need to co-operate, like business service providers, trade unions, marketing specialists, product designers, university laboratories, equipment manufacturers and customers;
manage conflicts that may arise among companies more accustomed to competing than co--operating;
view companies as 'packets of skill and equipment' that can be grouped into virtual co--operations in response to market signals; and
overcome obstacles to growth by creating group services; services that no small company could possibly afford except through network participation.

Source: Hatch (1995b: section1.html).

What is essential is that some of the network participants begin to build relationships with each other, in which the network broker is not central. Thus true networks are built with many dense relationships.

In order to network well, people need to know who has what capacity. Moreover, they need to be able to build trust with other participants. This will lead to selection of the most appropriate partners with which to identify joint needs, develop action projects or cook up deals.

6. EMPIRICAL MODELS OF FLEXIBLE MANUFACTURING NETWORK CREATION

There exist different empirical models to create flexible manufacturing networks. Almost all empirical models eventually lead back to the industrial districts or Third Italy model. On the basis of the Third Italy the Danish Technological Institute developed its own model for its 1989–1992 network creation programme. It has become a very popular model in the Western world. The last model dealt with here is that of the Appalachian Center of Economic

from the United States. It is also built on the experience in the Third Italy and it has similarities with the Danish model. However, its approach is broader than the latter.

7. THE INDUSTRIAL DISTRICT OR THIRD ITALY MODEL

The term 'industrial districts' goes back to Alfred Marshall. He used it for the concentration of specialised industries in particular localities (Marshall, 1920). Table 5 gives the main features of the industrial districts in the Third Italy. It is the economic success of the Third Italy and Emilia-Romagna in particular that brought the industrial districts model back to the attention of scientists and policy-makers.

Table 5. The main features of industrial districts in the Third Italy

Geographical proximity.
10–15 000 workers in 1 000–3 000 companies.
Sectoral specialisation in one or a few phases of a complete production process.
Production for one customer-oriented, fragmented and varied international market, like for example knitwear, furniture, ceramics or mechanics.
Absence of large dominant companies.
Close inter-firm collaboration by small groups of companies from the larger pool of 1 000–3000.
Inter-firm competition based on innovation, rather than lowering wages.
A socio-cultural identity, which facilitates trust relations between companies and between employers and skilled workers.
Active self-help organisations.
Innovative capacity of local industry.

Sources: ACENet (*A market driven...*: markfmn.html), Garmise (1995: 142), Harrison (1992: 471), Schmitz and Musyck (1994: 890).

The industrial districts in Third Italy[4] have received the most attention from scientists. However, some research has been carried into industrial districts in Baden-Wurttemberg and West-Jutland (Jacobson and Andréosso-O'Callaghan, 1996: 116–118; Schmitz and Musyck, 1994). Besides the traditionally rich North West, the First Italy, with large industrial concentrations and the poor South, the Second Italy, the small company districts of the North East and centre, the Third Italy, showed fast growth. For example, Emilia-Romagna's per capita income

[4] The term 'Third Italy' was first used by the Italian sociologist Bagnasco in his (1977) book *Tre Italie: la problematica territoriale dello sviluppo italiano*. The Third Italy encompasses the regions Emilia-Romagna, Umbria Trentino, Veneto, Lazio, Tuscane and parts of Lombardia.

grew dramatically. It was the 17th out of the 20 Italian regions in 1970. In 1985 it climbed up to be the second best region (ACENet, *Revitalizing...*: smallman.html).

One of the main explanations of this success is the predominance of small- and medium-sized companies, who collaborate and form networks within a confined geographical area. From a policy point of view it is important to know, that the flexible manufacturing networks in the Third Italy initially developed spontaneously. After that they received support from trade associations and local and regional governments. However, the model is under stress since the beginning of the 1990s. The main questions to be answered are what are the factors for the creation and continuation of flexible manufacturing networks in the Third Italy and why is it now under stress?

There are different factors, which created and/or maintained the flexible manufacturing networks in the Third Italy up to recently. The first factor is related to the production structure and territorial distribution of the companies. Companies specialised in one or a few phases of production, often more than a thousand within the same community. This fosters extensive subcontracting networks. These networks integrate the various phases of the production process. Living in the same community and working in the same industry facilitates co--operative networks among companies (Garmise, 1995: 142).

