Information Technology and Change in Danish Organizations
Results from a Survey

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Abstract

The aim of this paper is to explore the relationship between organizational change and information technology (IT) in Danish manufacturing and service companies. The data material is a survey covering 1900 Danish companies. In the paper it is shown that there in a three-year period are major correlations between introductions of IT´s and movements towards more integrative organizations. These moves are evident in companies which in the three-year period both have introduced IT and changed their organizations. However in organizations which have introduced IT but reported that they have not changed their organizations, there also seem to be this movement compared to companies which have not done anything. Accordingly moves towards integrative organizations seem to a high degree to go hand in hand with introductions of IT. Three conclusions are deduced from these results. First, that Danish companies apparently have learned the lesson from the mid-eighties, to think in terms of organization instead of technology when implementing IT. Second, that the word IT apparently comprises powerful technical systems that, when faced, pushes companies towards organizational change. Third I consider if the organizational changes reflect a new learning paradigm or another paradigm labelled reliability.

Keywords
Information technology, organizational change, integration.

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1. Introduction

Information technology (IT) has been the object of an increasing interest during the last decades as the diffusion of it has exploded. Today IT has an important impact upon social life simply because nearly all of us interact with it every day. In organizations it is widely diffused and used in the production of goods and services. However, even though the diffusion has exploded, this has not lead to better productivity figures. These have actually been rather poor. For example in Denmark the results within the manufacturing sector were negative during the computerization of this sector in the eighties (Gjerding et al, 1990. Nyholm, 1994. The Welfare Commission, 1995).

One of the explanations of this phenomenon is known as the theory of techno-economic paradigms (Freeman & Perez, 1988). In this theory economic growth is explained by the utilization of so-called mega technologies. Freeman & Perez argue that we are in a period where IT is the new mega technology but the efficient utilization depends upon innovations in the social context. This theory has been supported by investigations which lead to the conclusion that the poor productivity figures were caused by a lack of organizational change along with the introduction of IT. (Nyholm, 1994. The Welfare Commission, 1995).

This moves the focus point from technology to organization and it means that to understand technology it is necessary to understand the organizational context surrounding and embedding the technology. In this paper it is exactly the organizational context which is investigated. I will explore, if introductions of IT and organizational changes in Danish organizations are connected. For practical reasons IT is perceived as a technical system, not as a technology. That is important to recognize, because technology most often refers to knowledge (Kreiner, 1992). The organization of the paper is straight forward. First I introduce Kanter´s approach which I use as a structuring tool. Second I present the results and third I conclude on the material.

2. Kanter´s Approach

Kanter´s approach (1983) is adopted as a structuring device and is the subject of this section. Her approach is not particularly new. Rather, it reflects a traditional dualism in organizational theoretical history. For example the dualism is a lot like the distinction

between mechanistic and organic organizations (Burns & Stalker, 1961). Furthermore I would like to underline that her approach is used as a structuring tool, nothing else. For example, I do not automatically characterize integrative organizations as innovative and segmentalistic organizations as rigid.

It is important to recognize this usage of the model because Kanter was actually particularly interested in the relationship between innovation, in a broad sense, and organization. Her two organizational concepts, integration and segmentalism are her main elements in explaining differences in innovational ability. They are described below (Adapted from Kanter, 1983, p 28).

"Integrative thinking that actively embrace change is more likely in companies whose cultures and structures are also integrative, encouraging the treatment of problems as "wholes", considering the wider implications of actions. Such organizations reduce rancorous conflict and isolation between organizational units; create mechanisms for exchange of information and new ideas across organizational boundaries; ensure that multiple perspectives will be taken into account in decisions; and provide coherence and direction to the whole organization....There may be differences recognized and even encouraged - an array of different specialties, a diversity of people - but the mechanisms exist for transcending differences and finding common ground".

