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DRUID Working Paper No. 98-23

**Organizational and innovative
flexibility mechanisms
and their impact upon
organizational effectiveness**

by
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October 1998

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Abstract

This paper presents a lexical definition of firms' flexibility and its operationalization as used in the DISKO survey of 1900 Danish private firms. This operationalization is highlighted by data from a highly flexible firm which was visited in 1997 as part of a follow-up upon the questionnaire survey of which the firm in question was a part. The aim is to understand the flexible traits and their meaning for effectiveness. The analysis shows how the interviewees' statements give an understanding of the firm's flexibility and its effectiveness and how their explanations draw upon elements from the operationalization as well as elements not included in the operationalization but can be seen as part of the lexical definition. The results point to the importance for effectiveness of the firm's culture based upon openness, cooperation and service mindedness in combination with a group structure which means extended cross functional information processes. These processes are supported by information and communication technology founded on a common understanding among the users building upon learning activities. From these connections stem extended relationships with customers and a rich web of processes conducive for new ideas on products and services. Details of these relationships are presented. From this analysis is also drawn a few conclusions regarding the problem of operationalization of flexibility. Results from the questionnaire survey are given as background information and include the distribution of the 1900 firms as measured by a flexibility index and divided according to a typology of static, flexible, innovative and dynamic firms.

Keywords

Flexibility, innovation, effectiveness

JEL

L23, O31, D21

ISBN(87-7873-061-9)

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Introduction

Since 1996 the IKE group at the Department for Business Studies at Aalborg University has carried out a major investigation on 'The Danish Innovation System: Comparative analysis of challenges, strengths and bottlenecks.' It's known as the DISKO project and initiated by the Danish council for the promotion of business and trade. The first phase of this project comprised an analysis of organization, technology and product/market innovation of private firms. The other phases are directed towards the infrastructure of firms such as training institutions and financial organizations, analyses of national economic processes and international comparisons. The DISKO project is planned for the period 1996-99. The investigation on the firm level focuses upon organizational renewal in connection with new technology and innovation and its influence upon effectiveness of the firms. The investigation of the firms started with an enquete to 4000 firms of which 1900 answered the questionnaire by mail or telephone. The results were published as a book in Danish by Gjerding et al. (1997), and preliminary results are found in working papers by Gjerding (1996), Lund & Gjerding (1996) and Lundvall & Kristensen (1997). The results show the importance of competitive pressure for organizational changes directed towards more flexible organizations and better qualified employees. Moreover the research team found a correlation between flexibility and effectiveness and a type of firms called 'dynamic flexible' (to be explained below) which had a higher effectiveness (measured as value added per employees) than the rest of the firms.

After the enquete was finished, qualitative studies were carried out to get a better understanding of the processes which were favorable for flexibility and *inter alia* could change firms in the direction of the dynamic flexible type and increase effectiveness. A series of interviews were carried out in 24 firms representing both manufacturing and service, and both smaller and larger firms. A total number of 89 persons were interviewed comprising top and middle management and employees. Results from this investigation were published in Danish in a book by Jørgensen et al. (1998). Organizational renewal was found to be a complex process comprising clashes of interests and often it showed only partly planned changes. Active leaders, key employees and pilot groups working together were of much importance for successful organizational changes. At the same time it was seen that middle managers and shop stewards were under pressure for a change in their roles, as were the working tasks of employees.

The aim of this paper is to understand the flexible traits of firms, and their meaning for

effectiveness. The point of departure is the flexibility definition which was used in the analysis of the 1900 answers from the enquete as well as the operationalization of the definition. From the interviews taken in one very flexible firm, it's sought to highlight the meaning of the flexible elements of the chosen definition and to include other flexible elements which turned up during the interviews and see them in relation to the firm's effectiveness. In this way the paper develops the explanations of the quantitative study on flexibility and supplement the understanding given in the Danish qualitative study of the mechanisms combining flexibility and effectiveness.

The structure of the paper is the following. After this introduction follows an exposition of the chosen definition of flexibility and its operationalization. By results from the quantitative study is shown how firms with different degrees of flexibility differ with regard to effectiveness as measured by their value added per employee. Next follows information about the qualitative study of flexibility among 24 firms one of which is selected for the analysis of this paper. The main part of the paper is concentrated upon an examination of the interviewees' statements which can give an understanding of the firm's flexibility as seen along internal dimensions of structure, culture and processes and external dimensions of technology and product market innovations. This examination is followed by an analysis of the mechanisms connecting flexibility factors and effectiveness. Thereafter is presented a discussion of the measurements of flexibility including suggestions for other ways of operationalizing flexibility. The final section is a conclusion which stresses the new elements of flexibility not found in the operationalized definition and it also points to a couple of limitations of the study.

Definition and operationalization of flexibility

In the Danish book about 'The flexible firm' (Gjerding et al. 1997 ch.7) were discussed various approaches to flexibility used by social science researchers (Atkinson, 1985; Jørgensen et al. 1990, Nielsen, 1997; NUTEK, 1996; OECD, 1986, 1989, 1991 & 1996; Piore & Sabel, 1984; Wiklund & Karlsson 1994). Some researchers look upon labour market flexibility and others upon the capability of firms to adjust to new demands from customers and the firms' use of new technology. The DISKO project combines these approaches and has chosen the following lexical definition of flexibility:

The ability of the firm to react upon a turbulent environment with

new products and new technological processes on the basis of integrative organizational forms and a culture oriented towards renewal and learning.

The choice of this definition is based upon the DISKO researchers' concept of society as a learning economy (Lundvall & Johnson, 1994). Here innovations and the human resources are at the center of strategic interests. Flexibility built upon e.g. price competition or numerical adjustments of the labour force is seen as less constructive ways of handling the economy, and therefore not included in the definition.

By this definition flexibility becomes a concept with an internal and external dimension. Internally the question is whether the organization can make a constructive change which again is seen as a question about the will and the ability of the firm to renew itself towards a learning organization (Stahl et al. 1993). This includes the improvement of action competence and better use of the human resource potential promoted by organizational development. Externally a flexible organization is characterised by interaction with its environment through adjustment and the creation of new positions e.g. by new products and services and expansion on new markets. The use of new technology is also part of the flexible organization and can be seen from both an internal and external angle.