A second factor is that many of the normal day-to-day activities of people in local communities serve to support and amplify networking efforts. ACENet (1995: 7) gives two examples of this. First of all, the presence of a promenade in each town. Many families and groups of friends stroll there each evening, stopping often to chat with others. In the second place, mid-day lunch breaks are used as an opportunity for lively discussions. Both help people to build the trust, which is an essential element of successful creation of networks.

Another factor is that economic relations are heavily embedded in dense community-based social networks. The joint governance of the economy by the market and the community functions through conscious disappearance of boundaries between state and market and employer and employee (Garmise, 1995: 143). To a considerable extent this is due to the fact that most companies are locally owned. The owner-managers know one another and each others' families. As Rosenfeld (1990: 20) states:

> ... they [the local companies] will pay more to keep business and capital within their own community, purchasing as much as possible from local companies and investing locally, at times even if higher returns are possible elsewhere.

The last group of factors are related to the business support system. This can be divided into trade associations and regional development agencies. In the Third Italy most companies are members of a trade association, especially

the Confederazione Nazionale Dell Artigianato (CNA). They are founded on local inter-firm relationships and offer services to the local business community (Bonaduce and Miller, 1996: 12). The associations meet common needs and provide an environment in which companies get to know each other or as Rosenfeld (1990: 20) says: "the associations provide the glue that binds companies together". Companies are familiarised to shared activities by the associations' group services such as accounting, capital acquisition and training.

The main regional development agency in the Third Italy is Ente Regionale per la Valorizzazione Economica del Territorio (ERVET). It integrates the potential public and private sectors, credit and financial institutions, trade associations, chambers of commerce, etc. ERVET provides business services through eight sectoral service centres. Like in the rest of Italy, they provide traditional services related to the diffusion of innovation, internal functions of companies and links with external economies. However, what is unique, is that these and other service centres in the Third Italy promote the strengthening of inter-firm relationships (Garmise, 1995: 152–153).

Since the 1990s the Third Italy model is under stress. There are three reasons for this. First of all, there is an increased number of mergers and acquisitions. Secondly, large companies now have more flexible and aggressive strategies. Lastly, there is increased competition from low-wage countries.

The increase in mergers and acquisitions, as well as minority shareholdings, contractual agreements and joint ventures, create larger, better resourced and more powerful companies. After a while this can undermine the co-operative network relationships in the Third Italy. Although many companies continue to remain small after a take-over, the operational structure is now more hierarchical in order to control key strategic functions. This implies that certain companies are heading towards a dominant position within the Third Italy, that used to be without a controlling centre (Garmise, 1995: 154–155).

Large companies have become more aggressive and flexible. Faced with increased global competition, large companies have developed a more flexible management structure. They changed their focus from the mass market towards more diversified quality-conscious markets. Moreover, especially large companies in the machinery, garments and food-processing industries try to control distribution networks. Small- and medium-sized companies find this form of competition very difficult to combat, because they are often price-takers and product-followers. They react to the innovations of others. The last cause of stress is the increased competition from low-wage countries and then especially newly industrialising countries (Garmise, 1995: 155).

8. THE DANISH MODEL

As shown in the previous paragraph flexible manufacturing networks came into existence spontaneously in the Third Italy and other industrial districts in Europe. However, efforts have been made to create flexible manufacturing networks in some areas where these did not exist before. The best known one is the Danish effort. The Danish Minister of Industry and Trade launched a Plan of Action for Establishing Network Co-operation in Denmark in February 1989. It is the first European model for creating flexible manufacturing networks based on the industrial districts' successes in the Third Italy. It has become very popular on European, American and Australian continents. For example, the Norwegian Industrial and Regional Development Fund (Liston, 1996: 6), the Institute for the Production of Small- and Medium-sized Firms in Spain (Liston, 1996: 6), Menter a Busnes in Wales (Hughes, *Bussiness support...*: bn.html) and Plymouth Business School together with Business Net[5] (Chaston, 1996: 72) are using the model.