The contrasting style of thought is what she calls *"segmentalism because it is concerned with compartmentalizing actions, events, and problems and keeping each piece isolated from the others. Segmentalist approaches see problems as narrowly as possible, independently of their context, independently of their connections to any other problems. Companies with segmentalist cultures are likely to have segmented structures: a large number of compartments walled of from one another - department from department, level above from level below, field office from headquarters, labour from management, or men from women. Only the minimum number of exchanges takes place at the boundaries of segments; each slice is assumed to stand or fall rather independently of any other anyway so why should they need to cooperate? Segmentalism assumes that problems can be solved when they are carved into pieces and the pieces assigned to specialists who work in isolation"*. (Kanter, 1983, p 28).

In this paper the two concepts cover two ideal types of organizations. They are not connected to innovation or rigidity or anything else. Instead they are used as structuring tool. The two configurations are ideal types and will therefore not be found in reality (Weber, 1971). This seems appropriate in a questionnaire where the analysis is performed on a macro level and where many of the questions are dealing with the development from one organizational configuration to another.

So they tell if the organizations tend to move from one configuration to another without trying to describe how the single organizations specifically look like. In figure 1 I have derived some characteristics from her two concepts. They represent groups of questions in the questionnaire. Table one describes, what characteristics we can expect to find in integrative and segmentalistic organizations.

Table 1. Integrative and segmentalistic organizations.

	Integrative organizations	Segmentalistic organizations
Function.	Functional flexibility.	Specialization.
Control	Delegation of responsibility	The control located in the top of the organization.
Internal network	Cooperation and communication across internal organizational boundaries.	Little cooperation and communication across internal organizational boundaries.
Organizing in groups	Organizing in groups are often used.	Organizing in groups are used very little.
External networks	Cooperation and communication with external actors.	Little cooperation and communication with external actors.

A more detailed discussion of the characteristics is not the intention here. Such a discussion goes beyond the limits of the paper. Instead I will argue that the model is quite much in line with what has been known as contingency theory. Especially it does look a lot like Burn´s and Stalker´s work on mechanistic and organic organizational forms (Burns & Stalker, 1961). So Kanter is not alone in having such a dualistic approach to organizations.

Briefly put authors within contingency theory would argue that if environments are stable, then organizations like the bureaucracies, which are very similar too mechanistic and segmentalistic organizations, are the most efficient (Se also Mintzberg, 1983). If

environments are dynamic then organic or integrative organizations should be chosen because of their capability to promote innovative or flexible behaviour. As I have already stated, I do not argue this way but use the model as a structuring tool.

2.1.Structuration of Data.

Before proceeding with a presentation of the results I will present the four groups of companies, which the data material is divided according too. These are described in table 2. Because the subject is the impact of IT in organizations, the logic is that group one is "comparable" with group two. Both consist of companies which have done major organizational changes but only group one companies have introduced IT. Group three is comparable with group four because both of these groups consist of companies which have not done any major or significant organizational changes, while only group three companies have introduced IT.

Table 2.

Group 1. Companies which have done major or important organizational changes and introduced IT.
Group 2. Companies which indicate that they have done major or important organizational changes but not introduced IT.
Group 3. Companies which have introduced IT but not done major or important organizational changes.
Group 4. Companies which neither have introduced IT nor have done major or important organizational changes.

Furthermore I have distinguished between manufacturing and service in the tables that follow. Though there are differences between these two sectors the overall pattern is basically the same and therefore I will treat them as one in the discussion. I also checked to see how the size of companies affected the response pattern and though there are some major proportional differences, I will still argue that it is the fact, that there are major differences among the four groups, that is important in the paper. Looking at the data like that, the patterns of response are still quite similar among small (less than 50 employees) and big companies (More or equal to 50 employees).

3. Results from the Survey

In this section I present the results from the survey. A general overview of the data in terms of the relative proportions of the groups are presented in table 3.

Table 3

	Manufacturing		Service		in all	
	N	Percent	N	Percent	N	Percent
Group 1	368	57	406	35	774	43
Group 2	75	12	103	9	178	10
Group 3	111	17	297	26	408	23
Group 4	96	15	346	30	442	25

Note: Frequency missing = 98.