The DISKO project operationalized the internal dimension according to three perspectives upon the organization which included structure, processes and culture (Bakka & Fivelsdal 1986:22pp.). As flexible structures of the investigated firms were taken 'cross-occupational working groups' and 'quality circles/groups'. Processes were characterised by 'rotation between functions', 'integration of functions', 'continued vocational training', 'educational activities tailored to firm' and 'long-term educational planning'. Cultural traits which were seen as

Diagram 1 Operationalization of flexibility and notification of relationships between flexibility elements.

<i>Structure</i> s1.Cross-occupational work groups														
s2.Quality circles/-groups														
<i>Processes</i> p3.Rotation between functions	n x													
p4.Integration of functions	n x	x												
p5.Continued vocational training	n													
p6.Educational activities tailored to firm	n x	x												
p7.Long-term educational planning	n													
<i>Culture</i> c8.Delegation of responsibility	n x	n x	n	n	n	n	n	n						
c9.Employees' participation in weekly planning of work	x	x												
c10.Employees' participation in control of work tasks														
<i>New technology</i> t11.Information and communicat. techn.	n	x	n	x		x		n						
t12.Other forms of new technology														
<i>New products & markets</i> i13. New products-/services	n		n					n						
i14.Exports to new foreign customer groups														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14

Note: x means relationships between operationalized flexibility elements treated in this paper. With an (n) is notified new relationships between factors mentioned by the interviewees, but not part of the operationalization.

promoting flexibility comprised 'delegation of responsibility', 'employees' participation in weekly planning of work' and 'employees' participation in control of work tasks.'

The external dimension of flexibility was seen in relation to the market. Questions were asked about the introduction of 'new products/services' and 'exports to new foreign customer groups' as exports was of special interest from a Danish trade promotion point of view. New technology could as already mentioned be seen from both an internal and external oriented angle depending on whether new technology was directed towards organisational processes or the contents of products and market related attributes. In the DISKO questionnaire technology was included under the external dimension and operationalized as 'new technology based on information and communication technology' and 'other forms of new technology.' An overview of the operationalization of flexibility is given in diagram 1 which also presents an overview of the exemplified relationships between flexibility elements.

The analysis of the firms' degree of flexibility based upon the operationalization of the concept made it possible to distribute the investigated firms on index values between 0 and 14, cf. table 1 showing the distribution of the 1900 survey firms and diagram 2 which also shows the respective distributions for manufacturing and non-manufacturing firms.

Table 1. The percentage distribution of 1900 firms according to the flexibility index (I)

I	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14
%	2.3	3.1	5.3	6.7	7.3	7.7	8.5	9.7	10.3	10.0	8.9	9.2	5.7	3.7	1.7

The flexibility index correlated with the firms' effectiveness as measured by value added per employee. Especially non-manufacturing firms showed a strong correlation with effectiveness, cf. table 2 and diagram 3.

Table 2. Value added by 1000DKR per fulltime employees in 1994 within manufacturing firms (M) and in 1993 within non-manufacturing/services (S) distributed according to flexibility index values of the firms (I).

I	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14
M	332	346	404	412	416	401	474	445	491	484	477	484	424	517	420
S	440	402	341	390	412	465	461	472	473	475	547	592	585	649	696

Static, flexible, innovative and dynamic firms

The internal, organizational and external, product/market and technological dimensions of flexibility gave the basis for constructing four types of firms called respectively static, flexible, innovative and dynamic (Gjerding et al., 1997 ch.8), cf diagram 4. In this diagram is given information about the relative number of firms within each type and the average effectiveness as measured by value added per employee. By the construction of the four types it was aimed at

Diagram 2. Flexibility and distribution of total number of firms (1884), manufacturing (668) and service (1216)

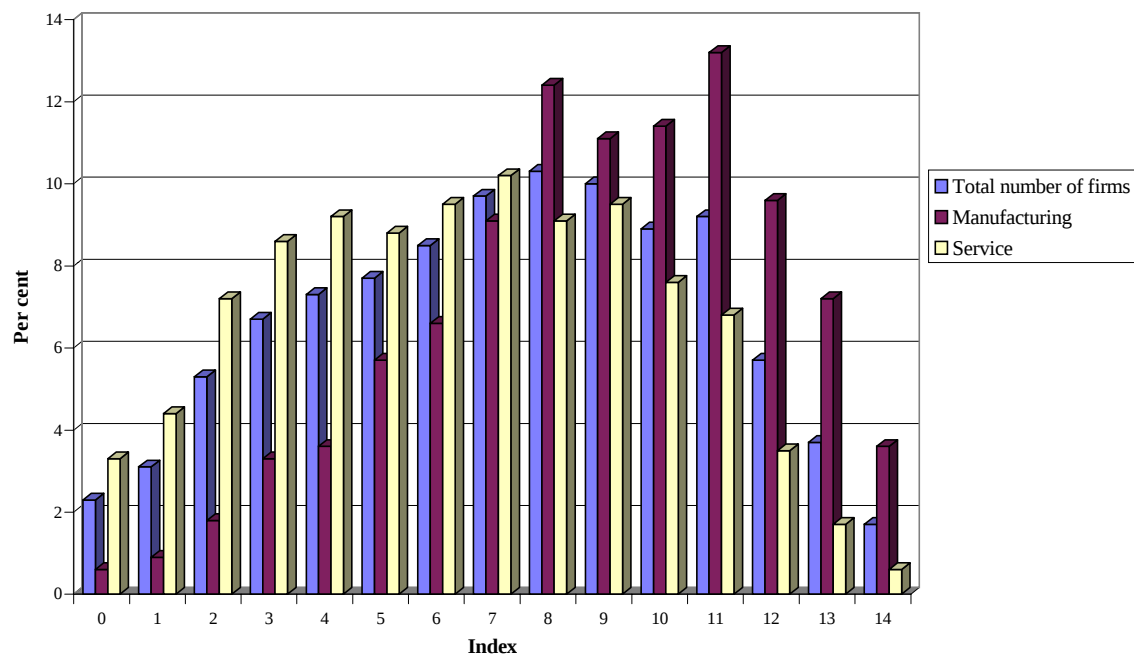


Diagram 3. Flexibility and value added per fulltime employee. Manufacturing 1994 and non-manufacturing 1993.

