Realization of a decentralized IS-strategy

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Abstract

Today almost all organizations are dependent on information technology. It is therefore of great importance to structure the information systems in a satisfying way. Different strategies for structuring information systems, in order to create an information systems architecture, have been used for several years. This paper discusses an IS-strategy that enables each business function in a decentralized organization to co-operate with other functions, without losing their autonomy. The IS-strategy could be described as an activity-based, functional approach. Three case studies in different organizations, with the strategy in common, have been conducted. Experiences of success and failure with the strategy realization in these organizations are presented and analysed in the paper. The conclusions show that the IS-strategy can give a substantial support to decentralized organizations. To achieve this result user participation during system development can not be disregarded. Otherwise, problems with the distribution of responsibility for the information systems almost inevitably occur. In decentralized organizations it is of greatest importance to take such problems into serious consideration.

Keywords

Decentralization, information systems, information systems strategy, information systems architecture, case studies, responsibility, user participation

INTRODUCTION

Most organizations have several information systems and the need to structure these systems accordingly is growing. Structural aspects are becoming more important when the coordination of the organization's information, and the co-operation between business functions within an organization, are increasing.

When organizations are organized in a decentralized way the structure of the information systems must support this. The by far most common way to create a structure today is just to let the structure appear without any planned strategy. The outcome of this could be a confused structure that no one would really understand. An alternative action is to follow a plan or a *strategy* that prescribes how to structure the information systems to each other and to the business functions (e. g. Zachman, 1978; Earl, 1987). A structure of information systems is, in this paper, called an *information systems architecture*. This concept denotes how information and responsibility are distributed between information systems and between different parts of the organization. A second meaning of the concept is how the communication and interaction are accomplished both between the information systems and between the systems and the rest of the organization. The concept has been further examined by Opdahl and Andersen (1994). Brancheau and Wetherbe (1986) use the expression information architecture to describe a high-level map of the information requirements of an organization.

Within our research program for system development there is a project concerning strategies for the structuring of information systems (e. g. Axelsson, 1995; Pettersson and Goldkuhl, 1993; Pettersson, 1994). The strategies are aiming at structuring the information systems of an organization in a way that will facilitate use of the information systems and future changes in the systems. The structure is built to avoid situations where information systems are difficult to survey, manage, maintain and change without unexpected consequences. The strategies present, however, different means for the realization of this aim.

A common way to create an information systems architecture is to separate the application processing from the data used to support it. The data is then integrated and made consistent in large databases, that can be reached by all users in an organization (Martin, 1989). A result from this *globalization of data* is that the possibility for local influences is drastically reduced. The administration of data must be conducted by a central IS-department, i. e. by a data manager. This can appear to be a serious problem in decentralized organizations, where many decisions are made at a local level. Hence, a centralized structure of the information systems can become a threat to the idea of decentralization.

An alternative to the centralized approach is to create a federation of small information systems that are able to interact with each other when necessary. If information systems can be designed so that an independence regarding the storage and processing of information is achieved, each information system will be more flexible. It will then be easier to change or modify existing information systems, and to implement new systems, without disturbing other information systems of the organization. This situation supports decentralized organizations in an efficient way. An IS-strategy that facilitates this is the subject of the paper. The strategy could be described as an *activity-based strategy* with a functional approach to the structuring of information systems*. It has been formulated and used in Sweden (Hugoson, 1989), but similar thoughts can also be identified in different international approaches (e. g. Davis, 1984; Woolfe, 1989).

* It is difficult to translate the Swedish expression for the strategy into English in a way that preserves the exact original conception. This translation is however as close to the origin as possible.

CASE STUDIES

Three case studies, conducted in the research project, were made in decentralized organizations and are therefore of interest in this paper. The three companies are all rather large organizations with over 200 employees each. Two of the companies have a divisional organization structure (Mintzberg, 1983) and all three companies have the IS-strategy in common. The realization of the IS-strategy and its consequences have been studied. The paper focuses on both success and failure that can be derived to the IS-strategy realization. A divisional structure seems to be well suited for this decentralized IS-strategy. Such large companies probably derive more advantages from message interaction and autonomy between business functions than smaller ones do. The organizations are made anonymous here; a short description of the companies is presented below.

Paper mill

The first case study was conducted at a paper mill producing cardboard for pre-packages of provisions. The organization is structured in different business functions, for example purchase, economy, manufacturing. There are around 40 information systems located and used in different functions. Each function is responsible for its own information systems and each system is only used in one function.