While a large proportion of manufacturing companies are group one companies, the proportions in service are more similar in size except from companies in group two, which only comprise 9% of the service companies. Overall group one comprises the largest number of companies with 43% while group two is the smallest with only 10%.

3.1. Functional flexibility

An indicator of integration is functional flexibility. It refers to, if the organizational members are capable of attending several functions or/and that these functions can be used in different circumstances; a presumption for the capability to react on new situations. On the contrary, it can be expected to find very specialized functions, as in Weber´s bureaucracy (Weber. 1971), in segmentalistic organizations.

Basically functional flexibility can be understood in two ways. The first refers to, if you actually attend or are capable of attending different functions in a company. That can be achieved by attending or rotating between different functions but it can also be achieved by holding close contact between the functions. Another form of functional flexibility refers to, if you are capable of using and adapting the same knowledge to different situations. The questions in table four relate too, if the organizational members directly attend different functions, rotate between jobs,
the broadness of job definition and the routine content of work.

Table 4 - functional flexibility.

	Group 1		Group 2		Group 3		Group 4	
	M	S	M	S	M	S	M	S
Do the company use planned job rotation?	59	39	52	18	45	25	44	14
Has the need for flexibility too high or some extent influenced upon the content of work?	91	81	81	60	77	59	57	41
Do the company too high or some extent use rotation between different functions?	80	56	68	47	60	38	48	30
Has the content of work become more or less specialized (More - less)?	31-27	40-17	23-16	29-15	33-15	32-9	19-8	21-4
Has the routine content of work decreased?	51	39	32	29	36	15	18	8

Source: Aalborg University. 1996. The figures show the percentage of the companies which have comfirmed the question.

The table clearly suggests that there is a connection between functional flexibility and IT. Compared with group two there is a stronger movement towards multi functional jobs in group one. This picture is confirmed comparing group three with group four. In this case the movement towards multi functional jobs are much stronger in group three.

However, there is apparently one surprising observation. In the companies using IT (group one and three. The jobs tend to become more specialized even though that these companies move towards more multi functional jobs. That observation seems to be quite paradoxical. On the other hand specialization does not have to refer to how narrow the jobs are. The word specialization can, for example, also be used in circumstances where people have acquired knowledge in a given field. It is impossible to say what the answers do reflect, but referring to that the routine content of work has decreased more in companies using IT, it is not likely that specialization refers to how narrow the jobs are.

3.2. Control

Control refers to what extent power is delegated or decentralized. In segmentalistic organization the power will tend to be located in the top of the hierarchy or at least the

power structure will be quite stable, distributing power on a predetermined manner. In integrative organizations it must be expected that power is delegated to a large extent. Kanter is here in line with Peters & Waterman´s concept “empowerment” (1982). In table 5 the figures for the answers relating to control of work are presented.

Table 5 - Control.

	Group 1		Group 2		Group 3		Group 4	
	M	S	M	S	M	S	M	S
Does the company use delegation of authority?	93	93	88	83	92	87	67	70
Has the job content been changed towards more autonomy at work?	80	71	73	51	50	46	41	24
Has greater influence upon work plans high or some importance for employees?	81	80	81	64	71	65	55	49

Source: Aalborg University. 1996. The figures show the percentage of the companies which have confirmed the question.

The table indicates that there is a connection between IT and decentralization in organizations. Decentralization is apparently most used in group one companies. Comparing group three and four there is again this tendency towards decentralization in companies introducing IT.

3.3. Internal Networks, Organizing in Groups and External Networks

I deal with these three characteristics in one section. They are somehow just different modes of the same phenomenon. They refer to cooperation and communication patterns in the organization. In integrative organization, it must be assumed that information and communication patterns can flow freely across internal and external organizational boundaries. These are quite fundamental characteristics for the integrative organization. Organizing in groups represents ways of formalizing this integration, but it is still basically the same. Furthermore there is a distinction between internal and external networks, where the internal refers to networks within the boundaries of the organizations and external refers to inter-organizational networks.

Table 6 - Internal networks.