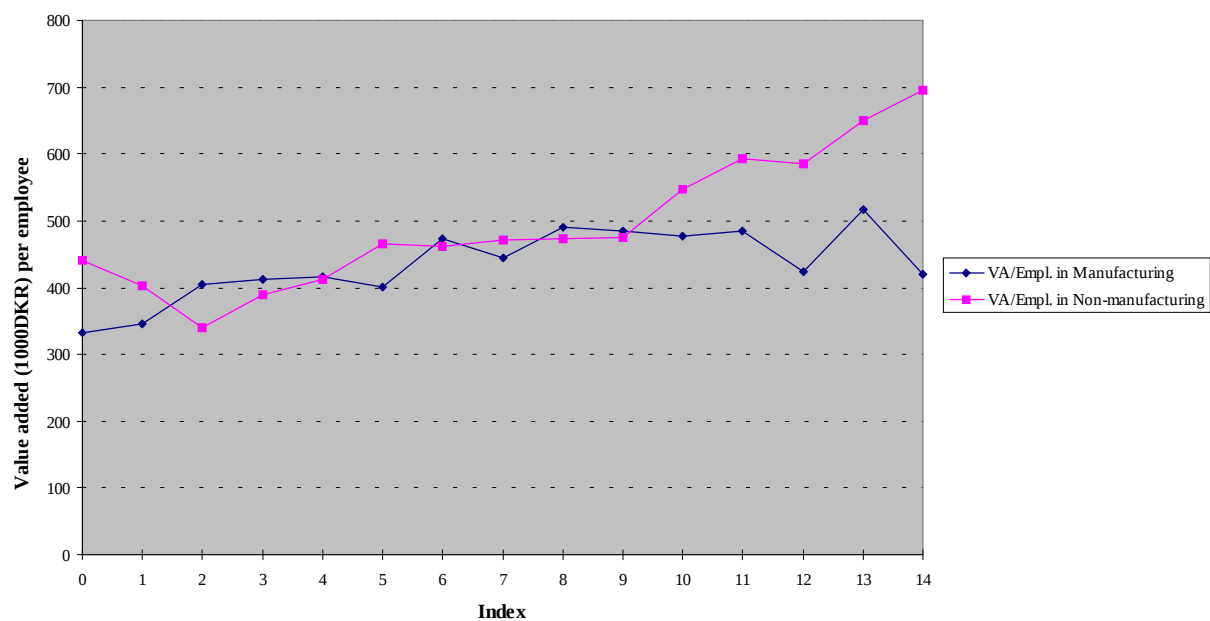


Diagram 4. Four types of firms, their distribution and the average value added per fulltime employees (VA/E 1000DKR)

N = 1884 firms		Organizational flexibility	
		Smaller	Larger
Product/market and technological flexibility	Smaller	Static 41 % VA/E = 425	Flexible 26 % VA/E = 478
	Larger	Innovative 8% VA/E = 450	Dynamic 25 % VA/E = 501

getting an equal distribution of more and less organizationally flexible firms. This condition was achieved by a cutting point of 5 on an index of the internal flexibility going from 0 to 10. Less flexible firms have values 0-5 and more flexible firms have values 6-10. Regarding technological and product/marked flexibility it was wanted that product/market traits were represented in the most flexible group which meant a division on the external dimension between firms with values on the external dimension of respectively 0-2 and 3-4.

According to the chosen criteria for dividing the firms, 25 per cent af the firms are assigned to the dynamic group which is characterised by both internal and external flexibility. 41 per cent are found in the static group with smaller degrees of flexibility on both dimensions. In this connection it has to be underlined that the number of firms in each group are dependent upon the chosen criteria. So, even though it is tempting to announce that 25 per cent of Danish firms are flexible in comparison with x per cent in another country, this is stretching the measurements too much as long as flexibility is not measured in the same way. Also the terms static etc have to be understood within the limits defined by the operationalizations.

Regarding effectiveness as measured by value added per employee, the dynamic type has a marked advantage in comparison with the other types of firms, whereas the static type is inferior to the other ones.

Understanding flexible mechanisms

When the DISKO project started, it was known from other investigations that flexibility could have some positive effects. For example it was demonstrated by the Swedish NUTEK (1996)

study published in the book 'Toward Flexible Organisations', that flexible organizations defined as firms which delegated decision-making responsibility and carried out educational and training measures among their employees were more productive than non-flexible. Most of the flexible firms were also more innovative than the rest. In the DISKO project organizational and innovative flexibility has been combined as previously explained, so it was expected that flexibility would correlate with effectiveness as it also turned out. However, the question now raised was what contributed to this correlation. This problem was investigated through the above mentioned study of the experiences among 24 private manufacturing and non-manufacturing firms which had changed their organization during the period 1993-95. By interviewing 89 managers and employees, it was highlighted which motives and effects could be related to the various elements of flexibility. In the Danish book 'Organizational renewal' by Jørgensen et al. (1998) is presented an analysis of organizational change, the importance of a combination of information and communication technology and cooperation across hierarchical levels and functions, and learning in connection with change.

This paper has a more narrow scope. The weight is placed upon the various elements of flexibility and their meaning for effectiveness. *Attention is directed towards the actors' attitudes and stories about the flexible mechanisms. Focus is upon mechanisms which activate the firms by interaction and other processes and also point towards improvements and higher effectiveness. When interpreting the interviews, care is taken to recognize the actors' structural positions and cultural background as well as changes in these factors.*

The analysis is based upon one of the visited firms situated within the service sector but also having a small manufacturing unit. The firm employed around 50 people. This firm is selected for the following presentation because it amounts to an extreme case of flexibility having a maximum flexibility score of 14 according to the answers giving to the questionnaire by the management. So, the firm is an example of the dynamic type. Intensive interviewing of a small sample of 2 managers and 2 employees confirmed the information given in the questionnaire. The interviews were taped and converted for use at pc's from which extracts are taken in the following. The English extracts are slightly edited versions of the Danish ones.