Manufacturing industry

The second case study was conducted in a manufacturing industry producing electronic equipment. The company belongs to a group of companies with factories both in Europe and in the United States. The organization has a divisional structure. Each division includes a number of factories with both local and central information systems. The central information systems are generic systems without any local variations. The systems are functioning to communicate both within and between factories.

Forestry company

The third case study was conducted at a forestry company, which is part of a large group of companies within different branches of business. The studied company sells paper for magazines, mostly on the basis of customer orders. This organization has a divisional structure and the sales offices at different locations interact through a sales system. The sales system consists of different parts containing information about customer orders, the stock, product distribution and invoices. The system is divided into subsystems and each subsystem supports a specific business function in the organization.

Data collection and data analysis

The first purpose with the case studies has been to find out *the possibilities to realize the theoretical strategy in real situations*. The case studies have given a reasonably convincing affirmative answer to this question. The second purpose has been to investigate *what*

consequences the realization of the strategy would have for people in an organization. Four different categories of consequences were studied:

- responsibility for information systems;
- functionality of information systems;
- transparency of information systems;
- possibility to change information systems.

The case studies were conducted through a qualitative approach and the main purpose of the studies has been to gain profound knowledge about some selected phenomena (i.e. the four categories above) rather than statistical information about whole organizations. Therefore, the method used for data collection was interviews. The persons in charge of the realization of the information systems architecture in each organization were the first to be interviewed. Then users and system analysts were interviewed. By "user", here, I mean persons who use the information system and the information in some part of their employment, not only the end-users who collect and register the data. Additional interviews with the same persons were conducted when necessary. Each interview lasted about two hours. A total sum of 20 interviews was conducted during the case studies.

The questions were not standardized and the interviews had the character of conversations about some interesting issues, i. e. the interviews were conducted according to the *guided interview principle* (Patton, 1990). The case studies also included investigations of other sources such as data models, tables and other types of documentation from the information system development processes. Furthermore, some of the information systems in the studied organizations were demonstrated and analysed.

The data analysis has been conducted with a grounded theory approach (Strauss and Corbin, 1990). The empirical data has been analyzed to find different concepts and categories. The categories have later been compared in order to find patterns, similarities and differences in the material. On basis of the comparison the categories have been related to each other and a theory has finally been constructed. This is a method for qualitative data analysis, which is suitable for studies where the field is rather unknown when the study starts. The approach is often used in studies where human beings are the objects and the researcher wants to study something without any prejudices. The findings presented in this paper are only a part of the total results from the case studies. The research project is further explained in Pettersson (1994).

THEORETICAL DESCRIPTION OF AN ACTIVITY-BASED IS-STRATEGY

The IS-strategy accentuates that the information of an organization should be structured in well-defined, activity-based, functional, autonomous systems. The responsibility for systems and information is decentralized and there is an in advance defined interaction between the systems (Hugoson, 1989; Magoulas and Pessi, 1991). Hugoson (1989) defines an autonomous information system:

"An Autonomous Information System is an Information System that reads and updates its own database, and that may be implemented in a separate computer. It has its own data storage and

can run for a period of time when other information systems are not running. An Autonomous Information System serves one and only one area of operations in the enterprise/organisation."

According to the strategy, responsibility for the information systems is a very important issue. The information system is located, due to the responsibility, in a specific organizational function, where the system conducts information processing tasks. This implies that the person in charge of a business function is the one responsible for the information systems in that function. These *business functions* could be for example purchase, economy or manufacturing. It is important to find the business functions when the IS-strategy is going to be realized. The business functions are not always the same as the departments found in an organization chart. Before the system development process begins the business functions must be defined.

The IS-strategy prescribes an organization with several functional-based information systems instead of one or a few centralized, global systems and databases. The information systems contain all necessary, local information in local databases. The autonomous information systems are, when necessary, able to communicate with each other. The IS-strategy distinguishes between local information and "connective information". Connective information is defined as information that is needed in other business functions and therefore sent as messages to these functions. The communication between autonomous, interacting information systems is conducted through exchange of messages according to defined rules, in contrast to the usage of common databases. The users in a business function can only reach information in the information systems of their function. They are not able to reach information in databases outside their own function. All computerized communication between functions is restricted by contracts established between the communicating functions. Hugoson (1989) states that:

"It is possible, and advisable, to define the message interaction structure and to describe every single message without knowing the data structure of any information system."

Each business function is able to decide about changes within its own information systems as long as the systems can still send and receive messages from the other business functions. The business functions are making the decisions but they are not designing the information systems. There can of course be an IS-department with that kind of expert knowledge in the organization.