	Group 1		Group 2		Group 3		Group 4	
	M	S	M	S	M	S	M	S
Has the content of work been changed towards more cooperation with colleques?	66	56	57	48	43	33	22	19
Has the content of work been changed towards more cooperation with management?	73	38	65	28	47	25	24	14
Has the company changed the demands regarding greater emphasis upon cooperation and communication abilities?	73	61	59	48	55	43	39	25
Does the company too high or some degree impel for cooperation and network between departments and groups?	80	70	66	42	69	48	52	31

Source: Aalborg University. 1996. The figures show the percentage of the companies which have confirmed the question.

The results are again very clear. IT is associated with a movement towards jobs characterized by more cooperation and communication across organizational boundaries. The connection is most evident in group 1-companies. But comparing group three with group four there is a very big difference too. The companies confirm that the need for cooperative and communicative skills are higher in group three companies which have introduced IT than in group 4-companies.

Organizing in groups and integration of functions are also two organizing principles which seek cooperation and communication between organizational members. These data are presented in table 7.

Table 7 - Organizing in groups.

	Group 1		Group 2		Group 3		Group 4	
	M	S	M	S	M	S	M	S
Does the company use cross functional work groups in the organizing of work?	82	64	49	32	61	38	39	16
Does the company use quality circles/groups in the organizing of work?	60	49	41	25	47	32	24	13
Does the company use integration of functions in the organizing of work?	74	68	64	52	69	54	42	30

Source: Aalborg University. 1996. The figures show the percentage of the companies which have confirmed the question.

The table confirms the general picture from table 6. In companies which have introduced IT there is a clear tendency towards using various kinds of group organizing. The group of companies which only have introduced IT (group 3) is even higher than the group of companies which only have changed their organization (group 2).

Table 8 - external networks.

	Group 1		Group 2		Group 3		Group 4	
	M	S	M	S	M	S	M	S
Has the job content been changed towards more contact to customers?	52	56	37	44	35	36	20	25
Has the job content been changed towards more contact to suppliers?	45	30	28	22	33	20	15	12
Has the job content been changed towards more contact to other companies?	30	20	24	21	24	14	15	10
Has the need for better contact to customers too high or some extent changed the job content?	68	75	51	62	44	53	33	37
Has the need for better contact to suppliers too high or some extent changed the job content?	56	40	45	31	34	27	26	16
Do the company cooperate with or outsource work to other companies/ individuals?	45	35	48	20	37	21	23	19

Source: Aalborg University. 1996. The figures show the percentage of the companies which have confirmed the question.

Table 8 suggests that while emphasizing internal cooperation and communication there is the same tendency regarding external cooperation and communication with important actors. The same picture as in the previous tables emerges.

3.4. Results from the Survey - A Summary

The results were rather clear in nearly every possible way. The companies, which both have made organizational changes and introduced new IT, were clearly the group, which mostly have moved towards integrative configurations. This is not just due to organizational changes. IT is an important factor in the organizational changes. For example the companies which only have changed their organization scored significantly lower than the first group of companies.

Actually companies which only have introduced IT were on many variables quite close to the organizations which only had undertaken organizational changes. On several variables, especially regarding organizing in groups they scored higher. So even though they had not undertaken organizational change efforts, they still moved towards integrative configurations. The companies which neither had introduced IT nor undertaken organizational changes were clearly the companies where the tendency to move towards integrative configurations were the lowest.

The only deviation from this picture was when we asked if the jobs had become more specialized in the period of 1993-95. It seemed that they had become more specialized, and that IT also was an important factor explaining this phenomenon. However I do not believe that these answers reflect that jobs have become more narrow. Because at the same time, the routine content of work has decreased.

So generally the conclusions were very clear. In Denmark the introduction of IT means a movement towards integrative organizational configurations. The jobs are more characterized by functional flexibility, delegation of responsibility, and based upon cooperation and communication in more fluid internal and an external network.

4. Conclusions

So what can we learn from these results? First of all I would recommend a little caution in interpreting the results. All the warnings against quantitative methods of this kind can be emphasized here. Here I will only call attention to three of these problems.