The interviewing of the management and the employees was not carried out by going through the

flexible elements of the flexible definition. Instead a conversation about the firm's organizational changes, new technology and new products took place. This means that the researchers got an impression of a number of elements which afterwards could be seen as representing flexible traits. Some of these were part of the chosen definition, but some were not. In the following these last-mentioned traits are notified with an (n) e.g. a new cultural trait as (c/n).

Experiences from a visited firm

First is presented the formal organization of the firm including its flexible traits of a structural nature. Hereafter follow the cultural traits of flexibility stressing the changes which have taken place. On this background an analysis is given of the relationships between structure and processes. Afterwards structure, processes and culture is seen as a totality. Next are added the external elements of flexibility with an analysis of the dynamic type. Finally the effectiveness of this type is discussed.

Formal organization and structural traits

When the interviewing took place, the firm was organized along divisions and bound together by a top management team. The top leaders were themselves at the head of teams of middle management leaders, and these middle managers headed their own teams of employees. The three management levels resulted in a flat hierarchy. The outlined organizational model is a good example of the Likert (1961) model of overlapping group leadership.

The top leadership found that the firm exhibited both structural traits of cross-functional work groups (s1 in diagram 1) and quality groups (s2). Quality was discussed both in ad hoc groups and in the permanent work groups and quality was one of the strategic priorities at the time of the interviewing.

Cultural change

According to the answers to the questionnaire, an expansion of cross-functional groups and quality groups had taken place during the period 1993-95 together with process oriented flexibility traits. There were also plans for further expansion of quality groups and a number of process oriented traits whereas the team design should continue unchanged. The interviewing showed that the

previous changes and those planned for were founded upon some basic attitudes held by the top management. These cultural traits on the part of the top management were gradually met by sympathy among the middle managers and employees part of whom were newcomers.

The culture of the firm before the changes was characterised by one of the new leaders as 'reserved' and 'egocentric'.

You can say that the whole culture in this shop was such that it was best to have been born here and have the knowledge - in any case you should not teach anybody anything. You kept things for yourself and did not teach others (14.4.5). (The notation refers to the printed version of the datafile).

The starting point regarding the firm's change towards more flexibility was a merger process and the new management board's decision to hire a new top manager. The new top manager got the support from one of the chief managers which he knew from a previous work relationship in a major firm in which they had both been employed. In the beginning this duo had to manage together with the old chiefs who continued in their positions. Within a short time the new managers learned that the cooperation at the top level did not function well. Partly this was a consequence of different cultures at the top level brought about by the merger process. Each of the managers run his own business, and loyalty was lacking among the top management. This created misinformation throughout the firm. Therefore the duo decided that something had to be done in that situation if the firm should become close-knit (14.4:1). By the help of external consultants a major structural change took place changing leaders at the top level.

The new leadership saw an advantage in the creation of an open (c/n) organization in which management and employees informed each other and cooperated (c/n) across the organization. Among the managers were found a will to delegate responsibility (c8) and involve the employees in the planning of their own activities (c9) and control their own work (c10).

One of the managers formulated the intentions in the following way:

We do a lot for delegation. Everybody has to be reached (14.1.9).

This statement was verified by the following opinion by one of the employees:

The orders are just delegated. We are given an order form about what to do and then the person can make his own decision about how to solve it (14.2.3).

According to the conceptualisation in the DISKO project such attitudes and activities express a development towards a more flexible firm. The new leadership showed consistency between their cultural values and their initiated activities in relationships with their employees.

However, in the beginning the employees were sceptical towards the leadership's talk about 'openness'. They were afraid that this openness might result in the managers nosing into the employees' own affairs and how they performed their work. If this was the case, the employees would come under more control than under the old managers, and experience harmful working conditions. Also the new management's wish to change the work organization run against conservatism among the employees who wanted to keep to their old ways of doing things learned in the firms upon which the merger was built.

At the time when the interviewing took place the situation had changed. Both the management and the employees pointed to the autonomy of each and everybody as a positive thing. Asked about his participation in work planning and control of work, an employee gave an answer which confirmed the management's response upon the DISKO questionnaire. The employee said:

There are many different commodity groups to get control of in this firm. So each of us has to help the others regarding this control. This means that people make it a point of honour to do it right and help solve the problems; you feel some codetermination.

When you say codetermination you mean much autonomy?

Yes, quite sure..

There are many tasks you can plan yourself?

Yes, that is the way, it is run.

How about the control of the quality of the work? Is this your own responsibility?

Yes, that is a fact. If I have to tell you about my own work which comprises responsibility for some equipment, you will see that I get the blame, if something is not as it should be. In the same way

the people who do the assembling work are responsible themselves. It is also written down who is doing what sort of work (14.2.3).

Summing up so far regarding the new culture, the management and employees of this firm stressed the value of 'openness' (c/n) meaning a free flow of information contrary to the former 'reserved' behaviour. Furthermore a basic attitude of 'cooperation' (c/n) had replaced former 'egocentric' attitudes. Cooperation meant helping each other and doing the job correct. The operationalized elements of the cultural flexibility dimensions such as delegation (c8) and participation in planning (c9) and control (c10) was explicitly mentioned by the interviewees. But it is also worth noticing that the change of culture as wanted by the new management had not been achieved without difficulties including the exit of former managers.

In the following is looked upon structures and processes which promote the ideas of the new leaders with respect to another way of organizing work which can be characterised as a more flexible system than the one they took over. A number of relationships between elements which are part of the operationalization (notified by x in diagram 1) are treated, but also relationships involving the new flexibility factors (notified by n in diagram 1) are found.

Structure and processes

The cultural traits pointed to a new structure which showed itself both in relation to the formal and informal patterns. It comprised a group organization (s1,s2) and a pattern of open interaction (s/n) implying the employees' participation in management's decision-making i.e. a participative structure. Formal contacts were based upon the overlapping group structure and a pattern of meetings attached to these groups. Depending upon the groups' tasks you found daily, weekly and monthly meetings with planning and information activities according to a fixed scheme (c9>s1,s2). (By > is shown the direction of the relationship). Introduction of personnel talks between managers and employees was also part of the new formal structure.