What is the Danish model? It is a model used by the Danish Technological Institute[6] (DTI) over the period 1989–1992. DKR 150 million[7] was available for it. The main aim was to further co-operation between at least three independent companies around strategically important functions, such as sales, product development and quality control. It was thought, that traditional resource, informational and scale disadvantages could be overcome through the pooling of resources, new joint ventures and the exploitation of complementarities (Amin and Thomas, 1996: 267). There was no specific rural or peripheral bias in the programme (Jensen-Butler, 1992: 896–897).

The key elements were challenge grants, network brokers and centres. Challenge grants provide companies and network brokers with incentives to spur co-operation. Network brokers are called upon to motivate co-operation, help establish contacts among companies, and make the arrangements for establishing networks. Lastly, the centres carry out functions needed by a network (Rosenfeld, 1990: 29).

Before going into detail regarding the different phases of the Danish model, it is useful to know that people operating as network brokers were given an action learning and training programme by the DTI. After about 400 initial inquiries and 125 applications, 40 individuals were selected for the nine-months training programme. They were mainly experienced industrial and marketing consultants.

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[5] Business Net is a subsidiary of DTI (Hughes, *Business support...*: bn.html).

[6] Initially it was the Jutland Technological Institute, but it merged to become the Danish Technological Institute (Rosenfeld, 1990: 29).

[7] DKR 150 million is now about Ł 16 million or ECU 12.5 million.

Rosenfeld (1990: 29–30) mentions some criticisms with respect to the training programme. This mainly focuses on the participants' belief that their experience was not fully appreciated. Moreover, they felt that the discussions were too theoretical. There were actually seven two-day training sessions spaced about six weeks apart. The criticisms are mainly related to the first two sessions.

With respect to the first session the criticism was that the participants would have preferred to look for potential companies to connect to another, rather than conducting mathematical sectoral analyses. The problem with the second session was that it was considered too conceptual. It did not address real problems of people working in groups. Since then the sessions were redesigned. They contained more traditional lectures and case studies on the essence of forming networks. The participants had free control to go out and begin implementing the newly learned strategies.

Chaston (1996: 73–77) identifies five phases (see figure 3) within the Danish model. This division is based on the six critical events in the network formation as given in table 6. The first phase involves raising the awareness and the acquisition of information about specific sectors. Raising of awareness has been done through a vigorous information campaign. This included direct mailing to every company in the country, full page newspaper ads, regional conferences co-hosted with trade associations and television talk shows (Hatch, 1995a: appendices.html).

The campaign also targeted on 'multiflyers'. These are people in a position, where they have an ongoing contact with many businesses and who also have a self-interest in strengthening these businesses. The clearest example of these are bankers (Schaefer and Roy, 1993: 11). Beside the launching of an information campaign, the network brokers acquire information on a specific industrial sector or geographical area. Validation of preliminary findings from this data collection is achieved by the undertaking of structured interviews with an appropriate number of companies.

In the second phase the network broker uses the just acquired information to organise a focus group meeting. Relevant sector companies are invited, who are potentially interested in flexible manufacturing networking. The network broker tries to stimulate debate between those present about the advantages and disadvantages of collaborating with other companies (Chaston, 1996: 76).

The network broker can enter phase three, the pre-analysis stage, if after the focus group meeting at least three companies intend to create a network. Pre-analysis includes an analysis of how the companies' product composition and production and market situation fit. Moreover, there will be an evaluation of any deficiencies and any investment needed to make the ideas about a network work in practice. The purpose is to give the companies the opportunity to evaluate whether collaboration in the form of a network is really likely to be as attractive

