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IS/IT-architectures & Processes

What it takes from an IS/IT-architecture to support a process oriented organization

Master of Science Thesis Project

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Abstract

Organizations today have to deal with increasing competition and customer demands, and one effect that this has on an organization is that it has to be flexible, to be able to adapt to new situations quickly. One way to increase the speed and flexibility within a company is to work process oriented instead of having isolated functions.
This structure, i.e. the process oriented, has to be supported by an equally flexible flow of information, and this in turn puts great pressure on the IS/IT-architecture, i.e. how to support the transfer and storage of information.
It is this situation that is the subject for this thesis, i.e. *what does it take from an IS/IT-architecture to support a process oriented organization?*
In order to answer this, there are lots of factors to consider. For example, *what should the systems structure be like? how are roles and responsibilities affected? is there a need for standardization or centralization/decentralization? what about terminology? etc.*
To try to answer these questions, and to reach a conclusion, this thesis is an empirical study that builds upon real-life facts, opinions and experiences in combination with a number of established theories.
Astra is our case study, and this is a company where this is a relevant issue, since the company is moving from a functional towards a process oriented structure.
The answer to our research question suggests that all the above factors, plus some more, are absolutely critical in order to reach success. But, they also can cause serious problems if not managed properly.
Consequently, this is an issue of great complexity, and it does indeed deserve thorough consideration within all companies that want to work process oriented and with the appropriate support from IS/IT.

1. Introduction

Companies and organizations are continuously facing new demands initiating from their environment. The competitors are continuously putting innovations on the market and the demands from the customers are getting higher and more refined. You can imagine an inner pressure where the company is trying to look for new markets, products and customers.

Companies are in a permanent state of change and re-organizations are frequent. One reason for this situation is, according toMagoulas, Pessi (1998, p. 16), recent years development in information technology. The ability to communicate quickly and over large distances has been a driving force for creating new forms of organizations.
The concept of process orientation has been a central issue in the debate about how organizations shall face the increasing complexity and dynamic in this new environment.

1.1 Background

This paper is, besides from being a Masters thesis at theGöteborg university, Department of Informatics, also an assignment forAstra Hässle, Mölndal, Sweden. It discusses the use of Information Systems (IS) and Information Technology (IT) in an organization that has/shall undergo transformation from functional structure to process structure[*].
More specifically, it is an attempt to describe the IS/IT-architecture that is needed to support the concept of processes instead of functions.
Our principal is Mr.Göran Wennberg, who is Chief Information Officer atAstra Hässle, and he will be our primary contact person during our work with this thesis.

Astra Hässle is (actually the entireAstra is) a company where this concept of a process oriented IS/IT-architecture is a highly relevant issue. One reason for this is a project (CANDELA[**]) at corporate level, which objective was to reduce lead times (without any loss in quality) in the clinical part of the drug development process[***] . In order to reach these objectives, parts of Astra should be re-engineered, from a functional structure into a structure of processes.

Such new organizational structure will of course affect lots of areas within the IS/IT field, e.g. areas of responsibility (system owners vs. process owners), the technical infrastructure, how information is stored and accessed (centralization vs. decentralization) etc.
Consequently, Astra would need to know that they have an appropriate IS/IT architecture to support this new organizational structure, and that its IS/IT operations are running smoothly.
Magoulas, Pessi (1998, p. 24) acknowledge this with their example of British Telecom. When British Telecom developed their process-oriented organization in

[*] From here on, we will use the term IS/IT.
[**] see section 4.3
[***] see section 4.2

the late 80´s, the creation of the systems architecture was one of the most important activities.

Why is This an Interesting Topic?
Since we both have ”Strategic IS/IT-management” as our major, and are also interested of the linkage between the business and the use of information technology, this is an area that suites us well.
The reason for studying the relation between processes and IS/IT-architectures becomes rather obvious when one considers the fact that many companies try to work process oriented, but often the expected advantages are not forthcoming. Instead, the result is a dissatisfied work force, loss in productivity, and unnecessary costs.
The natural reaction to this is of course to ask; ”Why is that? What is wrong**?**.

Unfortunately, there are no easy answers to these questions. Although, a starting-point for this thesis is that by having an IS/IT-architecture well aligned with the processes, the chances for success, and hence competitive advantage, are significantly increased.
Appropriate IS/IT support to the processes is a necessity to ensure that the right information is available at the right time, and at the right place. This is something that is vital to any company today when information considers being a very valuable resource.

We believe that this is an argument that is enough reason for conducting this study on the relationship between processes and IS/IT-architecture.

1.2 Problem Domain

Tapscott, Caston (1993, p. 6) describe seven driving forces for what they call the new business environment. These seven forces are increasing the demand for: *productivity in knowledge and service sector, ability to respond to changing market demands, globalization, outsourcing, partnership/networking,* and *increased responsibility for environmental and social development*.

Pessi (1997, p. 2) also writes about the new business environment when he discusses how Boynton and Victor (1991) think that organizations today have to deal with conflicting demands, such as delivering high-quality goods and services and at the same time reduce costs and lead-times. According to them, the biggest problem is that most organizations are designed for mass-production in an environment where change is slow and the future is predictable, and therefore cannot react quickly enough.

Thanks to the new business environment that is emerging, the organizations are now facing new demands. It will take an organization that is open, flexible, knowledgeable, and in every way open for change in order to handle these new demands. The organization should also have a suitable structure that supports a steady flow of material and information, and this often has to be supported by technology.

To become more competitive, organizations have to be more flexible and quicker to response in all different sections of the company, i.e. not just in marketing but also in production.
Rockart, Short (1991) illustrate this by saying that the organization, although getting larger and more complex, also has to be able to react and respond as quickly as a small organization.
One way to do this, to make the organization more flexible and customer oriented, is to have a flat organization, where the information can flow both horizontally and vertically with support from information technology.

An alternative to meet these new and increasingly higher demands on for example flexibility and shorter led times, is to work more process oriented. Process orientation is of current interest and is worth striving for many companies. To consider the activity from a process oriented perspective denotes among other things that you study the communication and coordination vertically instead of horizontally. The boundaries between the departments disappear and you try to work across the departments. Information technology plays a major role in this, since it considers being an important tool to support the process oriented organization.

Nevertheless, there are lots of problems that arise when an organization undertakes a transition from a functional structure to process orientation, and Hugoson (1997, p. 2) mentions two of these, namely;

1. The process is not supplied with the necessary resources (e.g. information), which is a prerequisite for the process orientation concept.
2. The processes are not supported with suitable information systems, i.e. the IS/IT-architecture is not aligned with the processes.

These two problems constitute the core in our study about process oriented IS/IT-architectures, and they are also closely connected to Astra´s situation. Actually, these are two areas of great concern to any organization that whishes to succeed in its process orientation.
Because of this correspondence between Astra´s and our own interests, it makes this company to an extraordinary case study.
We also believe that this situation will ensure us the necessary support from Astra Hässle throughout this study.

1.3 Purpose and Research Question

This thesis aims at investigating the relationship between process orientation and IS/IT-architecture.
This relationship will be studied by conducting a case study at Astra, where we will investigate the alignment of processes and IS/IT-architecture, problems that might occur, critical success factors etc.

If Astra, or any company, is to succeed with its process orientation, it is important that there is an adequate IS/IT-architecture.
So, what Astra needs to know are:

1. ”What are the most conspicuous problems and risks (from an IS/IT perspective) with this transition from functions to processes?”
2. ”Are there any evident critical success factors for succeeding with a process oriented IS/IT-architecture?”

Our assignment from Mr. Göran Wennberg is to gather reliable information in order to give an answer to these two questions.

Then, by analyzing the results from this case study combined with our theoretical framework, we will be able to answer our own research question, which is:
”What is needed of an IS/IT-architecture to support a process oriented organization?”

Target Audience
This thesis is intended for, besides from employees within Astra, people with their expertise within the field of IS/IT.
Since we have these two groups as our target, we feel free to use some common IS/IT terms without further explanation.

1.4 Conceptual Framework
Since IS/IT-architectures and processes are vital in this thesis, we will here introduce the reader to these core concepts.

IS/IT-architectures
There are many different definitions of IS and IT architectures in the literature. Some are very precise and narrow, whereas others have a much wider scope.
We realize that our work will be easier to structure if we have one single definition for the architectures instead of discussing them from several viewpoints all the time.
As a consequence, we have decided to use the following definitions:

- IS-architecture:
  The organizations information systems, the relations between them, and the relations to the processes they support (modified from Magoulas, Pessi (1998, p. 239)). *This structure consists of applications, databases, and supporting software* (modified from Wetherbe (1988, p. 306)).
- IT-architecture:
  IT-architecture is NOT equal to infrastructure (according to Magoulas, Pessi (1998, p. 329) is the architecture a framework for the infrastructure).
  The IT architecture defines how technical components shall fit together, protocols so that e.g. WAN´s and LAN´s can communicate, data standards, standards for hardware and software (adapted from Keen (1991) and Cash, McFarlan *et. al.* (1992)).

We chose these definitions with respect to what we think is most appropriate for our research question and Astra´s assignment.

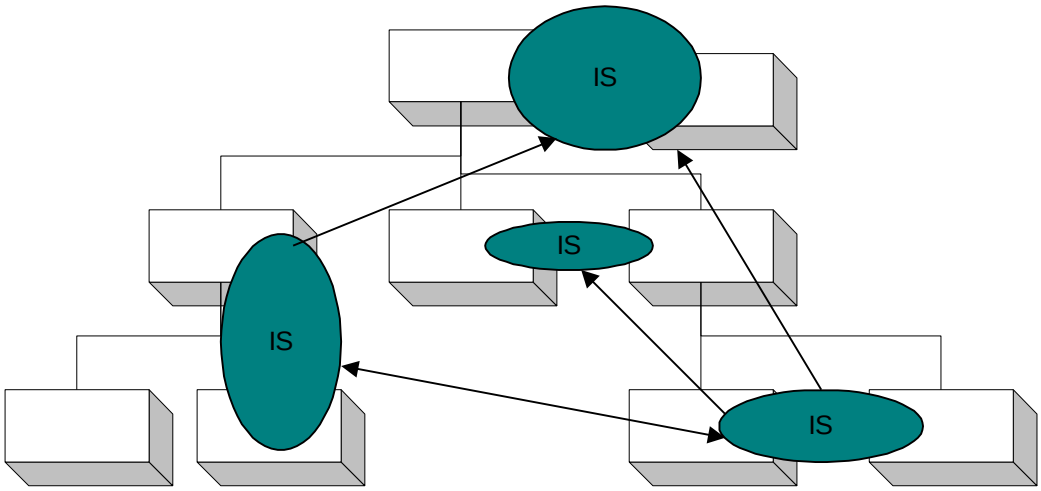

Figure 1. *IS-architetcure in the organizational chart* (source: modified from Andersen, 1994, p. 503).

As this picture illustrates, one way to describe an IS/IT-architecture is to show how it fits within the organizational structure. (Note that IT is not displayed here since we define the IT-architecture as e.g. standards and protocols rather than a physical structure).

Processes
As with an IS/IT-architecture, even a process can be defined in several ways (there is a large amount of literature dealing with the process concept). But, we have chosen to use the following definitions when we discuss processes:
A set of logically related tasks performed to achieve a defined business outcome Davenport & Short (1990). Or, put in another way, "*a structured, measured set of activities designed to produce a specified output for a particular customer or market. It implies a strong emphasis on how work is done within an organization*" (Davenport 1993).
In their view *processes have two important characteristics*: (i) They have customers (internal or external), (ii) They cross organizational boundaries, i.e., they occur across or between organizational subunits.

(IS/IT-architectures and processes will be discussed in further detail in section 3, “Theoretical framework”).

1.5 Delimitation

During this study we will not select a particular process within Astra and analyze its supporting IS/IT-architecture. Instead we will try to discuss in general terms, i.e. the results from this study should be applicable on any process within the organization. We believe that by having this wider perspective and getting influences from several different parts of the organization, we will get a result of greater relevance, both for us and for Astra. This perspective will hopefully reveal a greater variety of situations that may occur due to the process orientation than if we would have focused on one single process.
Main focus will be on IS, but we still use the term IS/IT-architecture throughout the thesis. The reason for this is that, even if focus is on IS, we will also discuss

certain IT related issues. So, in order to avoid confusion by using IS- and IT-architecture interchangeably, we chose to use IS/IT-architecture.

1.6 Disposition

In the *first part*, a brief introduction is made over why we choose the topic, we also explain the problem domain, the purpose, and our research question.

The *second part* is the methodology chapter. The chapter describes how the research will be conducted. First there is a discussion about different research types and philosophies that have to be considered when conducting a research. There is also a discussion about a number of different choices that have to be considered when constructing a research design. Finally we present our design and what methods we will use to gather and analyze the data.

Part three is the theoretical framework. We describe all the theories that we use as theoretical support for our analysis in part five. Here we give an in depth description of: IT management, IS/IT-architectures, process orientation, and information systems. Our definitions of information systems and processes are presented, so that the reader will have the same conceptual framework as the one used in the thesis.

In *part four* we give a brief description of Astra, the different research areas, and the research process. An introduction to the CANDELA project with its goals and purpose is also presented. And finally, there is an introduction to our case study.

Part five. Here the empirical study is presented, and in this section we explain the situation within Astra. During our research we make a number of interviews with employees at Astra and other persons that have a connection to our research, and here we describe the different views and opinions that the respondents have had on our questions. This part also contains the analysis.

In *part 6* we draw our conclusions from the interviews. It is in this section that we answer our research question, with established theories as support.

In the last section (*part 7*) we have a discussion about our research. There is a brief discussion about what could have been done differently, and how further research could be done.

2. Methodology

Our ambition is that this thesis should have two characteristics that Phillips and Pugh[1] mention as being characteristics of good research.
Firstly it should be based on an *open system of thought*, which means that we, at the same time as we review and criticize the ideas of other, also try to present some own ideas. Secondly, no conclusions must be drawn without the underlying *data being examined critically*, i.e. the thesis should be both *viable* and *reliable*.

2.1 Types of Research

To begin with, we must decide what kind of research this is, we must classify the research. The classification is mainly based on the expected outcomes, but one must remember that this grouping is theoretical, and that the result might have influences from more than one class.
Anyway, there are three classes (we use the classification of Easterby-Smith *et. al.* (1991, pp. 6)) namely, *pure research*, *applied research*, and *action research*.

Pure Research:
It is intended to lead to theoretical developments, with or without any practical implications. These developments are either in the form of *discovery*, *invention*, or *reflection*. Discovery and invention both produce new results, i.e. a new idea or technology. Reflection reexamines and eventually modifies an existing theory or technique.

Applied Research:
This kind of research should often lead to the solution of a specific problem, and it usually involves working with a client that has identified the problem.
A common form of applied research is the evaluation of the outcomes of a particular course of action, such as a BPR-project or the use of a new technology. The results of applied research are always reported back to the client.

Action Research:
A distinctive feature of action research is that it should lead to a change, and that change therefore also is part of the research process itself.
Collaboration between researcher and researched is important, so that a shared understanding can be developed and participants learn a lot from the research process.
However, the main idea is that if you want to understand a phenomenon well you should try to change it.

Choice of Research Type
This choice is based on two things, namely desired outcome and time. The purpose of this thesis, both our own research question and Astra´s assignment, is the most important factor in this decision, but also the fact that there is a time limit (June - 99) has an influence on this choice.

[1] Phillips, E.M., Pugh, D.S. (1987) *How to Get a PhD*, Open University Press, Milton Keynes.

Considering this, one can see that pure research is not appropriate here, since our purpose not is to create new or modify existing theories (our purpose is to answer a question, and base this answer on existing theories and observations/interviews). Neither is action research the right choice because we do not intend to change anything within Astra, only evaluate the current situation and draw conclusions from this. Although it would be interesting to apply our findings on the organization, to change it, this is not possible due to the time limit. A research project that includes a change process requires a considerable amount of time, and definitively more than 4-5 months.
This means that this thesis is an example of applied research, and the arguments for this are:

1. We do evaluate the outcomes of a particular course of action (how does the process orientation affect the IS/IT-architecture?).
2. We report the results back to our client, who also has identified our research area.

We also, as Easterby-Smith *et. al.* (1991, p. 7) suggest for applied research, include both *what* and *why* questions, i.e. we first evaluate the current situation at Astra (*what*), and then try to interpret/explain it (*why*).

Another way to describe this study would be to call it a **case study**. According to Kristin Braa[2], is an example of a case study a study that, by investigating e.g. an organization, aims for *understanding, interpretation*, and where *changes are only accidental.*
(The opposite of a case study, a *field experiment*, focuses on *hypothesis testing* and *controlled variables*, something that is not the case here).

2.2 Scientific Approach

There is interdependence between the scientific approach, the research design (method), and the research question. Prof. Bo Dahlbom[3] illustrates this relationship with the following picture:

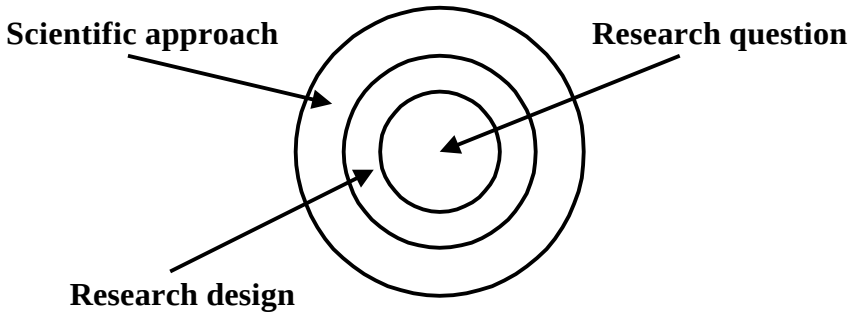

Figure 2. *Research interdependence.*

This picture symbolizes how the research question demands an adequate method, which in turn is based on a scientific approach, and this is the reason why it is important to be aware of the scientific approach.

[2] Braa, K. (1998) from a lecture in the course "Informatics as a science" 1998.
[3] Dahlbom, B. (1998) from a lecture in the course "Informatics as a science" 1998.