The responsibility for the total information systems architecture is a task for the managers of the organization, since this responsibility requires a general view of all the business functions, their goals and purposes. This responsibility also includes creation and maintenance of global concepts of the organization, that are necessary for the communication between information systems.

Figure 1 shows a schematic picture of the relationship between different business functions and their information systems.

Figure 1 Information systems in a decentralized structure interacting through messages.

Figure 2 illustrates the relations between different parts of the theory behind the IS-strategy, as it has been described here. By presenting the relations in a graphic form the theory becomes more transparent and communicable. This is more difficult to achieve when writing a linear text, which often hides parts of the theory. The graph follows the description principles presented in Goldkuhl and Röstlinger (1993).

Figure 2 Relations between different parts of the activity-based IS-strategy.

SUCCESS OF THE STRATEGY REALIZATION IN THE STUDIED ORGANIZATIONS

In this section, the findings indicating success in the case studies are structured within the categories of consequences, mentioned earlier in the paper. The category of responsibility is omitted since there was no success found in this field.

Functionality of information systems

When an organization decides to realize an IS-strategy, a process at several levels in the organization starts. The system development process is of course important, but it is not the only one. If the information systems architecture is going to be successfully developed, there are other features beside the information systems that must be considered. The way decisions are made, how responsibility is given and taken, how the managers act and how the users are fulfilling their tasks are a few significant examples. It is of course important to design information systems that support the business functions, but the information systems are not adequate without necessary organizational changes in the same direction. The case studies show that most of the *positive results concerned technical solutions during the system development*, such as implementing the information systems technically and connecting them to each other. The three organizations have all succeeded in developing many interacting information systems in a short time.

Transparency of information systems

The message interaction between information systems can be realized in different ways; with a separate communication system or file transmissions for example. *The studied organizations have chosen different solutions for the message interaction, but they have all succeeded in accomplishing this technical matter.* The business functions are able to interact and send the information needed in other functions. Thus, the business functions can work in a decentralized way and the IS-strategy has reached its purpose of supporting a decentralized organization.

To be able to interact through messages, contracts over the connective information are established between business functions, as mentioned previously. It takes time and accuracy to get these contracts correct and it is of great importance that the contracts are followed. In the three studied organizations this task has been taken seriously and *there have been contracts made for all messages*. A result from this is organizations with control over the interaction between each business function. This order is not only vital for the message interaction itself, but it also offers everyone a general view of the whole decentralized organization. A high degree of transparency of the information systems facilitates for example the control of goal fulfilment in the organization.

Possibility to change information systems

Autonomous information systems can be changed and modified without disturbing other information systems. To accomplish such a flexible and independent structure each information system must be well-defined and belong to one business function only. When the studied organizations have managed to find the business functions and develop autonomous

information systems, *the decentralized, flexible structure is a reality*. The organizations have all succeeded in most of their functions, but no one has done it without setbacks in some function (see section 5). One key to the success of the IS-strategy is that the autonomous information systems of each business function are well-defined and separated from the information systems of other functions. Hence, a lot of time and strength have to be spent on defining the business functions in a correct way.

FAILURE IN THE STRATEGY REALIZATION IN THE STUDIED ORGANIZATIONS

In this section the findings indicating failure in the case studies are structured within the categories of consequences, mentioned earlier in the paper. The section ends with a discussion about the connections between chosen actions and some of the negative consequences (failures) found in the studied organizations.

Responsibility for information systems

The responsibility for information, information systems and information systems architecture is a main issue in the IS-strategy. *The case studies show that the distribution of responsibility within the organizations is a very difficult task to accomplish*. Most failure and negative consequences found in the case studies originate, directly or indirectly, from different responsibility problems, as these two quotations state:

"We have total responsibility for the information systems, even though the business functions are supposed to take that responsibility. I would much rather be the one who supplies the business functions with technical knowledge." (System developer at the paper mill)

"It has been very difficult to engage the managers to take the overall responsibility for the realization of the strategy. Someone ought to do this at top level in the company." (System developer at the forestry company)

It seems like the importance of responsibility questions has not been taken sufficiently into account during the realization of the strategy, even though the responsibility distribution is fundamental to the existence of decentralized organizations.