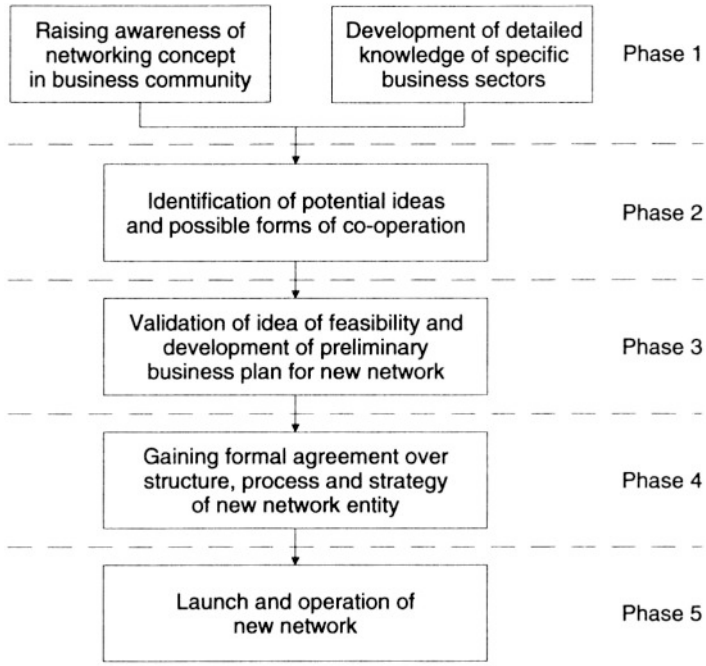

Fig. 3. The five phases of the Danish model
Source: Chaston (1996: 73)

Table 6. Critical events associated with the Danish model

Ensuring the local business community is made aware of the potential benefits of forming collaborative trading relationships by becoming involved in flexible manufacturing networks.
Building a provisional model, which defines available business opportunities and/or the nature of factors influencing the performance of companies in a specific industrial sector or geographical region.
Evolving a detailed model, which (a) validates whether business opportunities and/or performance influencing factors have been correctly identified, and (b) relates these findings to the capability of companies to exploit closer collaboration as a mechanism for enhancing future performance.
Persuading potential participants from the business community that there are benefits to be gained from formal collaboration in exploiting opportunities and/or overcoming performance problems.
Confirming both the commercial validity of the idea and the capability of identified participants to effectively co-operate with each other in the creation and operation of a new network.
Building a detailed strategic planning capable of successfully guiding participants through the final phases of network formation and business launch.

Source: Chaston (1996: 75).

as they imagine, before they go any further and commit themselves financially. The companies can apply for a grant for this preanalysis.

The companies will enter the fourth phase if the results of the pre-analysis are positive. The main aim in this phase is to gain formal agreement on the structure and the resource inputs of the network. The companies can apply for a grant to get the framework for the collaboration fixed. The following three plans are required to get this grant:

- an action plan;
- a financial plan for running-in the network's joint activities; and
- a collaboration plan for the organisation of the network.

The network broker's role changes in this phase from facilitator to mentor. Once agreement has been reached between the companies, the last phase can be implemented, that of the launch and operation of the network. A two-year grant can normally be attained for this phase. Thereafter, the network must be funded 100% by the companies themselves. This means that the companies must decide between themselves at a relative early stage how the network is to hang together financially, when it no longer can get grants.

It is useful to know what the results of the 1989–1992 programme are at the present moment, to see whether the network creation efforts are sustainable. However, the data available to me do not go further than September 1990. At that time about 2000 companies out of the target group of 7500 (Schaefer and Roy, 1993: 11) were involved in about 400 recognised network activities. Beside these 2000 another 1000 were involved outside the formal programme (Amin and Thomas, 1996: 267). About a hundred network activities were in the last phase. 94% of them thought the network would last after the grant period. 80% of the companies in the fifth phase thought they would enter the last phase. About 75% of all companies involved held the view that collaboration had strengthened their competitiveness due to increased turn-over and reduction of costs.

A criticism of the Danish model is, that the network brokers worked as isolated individuals with sets of companies and with little relationship to other networks. Therefore, it was impossible to develop knowledge of markets and multitude relationships among companies. Thus an on-going stream of networks was not guaranteed (ACENet, 1995: 9).