Two Philosophies for the Scientific Approach

There are, according to Dahlbom, Matthiassen (1993) two viewpoints, the *mechanistic* and the *romantic*. The mechanistic focuses on models, regularity and generalization, whereas the romantic focuses on reality (not models) and changes (not regularity), and tries to interpret the current situation (not to generalize). Examples of two research philosophies that each one represents one of these viewpoints are positivism (mechanistic), and phenomenology (romantic).
Before it is possible to say which philosophy that best describes this thesis, we must analyze the main differences between them.
At this point, it is also worth mentioning that one must be aware of that, even though there are some major differences between them in theory, these differences are not so distinct in practice. Easterby-Smith *et. al.* (1991, p. 26) argue that there is a move among researchers to bridge the gap between these two extremes. That is, there is no such thing as pure positivism or phenomenology, or at least it is not very common.

Nevertheless, by first describing the main characteristics, as depicted by Easterby-Smith *et. al.* (1991, pp. 22), for positivism and phenomenology respectively (see table 1. below), it should then be possible to decide which one of the two philosophies that exerts the strongest influence on this thesis.

Positivism	Phenomenology
- Focus on facts, i.e. measure	- Focus on meanings, i.e. interpret
- Reduce the situation to simple elements	- Try to see the whole picture
- Formulate hypotheses and test them (deduce)	- Develop ideas through induction
- Taking large samples (in order to generalize)	- Small samples investigated in depth

Table.1 *Positivism versus Phenomenology* (source: extract from Easterby-Smith *et. al.* ,1991, pp.22).

Considering these characteristics, it is now possible to say that our thesis is dominated by the phenomenological viewpoint, and the reasons for this are the following:
Firstly we will not be able to answer our research question by measuring the situation, instead we will have do draw our conclusions from what we can interpret from the situation.
Secondly, we will not reduce the situation, e.g. select one single process and analyze it. Instead we intend to grasp the entire situation with process oriented IS/IT-architectures within Astra.
Finally, we limit our sample size to one organization (Astra), and the reason for this is that we have no intentions to find a general solution to our research question. We only intend to come up with some ideas that may, or may not, be generally applicable.
But, there is one trait of positivism in the thesis, and that is the fact that we do not entirely develop our ideas and conclusions through induction. We answer our

research question by analyzing our collected data with help from existing theories (the theoretical framework), and this is not phenomenology.
So, instead of saying that our work is purely phenomenological, we must say that this thesis is an example of *phenomenology supported by a theoretical framework*.

2.3 Research Design

Some Choices and Issues

Research design is about organizing the research activity, and this includes collection of data in a way that the researchers aims are achieved. There are many potential choices to make when developing a research design. But, there are a few algorithms that can guide the researcher to make the best choices for the particular situation. Many of these key choices are related to the philosophical positioning, and awareness of this ensures at least that the research design is consistent.
We shall here in this section describe four (of five) key choices that Easterby-Smith *et. al.* (1991, pp. 33-38) discuss, and in the end present our design. The fifth alternative is verification or falsification, and since we are not going to verify or falsify any theory we decided not to take this under consideration.
These key choices are summarized in table 2.

	Positivism		Phenomenology
1	Researcher is independent	Vs.	Researcher is involved
2	Large samples	Vs.	Small numbers
3	Testing theories	Vs.	Generating theories
4	Experimental design	Vs.	Fieldwork methods

Table 2. *Key choices in the research design* (source: adapted from Easterby-Smith *et. al.*, 1991)

2.3.1 Involvement of Researcher

The first choice is about whether the researcher should be involved or not in the research process. The traditional assumption is that the researcher is completely independent, and clearly this comes from a philosophical view where it is possible to remain uninvolved. This traditional assumption is that the researcher is completely independent and should just observe the phenomenon.
In social science, which claims that it is hard for the researcher to stay independent, some researchers have turned this so-called problem into a virtue. This is the tradition of action research.

2.3.2 Sampling

The second design choice is whether to attempt sample across a large number of situations in the organization or to focus on a small number of situations and investigate them over a period of time. This is essentially a question of cross-sectional design or longitudinal design. Cross-sectional design usually involves the selection of different organizations or units, and to investigate how different factors vary. To investigate for example the relationships between expenditure on management training and corporate performance you have to select a sample that

represents the level of management training and corporate performance. One then checks if there is any correlation between the variables.
The cross-sectional design has two limitations that are frequently evident. First it does not explain why correlation exists and second it has difficulties eliminating all external factors that could possibly have caused the correlation.
In longitudinal research you focus on a small sample over a longer period of time. Pettigrew (1985)[4] suggests that the researcher should focus on the change process in a broader context. You should gather 'time series data' over a period of time significantly greater than the immediate focus. The disadvantages with the longitudinal design are that it is extremely time consuming and the complexity of data requires very high skills from the researcher involved.

2.3.3 Testing or Generating Theories

The third choice you make when you construct a research design is whether to generate theories or test them. This is again a split between the positivist and the phenomenological paradigms, how the researcher should conduct his or her work. In the first view, the researcher has a theory or a hypothesis about the nature of the world, and seeks data that will confirm or disconfirm that theory.
The advantage of the hypothesis testing is the initial clarity about what is to be investigated. This means in turn that it is easier for other researchers to replicate the study.
In the later case there is an approach called grounded theory, formulated by Strauss, Glaser (1967)[4]. Strauss and Glaser see the key task of the researcher as being to develop a theory through a comparative method. This means looking at the same event or process in different settings. By studying the event in different settings it is then possible to see a pattern. With this pattern as a basis, a theory is then generated.

2.3.4 Experimental Designs and Fieldwork

Experimental designs are some of the key elements in scientific methods, but they are not essentials to positivist methods. In the experimental design the researcher assigns a number of people to an experimental group or to a control group. Conditions for the experimental group are then manipulated by the researcher in order to asses the effects in comparison with the control group, which is subject of no manipulation. This kind of experiments is harder to conduct in organizations where there is no captive population from where to draw volunteers. Some researchers working from the positivist paradigm recognized the difficulties with the experimental design, and thus the quasi- experiment was developed. The classic exposition of this is Campbell, Stanley (1963)[4], where they evaluated a range of designs that made use of multiple measures over time in order to reduce effects of control and experimental groups not being fully matched.
The alternative to experimental and quasi designs is *fieldwork*, which is the study of real organizations or real social settings. Fieldwork could involve positivist methods with quantitative techniques, or it can be much more open ended and phenomenological.

[4] From Easterby-Smith. *et. al.*(1991)

One of the distinctive research styles in fieldwork is ethnography. Here the researcher tries to immersehimself in a setting to become a part of the group under study in order to understand how people react upon their environment.

2.4 Our Design

These are some of the choices that you have to consider to when you construct your research design (see table 2.). When we were studying the different choices, we realized that the phenomenological view supported our research aims best.
The first choice regards the involvement of the researcher. Just observing the people will not help us, we will not find out how people react to this new way of working if we are just looking at them. We have to be *involved,* to make interviews and interpret what they say and think of their situation.
The second choice is whether we will have a big or a small sample. We are going to use a small sample since we are only going to studyAstras´s organization, and this on a corporate level where we are studying the process in a broader view. The *longitudinal* design with a small sample seems most appropriate in this case. We do not gather data over a longer period of time (as the longitudinal design suggests) since this is not possible (due to the limited amount of time), but we still think longitudinal design supports our research aims best.
The third design choice is whether we are going to test theories or generate them. We do not have any theories to test (only a theoretical framework, which supports our phenomenological approach *see part 2.2),* so we will generate our theories from the data we collect from the people we interview.
In phase number four we decided to do a fieldwork. Experimental and quasi methods are more suitable in the positivist paradigm where you are testing a hypothesis. As mentioned earlier, we are not going test any theories so that method will not support our research. We are going to study how people and their use of IS/IT (the architecture) are affected by, and support, the process oriented organization, and with this perspective, the fieldwork method is more suitable to support our research aims.

2.5 Method

The above discussion is used as a framework for our research design, the next step of the research process is the determination of how to gather information. Figure 3 below shows a general view over our research process. We are going to search for both primary and secondary information. When it comes to finding information about process orientation and the IS/IT-architecture, we are partly going to use secondary data sources (this could for example be the Astra Intranet or other internal documents). But, the major part of the information will come from interviews, and therefore, primary data will constitute the main part of our information source.

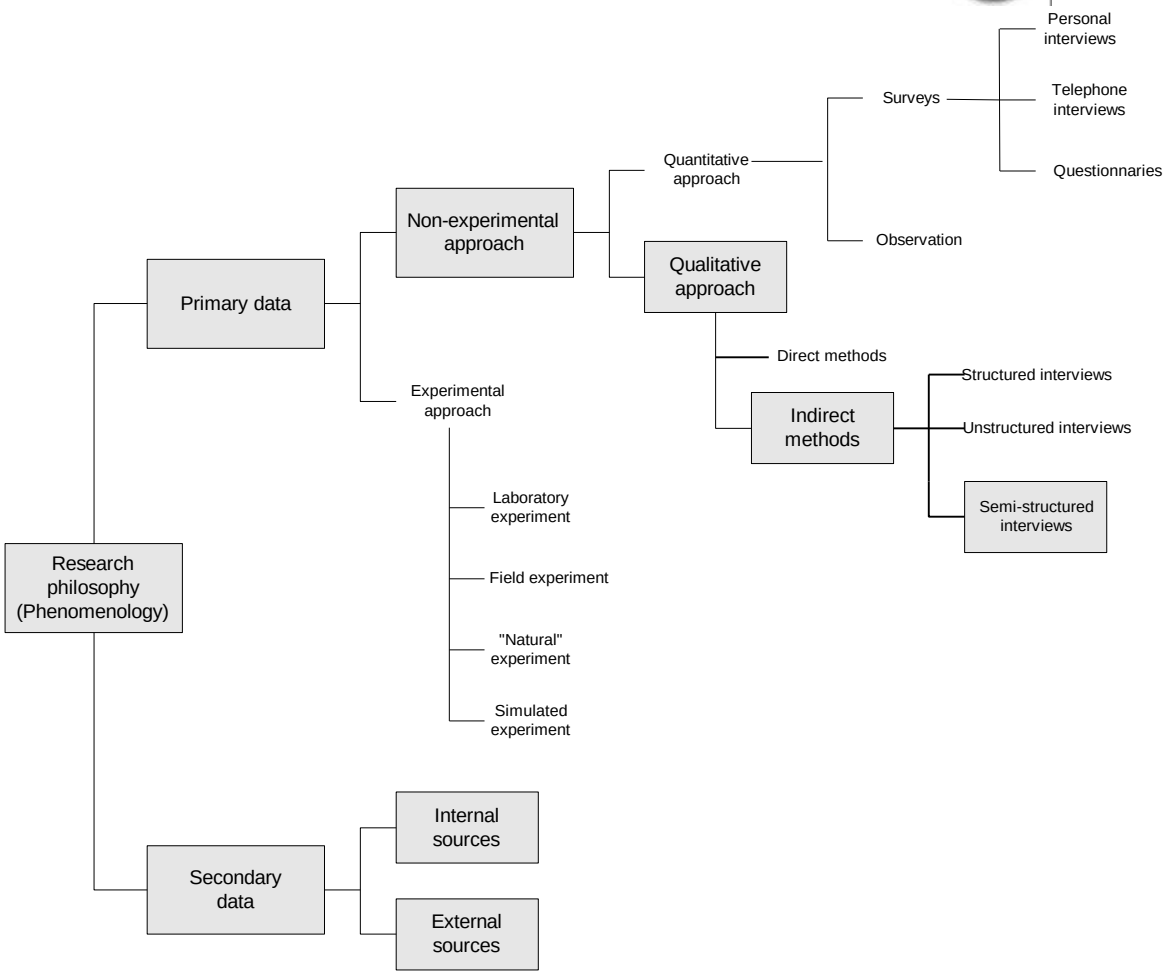

Figure 3. *Information sources and collection methods* (source: adapted from Mårtensson, 1991, p. 143).

Consequently, the technique we will use to gather primary data will mainly be interviews. The next step will be whether we should use an experimental or non-experimental approach. In our case, we are going to use the non-experimental approach, this since we are not going to do any experiments.
In section 2.2 we argued that the phenomenological philosophy was the most appropriate for our purpose. The phenomenological view presupposes a method/technique so you can interpret the information and understand how people apprehend to their situation.
In our research, we are going to study how a process oriented organization affects the use of IS/IT, and how the people apprehend their situation in this new way of working. The qualitative method is the best method to study these issues, since the qualitative method is more appropriate when you seek to describe, interpret, translate and decode the meaning, not the frequency, of a phenomenon in the social world (a phenomenological viewpoint).
The quantitative method, on the other hand, is more suitable for numeric information, for example counting how many times a certain phenomenon occurs (i.e. statistics).

2.5.1 Data Collection

Patel, Davidson (1994, p. 40) discuss that the technique for collecting the data presupposes that the collector knows how the result is to be presented, numeric or verbal. The reality that is under study has to be translated into the chosen type of presentation, i.e. numeric or verbal. Hence, the needed translation puts demand on the technique for collecting the data. With this dependency, it is clear that the technique for collecting data is very important when planning an investigation.
In our case we are going to make a verbal presentation, which means a data collection trough some form of interviews.
Of the most common techniques in the qualitative methods are interviews of different kinds, participation, and/or ethnological studies. There are also a number of less known techniques that provide useful ways of complementing the interviews and give greater insight into how the respondents perceive their world. Some of these instruments are – *critical incident technique, repertory grid technique* and *projective techniques.*
Interviewing is often claimed to be the best method to gather information, it is however very time consuming and its complexityis sometimes underestimated. Interviews can be used in both qualitative and quantitative methods. An example of a quantitative result is when 20 % said this and 10 % said that. In the qualitative perspective, the interviewer is more interested in finding out social settings or how people apprehend their own situation.
There are different ways to construct interviews, and you have to decide the degree of the structure and if the interview should be direct or indirect.Easterby-Smith *et. al.* (1997, p. 75) discuss three different ways to structure an interview; structured, unstructured, and semi-structured. Ekholm, Fransson (1992, p. 9) have an additional view on the method of collecting information. They also split the degree of structure in unstructured and structured (fig. 4), but in addition, they argue that the interviews are either direct or indirect. Direct methods mean that the researcher self observes, while indirect methods denote the use of someone else's observations (accordingly, indirect methods are used in this thesis, see fig. 4).

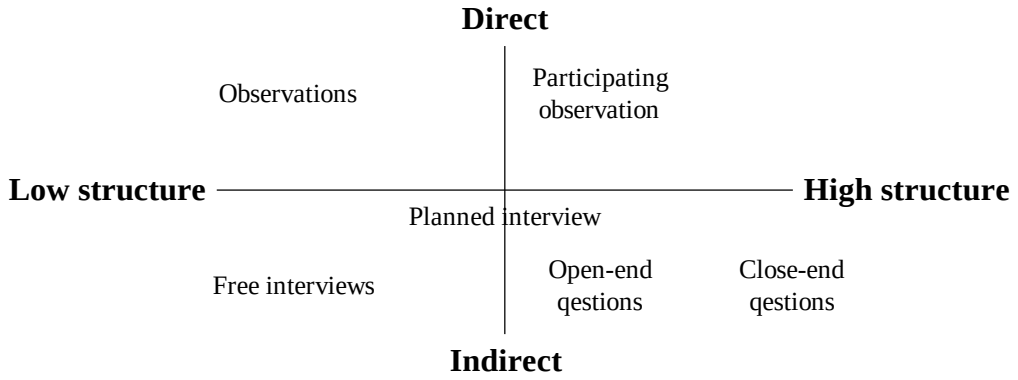

Figure 4. *Different data collecting methods* (source: Ekholm, Fransson, 1992, p. 16).

In the structured interview, the interviewer has prepared a number of questions for the respondent. These questions could be either close-end or open-end questions. In the open-end questions, the respondent could answer more freely to the questions than in the close-end questions. In the unstructured interview, the respondent is allowed to talk freely without intervention from the interviewer.

These non-directive interviews, where the respondent talks freely without interruption or intervention, could give the impression that the interviewer will achieve a clear picture of the respondent's perspective. This is far from true though. They are more likely to produce a non-clear picture in the mind of the interviewee of what questions the interviewer is interested in, and in the mind of the interviewer, a blurred picture of what questions the interviewee is answering. Too many assumptions of this kind will lead to poor data, which is difficult to interpret. In our research at Astra, we are going to try to understand how people apprehend their situation in the process oriented organization, and how they can/should use IS/IT to support it.
Semi-structured interviews, is therefore an appropriate technique in this case (see fig. 4). In our semi-structured interviews, we intend to ask some fundamental questions to a number of people in order to get the big picture of how the process orientation and IS/IT work. These answers will then form the basis for the rest of the interviews.

2.5.2 Analysis of Qualitative Data

Easterby-Smith *et. al.* (1991, p. 105) discuss two different ways of analyzing qualitative data, content analysis and grounded theory. In content analysis, the researcher goes by numbers and frequency. In grounded theory, the researcher goes by feel and intuition, aiming to produce common or contradictory themes or patterns from the data, which can be helpful for the interpretation. In our research, we are going to have a phenomenological approach, and therefore we are going to use the grounded theory to analyze our data. Grounded theory provides a more open approach to data analysis, which is particularly useful when dealing with transcripts. It recognizes the problems with large amounts of non-standard data. We will not follow the grounded theory by the numbers, we will instead adapt it to our needs.

The first thing we do is to familiarize ourselves with the transcripts, this is to get a better picture of the situation at Astra. The next stage is to evaluate if the material supports our research. Does it support our existing knowledge, does it challenge it, what is different, is it different? To find the answers to these questions, previous research has to be taken under consideration. The ideas we have are formulated and reformulated, but they are still at this stage just a "gut feeling". It is also important to define the different phenomenon that people were talking about in the interviews. For example, what do people mean by *flexibility*? Does it mean *mobile work force* or *flexible working hours*?
By now, the conceptual framework and patterns should have become clearer. We will now try to link all the variables that were identified as important into a more holistic theory. This is done by means of linking empirical data together with more general models, and it takes the form by tracking backward and forward between the theoretical framework and evidence collected in practice. In conclusion, we re-evaluate the material to see if there is anything we have missed, or if anything needs to be more worked on.