As to the informal contacts between management and employees, the following opinions by an employee express the situation:

In this firm we have no problems regarding such contacts. Because, we just walk up and talk with

them (14.2:2).

The informal contacts between the management and the employees were also helped by the director's habit of leadership 'by walking around'.

He walks around every morning and say good morning, and you can have a chat if there is something you want to talk about. I think, it's good that it's as free as that, and not hard-and-fast, so you was forced to follow the commando line (14.2:7).

Also the abolition of specific canteens for managers and various groups of employees and introduction of a joint canteen for everybody helped the informal contacts.

This structure had clear implications for processes which integrated groups within the different functions as well as integration across the functional structure (s1,s2&s/n>p3,p4. The top leadership got a common background which meant that they could supplement each other. In this way was always found a top leader who could take action if important questions demanded their participation in a decision. According to the management, the structure of meetings (s/n) was very helpful for the information processes and the related participation processes (p/n) expressing the participative structure. With our notation we have (s/n>p/n).

'You can distribute all the information so that people have the right information all the time about things. So when they are given this, they can all pull together. We all know what we are running for (14.4:6).

From an employee the meetings got a positive evaluation because of their implications for his knowledge of the firm's situation:

Well. I think in any case, I get much from such meetings. Quite sure. I like to know the situation as it is. This is what we are doing at the work shop meetings. We also get the accounts, so we can follow the economic development. I think it's positive (14.2:9).

Another element stemming from the widespread net of meetings was the development of personal

relations. The same consequence could be seen from the establishment of the joint canteen:

We closed all those canteens and started a joint one where we got some new dishes, and this have resulted in people getting together from all directions. On a Monday you may talk about the soccer matches, and you talk about personal experiences. This opens up for a better understanding of each other as human beings. This may also mean that you accept that some are good as technicians and others as salemen (14.1:11).

In this way the new open structure contributed to an improved integration of the organization because of positive contacts and a common understanding of cross functional activities within the firm. Looking at diagram 1 we notice the relationship (s/n>p4). More specifically the management saw a close relationship between its wish to build on groups and delegate responsibility for decision-making (c8>s1,s2).

Another new structural trait was personnel talks. This practice meant that both the managers and the employees expressed their evaluation of ongoing activities and wishes for the future. Specifically, this was the case with regard to education and training. The talks promoted processes having to do with planning of vocational education and the exact content of continuing education including tailor-made education (s/n>p5,p6,p7).

We have introduced what we call yearly personnel talks and in this connection we also make an individual plan for education and training .. in such a talk one from our mechanical work shop ... has expressed a wish for joining the sales function. So we make a program for educational and training activities comprising commodity knowledge, and via work in the warehouse he can achieve his new position after a while (14.1.8&10).

The condition for a positive effect af such talks and other formal and informal contacts was a trust relationship (c/n) between managers and employees. This had not been found previously but had developed during recent time as already mentioned and based upon a combined change of culture, structure and processes.

This section has shown how the management and employees have told about flexible structural

traits and their implications for new processes. Group organization (s1,s2) and a formalised meeting system (s/n) as well as a pattern of open interaction (s/n) have opened up for widespread information (p/n) processes and employees' participation (p/n) in decision-making. The personnel talks laid the foundation for the firms' educational/training activities which helped rotation between functions. The positive evaluation of these talks had to be understood by management's and employees attitudes of trust (c/n) towards each other.

Relationships between structure, processes and culture

Above, the relationship between structure and processes was presented from the structural viewpoint, but the processes had also clear consequences for the structure. The interactions at the meetings and their effects were evaluated as positive, so even if one could feel that much time was used for meetings, the opinion among management and employees was that the consequences made it worthwhile to maintain this structure. Similarly the processes of mutual help within the group organization contributed to the continuation of this form of organization. Formal and informal information processes based on the open structure of relationships including the new canteen and the personnel talks consolidated the new structural traits: the group organization, the pattern of open interaction and the participative structure.

The management could tell that the new team structure had demanded education and training (s1,s2><p6), and such activities were started to fulfil the management's values on cooperation within the firm (c/n >p5,p6,p7). One of the top leaders said:

The changes demand an entirely positive attitude towards cooperation, and in this respect we have done a lot by arranging joint courses. Last year we closed the firm for one day. We left on Thursday afternoon and stayed away until Saturday noon. Everybody was involved in the course. We solved a fictive cooperation problem together and had the help of external consultants. It was a big success, and we will repeat the idea this year. It's a relative expensive activity, but we feel that we have really got much valuable feedback (14.1:7).

This statement also shows that structure and processes as exemplified here with teams and education/training have an impact upon the culture of the firm. Through closer interaction as helped by the group organization and corresponding meetings, an openness was created. Also a

positive attitude towards cooperation (s1,s2&p5,p6,p7>c/n) as a new value was established. A manager said:

In any case, a strong development in the interest for and the ability to cooperate has taken place. Certainly, quite widespread ... Earlier, I could get no information without asking. All the time I had to go and get it myself. Now information goes up to me without my asking for it. I am informed about what is going on in our environment. This I take as an example of 'esprit-de-corps' which we have created. It means that everybody is interested in and fight for this firm (14.1:11).

The management used explicitly rotation of personnel between tasks within the groups as a way to prevent resource problems in case of sickness and holidays (s1>p3). This meant a softening of the structure i.e. more flexible patterns of roles and limits of authority (p3>s/n). An employee gave the following example:

NN (middle manager) can see the advantage of a situation where everybody knows as much as possible, know something about everything. Because, in case of summer holidays or sickness, it is of no use to paralyse a whole department because one or two are out, and this situation can be avoided if some other people can come and help. Maybe you cannot demand that he can do as much as the other ones, but a little help is also valuable (14.2.8).

Yet, this kind of rotation was not carried through all over the firm. According to the interviewing differences existed between the employees regarding both willingness and ability when it came to the replacement of one employees' work by the the contribution of another employee.

Due to the firm's new structure marked by a pattern of informal interaction based upon the management's priority for open contacts, the functions of buying, selling and production/repair were integrated (s/n&c/n&c8>p4). An employee from production/repair said:

If you have got an order form and one way or the other have your doubts about what to do, you only have to walk over to the salesman, and if cannot help you, you just contact the customer. In the same way, if we want to buy something, then you go to the purchasing manager
And this takes place just informally?