When responsibility for the information systems is distributed to each business function, this often means that the manager of the business function becomes the "system owner" of the information systems within his or her function. The capability of these managers differs of course; some take great responsibility for their information systems and some do not. One cause for problems could be that the managers of the business functions do not really use their systems, since they do not have the same tasks as other persons working in their function. The system owners are therefore not always at the right level in the hierarchy of the organization. They are often too high up to be able to see the needs of ordinary users. They do not always possess the knowledge necessary for system owners. Hence, these system owners are more satisfied than the users and do not contact the IS-department as long as the information systems are generating the information, that is needed in the business function. Another cause for these

problems is that the system owners sometimes are located far from the users in a geographical sense, for example at the headquarters of the organization. One user in the manufacturing industry complains about this:

"The system owner is not located in this factory and we have no contact with him. He is not concerned with our needs. Instead, we have to contact the data function at the headquarters by ourselves. We are however too few and unimportant to get our needs satisfied."

In some of the studied organizations *there is a lack of understanding for what it really means to be a system owner*. System owners have been appointed, but these persons do not have enough information and knowledge about their responsibility. This fact shows the importance of making the strategy known and accepted at all levels in the organization. Otherwise it will never be possible to distribute responsibility and some aspects of the strategy will therefore continue to be unrealized. In absence of responsible system owners the most common solution is that the system developers at the IS-department take the responsibility, even though they would prefer to have another role in the organization.

In the same way as the strategy presupposes active, responsible users in the business functions, it also emphasizes that the total responsibility for the information systems architecture is a strategic task belonging to the managers. This is the way responsibility is supposed to be organized, according to the theoretical description of the strategy. One major problem in the studied organizations has been to achieve this aspect of the strategy. A system developer at the forestry company says:

"Since the executives have not specified how the work should be done in the future, we have been forced to make decisions of this kind to be able to develop the information systems. We have not the right competence for making these decisions and therefore it should not be our task."

Both the users, the middle management (e. g. system owners) and the top managers seem to play very passive roles during the realization of the strategy. The managers have of course approved of the realization once, but the structuring of information systems is carried out by system analysts and system developers with very little interest from the managers. The low degree of participation from two important groups (users and managers) continues after the realization is completed. The result is instead that the system developers become responsible both for the information systems of the business functions and for the information systems architecture. The main reason for this situation is not that the system developers are unwilling to distribute the responsibility, but that the business functions and the managers are reluctant to take their responsibility.

Functionality of information systems

A fact, that can cause problems for users, is that large companies sometimes have the same types of business functions at different factories. The managers consider it to be one function for marketing, only geographically divided into a number of places. The users at each factory, on the other hand, consider their business function to be a whole, independent function, not a part of a bigger one. *If the factories are working slightly different in some way, but use*

instances of the same information systems, this situation can be very problematic for the users. Their needs for changes in the information systems can not be effectuated unless the users at the other factories also ask for the same changes. A common situation is that a new and unfamiliar language is implemented in the information system, which is difficult to accept for some users. A user at the manufacturing industry says:

"We have never used the word 'delivery time' in the same way as the other factories have. Though, since we got this generic system we are forced to use it in the same way, whether we like it or not. This leads to a lot of misunderstandings and dissatisfaction."

The case studies show that this situation gives the organization an easier maintenance of the information systems, but on the other hand decreases the autonomy for each business function. Furthermore, this proves that the way the information systems of an organization are structured sometimes aggravates existing antagonism between groups of personnel as well as creates new conflicts.

Transparency of information systems

The IS-strategy offers, when it is realized in a successful way, flexibility for the business functions. This is supposed to give the users increased possibilities to influence the system development, changes in the information systems and their total working environment. The strategy makes this desired situation possible, though it does not necessary lead to it. A failure made in the studied organizations was to believe that this would happen without any special effort. It turned out to be many other things that take effect on the users' possibility to influence their situation. *If the common attitude in the organization does not correspond with the intentions of the strategy, then the strategy will not change the climate in the organization.* In spite of the decentralized strategy the decisions can be made by top managers and IS-department without them knowing the users' needs and wishes, as this quotation shows:

"We are very restrictive when it comes to changes in the information systems required by the users. The fact that users wish something is not enough for us to redesign the system."
(System developer at the manufacturing industry)

A result from such a situation, where no one listens to the users, is often that users start to dislike their information systems. The user acceptance of the systems becomes rather low in the organization. There are many explanations for low degree of user acceptance. One reason, that was obvious in the case studies, is that the system development process was accomplished with no or very little user participation. This happened because of time pressure and a doubtful attitude towards user participation.