9. THE APPALACHIAN CENTER FOR ECONOMIC NETWORKS MODEL

The Appalachian Center for Economic Networks (ACENet) is a south-eastern Ohio-based non-profit economic development organisation. It started in 1985 with the aim to create worker co-operatives. After five years it decided that this

strategy was not dynamic enough. Moreover, it could no longer obtain sufficient financial support for this. In 1989 it received a grant to investigate the feasibility of adapting a flexible manufacturing network approach. This included extensive review of the literature on the Third Italy experience, as well as with networking in other regions (ACENet, 1995: 10). Presently ACENet is implementing several projects designed to revitalise the regional economy, all involving flexible manufacturing networks (ACENet, 1994: polrec. html).

The ACENet's strategy to create flexible manufacturing networks is to set up a learning consortium. This learning consortium will grow in three dimensions, namely among the companies, around a market niche, and in conjunction with support organisations in the community.

Especially the latter is what distinguishes it from the Danish model. Here the network broker does not only facilitate the creation of flexible manufacturing networks but also of flexible support networks. ACENet uses a 2–6 phase model as shown in figure 4.

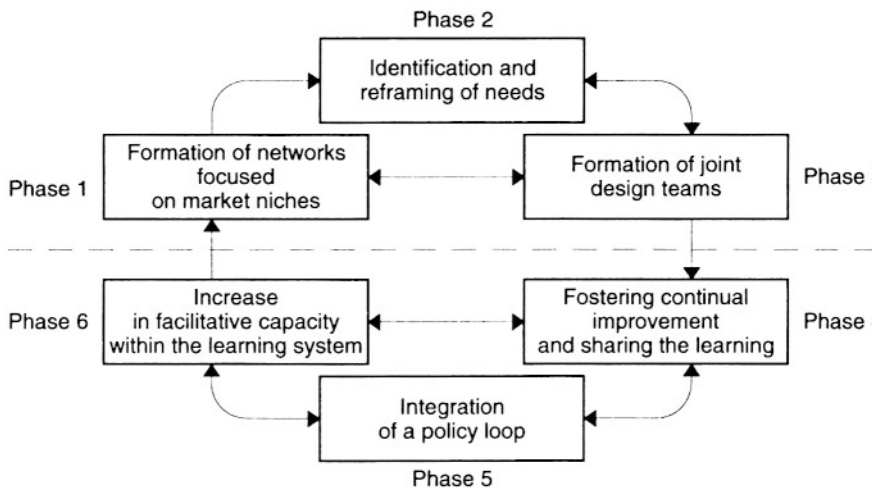

Fig. 4. The 2–6 phase model of ACENet
Source: ACENet, *Creating high. . .* : learncon.html

In the first phase the network broker brings companies together to focus on serving a particular market niche. During the first three months the network broker will work to establish a core group of companies. This core group has to act as a leadership group for a larger consortium. The network broker will use group and one-to-one meetings to help the companies identify key issues.

During this phase the network broker also works with groups and individual owner-managers to develop *ad hoc* solutions. He draws on other ACENet staff and other support organisations in the community to provide spot training in

areas, which will serve for the development of a learning system among the companies involved. Another system should be developed to help companies with basic issues of collaborated production, like: production co-ordination, quality control, timeliness, cost tracking, and inventory.

The second phase is the identification and re-framing of needs. The first step here is for companies to identify specific needs, that are not met at present. The next step is that those companies, which have a sense of the larger economic situation help the whole group to re-frame their understanding of the identified needs. During this phase the network broker will pull in new companies by providing a forum to solve real and immediate common problems. She will offer some new perspectives on the identified needs. This is to help companies to identify their place in the world economy and to see the potential open to them.

In the third phase small joint design teams are formed to focus on specific, expressed and re-framed needs. These teams include companies, educational institutions, social service agencies, banks and community groups. The teams address development needs in four areas (Ratner, 1995: 13), namely:

– training and workforce development;
– access to capital;
– telecommunications; and
– modernisation.

In the next six months the other three phases aim to create a more advanced and integrated learning system. The first phase here is the fostering of continual improvement and sharing of the things learnt. This assessment should result in a redesign of the program. It has to take into account the concerns and creativity of the companies involved. What is learned from the process of collaborative program design and program implementation should be shared throughout the larger learning consortium. Thus other joint design teams can benefit from it.