3. Theoretical Framework

In this part we are going to discuss some theories that we believe are relevant for our research question. We discuss the definition of information systems, theories about IT-management, process orientation, processes, the relationship between process orientation and IS/IT, and IS/IT-architectures. This part contains no discussions about our case, although the entire theoretical framework has relevance for our research question.
How each theory and concept will be used in our study is described in part 3.7 (*Using the theoretical framework).*

3.1 Information Systems

There are a number of definitions of information systems described in the literature. In the following section, we present our definition of an information system, this just to make sure that the readers will have the same conceptual framework.

A number of different definitions of information systems have occurred during times from different authors. The definition you have also depends on what perspective you have on information system.
An information system could be described with a number of different characteristics. These, according to Andersen (1994, pp. 12-13), are;

⇒ That an information system is a human construction.
⇒ An information system has to be connected to a specific task. Andersen argues that one can not talk about general information systems, it has to be made for a specific task.
⇒ It delivers information from one person to another.
⇒ The processing of the information could be either manual or automated. E.g. when a person applies to the university,the application is judged by a human not a machine.
⇒ The processing of the information could be performed in different ways, *gathering, storing, presenting or working.*

Andersen's view is that to be able to understand what an information system is, you first have to understand the two concepts of information and system.
Andersen argues that information is data about actual or imagined relationships. It is important to point out that when you use information you should be aware that it does not have to be correct, complete or truthful.
Andersen defines a system as a pattern or a context including its parts and its relationships. An information system is a system (a pattern) for how to process information (Andersen, 1994, p. 14).
With these different characteristics in mind, Andersen's formal definition of an information system is;

> *An information system is a system for gathering, processing, storing, delivering and presentation of information. (Andersen, 1994, p. 15)*

If we return to the discussion about information again, it could sometimes be considered uninteresting. Information is sometimes lacking intrinsic value which could be shown with the following quotation:

> *…information in itself is uninteresting […] information is only interesting when someone can do something with it, and doing something with it implies more than just handling it of further information. (Denning, Winigrad, 1996, p. 122[5])*

The above thoughts enlighten the action aspect that is related to information and information system. Its clear that the author's view is that information should not just be delivered around, it has to be connected to a meaningful human activity. The information that is delivered has to result in some type of action. In the next section we are going to discuss information systems from an action perspective.

Information Systems from an Action Perspective

Action is a central concept in Goldkuhls (1996b)[6] definition of information systems. An information system, in the context of a data based system, is not just a tool for delivering information, it is also a tool for communicating. An information system is a communications system, not just an information processing system. Communication could in turn imply actions of a specific type that will be executed (Goldkuhl, 1993, p.14)[7]. Goldkuhl criticizes the perspective where information systems are depicted as reproduction metaphors and as tools for describing the reality. Information systems could very well be used to describe and inform, but this view is too narrow according to the author. The action metaphor is more comprehensive, and it shows what the organization is really doing and how it may use the information systems.

Information Systems in an Operational Context

In our study it is very important to observe the information systems from an operational context. Changes in the information systems always influences the operation, e.g. see the following quotation:

> *When new technologies are introduced into a workplace, the work is not just facilitated. The work is reorganized, whether deliberately or unconsciously. (Denning, Winograd, 1996, p. 121)[8]*

This quotation reflects that whether it is intentional or not, introduction of new technologies will affect the work. It is a natural ambition that the information system should simplify the work but it is not always so. Another dimension of this is described below where the focus is on the use of technology;

[5] From Melin (1998, p.49).
[6] From Melin (1998, p.49)
[7] From Melin (1998, p.50)
[8] From Melin (1998, p.51)

> *The use of technology […] leads to fundamental changes in what we do, and ultimately what is human. (Winograd, Flores, 1986, p. xi)*[7]

The change that is described in the quotation, on what is fundamental or not, could vary depending on what level we choose to look at. On an individual level, the use of information systems could change the work situation fundamentally. On an organizational level could the same change be quite undramatic.

Well known models like Leawitts diamond diagram (1964) describes the relationship between technology and work.

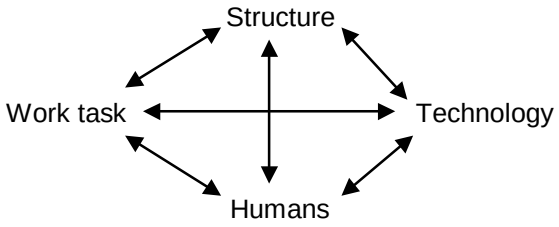

Figure 5. *Relationship between technology and work* (source: adopted from Leawitt, 1964)[9].

The purpose with this diagram is to show the relationship between the different variables that are affected. Based on this knowledge about the mutual dependencies between the variables you can see that it is important to develop structure, technology, work, and humans parallel according to the socio-technical research tradition (Bansler, 1990; Nurminen, 1988)[8].

We believe that these four variables are very important to be aware of when studying the relationships between process orientation, IS/IT, and business processes.

3.2 IT-management

Magoulas, Pessi (1998, p. 44) relate the origin of the term IT-management to the increase in environmental dynamics and rapid technology development which resulted in a situation where long range planning was no longer sufficient. Instead a more continuous process of IT-planning was needed, and so the term IT-management was coined.

This thesis does not really focus on IT-management, but this is still a concept of great relevance, since the purpose of IT-management is to *coordinate IS/IT activities with the business activities*[10].
A useful definition of IT-management is given by Magoulas, Pessi (1998, p. 4) when they say that IT-management is about dealing with issues such as the use of new technology, systems development and maintenance, and strategic exploitation of possibilities offered by the technology. They also include questions about IT-organization and responsibilities, authorities, risks etc.

[9] From Melin (1998, p.52)
[10] Hugoson, M-Å. (1998) from a lecture in the course ”IS/IT planning and management”.

Consequently, this implies that even though we are studying IS/IT-architectures and processes, it is necessary that we also discuss the role of IT-management in this context.
Although our research aims at investigating how to ensure that the IS/IT-architecture supports the business process, it is also necessary to realize that any successful use of IS/IT is critically dependent upon the actions of IT-management, and therefore we want to discuss this topic in this section.
The following figure (fig. 6) illustrates IT-management as the activities by which the business and the IS/IT-architecture match each other.

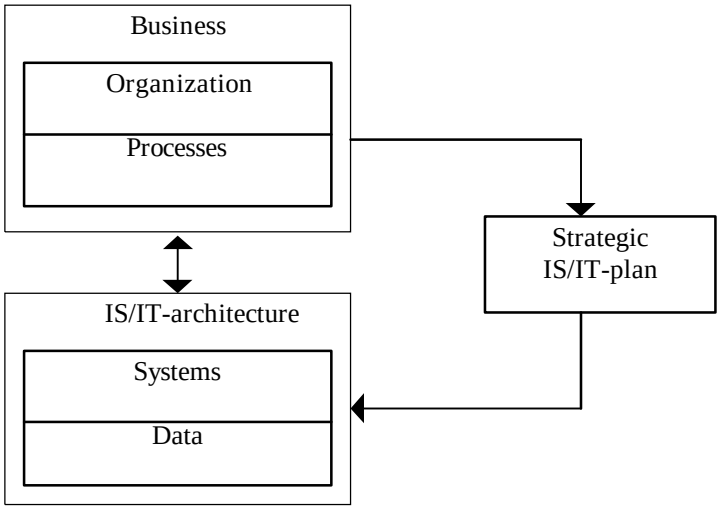

Figure 6. *The IS/IT-management framework* (source: modified from Magoulas, Pessi (1998, p. 222)).

As this picture illustrates, IT-management includes all those activities that aim to create the adequate IS/IT-support for the business.

Willcocks *et. al.* (1997, pp. xix) explain IT-management as the navigation through four IS/IT domains, where each domain represents a specific way that a company might use their IS/IT resources. The four domains are:

⇒ *IS/IT hype.* Here the focus lies on potential capabilities and uses of IS/IT, i.e. all possibilities included.
⇒ *IS/IT capability.* This domain contains those technologies that are available for organizations to exploit today (within reasonable limits).
⇒ *Useful IS/IT.* Now the company focuses only on those technologies and uses that are actually useful, and generate at least some return on investment.
⇒ *Strategic IS/IT.* When a company reaches this domain, it is able to use IS/IT in a way that provides significant rather than marginal contribution to the overall business objectives.

So, successful IT-management, according to Willcocks *et. al.*, will ensure that the organization focuses on *strategic* rather than *useful* IS/IT investments.

3.2.1 The Tasks for, and Difficulties with, IT-management

The use of information technology has been more and more a question of creating competitive advantage, and not only as a means for increased efficiency. Focus on IS/IT is no longer only on systems and databases.
This changed focus means that IS/IT is no longer of interest only for the IS/IT department, but also for management and users throughout the entire organization. What this means for IT-management is that more complex relations exist within the company and that there is an increase in the need to use IS/IT as a tool for competitive advantage. It is no longer only a question of technology. Instead IT-management has to deal with business issues as well as technology issues.
Magoulas, Pessi (1998, p. 45) acknowledge this when they say that IT-management is characterized by an increased focus on business, and that IS/IT´s role has become more of an enabler of business objectives.
They also mention that IT-management is driven by an increased need for flexibility and short lead times in today's organizations.
But, if this business focus should be maintained, top management must be engaged in IT-management. Otherwise, there is a risk that IS/IT decisions are not supported by sufficient authority, and instead of having this business perspective, IT-management focuses too much on technology and systems development.

Considering organizations increased dependence on IS/IT for reaching their business objectives, one can understand that this has implications on IT-management, and Ward,Griffiths (1996, p. 36) discuss this when they describe the dilemma that occurs when a company becomes dependent on IS/IT. The dilemma is that the company requires a *centralized planning approach* (for avoiding e.g. sub-optimization) and *a decentralized technology control* (in order to facilitate a creative use of IS/IT), i.e. both high *diffusion* and high *infusion* (see part 4.4).
This situation calls for a complex set of IT-management approaches, and one way to deal with this is to adopt *Earl´s multiple methods* (Robson (1997, pp. 190)).
This means an IT-management approach that is very flexible and adaptable in order to satisfy the needs of the entire organization, and focuses simultaneously on both IS/IT and business.

The main difficulty with IT-management is to be able to ensure that information is available wherever it is needed (Magoulas, Pessi (1998, p. 48)).
Another aspect they mention is the technological one. IT-management becomes a highly complex task because of the rapid technological development, which in turn leads to difficulties when trying to predict what IS/IT solutions to adopt (1998, p. 84).

Hugoson[11] also mentions roles and responsibilities as two major difficulties that IT-management has to deal with.
In addition, he argues that IS/IT projects *must* be coordinated with the processes, since a new system without matching operations is useless (see fig. 7 below).

[11] Hugoson, M-Å. (1998) from a lecture in the course "IS/IT planning and management".

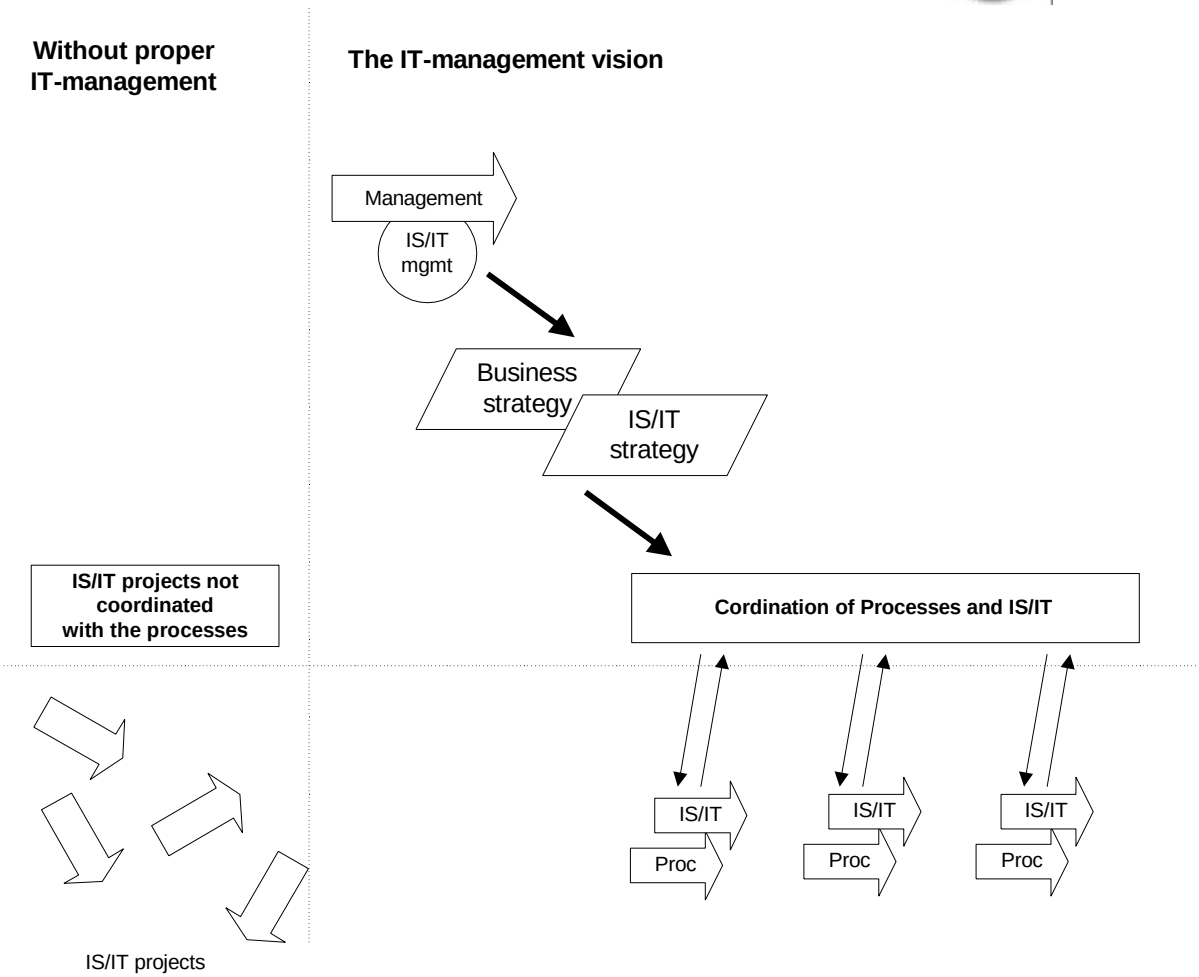

Figure 7. *Coordination of IS/IT and processes* (source: modified from Hugoson[12])

To ensure this coordination, Hugoson recommends that; first, the processes are delineated (IT-management is partly about documenting the business); second, the processes are completed with the flow of information; third, break down the processes (to get to the operational level); and finally, begin to work with the systems structure.

[12] Hugoson, M-Å. (1998) material from a lecture in the course "IS/IT planning and management".

3.2.2 Guidelines for IT-management in a Process Oriented Organization

Smith *et. al.* (1995, pp. 612) have investigated how IS/IT should be managed in order to support the processes. To get an idea about how this should be done, a group of senior IS/IT managers were asked about their opinions in this matter. The group consisted of participants from ten leading Canadian firms representing five industry sectors (retail, manufacturing, banking, communications, and insurance) and another ten leading U.S companies representing seven industries (manufacturing, chemical, communications, insurance, higher education, healthcare, and federal government).
These discussions resulted in six practical suggestions for IS/IT managers trying to develop a process oriented IS/IT architecture (see table 3. below):

	Guidelines for process oriented IT-management
Benchmark development	It is a requisite to develop systems faster, with higher quality, at lower cost, and with fewer people. Therefore, the following benchmarks for applications development are suggested: - speed of development; e.g. project cycle time ("time to market") - cost of development - development productivity; e.g. function points per person/month - quality measurements; e.g. number of defects per function point
Invest wisely in technology	Realize that new tools such as CASE and 4G languages are not panaceas for systems development problems and often, proven technology is more cost-effective to implement. Therefore it is not always appropriate to invest in the newest IS/IT solutions (although it might be appealing to IS/IT staff).
Adopt a single application system image	A single system imagesaves both developer and user time to adopt; i.e. standardized look and functionality for all systems within the process. Access to systems is standardized and function keys are the same. A single system image promotes shared program modules and common data elements across systems.
Reuse existing software	The fastest application development generally occurs when applications are created from pre-existing designs or building blocks. Reuse of software also includes packaged software. Unfortunately, many IS/IT staff considers packaged software being undesirable, and therefore, many hours are spent developing systems for which packages are readily available.
Evaluate procurement practices	The larger and more decentralized the company, the higher the likelihood of finding inefficient procurement practices. Vendors consider these companies as easy mark, and can use a strategy of "divide and conquer", selling to the individual parts of the company all over the organization.
Standardize platforms	Non-standard platforms cause large expenses, so it is recommended that a standardized platform be selected from which all systems should operate. The platform should provide options, but limit the amount of infrastructure required to maintain it. Systems that uses non-standard platforms should be able to migrate onto the standard platform within a reasonable time frame.

Table 3. *Suggestions for managers developing a process oriented IS/IT-architecture* (source: adapted from Smith *et. al.*, 1995, pp. 612).

As we mentioned in the beginning of this section, IT-management is not the main focus in this thesis. But we chose to discuss it anyway because it is necessary that the reader get an understanding of the concept, since any IS/IT-architecture we may discuss or suggest throughout this paper will depend on an appropriate IT-management approach. Without proper IT-management it is not possible to realize an architecture, however good it may be.