Yes, it does (14.2.12).

The cultural change which the top management had initiated had consequences for information processes, and they in their turn had formed the basis for employees' participation (c/n>p/n):

Today people understand, this is what I see, that management has positive intentions. When we give information, it's not for disturbing people in their work. They can see that it may help them and make them participate more in things (14.4.7).

Summing up the new processes of widespread information, participation and education/training activities were conducive to the group organization and the pattern of open interaction. Again the new culture was part of these relationships as a motivator for the management to work with the necessary processes to support and develop the new structure. On the part of the employees, the processes of open information produced - after a while - a change in their basic values and an acceptance of the new structural developments.

Dynamic flexibility

The management and the employees were much aware of their dependence upon satisfied customers. It was part of the culture to develop service mindedness (c/n). To achieve this objective the management worked on a change of the organization as well as introducing new technology and new products. In this way the organizational flexibility became integrated with technological, product and market flexibility in the investigated firm. Examples of this integration follow before the consequences of flexibility traits of the dynamic firm are analysed as a totality based on a discussion of the impact on the organization's effectiveness.

INFORMATION AND COMMUNICATION TECHNOLOGY (ICT)

New technology was supported by the group structure and the processes of education/training. The change towards a more integrated electronic data processing (edp) system was based upon preparations in a project group which comprised employees from the different departments (s2>t11). In this way the management wanted to be sure of the acceptance of the new system, and the understanding of it based on information and participation among the employees (p/n>t11). The top manager in charge of this edp project said:

Of course, I have established a project group right at the beginning of the project where the different departments were represented and supplied some expertise. They have taken part during the whole process, and have participated in the decisions.

Both managers and employees took part?

Yes.

Could you mention the departments or the people who took part in such a group?

There were found both a sub-manager/confidential clerk, a purchase manager, a salesman, a marketing chief, one from the warehouse and one from production/repair (14.4:2-3).

The members of the project group got the additional task of training their colleagues in the new edp system (s2>p6>t11).

We used the project group because they were top trained. They can be called supervisors. As they are members of different departments, it is they who can help their colleagues with daily problems. They can start them up. You can say that one in each department is better than the others and can act as supervisors (14.4:4).

The edp system meant that the different functions became better integrated (t11>p4).

PRODUCT/SERVICES INNOVATION

The firm's culture and its pattern of open interaction signified a more creative environment as the employees could see that new ideas were welcome, and they had easy access to present such ideas on products and markets for the right persons (c/n&s/n>i13).

'Well, regarding new ideas, we are all welcome to come with suggestions. Quite sure. And all the time you will see them pop up (14.2:12).

Also the positive attitudes towards wishes from the firm's customers i.e. the firm's culture of service mindedness (c/n) together with the new structure helped product innovation as spelled out below (c/n&s/n>i13).

In this section on dynamic flexibility service mindedness (c/n) was introduced as a new cultural

value to understand how the two dimensions of internal and external flexibility were seen as complimentary by the interviewees and in this way realized the dynamic firm. Technology was used in combination with processes signifying the importance of information and participation as well as training. New products were developed on the basis of internal and external cooperation *inter alia* founded on the participative structure.

Effectiveness

Each in its own way, internal and external flexibility contributes towards effectiveness. By this concept is understood the degree to which an organization realizes its goals (Daft 1983 p.92). It's a broad concept and shall be used both to imply a larger output in relation to the amount of resources, or the same output with less resources. This means that effectiveness follows from managers and employees who pull better together. Effectiveness may also show itself by an improved fulfilment of the wishes of the customers. Therefore product innovation in cooperation with suppliers and buyers can also be taken as an indicator for effectiveness. (Cfr. also Porter (1990:40pp.) concerning the concept of value chain and the exploitation of linkages)

The combination of internal and external flexibility meant an additional strengthening of the flexibility. From the interviewing were given examples of improvements of effectiveness. Larger output was exemplified by pointing to customers who got their expectations fulfilled and were helped by fast deliverances. The products and services of the firm were needed by the customers within short periods which had to go together with other production considerations of the customers. So the firm's output depended upon its ability to deliver at the right moment.

Stocks of products and agreements with suppliers were major conditions for this form of effectiveness. Both conditions were given a high priority by the management, but the management also carried through an explicit coordination of organizational and technological flexibility which was another important condition for fast deliverances.

New technology was part of the order system and the control system of stocks. The interviewing showed that these systems got into difficulties if they were seen as only technical systems because they were continuously interpreted by the management and employees. It was consequently seen as important that this interpretation had a common content. In the visited firm the flexible

structure, the communication processes and the openness meant that the order and control systems were based upon a common understanding which benefited output and effectiveness (effectiveness conditioned by s,p,c).

One person controls the order forms and he takes part in the mechanical shop meetings. If something has to be corrected or we are in doubt about what to do, we can ask him or get it discussed. We can always ask him, but when we are all together, it's an advantage that everybody get to know how to do the work (14.2:9).

Another aspect of the new technology which helped a more effective execution of customers' orders had to do with the common data base and the way it was accessible to the employees.

We have a very open edp system. We use system x, and it gives us possibilities to delimit the access and differentiate between different users. But except for finance, almost everybody can see almost everything with regard to what is going on. It is partly a consequence of our output conditions. During the high season we are very busy, and all of us have to react fast to customer needs. Everybody must take the telephone and take orders and answer questions from our customers. This situation makes it necessary that everybody has access to updated information about production/repair, and can say when the deliverance is ready or whether we have wanted equipment in the warehouse or when it is expected to show up (14.4.3).

Again, it should be recognised that the use of this system did not come about as an automatic process, but was affected by other processes which meant understanding and accept of openness and had demanded prior education/training regarding new technology. The new leadership had met resistance by the old leaders and the employees. This situation had to be overcome before organizational, technical and market flexibility could get established in its new form. The management delivered the following reminder:

Now the edp system functions well. But you also know that you have something called resistance against change, and quite a lot of people thought that this system would never function (14.4:2-3).