The second phase is to integrate a policy loop. This should be done through the creation of vertical policy networks. Government agencies and other support organisations, such as banks, have to learn to interact with inter-firm networks. The creation of policy networks has to be done through action groups. These policy networks should be flexible, for companies to be flexible (ACENet, 1994: polrec.html).

The last phase is the increase in the facilitative capacity. This is the ability to bring people together to act effectively and reflect on the quality of programs designed to meet specific needs. The network broker should train company owners, employees and support organisations how to listen well to each other and how to execute the steps of basic collaborative processes, such as decision--making, planning, conflict resolution, negotiation, and reflection. This type of training will be distributed throughout the year in a variety of settings.

ACENet started with the creation of a network to manufacture household products for persons with disabilities. To fill this market niche it asked for

collaboration between electronics and machine companies as well as small woodworking shops (Ratner, 1995: 12). The aim was to involve small companies in eight industries in this network.

Together they produce four products.[8] Each of these products is manufactured by two or more companies.

ACENet had to take the lead in product development and distribution, because the chosen market niche was still emerging. The costs of this were added to those of the network creation. It also made the network more complex. From this experience ACENet learnt not to start with a product, but with the innovative companies themselves (Ratner, 1995: 12–13). At present ACENet tries to create networks in two other areas, namely speciality food production and resource re-use and re-manufacturing. More than fifty companies are involved in its three network creation projects.

The creation of networks of companies and support organisations is a slow process. ACENet is still building a solid support base among support organisations like bankers, economic development agencies, Chambers of Commerce, small business development centres and innovation centres, etc. Moreover it tries to identify a smaller group of support organisations, who are interested in developing new programs for networking companies, and to work with them on specific projects that will increase modernisation assistance, access to capital and targeted training programs (ACENet, *A market driven...*: markfmn.html).

The results of the ACENet have not been completely successful in this field. The main actual project is training provision. ACENet brought sixteen representatives of networking companies, community groups, human resource agencies and a vocational school together. This team developed a three-year customised training program. Besides classroom training it includes on-the-job training in networking companies. However ACENet failed to get conventional sources of funding to meet the costs of this training program. This was due to the inflexible and obsolete guidelines of the conventional sources of funding.

10. THE PROS AND CONS OF THE THREE MODELS

The main advantage of the industrial districts or Third Italy model is that it shows the role support organisations can play in creating and maintaining flexible manufacturing networks. The pro-active role from the trade associations and regional development agencies towards flexible manufacturing networks

[8] These four products are a wall-mounted, adjustable desk; a free-standing, adjustable desk; an accessible kitchen; and a gardening tool for people with limited grip or hand strength.

seems to have a positive effect on the creation and maintenance of these networks. The main weakness is that the model developed spontaneously. Therefore it does not really suit as a blueprint for areas, where such networks do not exist. Another problem of this model is, that there is a high degree of specialisation in one sector. Such a degree of specialisation within a relatively small geographical area hardly exists everywhere in Europe. A last problem is the fact that not everywhere in Europe there is a community spirit, where companies are prepared to pay more to keep business and capital within their own community.

The main pro of the Danish model is that is developed to create flexible manufacturing networks in areas or sectors where they did not exist before. Moreover, the different phases look very consistent. The main disadvantage of this model is that it confines itself to the creation networks of companies and does not include the setting up of support networks. Thus it is unclear who is going to assist network creation after the program finished in 1992. Moreover, not only companies but also support organisations are not used to the networking. To make the creation of flexible manufacturing networks sustainable, the latter should be trained to support networking companies as well.

The main strength of the ACENet model is that it includes the creation of networks of companies and support organisations. Another advantage is the continual assessment as built in the different phases of its model. A main weakness is that its approach is quite slow. The creation of networks of companies and support organisations takes time.

ACENet staff visited the Third Italy and Denmark in October 1994. They came with the following general conclusions (ACENet, 1995: 4–5):

– each network is unique and provides evidence of a creative local community process, rather than a standard flexible manufacturing network model;

– economic networks do not operate in isolation, but are supported by extensive informal networking;

– much of the impact of the network comes from companies' links to markets so that new sales are continually generated; and

– community-based industrial districts are linked through a variety of informal relationships through which leaders share information about successes and work on regional and national policy.

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