3.3 Processes and Change Concepts

In the world around us the environment is changing more frequent and more radical than before. Therefore, organizations are spending more and more resources on different concepts for changing the organizational structure.
Some of the modern concepts are Business Process Reengineering, TQM, Kaizen, Time Based Management and lean production. TQM and Kaizen are different from BPR in that TQM and Kaizen advocate continuous improvements, whereas BPR is more radical. Normally, companies do not use just one concept, it is often a mixture between radical and incremental improvement.
Since process orientation is a concept of current interest withinAstra, we are going to focus on this in our study. First we give a brief introduction to *TQM, Kaizen, innovation, BPR*, and then a more thorough one on *process orientation.* The purpose with this section is not to give a complete definition of the process concept, it should more be seen like a familiarization of the subject.

3.3.1 Incremental Change

Total Quality Management.
Davenport (1993) notes that *Quality management,* often referred to as total quality management (TQM) or continuous improvement, refers to programs and initiatives that emphasize incremental improvement in work processes and outputs over an open-ended period of time.
Modern quality thinking is however not really about building products that are durable, as it is about constructing according to the rules. This means that quality is a measure of how well we can fulfill our task. Total Quality Management is an organizational theory that tells us that if we make every thing right from the start, then the final result will be right as well. The problem with this is that even a poor product could be made with perfect quality. One could make a lifejacket out of concrete just as long as the proper procedures are being followed.

Kaizen
Kaizen is a philosophy that originates from Japan. The word comes from the two words: *Kai*, meaning ‘change’, and*zen* meaning ‘good (for the better)’. So Kaizen means continuous improvement, and as applied to companies, it means small steps in the right direction to improve the workplace. The underlying principle is that internal and external customers should drive the change process, and it should involve everyone through a systematic and open communication. Kaizen emphasizes fast, constant, and practical improvement. There is less emphasis on defining and measuring quality than in TQM efforts. A usual way to practice Kaizen is to encourage the employees to come with suggestions about how to improve the workplace. Focus on the customer is important in Kaizen.

3.3.2 Radical Change

Innovation
Innovation in this context is when an organization can reach improvements by leap, or discontinuously by breaking down established structures. Innovation is often put into contrast to continuous improvements. These two however does not have to exclude each other as described in Kaizen (Imai, 1986, pp.25)[13]
Below, a change concept is described where innovation is an important feature together with business and process orientation. The change process has its starting point from two articles, Hammer (1990) and Davenport, Short (1990). According to Melin (1998) did the authors not invent anything new, the just put a label on a concept. One of the explanations to why Hammers article gained such reputation was that he used new, provocative, word combinations like *"reengineering works"*, he also published the articles in the right time (Melin, 1998, p. 65).

BPR, Business Process Reengineering
Business Process Reengineering could be seen as a reaction from the productivity crises that many companies experienced in the beginning of the 90's. These new and radical changes came as an answer to the continuously improvements which was described as not enough. According to Hammer (1990) and Hammer, Champy (1993), the principle for this concept is that several jobs should be put together and combined into one, despite the boundaries that existed between the departments. Companies that undertake reengineering, not only compress processes horizontally but also vertically. In situations where workers normally went up in the managerial hierarchy to get answers, they now make their own decisions. (Hammer, Champy, 1993 p.53) argue that the workers should make the decisions themselves in this new decentralized organization. BPR means going back to the beginning and inventing new and better ways of doing work.
A more formal definition from Hammer and Champy (1993) is:

> *"The fundamental rethinking and radical redesign of business processes to achieve dramatic improvements in critical contemporary measures of performance, such as cost, quality and speed. (Hammer, Champy, 1993, p. 40)*

From this definition, Hammer and Champy emphasize four key words: *fundamental, radical, dramatic* and *process.*

Process innovation originated from about the same time as Business Process Reengineering (Davenport, Short, 1990 and Davenport, 1993), and in many aspects it was identical to the BPR concept according to Hammer. Process innovation is, like reengineering, about designing new ways of how to work. There are however some differences. Process innovation or Business Process Redesign as it also is called, is generally considered to advocate less radical changes in the processes than BPR.

[13] From Melin (1998, p.65)

Critics Towards Radical Change

When this kind of radical change concepts are presented extensive critics is often formulated, so in this case. Keen, Knapp (1996, p. 59) vindicate that against the ideal BPR is advocating that the organizations are centralized and workers lose their jobs. In contradiction to what Hammer andChampy advocate, the employees get less freedom of act and authority according to Keen (1997, p.150).
Even Hammer (1996) admits that the process concept is more important than the radical changes. Hammer and Davenport also later realized that it is not that easy to start from scratch, companies have to consider the old systems in the company which Davenport also have commented;

> *It is easy to suggest that firms ignore existing systems and technology infrastructure in designing a new process, but it is seldom realistic to do so. Existing systems are often too expensive, complex, and embedded in an organization to simply assume them away. (Davenport, 1993, p. 63)*

3.3.3 The Process Concept

The process concept is a central part in both innovation (BPR) and TQM, although the major difference is whether you want a radical change or an incremental improvement. Processes are not new, according to Hammer (1996, p10), they have always existed, often broken down into small invisible activities.
So why focus on processes? One reason is that the processes are able to see across the boundaries of the departments, the process will give a comprehensive view over what is going on in the organization.
Bergman *et. al.* (1995, p.2)[14] identify five different reasons why a process view is preferable; *to focus on customers, create conditions for incremental improvement, to structure work, optimize processes* and *to better understand the organizational complexity.* Processes however are not only good, when a company is changing into a process oriented view, it also has to cope with conflicts like roles and responsibilities.

What is a Process?

The fundamental thought with a process in process orientation is that it should deliver something of value to the customer (Hugoson, 1997, p. 3). Both Hammer, Champy (1993) and Davenport, Short (1993) have similar ideas that one should take a customer view. The objective with process orientation is to give a comprehensive view of all different activities in the organization, and to form structures for the workflow (Melin, 1998, p. 73). If you have the whole picture of what is going on in the company, it is easier to see which activities that are adding value to the customer. The process perspective means that the company has a customer philosophy where the focus is on customer needs. Davenport and Short argue that a process-oriented perspective also denotes that you have to create a balance between product and process investment (Davenport, Short, 1993).

[14] From Melin (1998, p.72)

A more formal definition from Hammer is:

> *a collection of activities that take one or more kinds of inputs and creates an output that is of value to the customer (Hammer, Champy, 1993, p. 35).*

Keen, Knapp (1996) distinguish two different perspectives on business processes, they are;

⇒ Workflow, a number of activities whose purpose is to produce a value to the customer
⇒ Coordination of work, a number of properties and routines whose purpose is to coordinate work between workers and create something that is hard for the competitors to imitate.

Keen (1997) argues that the workflow perspective is the dominating one in BPR and TQM.

Davenport (1993, p. 5) can also be classified as belonging to the workflow perspective with his definition;

> *…a process is simply a structured, measured set of activities designed to produce a specific output for a particular customer or market. […] A process is thus a specific ordering of work activities across time and place, with a beginning and an end and defined inputs and out puts: a structure for action.*

One can see on Davenport's quotation above that he has a strong focus on *how* work is being done in the organization rather than on *what* is being done. As a comparison, TQM focuses more on the process, which describes inputs and outputs.

The symbol that is often being used to describe a process is an arrow pointing towards the customer (see fig. 8). The process deliverers either products or services, and in most cases information as well. If there is no customer, there is no process, and if nothing is delivered, then the process is rather useless. It is not necessary that the process delivers to the principal i.e. principal and customer is not always the same thing. In the other end of the process there is usually a supplier who supplies material to the process.

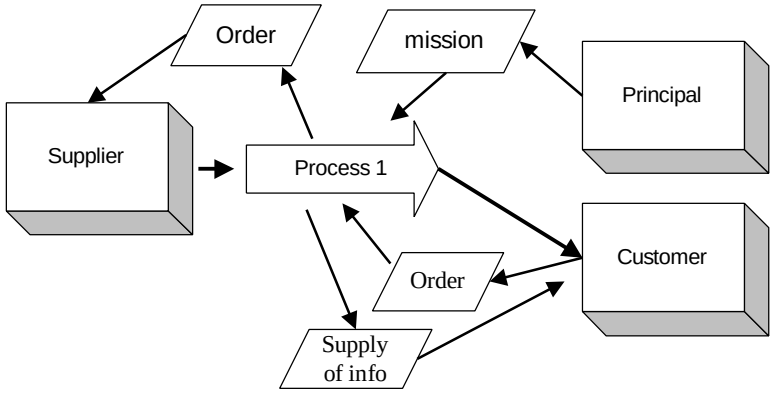

Figure 8. *Processes* (source: modified from Hugoson, 1997, p. 4).

The material that the supplier provides the process with could be provided by either *push* or *pull*. If the process orders material from the supplier, then it is pull. If the supplier delivers without an order from the process, then you have a pressure (push), and the process can not be responsible for queues and other faults that may occur (Hugoson, 1997, p 5).

The activities inside the process are consuming resources of different kinds, for example, raw material or human labor. *Products*, *activities* and *resources* are the three essential elements in the process (Bergstrand, Wallin, 1995, p. 56).
If process 1 (see fig. 9) does not have all the resources needed by itself, it could use a contract manufacturer for help. The contract manufacturer could for example produce certain parts of the product and deliver to the main process.
Although process 2 has a responsibility towards the main process, the main process still has the overall responsibility towards the customer. This means that you have to make a very strict agreement about how and when the product/service should be delivered.

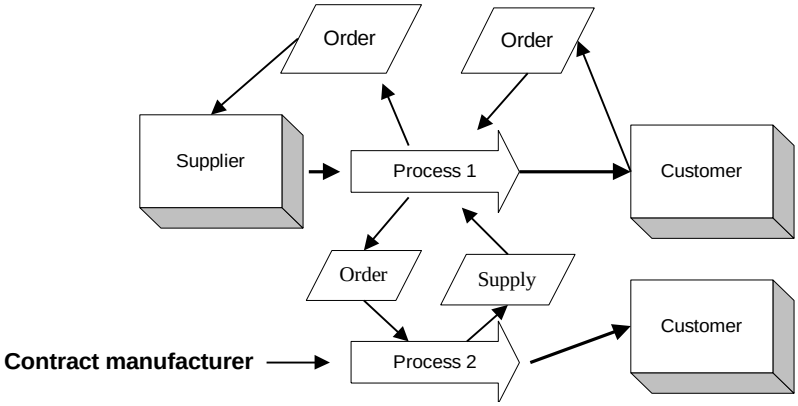

Figure 9. *Supply of external resources* (source: adapted from Hugoson, 1997, p. 11).

Another characteristic for process orientation is that it cuts across organizational boundaries (see fig. 10). When the interfaces between the departments are de-emphasized, products and services can float freely over the boundaries parallel with information as support. The processes gather recourses that are necessary for completing the tasks from the different departments. The different departments

provide the process with recourses, training and other competencies that are needed. There should be a person (a process manager) within each department that is authorized to provide resources to the process, but he does not have any responsibility for what the process actually produces (effectiveness).

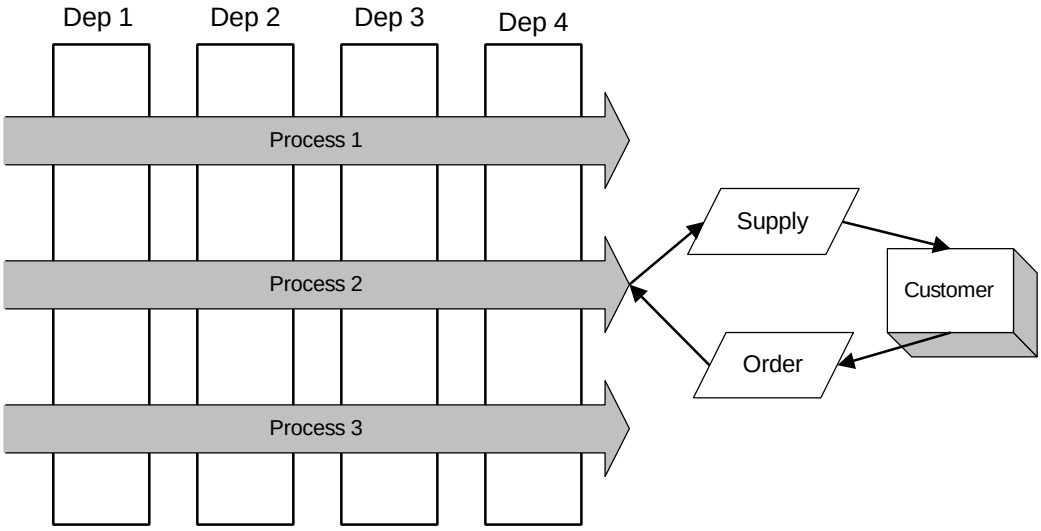

Figure 10. *Across organizational boundaries* (source: Hugoson, 1997, p. 8).

Except from contract manufactures, main processes could also be divided into sub-processes (Bergstrand, Wallin, 1995, p. 64). Not all processes meet the external customer, but they should always deliver a value to the customer. The internal processes should be motivated by an ennoblement value, so that the main process that faces the customer performs as well as possible.
Along with an increased number of sub-processes, there is a need for a description of the cooperation between the processes. Changes in one process could result in a domino effect and affect other processes. For example, customer order initiates production order, which initiates a purchase order etc. The more processes that the organization has, the more important it is to have a process map where you can see how the different processes are cooperating. When several processes are cooperating with each other, the need for coordination is even more important. When a process is reaching over different departments it is very important that there is a process owner who has the overall responsibility. If there is no process owner, the risk is very high that each department is optimizing its part of the process without thinking about the other departments (sub-optimizing). It is also the process owner's responsibility to ensure the overall effectiveness of the process (compare this with the responsibilities of process manager mentioned earlier).

Different Kinds of Processes
There are, according to Bergstrand, Wallin (1995, p. 63), two basic process types, namely *refinement processes* and *change processes*.

Refinement processes are those where the products/services are actually produced, and there are four different types of refinement processes:
⇒ Core processes, i.e. where the businesses main products/services are produced.
⇒ Investment processes, i.e. processes that result in the product investment and later used to support or be consumed by the core processes.

⇒ Support processes, e.g. maintenance of systems and machinery.
⇒ Steering processes (management processes): used by management for guiding the different activities towards the business objectives. This process differs from the other three since it is "two-way". In one direction go "as is"-values (e.g. measures of economy and quality), which result in the product *"to be"-values* (i.e. the desired situation). In the other direction are these "to be"-values a resource that results in the product *satisfying "as is"-values.*

A characteristic for these four processes is that they *consume resources* and they *refine*, i.e. they contribute to the final product/service that the business distributes to its customers.

Change processes are processes that shall guarantee that appropriate technology, competence, routines, etc., are available in order to produce the product/service. A change process must be continuous, since the company is constantly facing new demands. Examples of such demands are increased speed and flexibility within the refinement processes, shorter product life cycles, etc.

As a conclusion, all companies must focus on both their refinement- and change processes in order to be successful.

3.4 IS/IT and Processes

> *"It was easy for IS professionals to understand that the business had to change…It was harder for them to understand that they had to change" Moad (1993, p. 22).*

This part discusses the relationship between process orientation and IS/IT. It is quite obvious that such a major change as a transformation from functional structure to process oriented structure will have consequences for IS/IT, and that IS/IT will have to deal with these in order to support the new organization in a proper way.
For example, according to Zeibig (1995, p. 666) will a process oriented organization raise new questions of priority and put new demands on the existing IS/IT-architecture capabilities, challenge traditional roles and responsibilities, and increase the demands on the IS/IT delivery process.
This organizational structure is a more complex and dynamic one than the traditional functional structure, and therefore IS/IT will have to develop and adapt itself in order to handle those significant impacts that a process orientation might generate.
Smith *et. al.* (1995, p. 612) also acknowledge this when they say that IS/IT often is seen as the "crucial enabler" that is needed for re-engineering the organization, which eventually will lead to dramatic improvements in cost, lead-times, etc. (those things that a process orientation aims for). But, these "crucial enablers" also have to be process oriented themselves in order to be effective in the new organization, otherwise the IS/IT function might be considered poor and outsourced to an external company.

To avoid situations where IS/IT is not changed in the same way as the organization, or not changed at all, it is necessary to be aware of the impacts that process orientation has on IS/IT and what can/must be done to handle the situation.
The following discussion will focus not only on IS/IT-architecture, but also on roles and responsibilities since the concept of process orientation raises issues about new skills, responsibilities, etc.

3.4.1 Process Orientation with Different Scopes and Different IS/IT Delivery Strategies

Depending on the scope, the implications on IS/IT will vary. One classification that can be used to define the scope of the process orientation is to decide whether it is *intra-functional, inter-functional,* or *inter-organizational* (Ponce-de-Leon *et. al.* (1995, p. 187)).

⇒ Intra-functional: processes that are aimed at single and isolated tasks, activities, or single functions.
⇒ Inter-functional: processes that target cross-functional activities, but are contained within a business unit.
⇒ Inter-organizational: process orientation projects that bridge between two or more business units.

(We will not consider intra-functional process projects in this study)

There is a relationship between the process orientation scope and the IS/IT delivery strategy, and the delivery strategy can be, according to Ponce-de-Leon *et. al.* (1995, p. 188), either *adoption, adaptation,* or *customization.*
This means that organizations can rely on off-the-shelf IS/IT solutions, develop in-house, or balance both strategies to create the IS/IT needed to support the business processes.

⇒ **Adoption**: purchase of an off-the-shelf or standardized prepackaged software that requires little or no modification.
⇒ **Adaptation**: purchase of packaged software that serves as the backbone of the application requiring partial customization to the processes.
⇒ **Customization**: the organization undertakes a development effort to build the necessary applications.

Delivery Strategies in Inter-functional Projects

The alternatives ranges from buying from a vendor to develop in-house, i.e. at one end there is a vendor driven strategy where the business process is built up around the prepackaged software. This is possible in situations where the process is not unique to the company, and IS/IT solutions are available on the market. In this case the vendors application becomes the solution but also the constraint, and this is because the solution is specific to the task or focused on an industry (this is called *vertical market application*).
IS/IT personnel have a leading role in this kind of IS/IT delivery strategy because the selection decision is responsible for ensuring compatibility between the applications and the requirements of the process.
When there are processes that require adaptation of prepackaged solutions, the choice falls on horizontal market applications (as opposed to vertical).