First, that we cannot know if the phenomena under investigation are actually connected or are just symbols of a third factor unknown to us. Words like IT and the factors characterizing integrative organizations, like cooperation, flexibility etc. can be expected to be "buzzword" adopted simultaneously by some organizations to symbolize professionalism and renewal.

Second, there will be tremendous variation among the companies. The results and therefore also the conclusions are not universal but represent some kind of average, which may not be very meaningful for the single company. The problem here is also that the language has been picked by the investigators and not the companies. Words like organization, autonomy, quality circles, flexibility, cooperation etc. have, most likely, a very different content and meaning among the companies.

And third, it is unfortunate that it is not possible to know how the respondents perceive the word IT. It was not defined in the questionnaire and that is unfortunate thinking about the wide range of application that the word has. Freeman & Perez (1988) calls it the new mega technology partially because IT can be used throughout the economy. Therefore it can be expected that there is tremendous variation in what IT really means in the different sectors of the economy.

The first conclusion is that Danish companies apparently have learned the lesson from the mid-eighties where there was a negative impact of the introduction of IT in Danish manufacturing (Gjerding et.al. 1990): Not to think in terms of technology but to think in terms of organization. A clear majority of companies which have introduced IT have also changed their organization. Thinking about the poor results from the mid-eighties, this is a positive sign. Whether the integrative organization is the kind of "best practice organization" as Freeman & Perez were looking for, is however a question, that I will not answer, because that depends on many internal and external factors. In other words a best

practice organization cannot be separated from the history and context of the single company.
Second IT seem to comprise powerful technical systems which push companies towards organizational change. IT is not just a manifestation of the social system surrounding it. To a certain degree IT seem to have an "independent" influence on the social system. The fact that there is a stronger move towards integrative organizations in companies which have introduced IT, can be an indicator of this phenomenon. It seems like IT poses new questions and demands that companies have to respond upon.

Weick (1990) has an interesting comment here. *"...technology often follows rather than precedes a technical system. Especially with new technologies, a specific technical system is often the vehicle to discover cause-effect linkages in human action that we had not seen before, but which can now be used in subsequent designs"* (Weick, 1990). In other the words the knowledge (technology) and the organization of this knowledge may first arise after the introduction of IT.

The third conclusion, I would like to consider is Kanter´s linkage between innovation and integrative organizations. Does the integrative organization for example reflect the learning organization, which could be a logical deduction from Kanter´s work, and does it therefore reflect a new learning paradigm, which also is in line with Zuboff´s informating thesis (1988).

However, it is not as simple as that. There are popular organizational concepts such as total quality management, business process re-engineering, just-in-time production etc. which use the same kind of integrative organization as for example the learning organization. Such concepts are not concerned with learning in an explorative sense. They are concerned with exploiting existing knowledge (See Weick, 1996, on exploration and exploitation).
Argyris & Schön (1993) calls this single loop learning. However Senge´s learning organization (1990) are concerned with exploration (Weick, 1990. Morgan, 1986) or double loop learning (Argyris & Schön, 1993).

The important thing to recognize is that these concepts organize routines differently compared to traditional organizational theory. The difference is that routines become more

cross functionally organized. That IT might be a basis for these new kinds of routines is supported by several authors (Harrington, 1991. Zuboff, 1988. Weick, 1990) who underline that IT is an integrative technology in that sense that it integrates information across physical and social boundaries.

The imperative here is not learning in the sense of the learning organization. On the other hand I will not call it efficiency. Routines are cross functionally organized to account for variation, complexity and quality as the demands for customer-orientated products, reduced time of delivery and quality products have increased. Therefore the imperative should be labelled “reliability” (Weick, 1990) because organizing is linked to high quality processes, and the reduction of errors in circumstances characterized by variation and complexity. To what extent this is the case and to what extent the learning paradigm or other approaches can be applied to the introduction of IT´s can however only be settled through more qualitative case studies.

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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 empha-

sising 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 wants to work on subjects and project 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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