Possibility to change information systems

As mentioned before, the success of the IS-strategy is depending on how well the business functions are defined, since it is crucial that each information system supports only one function. *If the functions are not clearly defined, an information system could be reached by users from different business functions.* In that situation some of the flexibility and autonomy

in the business functions are lost, since changes and modifications can not be done independently of the other function, its needs and wishes. This can either be an unconscious action or a deliberate choice to gain some technical advantages, such as faster access to information. A system developer at the paper mill says:

"I'm very unsatisfied with our two integrated systems. They are a deviation from the IS-strategy. When we developed the systems it seemed as a good idea to integrate them, in order to decrease the amount of transactions between them. Now, I realize that it would be difficult to change or modify one of them."

Whatever the reason is, it is important to be aware of the loss of autonomy for the business functions, before the decision is made. In the case studies, where this had happened, the effects of the deviation from the theoretical strategy seemed to come as a surprise to most of the involved persons.

In organizations, where managers are rather uninterested in the structuring of information systems, *the system developers are forced to make strategic decisions far outside their formal responsibility and knowledge*. The freedom for each business function to adjust their information systems is then almost complete due to the lack of management control. Problems that occur are for example to decide whether an adjustment should be local or global. During the case studies some complaints about the easiness to reach special solutions for small groups in the organizations were mentioned. These solutions were not always good for the whole organization and they were considered to be the result from a weak central interest in these questions.

Discussion

Figure 3 shows possible connections between chosen actions and some of the negative consequences found in the studied organizations. The analysis starts with two important questions: the users' influence on system development as well as on changes in the information systems. There are several things that decrease the possibilities of user influence. One factor is the persons who are representing the users during the system development process. If there are no end-users present, the users' influence can be decreased. Two other factors are if the users are getting insufficient information about the consequences of the system development process and the lack of time that often appears in system development projects. Many authors have discussed the importance of user participation (e. g. Mumford, 1984). If the organization has a restrictive attitude towards any kind of changes, this also affects the user influence in a negative way. The lack of user influence can result in a general negative attitude towards the information systems and low user acceptance of the systems, but also unwanted changes in the usage of professional language in the information systems (Goldkuhl and Lyytinen, 1982). This can be a serious problem for the whole organization and give negative consequences for its total effectiveness.

Figure 3 Possible relations between chosen actions and negative consequences in the studied organizations.

Another problem, which has been observed in many organizational studies over the years (e. g. Davenport, 1993), seems to be that the IS-department often initiates and realizes the strategy with little or no participation from the managers or from the users. This can lead to a diffused distribution of responsibility as well as an IS-department that takes all responsibility. Another cause for this is that the system owners, who, sometimes, are not active system users, do not take their full responsibility for the information systems. If the IS-department has the responsibility it also has to make strategical decisions, which sometimes appears to be wrong due to lack of organizational knowledge. The result from all these problems could at its worst be that the users do not take any responsibility for the information systems and instead leave this to the IS-department. This function will become very powerful in such a situation. When the users have a negative attitude towards the systems and do not trust the information correctness, they might refuse to use them in a correct way or they do not use them at all.

These are results that no one wants to see in their organization. Nevertheless, they can come true if the strategy is realized without influence from the whole organization. A conclusion from this is that the IS-strategy is appropriate in decentralized organizations when the realization is done carefully. The strategy does not, however, give positive contributions to the organization if these issues are not considered seriously. The realization of the IS-strategy must therefore be accomplished at all levels in the organization, with representatives of involved groups.

CONCLUSIONS

The two previous sections emphasize that the strategy realizations in the studied organizations were successful in some aspects and unsuccessful in others. The organizations seem to be more successful regarding the technical realization of the strategy. When it comes to handling organizational issues problems often emerge. It is important, though, to remember that these consequences are possible consequences. They are not supposed to be seen as inevitable effects occurring in all organizations that choose to realize this specific IS-strategy. The conclusions drawn from the case studies are:

- The organizations succeed in developing several interacting information systems in a short time.
- The message interaction between business functions is successfully accomplished.
- The organizations manage to develop a, to some extent, decentralized, flexible structure of information systems, where changes and adaptations are easily made.
- Users and managers are much too passive during the system development process.
- Users have no or little influence on development or changes in their information systems.
- Difficulties occur when the responsibility for information systems and architecture is going to be distributed within the organization.
- The IS-department take the total responsibility for information systems and message interaction instead of distributing the responsibility to the business functions and the managers.

A final conclusion to be drawn from this material is that the IS-strategy can give a substantial support to decentralized organizations, if only the pitfalls mentioned here are avoided.

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* Married name has changed to Axelsson.