At the other end of the delivery strategy there is customization of IS/IT solutions, and the more unstructured and complex the business process, the more it will require customization (or at least adaptation).
Customization is the preferred alternative when the solutions available on the market do not meet the requirements of the process orientation, and the necessary skills can be found within the organization. The effectiveness of the IS/IT team in developing the IS/IT solutions largely determines the chance of success of the process orientation project.
In these projects both IS/IT personnel and users take an active part. The users have great knowledge about the processes and their needs, and the IS/IT personnel take the role as advisors, both as experts in available technologies and as systems developers.
Ponce-de-Leon *et. al.* (1995, p. 197) mention that an advantage of this delivery strategy is that both teams (users and IS/IT) constantly interact during the process orientation project, which increases the chances of success. A downside is the cost associated with assigning a group of programmers and systems analysts to work full-time with the development of the IS/IT solution and the likelihood of running over time and budget.

Delivery Strategies in Inter-organizational Projects
With this wider scope IS/IT delivery plays a very important role since this kind of process orientations affects the entire organization by cutting across several business units, and, as Davenport (1993) says, the interaction between processes, IS/IT, and business strategy is a crucial one. IS/IT is an enabler of both *implementation* and *effectiveness* of process orientation.
Also in this case, the available choices range from off-the-shelf to in-house development, and again it is the scope and organizational resources required by the process orientation project that determines whether it should be adoption, adaptation, or customization.
According to Ponce-de-Leon *et. al.* (1995, p. 200) is the typical role of IS/IT personnel in these situations one of business wide expert advisors in IS/IT matters as well as implementers and providers of support.
If it is decided to by prepackaged solutions, then the IS/IT function is to be responsible for evaluating and selection of the applications that best fit the processes, i.e. they are a key resource to the project.
At the other extreme, with the internally developed IS/IT solutions, the complexity increases and these delivery strategies require detailed planning and assessment of resources needed, time, and coordination. Many experts suggest careful consideration before choosing the strategy of customization in inter-organizational process orientation. Greenbaum (1993, pp. 36-44) recommends consideration of the following:

⇒ the business needs
⇒ the programming skills of the IS/IT organization
⇒ the cost of maintaining technology
⇒ the need for added functionality and flexibility of the applications
⇒ the workload involved
⇒ the risk of failure

⇒ the required training and flexibility of the IS/IT organization
⇒ the time it will take to develop, test, and implement
⇒ the degree of portability between platforms
⇒ who will manage the application?

To end this discussion about the scope of the process orientation and the corresponding IS/IT delivery strategy, we can conclude that the choice between buying or building is a difficult one.
The possibilities range from *cross-functional adoption* to *between business units-customized* solution, and each has its own implications for IS/IT, which should be considered in detail before making a choice.
It is clear though, as Ponce-de-Leon *et. al.* (1995, p.205) argue, that the decision to buy, adapt, or internally develop IS/IT hinges not only on the capabilities of the organization but also on the available time, costs, risk preferences etc., so all factors must be considered when planning for the IS/IT delivery strategy.

3.4.2 The IS/IT Professionals Role

The concept of process orientation has risen numerous points of disagreement regarding philosophies, methods, and techniques. One of these is the role of IS/IT professionals, both during the transition from functions to processes and after completion of the process orientation.
Almost everyone agree that IS/IT personnel plays an important role in ensuring the proper IS/IT-architecture for the process orientation (i.e. everyone except external consultants), and here are some theories and arguments about what the appropriate role of IS/IT personnel in process orientation should be.

IS/IT Personnel - Excluded andExpelled

Even though the great importance of IS/IT in process orientation, it happens that internal IS/IT personnel are left out of the projects or involved too late (Markus, Robey (1995, p. 593).
This may of course result in a process orientation without the necessary IS/IT-architecture to support it, but there must be a reason for this.
The main reason is that management often tend to believe that IS/IT personnel:

1. Do not understand the business and cannot describe technological issues in business terms.
2. Do not see value in change proposals that do not involve systems.
3. Try to turn process orientation projects into system development projects.
4. Are so preoccupied with the limitations of current IS/IT and the difficulties of changing it that they reject innovative proposals made by others within the organization.
5. Cannot produce modifications or new solutions in the time required by company management.

(adapted from Grover, Kettinger (1995, p. 593f)).

Another problem that might occur during process orientation projects is that of sub-optimization, and this is not only a problem within IS/IT but in all functions of the organization. What happens is that each function tries to optimize its own specialty, believing that this will make the greatest contribution to the process

performance. For example, strategists focus on market share, human resource managers focus on quality of work life, accountants on costs, and IS/IT specialists on data quality, etc.
These are problems that have to be dealt with in order to have an effective IS/IT support to the process orientation.

To avoid this situation, where IS/IT personnel fails to collaborate effectively with other parts of the organization, Markus, Robey (1995, p. 606) suggest that IS/IT specialists possess the following knowledge and skills:

⇒ Knowledge of the business, i.e. familiarity with the industry and the firms business strategy.
⇒ Communication skills, i.e. ability to listen and to describe technologies in business terms.
⇒ Consulting skills, i.e. ability to enter into a collaborative relationship with non-IS/IT staff.
⇒ Change management skills, i.e. ability to diagnose resistance and deal with it.
⇒ Organizational systems integration, i.e. ability to integrate information systems development and implementation projects with other dimensions of the organization.
⇒ Knowledge of non-IS/IT approaches to organizational improvement, i.e. such things as cost control, human resources management, organizational development; understanding of the strengths and weaknesses of each etc.
⇒ Knowledge of the concept of process orientation, i.e. ability to describe, document, and analyze business processes, awareness of the risks of sub-optimization.
(modified from Markus, Robey (1995, p. 606)).

By having these skills, reflecting the spirit of collaboration rather than technical expertise, Markus, Robey (1995, pp. 604) argue that the chances of developing appropriate IS/IT support for the processes are increased significantly.

3.4.3 Process Orientation Impacts on IS/IT

A process orientation will affect the existing IS/IT and call for some changes to support the new organization. Zeibig (1995, p. 655) discusses how historically, most IS/IT applications have been built to match the needs of the functional departments they support. It is then no surprise that a cross-functional process orientation will show some inadequacies of this IS/IT-architecture, and these inadequacies include:

⇒ Lack of inappropriate functionality to support the needs of the process.
⇒ Conflicting definitions of information and data elements.
⇒ Inability to provide information to the right place, and on time.
⇒ Incompatibility of technologies, i.e. lack of standards.

Teamwork and empowerment are often both consequences and prerequisites for process orientation, and this implies that the need for easy access to information increases, since decisions oftenare expected to be made in a decentralized fashion. In addition, requirements for ”meta-information”, or information about the process

and its performance, also increases, since this information is crucial for ensuring proper workflow coordination.
This will of course put greater demands on the IS/IT-architecture, and calls for action within the IS/IT departments throughout the organization.

Zeibig (1995, pp. 658) describes five major impacts that process orientation has on IS/IT, along with the appropriate strategies to deal with the impacts:
The first one is **impact on IS/IT capabilities** This is something that organizations come to realize when they have IS/IT-architectures that are designed completely without realizing that the future shape and structure of the company will most likely be quite different from the original one that the architecture was designed to support. The consequence of this is that the company does not have the needed IS/IT capabilities for a process-oriented structure.

The strategy to deal with/avoid this situation is to adopt a ”plug-and-play” modularity, which means a design principle that ensures the ability to quickly and easily add new capabilities.

The second is **impact on IT infrastructure** and this is a part that often must bear considerable impact as the result of a process orientation initiative. Capacity implications are perhaps the most obvious since processes may require higher degree of availability, reliability, and throughput (this is especially true if external units are to be integrated into the new design).
Even the service provided by the infrastructure- telecommunications, data storage/retrieval, transactions, etc.-may be affected by the process orientation. Another issue is that of compliance with technical standards and compatibility of components/applications.

Here the strategy is to design the infrastructure based on its service contributions to IS/IT capabilities and business objectives. Servicelevels, capacities and constraints, as well as appropriate standards, must be clearly delineated.

The third one is **impact on the IS/IT delivery process** Along with the process orientation come heightened expectations on the benefits from the business community, and this has implications for IS/IT. The delivery of new functionality will be demanded in terms of days and weeks instead of months and years. Time is money, and the company cannot afford to wait too long before a new system comes on-line. This means that the delivery process must change from traditional methodological life cycle to a much more fluid, interactive, ”build-as-you-go” process.
If IS/IT delivery fails, then the benefits from a process orientation may not occur.

The strategy for the delivery process includes the earlier discussion of build versus buy, and vendor relationships should be strengthened since they might be valuable resources. Do not define success in terms of application code tested and delivered, but rather in terms of ”average time from customer order to shipment received” or ”percent of increase in customer satisfaction”.

The fourth is **impact on IS resources**, and this is a result of new technologies and development processes being identified through the process orientation that demands not only technical skills, but also managerial and organizational skills. Interpersonal skills such as group facilitation and negotiation are also often required.
Some of these skills are often short in supply, since they have not been part of the IS/IT job description until now, and this lack of qualified resources often results in outsourcing.

The strategy for handling this is to ensure significant breadth and depth in interpersonal, managerial, and business skills as well as advanced technical skills. Also, capabilities in the user community should not be underestimated.

Finally, it is the **impact on the IT management process**. During a process orientation project, it is possible to overlook the fact that most of the organizations IS/IT resources are already committed to some purpose. Because of the massive developmental and architectural requirements put on IS/IT in process orientation, the question of priorities and resource allocation becomes very important, the resource allocation and prioritization that is ensured by effective IT management.

The strategy for this dilemma is to let the IT management process be part of the organizations business management process. Also, a clear definition of the expected benefits and an orientation towards their achievement is the most powerful means for clarifying the priority and resource allocation issues that inevitably arise.

As a conclusion, these impacts and their corresponding strategies indicate that best practice is to be built on a shared understanding between management, the business community, and the IS/IT function.

3.5 IS/IT-architectures

We have already given our definition to these terms (see part 1.4), but now it is time to discuss them in more detail. For example, *why architecture*?, *what are the driving forces that create the need for an architecture*?, *is the architecture appropriate?* etc.

Considering our definition of IS/IT-architectures, one sees that this is the result of some planning, and not something that just exists in an organization using IS/IT. But what is it that determines the shape of the architecture?

> *Systems that are centered around the basic business of a company are more stable and elastic than systems based around a piecemeal collection of requirements (Inmon, 1986, p. 1).*

To achieve this (in our case, to coordinate the IS/IT-architecture and the processes), Inmon suggests that one uses a *business model.* A model which describes the data and the processes of the business, and which changes only as the nature of the business changes. It is this model that then determines what the IS/IT-architecture should look like.

But, to be useful, this model must be able to communicate to the non-IS/IT parts of the organization, define the data in a way that represents the actual usage of the data throughout the business, define the processes (at all levels), and, to represent the company's business in its most basic form.
According to Inmon (1986, p. 4) the business model should result in an architecture where systems are tightly interwoven and without any overlap (almost like a jigsaw puzzle).
If the architecture shall be appropriate, the business model must possess certain characteristics, and these are:

⇒ Data keys are defined globally; i.e. in a bank a customer of one branch can be identified at another branch.
⇒ Wholesale redundancy is reduced; i.e. any data element is defined in a single place.
⇒ Compatibility at critical interfaces; i.e. functionally different, but related, systems must be able to communicate.
⇒ There is an ability to communicate from one data process to another; i.e. as data is processed and its value changes, the results are known throughout all systems, not just the system doing the processing.
⇒ Representation of the business processes exists at the most basic level; i.e. only the processes most important and critical to the business are the focus of the business model.

But, in order to establish the desired architecture, the management approach must change from the traditional local one, where the needs of each user are considered being independent of any other user, and the applications are developed with this in mind (see fig. 11 below).

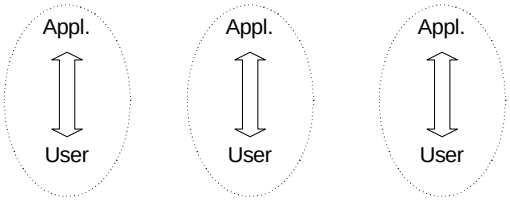

Figure 11. *Local approach to IT-management* (source: adapted from Inmon, 1986, p. 3).

Instead, since the business applies to all users, so is the business model, and therefore the management approach must be global when the architecture is created. This approach is illustrated with the picture below.

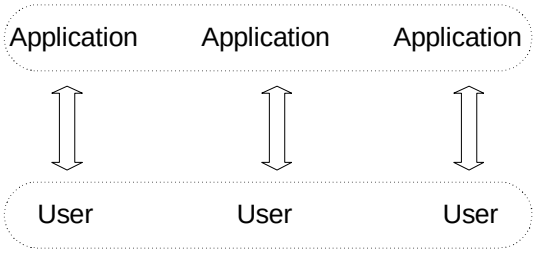

Figure 12. *Global approach to IT-management* (source: adapted from Inmon, 1986, p. 3).

It is worth noticing that although necessary, the global approach can sometimes be resisted, mainly because it requires organizational change and often questions the areas of responsibility of the users.

Inmon (1986) argues that by using a business model as a foundation, architectures can be built and maintained in a way that is aligned with the overall business. Note that the business model focuses on the *definition* of the architecture, *not the implementation.*

Tozer (1996, p. 220) also discusses the use of a business model as a foundation for the architecture, and according to him, the business model is the result of a business analysis. This model consists of:

⇒ the functional structure of the business, which is useful when assessing options for process support- e.g. BPR;
⇒ process schematic;
⇒ organization and responsibility definitions;
⇒ information and resource flows;

The usefulness of a business model that directs the creation of an IS/IT-architecture can be illustrated with the term "city-plan"[15]. This implies that just asa city plan guides the growth of a city shall also the business model direct the creation of the IS/IT-architecture. In order to remain structured, a city must grow in a controlled fashion, and houses cannot be built haphazardly. The same thing is true when it comes to the IS/IT-architecture of an organization. There must be a "city plan" that points the way towards the desired architecture. If systems are built without the business model as a blueprint, the result will be overlapping and redundancy of systems and data, and an architecture that is complex and certainly not flexible. This uncontrolled growth can be illustrated like this:

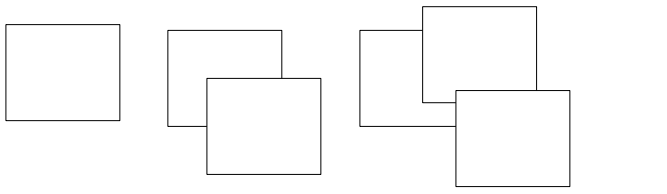

Figure 13. *Uncontrolled systems growth.* (Source: Hugoson, M-Å. (1998) From a lecture in the course "IS/IT planning and management").

As the picture shows, the resulting architecture is not organized, and there is a risk that the business processes will not receive the necessary IS/IT support. If, on the other hand a business model is used as a blueprint, the architecture can, according to Inmon (1986, p. 7), be developed with respect to:

⇒ *Prioritization of activities*: which parts shall be built first, second, etc.

[15] Hugoson, M-Å. (1998) From a lecture in the course "IS/IT planning and management".

⇒ *Total business requirements*: ensuring that each system serves the major purposes of the business and relates to other systems in an efficient manner.
⇒ *Reuse of code and data*: i.e. do not invent the wheel over and over again, as often is the case when there is no sufficient IS/IT-architecture.
⇒ *Domains*: definition of domains, so that it is clear who has what responsibilities (e.g. system owners).

To achieve these results it is important that both IS/IT personnel and users work together when producing the business model, since a business model developed solely by IS/IT personnel only becomes a technical, data processing activity. On the other hand, without the IS/IT personnel, it will not be useful as a blueprint for systems.

Inmon (1986) and Tozer (1996) talk about the business model as the foundation for the IS/IT-architecture. Wetherbe, Brancheau (1986, pp. 453) have another perspective on how to form the basis for the IS/IT-architecture. They use an *information architecture* as a blueprint for applications development and sharing of data within the organization. The information architecture reflects the information requirements of the company and relates them to the specific business processes. It also documents the relationships between different information needs.

> *An information architecture is a […] personnel-, organization- and technology-independent profile of the major information categories used within an enterprise. The profile shows how the information categories relate to business processes and how the information categories must be interconnected to facilitate support for decision makers (Brancheau, Wetherbe, 1986, p. 453).*

There are lots of methods available for assessing the information requirements, e.g. BSP[16], CSF-analysis[17],and Ends/means analysis[18].
Brancheau, Wetherbe (1986, p. 457) advocate a mixture of these methods for developing the information architecture. This approach combines elements of BSP with CSF and E/M in a way that after the organizational processes have been defined (BSP), a series of interviews with key managers (CSF and E/M) reveal the required flow of information. Through this knowledge of required information, it is then possible to map the information architecture.

[16] An IBM technique developed in the 70s, also known as *enterprise modeling* or *information resource management.*
[17] Developed at MIT by Rockart (1979). This is a method that allows senior managers to articulate their most critical information needs.
[18] Developed at University of Minnesota by Davis, Wetherbe (1983). The method aims at, by thinking in terms of input-output, finding information that crosses departmental/functional boundaries.

3.5.1 Why Creating an IS/IT-architecture?

> *The world of information systems that exists in many large organizations has by many been characterized as "rigid structures", "spagetthi-structures", or as "systems islands". Difficulties to survey the situation, inflexibility, change inertia, ineffective cooperation, inaccessible information, and high maintenance costs are some of the problems…(Magoulas, Pessi, 1998, p. 239).*

Since this situation obviously exists, something has to be done to prevent it. As a means to avoid, or handle, this situation, many companies create IS/IT-architectures, since an IS/IT-architecture adequate to the situation is believed to eliminate the inflexibility of IS/IT, and to make it more adaptable to new situations. Allen, Boynton (1991, p. 435) urge companies to break old rules, and to create an architecture that is moving away from the apprehension that "*systems don't bend, they won't change, and they can't adapt*" (they suggest two ways for how this can be done in section 3.5.3). They also argue that by having an IS/IT-architecture, many important considerations areacknowledged, such as: What data and applications should be company wide, and what could be managed locally? What standards should be adopted or what vendors chosen? What rules should govern the decisions? Etc.
Another major argument for creating an IS/IT-architecture is the ideas behind the term "city plan" discussed earlier in this chapter.