In this firm effectiveness was also achieved by presenting the same output with less resources. As

an example was given the new way in which the salesmen took care of more types of products. Instead of only handling one product, the new internal integration meant that the salesmen could represent more products in relationship to the customers. Unfortunately, this topic was not followed-up with regard to the probable need for extended training and education.

We have experienced customers who called us by telephone and told us that a salesman of good X visited him during the morning whereas our salesman of good Y came to the same customer during the afternoon. And we were asked whether they did not come from the same firm? (With an expansion of the tasks) this results in effectiveness because now we can reach twice as many customers because we do not have to have two salesmen to run one after the other (14.4.7-8).

The fulfilment of the customers' expectations was supported by the cooperation between the salesmen who visited the customers and the staff at home. A manager said:

We stress that the development of new products must come from the customers. I think our sales people are important messengers of information from the customer to the staff at home. They can take the decisions about how to handle the information (14.1:9).

Another feature of the firm which increased the effectiveness was the group organization and the overlapping of work tasks which gave the possibility for the managers and employees to supplement each other. This was announced to the customers who had also got an organizational diagram which showed this flexibility. In this way the customers got an assurance of fast execution of their requests. An employee said:

I have got a much more close relationship with the customers, also because we have created teamwork as you know ... if NN is not at home, he is my outgoing salesman, then it's me to take care of calls from the customers, and they must have trust in me ... the customers have got an organization plan with pictures of all us (14.3.11).

The firm's development of new products was motivated by a wish for the creation of more service friendliness as services were an important part of the firm's activities. This sort of product innovation can be seen as one dimension of effectiveness. In this case the innovation was

conditioned by the culture based on the employees' participation in decision-making, processes of information and the group structure in the form of ad hoc groups as seen from the following statement (c/n,p/n,s/n>i13).

(The management board) has the final decision-making authority, but the decision-making process has also included employees from the production shop, sales and other functions. I can add that such a product will have its teething troubles. For example one of the new products is produced in another firm with which we have close cooperation. When we meet with them about changes of the product, it is the technical chief, one employee from the shop and myself who take part and make the decisions together with two or three people from the producing firm (14.1.4).

By this section it is seen that effectiveness follows from both the internal and the external dimension of flexibility. Moreover the combination of organisational and technological elements and organisational and innovative elements secured specifically higher effectiveness than these internal and external elements could account for alone.

Discussion of the measurement of flexibility and its relationships with effectiveness

The ambition of this paper has been to highlight the mechanisms which spring from the DISKO operationalization of flexibility and from this understanding to analyse the connections between flexibility and effectiveness. Therefore a firm which showed the maximum score on the flexibility measure was selected. In no way astonishing this analysis has shown that the managers and employees pointed to factors which could be seen as part of the lexical definition of flexibility but not included in the DISKO operationalization of the concept. This gives us a broader basis for a discussion of the fruitfulness of the operationalization.

CULTURAL CHANGE AND INFLUENCE PROCESSES

Experiences from the visited firm showed that the top management's culture had been highly influential upon the firm's development of flexibility. The interviews confirmed the importance of those traits which have been part of the DISKO operationalization of flexibility, but other traits also showed up. Service mindedness was a central value. Regarding the internal dimension both management and employees often referred to 'openness' as contrary to abstaining from speech or

action, or 'reserved' as mentioned above. Another dimension was 'cooperation' which was seen as contrary to 'egocentric' attitudes and behaviour. The occurrence of cooperation between the management and the employees was investigated in the enquete answered by 1900 private firms. A comparison with the flexibility measure showed a high degree of correlation between the two characteristics of the firms, cf. table 3. When flexibility is understood as an 'integrative organizational form' it is not difficult to take 'cooperation' as one of the traits contributing towards flexibility. Regarding 'openness' the enquete had no question about this feature, but from a logical point of view an open interaction supporting more extended and accurate information should be part of a flexible firm. This characteristic could have been included, had it not been for the necessity of limiting the number of questions. Cultural features regarding customer orientation also had to be excluded but changes in contacts with customers and others were part of the questionnaire.

Table 3. The percentage distribution of firms showing more cooperation between the management and the employees (M), and between the employees themselves (E) for the period 1993-95 according to the degree of flexibility (F).

F	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14
M	7	8	13	21	25	30	40	43	55	56	64	71	72	84	91
E	7	8	12	18	23	30	40	37	47	55	58	64	69	80	91

To this must be added more general considerations about the operationalization of a lexical concept. You can include factors which correlate to a high extent and/or factors which show the scope of the concept and do not correlate. 'Cooperation' and 'openness' could be included because of high correlation with other factors already included in the DISKO flexibility concept. On the other hand, the more factors which are included, the less correlations are to be presented with regard to the index. It is usually recommended to economise with regard to factors put into an index, and the DISKO operationalization can be criticised for having included too many factors. With fewer factors it is easier to find out about the mechanisms behind the quantitative correlations. If you do use many indicators a qualitative study as this one may help to interpret the meaning of the index.

Openness, cooperation and trust were new cultural features in the visited firm. The introduction of these features were caused by a new management which had manipulated the old leadership and

consciously influenced the employees' cultural values. So, to some extent influence or power processes had taken place and they had been recognised by the employees. The old leaders had left the firm, and the employees had accepted the new style, and also been convinced that it worked to their advantage. The change process had been helped on its way by consultants, but the major burden of change had been borne by the the new management. These influence processes have not been investigated. It means that the consequences of flexibility as highlighten in this study must be seen in the context of a harmonious relationship between the management and employees, and within each of these two groups. For example, under other circumstances a group organization or an open access to a common data file might be used for internal fights for resources or careers. Seen in relation to the enquete it was based upon answers from the current leadership and it was not to be expected that questions on power processes would give valid answers, and quite to the opposite might contribute to a higher non-response rate.

STRUCTURE

Regarding structure the factors used for operationalization have shown themselves useful for understanding flexibility. Just as in the case of the cultural traits, the interviewing gave examples of other flexibility traits than those used for the operationalization. These traits comprised a widespread system of planned meetings at various levels of the firm, formal personnel talks underlining education/training, and a joint canteen for both the management and all the employees. These traits contributed to flexibility as they had a positive influence upon communication processes and common attitudes and norms, just as was the case with the included characteristics of group organization. Neither meeting structure, nor personnel talks or canteen facilities were included in the enquete, but formal personnel talks had been included in a pilot study. The topic had to be left out because of a necessary reduction in the number of questions.