According to Tozer (1996, p. 219) is the objective of an IS/IT-architecture to make sure that applications are:

⇒ Designed as simply as possible.
⇒ Implemented quickly using the most appropriate tools.
⇒ Operated quickly and reliably.
⇒ Enhanced to meet business requirements.

Another potential with the IS/IT-architecture thatTozer (1996, p. 223) mentions is that by studying the interactions between architecture components (an activity termed *affinity analysis*), one can:

⇒ Analyze how similar functions are performed in different business units, and thereby reduce wasteful duplication of effort and infrastructure.
⇒ Identify usage patterns between applications and databases, and hence organize databases and application flows for smoother operation.
⇒ Decide *who* should be responsible for *what*, and *who* uses *which resource*, and for *what purpose*.

Further benefits of an IS/IT-architecture:

⇒ Ability to base databases and applications on data structures/information requirements that are known to be relatively stable and in accordance with the business.
⇒ A basis for IS/IT investment decisions.
⇒ Control over information completeness, consistency, and timeliness.

Brancheau, Wetherbe (1986, p. 461) also discuss the benefits of an architecture. They argue that the architecture is almost a necessity, since the rapid changes in technology and increase in competitive significance of IS/IT requires that any organization is in complete control of its information requirements and resources. The main benefits that can be mentioned are these:

⇒ alignment of IS/IT planning with overall business planning;
⇒ involvement and understanding of senior management;
⇒ systems are built that will support the actual business processes;
⇒ guidance of the development of the applications portfolio;

3.5.2 Driving Forces for an IS/IT-architecture

The above discussion introduced some of the expected benefits of an IS/IT-architecture, but what has triggered this awareness of architectural IS/IT? It is quite obvious that this awareness exists due to external forces changing the conditions for competition and survival, and the usual answer to this question is increased complexity and competitiveness due to the possibilities offered by rapid developments in the IT field.
Brancheau, Wetherbe (1986, pp. 453-454) mention especially three factors that give companies reasons to reflect upon their IS/IT-architectures, and these are:*the escalating cost of information* (or even more important, the cost of not having the right information),*spreading distribution of data storage and use* (much due to decentralization and global presence), and of course*the increasing use of information as a competitive weapon.*

Two other authors that talk about factors increasing the need for an architecture are van der Poel, van Waes (1989, pp.177-178). They talk about how globalization and fierce competition are increasing the demands made on the control of the organizations, and this includes control of IS/IT as well as other resources. They describe how the rapid decrease in the price/performance ratio ofPC´s, workstations, and networks enable a much better use of information resources (and hence should motivate the creation of an IS/IT-architecture in order to facilitate the exploitation of these possibilities). The results of this, they argue, are profound changes in the organizational structure and information supply functions. To handle this, to gain control over information resources and aligning them to the business processes, an architecture is needed.

> *…architectures are becoming less of an option and more of a necessity in the process of information planning today (van der Poel, van Waes, 1989, p. 178).*

3.5.3 What is Needed to Establish a Good IS/IT-architecture?

Magoulas, Pessi (1998, pp. 70-83) discuss several factors that, in order to create an adequate IS/IT-architecture, must be considered and dealt with. Here are those that we feel are of great significance for our study.

The *first* is the issue about IS/IT inheritance, that is, how the existing systems and their relationship shall/can be used within the new IS/IT-architecture. To make sure that this question is tackled, Magoulas and Pessi suggest that the following factors be considered:

Increase Control and General View Over All Information Systems
This is something that is especially important in large organizations with many different systems. Without this control, it becomes difficult to understand system interrelationships and to detect redundancy etc.

Settle Outdated IS/IT
Changes in organizational structure and responsibilities (as in a process orientation) may cause some systems to become inappropriate, and therefore they must be either modified or rejected. Otherwise they will cause operational disturbances.

Reduce Complexity and Inflexibility in Tightly Coupled Systems
If systems are tightly coupled, any change within the IS/IT-architecture will become very lengthy and expensive, due to the many interdependencies. Hence, it is desirable to create an architecture where changes in one system can be made without affecting the other systems.

Do Not Create "Information Islands"
There is a risk that systems that cannot communicate with each other are developed, especially in a highly decentralized organization. This occurs when the information requirement throughout the organization is not known, and therefore the systems are developed without regard to their ability/need to share information.

The *second* issue regards the demands on the intra-organizational environment, and here the question is about how changes in certain areas might lead to a better IS/IT-architecture. To ensure an appropriate intra-organizational environment, the following factors should be considered:

Make Clear Areas of Responsibility
It is important to define such things as who is system owner, who is responsible for; development, maintenance, support, technology, etc.
In a process oriented environment it is also of interest to discuss process owner v. system owner, i.e. who has the overall systems responsibility within the process?

Enable Change, Flexibility, and Freedom of Act
Due to the rapid change in both business and technology, which continuously is creating new business opportunities, it is a requirement that systems are easy to adapt to new circumstances. An example of the need for change and flexibility is given in "Guidelines for process oriented IT-management" (section 3.2.2), where

systems that use non-standard platforms are required to be able to migrate onto the standard platform within a reasonable time frame.

Make Clear Couplings between the Information Systems and the Business Processes
Situations where a system is used by several different parts of the organization are not uncommon. The risk though, is that, in order to serve the needs of all, the system becomes a compromise. The system does not really perform any function in an optimized way. To avoid these compromises, it is important to investigate how well the systems are supporting the business.

Increase the Quality and Accessibility of Information
This is one of the most important objectives of the IS/IT-architecture. From a technical perspective, this can be done by ensuring that IS/IT support and data- and telecommunications are operating 24h a day (especially important in a multinational organization, where different time zones otherwise could cause problems).

Create an Adequate Concurrence and Integration between Systems
This relates to the subject of "information islands" discussed above, and it is also one of the most important tasks for the IS/IT-architecture. Since systems often are designed and demarcated with the departmental boundaries in mind, this becomes a highly relevant issue when an organization merges towards a process-oriented structure and where systems from former departments might be needed to cooperate.

Empowerment
This means that each part of the business should be authorized to decide about their own systems (although, without losing the ability to communicate and cooperate with other systems as needed). The empowerment aims at ensuring that each system is optimized for its main task.

Standardized and/or Common Systems
In organizations with similar operations/functions on several locations, the question arises whether to adopt standard or common systems, that is, several similar systems (one for each operation/function) or one common system (all operations/functions uses the same).
One solution to this question is to invest in packaged software, such as e.g. SAP R/3 or Movex. This is actually a mixture between*several similar* and *one common*, since packaged software is basically one common system, but with the possibility for minor modifications for each operation/function so that the system is adapted to fit the specific needs throughout the organization.
Nevertheless, it is a fact that this solution calls for heavy investments, and maybe also a lengthy implementation procedure.

The *third* area of great importance deals with the technological infrastructure. Questions here concern relations between IS and IT, and also the actual nature of the infrastructure (i.e. should it be standardized or diverse). To be able to take a stand in these issues, the following matters should be considered:

Technology Should be Replaceable
Due to the rapid development of IT, the technology becomes outdated relatively quickly. The systems on the other hand, do not become inappropriate in the same way. Therefore, it is desirable that the underlying infrastructure should be possible to replace without affecting the systems.
The consequence of this is that systems should not be dependent on a specific technology when implemented and hence, systems and contemporary technology cannot be integrated, and should be dealt with separately.

Unity in the Technical Environment
With too much variety in the infrastructure, a number of problems are almost certain to occur. The most obvious one is inability to communicate due to incompatible equipment. In order to ensure that the needed information is available to everybody throughout the organization, and that "information islands" are not created, this is something that ought to be considered.
Another problem that one should be aware of is that a very diverse technical environment calls for an equally diverse support competence (that is, people with the knowledge to support the infrastructure), and this is something that can be very costly to keep up to-date.

Allen, Boynton (1991, pp.436-442) are two other authors that write about how to choose the most appropriate architecture. They assert that the most important is to choose an IS/IT-architecture that ensures both *efficiency* and *flexibility*, and in order to do this they suggest two alternative solutions. The "low road" and the "high road".

The Low Road
This approach is an example of true decentralization, where IS/IT becomes the responsibility of every manager throughout the organization. If this decentralization is to be possible, all critical units must be able to communicate and have full access to information, and there must be data exchange conventions so that full access to information is granted. Since this concept demands full access to information, it is a concept based on trust, and each "owner" of information must provide access to anyone that requires it. The concept also disregards standards (e.g. programming languages, DBMS[19], hardware etc.) because this is only seen as an impediment to progress. Instead, this philosophy advocates use of the latest technology, best development tools, and most appropriate software.
Some pros:

Quick implementation of new systems, innovative, effective (locally developed systems best meet local needs), efficient (a networked IS/IT structure will capitalize on economics of computing throughLANS, WANS, and low-cost software), a natural solution (a natural fit with many dispersed organizational structures).

Some cons:

integration (complex linkage between separate business entities and with headquarters), data exchange (difficulties to maintain an effective data exchange

[19] Database management system.

system due to lack of core data definitions), uneven efforts (some business units will almost certainly fall behind and slow businesses down), sub-optimization and short planning horizon.

The High Road

This is the antithesis of the low road and it means a high degree of centralization. It consists of centralized IS/IT activities and data collection, common applications and business practices, standardized hardware, databases, and platforms, etc. Core applications are "organizationally independent", i.e. not belonging to any specific department, and are therefore not affected by any restructuring as it would if owned by a single division or department.

Some pros:

Integration (easy-access due to large and advanced storage systems), efficiency (one set of data, one set of core applications, minimal redundancy), flexibility (provided by relational data systems and organizationally independent applications), strategic use of IS/IT (by avoiding sub-optimization).

Some cons:

Expense (risk of expensive failures due to the large scale), customizing (packaged software is often not suitable for organizationally independent applications), management dependence(senior management must plan and support not only business, but also IS/IT), politics (operational managers v. central solutions).

Obviously, the optimal solution is to combine these two and at the same time avoid their drawbacks, and this is the challenge that faces all organizations trying to develop a good IS/IT-architecture. Combination is a necessity, since *flexibility* is best achieved via the low road, whereas *efficiency* comes along the high road.

3.6 Two Design Philosophies

In many organizations there are really no principles for how to structure systems (to design an IS/IT-architecture). The structure is more a consequence than a result of the strategic design work. There are two different design theories that have been used to handle system structuring, and these are IRM (Information Resource Management) and BBS (Business Based Systems)[20].

The two design philosophies are quite different from each other but they have one similarity. They are both used as a procedure to handle design of systems structuring. With these two different approaches one could avoid entangled system structures.

IRM and BBS follow two different metaphors for information systems in organizations. IRM has a reproduction view. The information system (with its databases) can be seen as a representation of the reality. One could get a picture of reality if you look at the reflection in the database (Axelsson, Goldkuhl 1998, p. 15).

[20] Our translation of *VBS* (Verksamhets Baserade System).

BBS is based on the role as an information delivery system. The information system is seen as a function that processes information and delivers it to the business (Axelsson, Goldkuhl, 1998, p. 15).

In IRM, the emphasis is that the information system should give a correct picture of reality. In BBS the emphasis is more on providing the business with information. In both cases the main point with the system is to deliver information to the business (Goldkuhl, 1998, p. 15).

3.6.1 IRM, Information Resource Management

The demands on cooperation between information systems, inside the functions as well as between, are continuously increasing. This cooperation can be solved in different ways. There are a number of assumptions that are used as a basis when the structure of the information systems is chosen. One of these assumptions is to see the information as a resource, in the same way as machines, people, or financial resources. When the information is viewed as resource one have to find a way to manage and administrate the resources, in the same way one controls the other resources in the company.

This means that the information should be:

⇒ *Planned* with help of data models.
⇒ *Procured* by the source.
⇒ *Stored* in a way so that everybody has access to the information.

These are the bases for the IRM strategy (Axelsson, Goldkuhl, 1998, p. 35).

In the IRM strategy, the information is a central resource and it should be controlled. The purpose is to make as much as possible of the information available for the users. One of the fundamental principles is to disconnect the information from the processing applications that supports the business with information. The applications and the information could change and adapt gradually, the database for that matter should be controlled so that stability is attained in the database.

Data Structures

In this type of approach, the data and data structures in the database are fundamental for the information system. The reason for this is that the data structure is considered to be stable over time. This means that even if the business is changing, the objects and concepts arestill the same (unless the business changes course completely). The objects remain the same but the contents in the objects could change. These different objects could for example be customer, product, or bill.
The different objects are identified and related to each other with help from a data model, and by creating a data model of the business one can keep the number of objects and concepts down to a minimum.
The data model constitutes a model of the reality that the company operates in, and different concepts in the data model correspond to different events in the business. The reproduction of the business reality is done in two steps (see figure 14) and is a fundamental approach for a data driven model as the IRM strategy suggests.

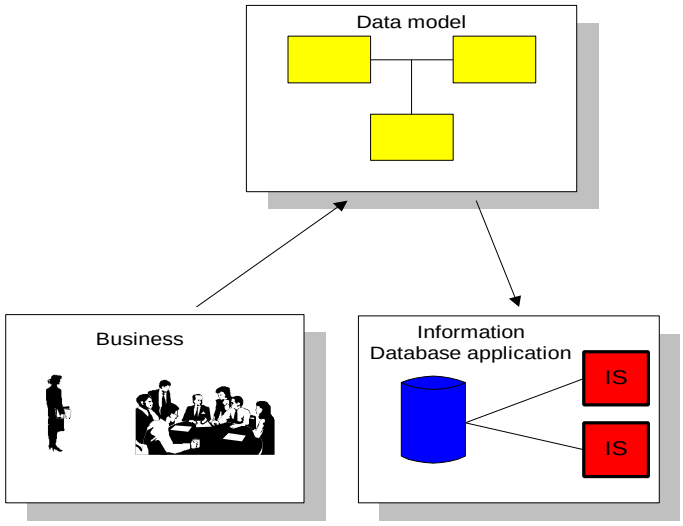

Figure 14. *The connections between business, data model and information systems* (source: Axelsson, Goldkuhl, 1998, p. 36).

The database is structured after the stable objects in the business (as figure 14 illustrates). This means that it is not the users information needs that is deciding how the data is structured. The reason for this is that the users information needs, in contradiction to data structure, are considered to change over time. If one where structuring the database after the users information needs one would have to change the database every time the user needs were changing.
The independence between the information resources and the system is a fundamental principle for the IRM strategy (Magoulas, Pessi, 1998, p. 253).
The overarching data model is not only basis for the structuring of one separate system but for all the information systems in the entire business, i.e. how the information systems are related to each other (Magoulas, Pessi, 1991)[21].

Data/Program Independence
The overarching structure for the information system in the IRM concept could be described in two parts; a database, and a number of applications. The data model for the business is implemented in the database, which is separated from the business local applications. The user could then have access to the information through these applications (see fig. 15).

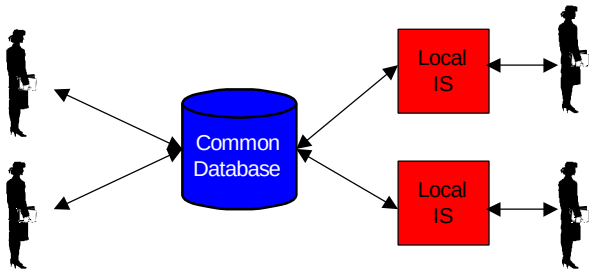

Figure 15. *Schematic description of data administrative structuring* (source: Axelsson, Goldkuhl, 1998, p. 37).

[21] From Axelsson, Goldkuhl (1998, p. 36).

The figure displays two different ways to retrieve the information, it is either by direct search with some type of query language, or through the local applications. This course of action means that one is separating the information resources from the applications (Goldkuhl, 1998, p. 37). This principle is called the "principle of separation", and Martin, Nolan and Zachman are some of those behind this principle (Magoulas, Pessi, 1998, p. 253).
The separation principle leads to considerable data, and program independence. This means that one could change the data without changing the structure in the database. The applications does not have to be known when you are designing the database, as long as the programs and the data structures follow agreed standards. The argument for this independence between data and program is that changes could be made in the data and it does not affect the applications or risking that the program logic collapses.
As a result of this general structure, the structure in the database is independent for how the information is used, and for what purpose. This independence denotes that the organization is more able to cope with changes in the environment. Changes could be made in the data and the applications, but the structure in the database remains stable (Axelsson, Goldkuhl, 1998, p. 37).

What is to be Avoided with the IRM Strategy?
According to Goldkuhl (1998, p. 43) the idea with data driven viewpoint is to avoid that the information is stored longer then necessary. This is for decreasing the risk that the information will go out of date. The strategy also aims to avoid that the information in the database is not used.
Changes in the database structure are also to be avoided. In spite of changes in the environment, the database structure should remain stabile. Duplication of data, inefficiency when gathering data, risks and costs when using bad information are also things that the data driven model tries to avoid.

What is to be Achieved with the IRM Strategy?
There is a strive for globalization of the stored information in the IRM strategy and other data driven approaches. The information should be accessible for the major part of the employees in the company, the information should also be consistent and free from logical contradictions. The advantage with globalization is that one can reduce administrational costs and increase the life cycle and the reliability of the information system (as a consequence of fewer responsible for the information). The standardized data architecture will reduce the amount of data that have to be fed into the system. The maintenance and development will also be easier and less costly (Axelsson, Goldkuhl, 1998, p. 43).

3.6.2 BBS, Business Based Systems
The other design philosophy of information structuring is Business Based Systems (BBS), which denotes that you delimit the information system with a decentralized responsibility (Hugoson, 1986, and Magoulas, Pessi, 1991)[22]. In this philosophy the cooperation between the information systems are defined in advance.