PROCESSES

Regarding processes the importance of information was mentioned in several connections during the interviewing. Both the management and the employees stressed mutual information. The direction of information should be both up and down and criss-cross. The pilot study had a question on communication but again, this had to be left out. On the other hand it is surely the case, that questions about the direction and extent of communication/information ought to have a high priority when investigating flexibility, and on second thoughts it is to be regretted that this

characteristic was not included in the final enquete. Educational/training processes were well represented in the operationalized concept of flexibility and the stories by the management and the employees confirmed the rationality of this arrangement because of the importance of such processes for the cultural change and for the use of new technology.

DYNAMIC FLEXIBILITY

The dynamic flexible type of firms is by definition characterised by both external and internal flexibility. This paper has shown how the investigated firm has combined the two dimensions. For example, the introduction and use of edp was strongly integrated with educational/training processes. This situation could have been investigated in the enquete. According to the pilot study the firms should have answered a question on the employees' participation in the decision-making regarding introduction and use of information technology. Regarding the connection between innnovation and internal characteristic, the pilot study had questions about the relationship between new products/services and such characteristics as work groups, job rotation, decentralised decision-making, and integration of different functions.

EFFECTIVENESS

Contrary to most approaches towards flexibility, this paper and the DISCO project has chosen a lexical definition of flexibility which included both organizational, technological and product and market dimensions. This combination had a decisive influence upon the understanding of the connection between flexibility and effectiveness as shown by the experiences from the visited firm. The reason is that technological and product and market attributes worked together with organizational ones resulting in synergy when it came to the improvement of the fulfilment of products/services for the customers.

From the quantitative study of the 1900 firms, it is known that 'the more flexible firms pay more attention than the less flexible ones to compensation systems which favour performance in the sense that they include payments by quality and results' (Lund & Gjerding 1996 p.26). In the investigated firm which used bonus systems it was the management's expressed view that such systems were promoting effectiveness. In the literature on flexibility it is often the case that wages based on quality and results are seen as an element of flexibility. Our lexical definition of flexibility does not directly point in that direction.

Conclusions

This paper has treated the concept of firms' flexibility from the point of view of a learning society and included both internal organizational and external innovative elements. The chosen lexical definition of flexibility was the following:

The ability of the firm to react upon a turbulent environment with new products and new technological processes on the basis of integrative organizational forms and a culture oriented towards renewal and learning.

As stated in the introductory paragraph, the aim was to understand the firm's flexible traits, and their meaning for effectiveness. The lexical definition was operationalized in accordance with the quantitative study of which this analysis is a part, cf. diagram 1. From interviews with management and employees in a highly flexible firm (having crossed all the elements in the quantitative part of the project), it has been possible to recognize many but not all of the elements in the operationalized definition. The reason is that they were no intention of going into details with the chosen definition during the interviewing. Instead the researchers were interested in the interviewees' own way of presenting information about the firm. Therefore the paper can present new elements of flexibility as introduced by the interviewees. They comprised a culture of openness, cooperation, trust and service mindedness; a structure of group organization and a related system of meetings, a participative structure and personnel talks; processes of information and participation which supplemented education/training which were well represented by the operationalized definition. New technology and product/services innovations were also broadly defined in the operationalized definition and there was no need for introducing other external elements.

The mechanisms of flexibility were seen as springing from a new management's values favouring openness etc as mentioned above. By having the will to remove opposition from the old set-up of managers, the new management succeeded to carry out a change towards more flexibility by using education/training and information. These processes gave the foundation for a participative structure organised along overlapping groups. The internal changes became part of the external dimensions of flexibility. New electronic data processing technology was introduced by participation, information and education/training. New developments regarding customers' wishes

were based on the group organisation and information. From the discussion of the operationalization is seen that the direction and extent of communication/information processes might have been an element worth to include when operationalizing flexibility.

Two limitations of the study must be mentioned. One with regard to the lexical definition of flexibility. It has been twisted towards functional flexibility so far as the internal dimension is concerned. This was deliberately done because of the DISKO researchers' favouring of the learning society. Secondly the new management of the investigated firm had carried through a major change at the top level management when both the quantitative and the qualitative investigation took place. This meant that harmonious relationships reigned at the time of investigation. This was an important condition for the observed relationships. For example openness could become abused in case of a conflictual situation.

Acknowledgement

This paper is based upon the joint work of the DISKO project group, Aalborg University comprising Allan Næs Gjerding, Kenneth Jørgensen, Frank Skov Kristensen, Bengt-Åke Lundvall, Peter Nielsen and Søren Nymark. Comments upon this paper from Jesper Lindgaard Christensen, Allan Næs Gjerding, Peter Nielsen, Søren Nymark and Jørgen Gulddahl Rasmussen were gratefully acknowledged.

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

The Research Programme

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

- ***The firm as a learning organisation***
- ***Competence building and inter-firm dynamics***
- ***The learning economy and the competitiveness of systems of innovation***

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

Theme A: The firm as a learning organisation

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

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

Theme B: Competence building and inter-firm dynamics

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

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

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

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

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

The Ph.D.-programme

There are at present more than 10 Ph.D.-students working in close connection to the DRUID research programme. DRUID organises regularly specific Ph.D.-activities such as workshops, seminars and courses, often in a co-operation with other Danish or international institutes. Also important is the role of DRUID as an environment which stimulates the Ph.D.-students to become creative and effective. This involves several elements:

- access to the international network in the form of visiting fellows and visits at the sister institutions
- participation in research projects
- access to supervision of theses
- access to databases

Each year DRUID welcomes a limited number of foreign Ph.D.-students who want to work on subjects and projects close to the core of the DRUID-research programme.

External projects

DRUID-members are involved in projects with external support. One major project which covers several of the elements of the research programme is DISKO; a comparative analysis of the Danish Innovation System; and there are several projects involving international co-operation within EU's 4th Framework Programme. DRUID is open to host other projects as far as they fall within its research profile. Special attention is given to the communication of research results from such projects to a wide set of social actors and policy makers.

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