[22] From Axelsson, Goldkuhl (1998, p. 45).

The Dependency between System and Responsibilities

According to Goldkuhl (1998, p. 45) responsibilities is an important aspect in the business based view. The information system is localized to a specific business unit and it has the responsibility to process the information for that specific unit or department. The separation in different business units is not necessary the same as the organizational boundaries, it is strictly based on the responsibility structure. A business unit is a well-delimited part of the organization, and it has a certain task to fulfill. The business unit has a number of resources at its disposal, and one of these resources is the information system.

Axelsson, Goldkuhl (1998, p. 45) argue that a dependency and unclear areas of responsibilities is created if several business units share the same resources. The act of freedom of the business functions increases if the unit disposes all its resources for itself. Therefore, it is very important that the delimitation of the business unit and the information system is the same as the area of responsibility.

Figure16 illustrates how the business and functional information systems work. The systems main object is to satisfy the functions with their information needs, the business unit also has the responsibility for the operation of the information system. Each business unit acquires the information from the local systemthey also communicate with other business units through predefined messages.

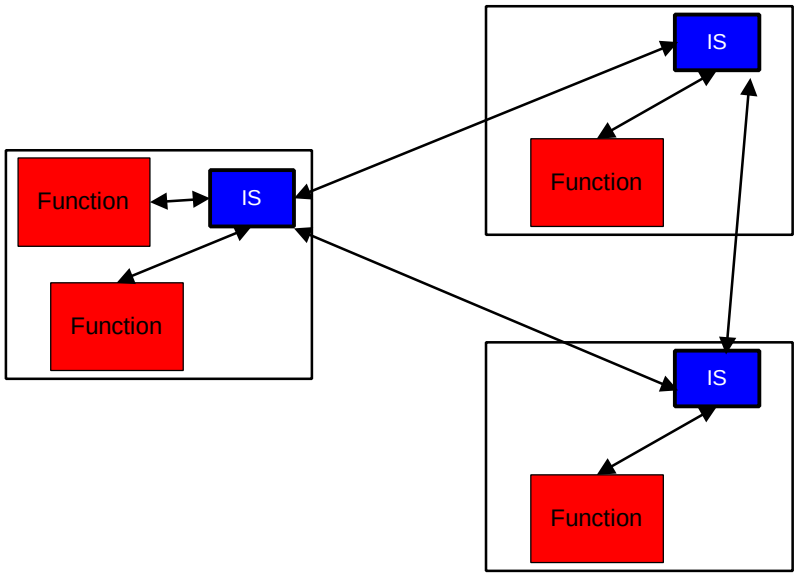

Figure 16. *Schematic description of business based structuring of information system (BBS)* (Source: Axelsson, Goldkuhl, 1998, p. 46).

It is very important that the area of responsibility is very well defined in the BBS strategy. Another important condition is that the area of responsibility is well defined before the information system isimplemented. If the users in the organization are not aware of who is responsible for what, it could be very difficult to structure the system (Hugoson, 1991).

Messaging

In the business based view the communication between autonomous systems is called messaging, or transaction cooperation. The opposite is register cooperation,

which is when two systems are using the same database (see fig. 15). Messaging means communication between systems in a predefined way. The transmission of messages between information systems can be done in different ways, e.g. file transfer, common message buffer between information systems, local communication systems inside the information system, or separate message cooperation (Hugoson, 1991). Figure 17 shows the communication between the information systems.

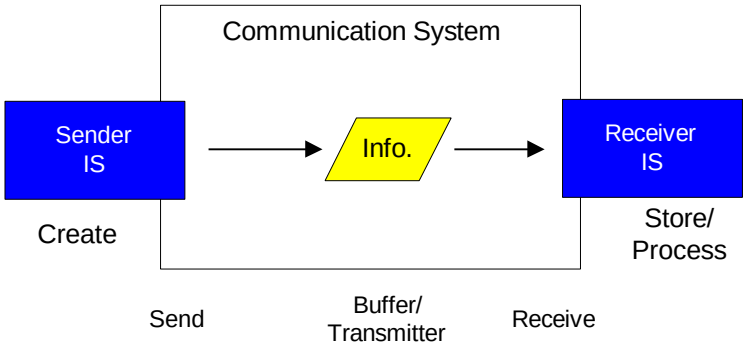

Figure 17. *Communication tasks in messaging* (Source: Magoulas, Pessi, 1991).

The messages are not stored or updated in any database, but they can be queued in a buffer. The transmission is handled by the system that initiates the transmission, and this could be either the receiving or the sending system. The messaging could be done without the sending system knowing how the receiving system stores its data, the only information that is needed is, sender, receiver, type of message.

Different Types of Information

In the BBS strategy, separation is done between local (internal information), and messages (external information). The local information (with certain exceptions) is the information to/from people within the business (see fig. 18).

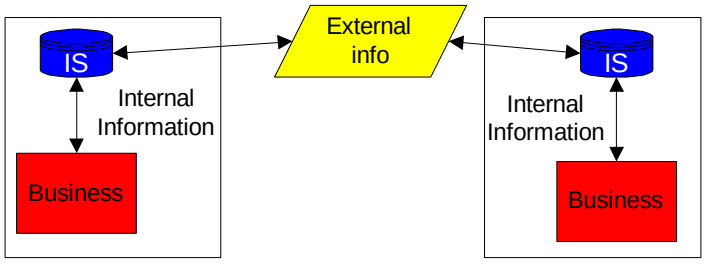

Figure 18. *The internal and external communication* (source: own construction).

The external information is the information between the information systems Hugoson (1991) calls this *message-information.* The other type of information, from/to people, is not spread to other business units, but stored in the local database. This information is characterized by:

⇒ Relationships, phenomenon inside the function;
⇒ High accessibility demands;
⇒ Large volumes;
⇒ Complexity;

⇒ Continuous change;

The message information reflects the communication between different business units. For example, if the marketing department receives an order from a customer, they first have to check whether they have enough material. Then they have to send an order to the production plant so that they can produce the products, and finally notify transportation department so they can deliver the products to the customer. Hugoson (1991) describes it like this:

> *The message-information is a computerized message that is transmitted between different information systems. It reflects the normal communication between business functions.*

The external message is information about an activity, decision, result etc. inside a business and it has to be accessible for other businesses information systems.

The external information is characterized by:

⇒ Low volume;
⇒ Intentional character;
⇒ Simple character (easy to describe);
⇒ Relatively stable;

The intensity varies between local and external communication, the local communication could be as much as 90 % of the total communication.

Two Kinds of Obligation
The local responsibility over the information denotes that the business unit should make sure that the information is accessible for other information systems. When using the BBS strategy you have to make two commitments
(Hugoson, 1987, p.12):

1. Supply yourself with information.

This obligation means that the information should be accessible for decisions, actions and measures in the business. One should not expect any other department to provide the information that is needed. It is the department itself that has the responsibility for collection, quality and the correctness of the information. When information is needed from other functions it should be based on their information systems. This leads to a requirement for messaging.

2. Supply other functions with information.

The second obligation is to provide information to other functions. If another function needs information that your system has access to, then the system has to provide the information through the predefined messaging. Your system is however not allowed to update information that is stored in the other information system.

These commitments elucidate the area of responsibilities and the messaging for the business based systems. They also create conditions for independence between the different business areas. Independence denotes that one can change in one system without affecting other systems (Hugoson, 1991, p.18).

What is to be Avoided with the BBS Strategy?
The purpose with creating autonomous systems is to avoid mainframe computers, centralization and globalization of the information systems. Another reason is to decrease the inflexibility in the system structure and avoid big change- and administration costs. One is also trying to avoid dependencies between the different functions information systems. Another situation, which hopefully is avoided, is that if the information system is centralized, people might consider it belonging to the computer department, and therefore not their responsibility, and this is not a desirable development (Axelsson, Goldkuhl, 1998, p. 52).

What is to be Achieved with the BBS Strategy?
An important result of the BBS strategy is to achieve several kinds of independence between the information systems. These types of independence are:

⇒ Functional;

⇒ Technical;

⇒ Development;

⇒ Timely;

The *functional* independence could for example be when the business unit itself can decide how to store, gather, put together, administrate, and present the information system. Functional independence has been achieved when the business unit could formulate and change the information without affecting the other business units. *Technical* independence denotes that the systems are declutched logically from the technology. This means that the business unit can choose any technical system it wants and change it without affecting the other systems in the business. *Developmental* independence means that one could develop the system with different tools (Magoulas, Pessi, 1991)[23]. *Timely* independence is when the system could work even if the other systems are not on line.

3.6.3 Strengths and Weaknesses

In this part we are going to show some of the strengths and weaknesses associated with the IRM and BBS strategies. The material is collected from Axelsson, Goldkuhl (1998, pp. 82-130), and the areas we have chosen to display are those that are of interest for our research question. The material is gathered from different case studies that Axelsson and Goldkuhl have performed.
Some of these strengths and weaknesses could also appear in businesses who do not have an IRM or BBS strategy.

IRM, Strengths and Weaknesses

[23] From Axelsson, Goldkuhl (1998, p. 52).

Functionality in the Information System
Strengths
⇒ In an integrated information system, it is easy to make the information perspicuous.
⇒ The IRM architecture increases the users access to the information.
⇒ The correctness and the control of the information increase.

Weaknesses
⇒ It is difficult to satisfy the information need if the information structure is to general.
⇒ If the system is too formal, users could feel controlled.

The Systems Accessibility
Strength
⇒ The users have access to all the information.

Weakness
⇒ Menus control the systems accessibility. You cannot do anything that is not in the menu.

User Acceptance
Strength
⇒ The user acceptance is influenced by how much they have been a part in the development of the information system. If they have been participating in the development process, they will see the system as theirs, and it is therefore easier to accept the system.

Weaknesses
⇒ If the user instructions to the system are defective, then there is a risk that the acceptance is becoming lower.
⇒ All systems restrain the users in some form but if this is exaggerated, then the users could loose acceptance for he system.

The Systems Ability to Change
Strength
⇒ Change that does not concern the database structure is easily accomplished.

Weakness
⇒ It could be very hard to make changes in the database structure. Stability does not arise by itself, it is maintained by the use of several numbers of measures.

Responsibility with Respect to the Different Systems
Strength
⇒ An advantage with a central data administration is that it is easy to have control over the system and its information.

Weakness

⇒ The users could see the system as the data administrators system, and not theirs. If this is the case then there is a risk that they transfer all the problems and decisions to the data administrator. On the other hand, if one does not have a data administrator then the responsibility could be unclear.

BBS, Strengths and Weaknesses

Functionality in the Information System

Strengths

⇒ The BBS strategy is considered to be very beneficial indepartments which are strongly formalized. This is because they are easier to computerize.

⇒ Systems that are functionally divided are considered to be more supportive in functional organizations.

Weaknesses

⇒ In the BBS based strategy, messaging could be apprehended as quite complicated to the users.

⇒ In large businesses, conflicts could arise when it has to be decided what is functionally the best way to perform work for a business function.

The Systems Accessibility

Strength

⇒ Most of the users are satisfied with the information in the system. There is no desire to increase or decrease the accessibility of the information.

Weakness

⇒ If the delimitation is done incorrectly, then the employees could unintentionally update other businesses information systems.

User Acceptance

Strength

⇒ Since the information is locally stored, the users may have more confidence in the system.

Weakness

⇒ Organizations that use BBS are often large ones. Therefore, only a few people (relatively spoken) are involved in the development process. The final acceptance is dependent upon how well these few people could establish the systems to the rest of the users.

The Systems Ability to Change

Strength

⇒ Since the systems are autonomous, it is fairly easy to change the systems without affecting other systems.

Weaknesses

⇒ An organization that has implemented generic systems could decide that similar changes should be done in all businesses. The systems ability to adapt to the

environment is reduced after such a decision, since each business unit has its own needs (the systems become compromises).

⇒ BBS based systems contain some redundant information. Some system administrators view this as a problem. If changes have to be made, updates have to be made in many different systems.

Responsibility with Respect to the Different Systems

Strength

⇒ It is easy to succeed with aligning the areas of responsibility with the systems structure in those departments where they do not have an IT department.

Weaknesses

⇒ System owners do not take responsibility for the information systems.

⇒ The person who has responsibility for the system is not the same person as the one that has responsibility for the business.

⇒ Management does not want to take responsibility for the strategic system structuring.

These were the main characteristics of these two design philosophies, and they are important to be aware of when discussing which philosophy that would be the most appropriate for a specific organization.

3.7 Using the Theoretical Framework

In this theoretical framework we have discussed several theories and concepts related to our research question. How each theory will be used to analyze the situation at Astra, and to reach a conclusion (i.e. answer our research question), depends on our findings in the empirical study.
The idea is to view the theoretical framework as a “tool-box”, that is, in order to analyze our qualitative data, collected through various interviews, we choose the theory most appropriate for each particular situation.

The fact that it is the findings in our study that will guide our choice of theory means that, depending on what we discover, not all parts of the theoretical framework will be used in an equal amount, actually, some parts might even not be used at all. This should not be viewed as a poor choice of theories though, since all theories were chosen with our area of research in mind and they are all closely related to the area under study.

4. Astra

In this description, we will not take into consideration the recent merger between Astra and Zeneca, and the reasons why we have made this choice are (besides the fact that the merger was approved after we had begun our work):

1. *We do not believe that the merger will affect the validity or reliability of this study, since our results not should be unique to a specific situation.*
2. *We believe that, although a new organization, this description will still serve its purpose as an orientation of the company and its business.*

The purpose of this section is to introduce the company to the reader so that it becomes easier to understand the nature of the organization and the complexity that exists due to it. It may also be easier to understand the background that initiated CANDELA.

4.1 About Astra

(For Astra´s organizational structure, see appendix A).

Astra´s first statutory meeting was held in Södertälje on June 18, 1913. The Swedish government had just abolished the drug preparation monopoly of the pharmacies, and Astra´s founders, Adolf Rising, Hans von Euler and Knut Sjöberg, were determined to become a Swedish competitor to the foreign companies in the domestic market.
In 1917, Astra had 200 employees, and posted a profit of 148,000 Swedish kronor.

Today, Astra is an international pharmaceutical company in a phase of rapid growth and change.
The number of employees has risen to 24,958 (8,060 in Sweden), and pretax earnings for the fourth quarter of 1998 totaled 5,186 m Swedish kronor.*
Astra´s shares have been listed on the Stockholm Stock Exchange since 1955, on the London Stock Exchange since 1985, and on the New York Stock Exchange since 1996.
(Astra is owned by approximately 244,000 shareholders all over the world).

The company has a global presence through its marketing subsidiaries in about 45 countries, and in a large amount of other countries where Astra´s products are marketed through agents and licensees.
About half of Astra´s production takes place in Sweden. The rest is handled by subsidiaries in other countries.

Indeed, one can say that the company has been a success so far, with products such as the antipeptic ulcer drug *Losec*, the asthma drug *Pulmicort*, and the beta-blocker *Seloken*.
In many countries, Astra now ranks among the largest pharmaceutical companies on the market.

*Source: Year-end report January-December 1998.

4.2 Research

The focus on research intensified in the late 1950s, and today the research organization is Astra´s lifeblood, and research development, which is crucially for success, is dependent on a steady flow of new and exploitable ideas.
R&D within Astra is conducted primarily at five major research units (see fig. 19 below), and the main research areas are the following:
Priority research areas:

⇒ Respiratory disease (Charnwood and Draco)
⇒ Cardiovascular disease (Charnwood and Hässle)
⇒ Gastrointestinal disease (Hässle and Draco)
⇒ Pain control

Other research areas:

⇒ Central Nervous System (Arcus)
⇒ Anti-infective (Arcus)

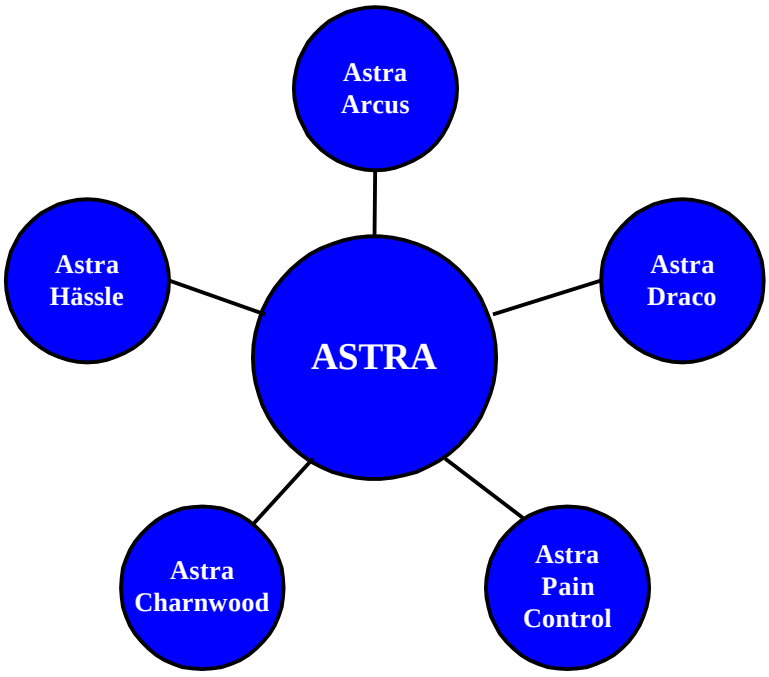

Figure 19. *Major research units* (Source: adapted from www.astra.com/astra/research/units.html).

Astra´s first key objective is to strengthen the expertise and commercial success in the four prioritized areas. A second key objective is to add at least two new priority research areas within the next 10-15 years.
Considering these objectives, and the dependence upon a steady stream of new ideas within the organization, one can say that this is a company that needs easy access to reliable information and knowledge throughout the entire organization.

This dependency on easy access to information and knowledge does of course have implications on the IS/IT-infrastructure, since an appropriate infrastructure is essential for an effective information/knowledge flow.
This situation is very interesting to us, since our question about IS/IT-architectures has great relevance in an information intense environment like this.

From Concept to New Drug
The process of developing a new drug is highly complicated. This long and complex process, in combination with authorities rising demands for safer and more effective pharmaceutics, has resulted in an increasingly complex research process and longer development times for new drugs.
The time for developing a new drug has in recent decades increased from 8 to 15 years, and, at the same time have the costs for clinical evaluation of drugs risen considerably.
Today, the estimated cost for bringing a new drug to market is approximately 4bn Swedish kronor.

The development process consists of two major parts, *preclinical studies* and *clinical trials*, and it is the clinical part that is of interest here.
As a result of revolutionary changes taking place within the preclinical research (e.g. genetic research), Astra expects each year to be able to identify considerably more new substances than in the past for documentation in clinical trials on patients.
This will of course increase the demands on Astra´s clinical research resources, which is one reason for this part being of special interest. The other, and maybe even more important reason, is the fact that when a research project enters the clinical phase, the costs rise exponentially.

The clinical development begins with IND (Investigational New Drug), which is an application for permission to administer a new drug to humans.
Then the clinical trials begin, and these are normally divided into three phases:

⇒ phase I: efficacy studies on healthy volunteers (50-100 persons)
⇒ phase II: clinical studies on a limited number of patients (100-200)
⇒ phase III: comparative studies on a large number of patients (500-5,000)

After these steps, it is the NDA (New Drug Application), which is an application to market a new drug.

4.3 CANDELA
In the competitive environment of today, Astra can waste no time in the development stage.
So, as a consequence of the long development times and heavy investments, especially in the clinical development part where costs rise exponentially, it has been of great interest to Astra to find a way to reduce lead times in the drug development process.

CANDELA (*Clinical Appraisal, New Design, Engaging Large Areas*) was Astra´s solution to these problems. This was an internal action program (launched in 1996, and then transformed into an activity called *business simulation*[*] , which has now been stopped due to the merger between Astra and Zeneca), and it aimed at making Astra one of the leading pharmaceutical companies in the world with respect to the quality and speed of clinical research. The project investigated and analyzed business processes, and proposed new strategies, structures, processes, and technologies. It focused mainly on clinical research or, more specifically, on the phases IND to NDA[**] (including the interface to the marketing companies), because costs are highest here.

- *One reason for the high costs and long development times may be the fact that the five research units conduct their research in different ways, i.e. no coordination or synergy effects.*

The purpose with CANDELA was to, by adopting new ways of working (which means a process oriented research organization with highly standardized work methods) and using the appropriate information technology, coordinate the clinical research within Astra, so that effectiveness was increased and lead times reduced. Such an increased productivity in the clinical research phases would not only reduce the cost for each new drug developed, but also lengthen the effective patent terms for future products since they would enter the market quicker.

Project Organization
The CANDELA project was managed by a central steering committee, and this committee handled both process- and IS/IT-issues.
For each area of responsibility within the project, there was only one group of people responsible, that is, each phase of the project was managed in the same way throughout the entire organization (this would hopefully ensure the desired degree of standardization).

4.4 Introduction to the Case Study

CANDELA is, although never implemented, with its focus on process orientation and IS/IT, a perfect case to gather experiences from, considering our research question and Astra´s assignment.
To get an understanding for the situation under study, it is important to first be aware of the nature of the environment and how this affects Astra.
The figure below illustrates the situation that Astra has to deal with, and which also has implications on the probability of success for projects such as CANDELA.

[*] 5 systems within clinical operations that were selected and tested for alignment to processes.
[**] See section 4.2.

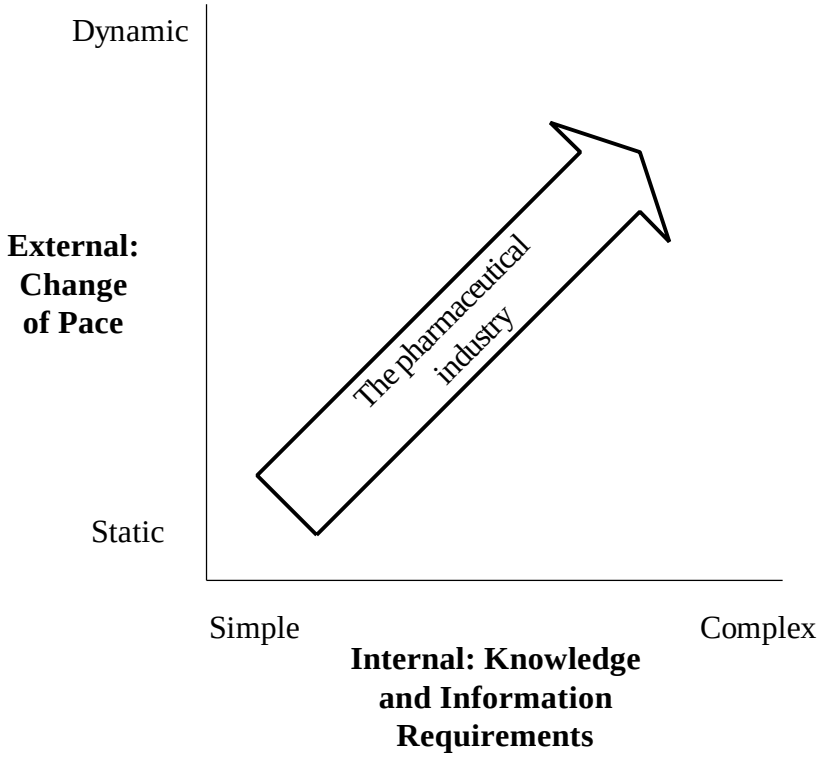

Figure 20. *Changes within the pharmaceutical industry* (source: modified from Savage, 5th Generation management, 1990).

As this picture shows, the pharmaceutical industry is becoming increasingly dynamic and complex all the time, and the fact that Astra is moving in the direction of that arrow is something that must be considered.
For Astra it raises obstacles when trying to integrate IS/IT and processes (as in the CANDELA project) in a way that is suitable in this kind of environment.
For us, it means an important factor to consider when studying process oriented IS/IT-architectures and their appropriateness.
It is even easier to understand this situation when considering that Astra has over 2,000 employees worldwide that work on organizing, monitoring, and compiling the results of clinical trials.
This, together with fierce competition and authorities increasing demands make the above figure perfectly understandable.

Situations like this have been described and discussed by several authors, for example by Ward, Griffiths (1996, pp. 33). They describe this increasing complexity with respect to the role that IS/IT plays within the organization, and they use a matrix suggested by Sullivan (1985) to illustrate the situation (see fig. 21 below). According to this matrix, two forces that are outside of its control affect the organization, and these are; *external competitive pressures*, a force that increases the criticality of IS/IT to the company, and *internal organizational pressures*, which demand a decentralized IS/IT control.

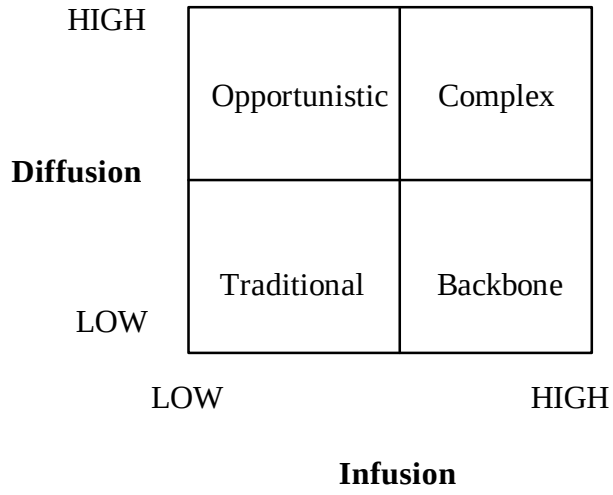

Figure 21. *Environments of IS/IT planning* (source: adapted from Ward, Griffiths, 1996, p. 35).

The two axes that determine the nature of an organizations relation to IS/IT are:

⇒ **Diffusion**, which is degree of decentralization of IS/IT control. This is increased due to internal organizational pressures.
⇒ **Infusion**, which is degree of dependence upon IS/IT. This increases due to external competitive pressures.

One can see that these forces (internal and external pressure) are about the same as those affecting Astra (making the pharmaceutical industry more dynamic and complex), such as competition, authority demands, a work force that is geographically scattered and therefore needs distributed IS/IT control, etc.
Since Astra lies in the high-high quadrant (due to the factors mentioned above) and therefore is a complex organization according to this model, it will raise difficulties to manage IS/IT so that the processes get the optimal support. If there is too much decentralization, the core systems may not be easy to integrate, and on the other hand, if there is too little decentralization innovation will be limited.

Finally, we can conclude that the fact thatAstra operates in an industry that is becoming more complex and dynamic, while and at the same time is becoming more complex in its relation to IS/IT, is something that will put great demands on IT-management and the ability to create the right IS/IT-architecture, i.e. an architecture that supports the processes.

5. Astra - empirical study

In this part we try to show the situation within Astra, according to the interviewees, and this situation is based on actual circumstances as well as on how employees comprehend the situation. Important to notice though, is that this is an "as is" situation, and not a "to be" situation, and this part (except from 5.4) contains no interpretations or opinions at all from our side, but is only based on authentic interview material and observations.
Some of the things discussed may not be exclusive to process orientation, but everything is still of relevance to our research question.

5.1 Selection of Interviewees

Our selection of interviewees is not based on common specific criteria, such as *only people in a key position.* Instead, these choices are based on recommendations from other people within the company, by studying the organizational charts, roles, degree of experience, participation in the CANDELA project, and finally, an aspiration to gather respondents from various departments and Astra units in order to get a wider and more reliable picture. Some interviewees have been interviewed on several occasions.
For a complete list of all the positions/roles we have interviewed, see table 4 below. (With respect to the integrity of our interviewees, we do not intend to display their names, neither do we relate specific information to a specific position within the company).

Position	Department / Company
Area Director (Australia, New Zealand, England & Ireland) / CANDELA Project Manager	Astra (corporate level)
Manager	IS/IT strategy & coordination / Astra (corporate level)
Technology Watch	Clinical R&D / Astra Hässle
Director, Process Development	Clinical R&D / Astra Hässle (company level)
Associate Director (responsible for the clinical drug safety IS/IT applications)	Clinical Research Information Management / Astra Hässle
IS-architect	Astra Hässle (company level)
Quality Assurance Manager	Information Systems Technology / Astra Hässle
Intranet Project Manager	Astra Hässle (company level)
Director	Research informatics / Astra Hässle
Analyst (member of the IT-architecture team)	Information Systems & Technology / Astra (corporate level)
Information analyst (member of the Clinical Informatics team)	Clinical Research Information Management / Astra Hässle

Table 4. *List of interviewees.*

5.2 The Process Concept at Astra

This part describes the current situation regarding processes, and its purpose is to constitute a foundation for further analysis and understanding of process orientation and IS/IT within Astra.

Today, there are ambitions to work process oriented, but the organization is divided into four groups of people, namely: *those who like to talk about processes, those who refuse to talk about processes, those who do not care,* and *those who actually work process oriented.*

Since process orientation is not an established idea yet, there are still several shortcomings, for example:
- There is no common process methodology, e.g. process definition, how to map processes, how to communicate and get acceptance for the process concept throughout the company, etc.
- Managers are often not very well informed on the process concept, and choose therefore to employ consultants who have their own methodology. This becomes a problem when different consultants are used on several different occasions, since the documentation becomes very diverse (each consultant has his/her own way of documenting). Consultants are also not familiar with the business, which can affect the quality on the documented processes.
- There is no specific method for measuring the processes, that is, to evaluate what they contribute to the organization (there have been discussions about using *balanced scorecard* to do this).
- There is no systematic classification, a terminology, for categorizing processes into process types, such as support processes, management processes, etc. (except from *core process*).
- There are no routines/requirements for establishing process owners. For systems owners it is different, since there is a requirement that a systems owner should be selected, but not even this role is defined (i.e. what are the systemsowners responsibilities?).
- There are no routines for how the process owner should deal with meta-information (i.e. information about the process). Many managers do not realize the need for a meta-process (that generates meta-information), since they do not look outside their own process.

But there are some good things also:
- There is potential for succeeding with process orientation, since several people act as driving forces for a change process.
- More and more are beginning to "*think globally and act locally*", i.e. to realize the risk with sub-optimization and the advantages with removing functional boundaries.

Process development within Astra (as in most companies) so far has been a mixture of both incremental and radical change. CANDELA, for example, was intended to be a radical change, but the only changes that occurred were incremental.

What are the Processes Different Roles and Responsibilities?
Each process should have a process owner, who also acts as a systems owner for all systems within the process. The process owner's responsibilities are to:
- Evaluate the process.
- Ensure that systems are implemented and, if needed, adapted to the situation.

- Ensure that necessary competencies and skills are available to the process, and also define the nature of these necessary competencies and skills.
- Create requirement specifications. Although, the process owner do not actually produce these specifications. Instead, each department/function does this.
- Ensure that the resources that the process requires are supplied from each function. A problem though, is that there is no one in each function that is responsible for making these resources available to the process. Instead, resources are supplied to the process on an ad-hoc basis.

For each system in the process, there is a maintenance organization that meets with the process owner every now and then. It is the systems owner (the owner of one single system, as opposed to the process owner who has overall responsibility) who is responsible for the maintenance organization.
The systems owner reports directly to the process owner.

Since there can be more than one occurrence of a specific process (e.g. the clinical development process), there is a central steering committee on corporate level. This committee consists of process owners from all process occurrences (of the same kind), and here are common issues, such as systems that are standard within, for example, the clinical trials, discussed.
In this committee there is an opportunity for all process owners to share their experiences and opinions and to learn from each other.
There is one person that has overall responsibility for the steering committee, for example, there is one person that is responsible for the clinical drug development process on a corporate level.
Each process type has such a steering committee, and each committee is also without representation of IS/IT.
Figure 22 below illustrates this process organization.

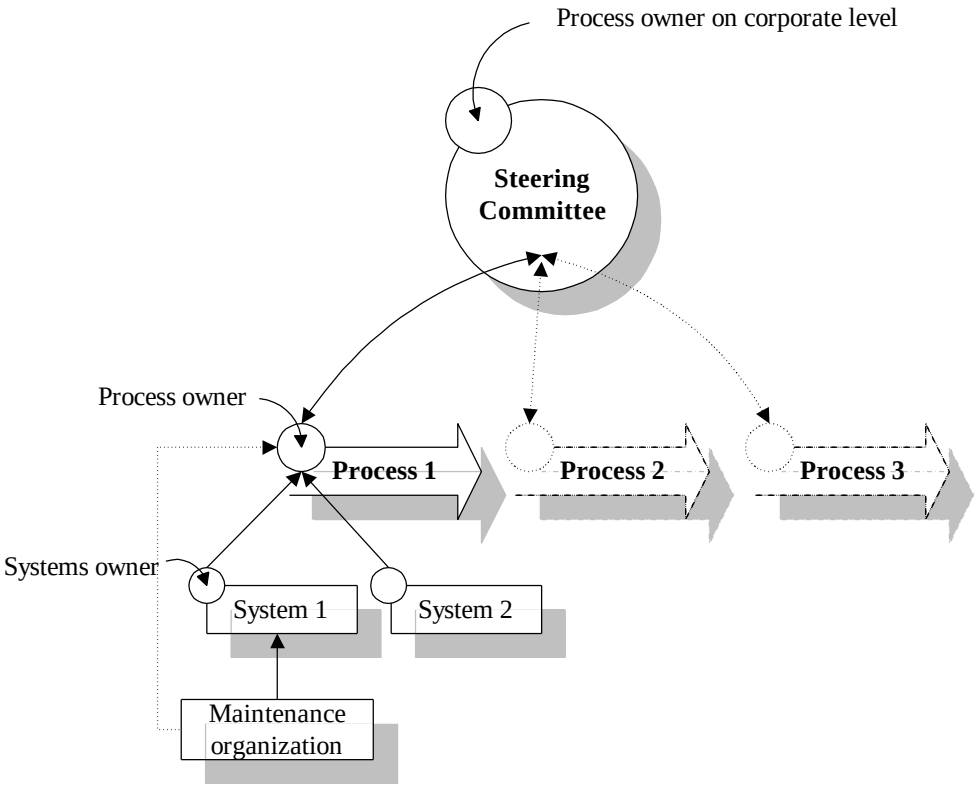

Figure 22. *Processes and their roles within Astra* (source: own construction).

5.3 IS/IT and Processes at Astra

The following subjects are those that we think are of special importance for us in order to answer our research question and Astra´s assignment, and the creation and selection of these specific subjects are based on our theoretical framework.
All opinions and facts that are presented here are entirely without our interpretation.

Problems with a Transition from a Functional to a Process Oriented Organization?

These are mainly problems seen from an IS/IT perspective, and they relate to, on one hand the transformation process, and on the other hand to the situation that exists after the process orientation project is completed.

Two factors that seem to cause great concern amongst the employees are *roles* and *responsibilities.* Since a process orientation means crossing organizational boundaries, unclear areas of responsibility is seen as a great problem for most of the interviewees. One example of such an area of responsibility is the process owner. Several employees feel that there is a risk that this role has not been properly defined, neither for the process owner him/her self, nor for the other people in the process, which will cause confusion and misunderstandings in the new organization

Another problem that where put forward was *authorization*, i.e. who may update, write, and make changes in a system/database? This problem arises due to the fact that systems will cross earlier functional boundaries, and if an error occurs, who is

responsible?
This is in fact the processowners responsibility. But, some of the interviewees feel that the process owner does not have the necessary knowledge on a functional level, only an overall understanding of the process, and therefore cannot handle these issues.

Terminology is a major problem that almost all interviewees acknowledge. This is not a problem exclusively within process orientation, but since a process orientation project requires that people from different disciplines work together it becomes very important. One problem that IS/IT-personnel specifically expressis that top-management does not understand their terminology, and vice versa. This is seen as a major problem since it is extremely important to understand each other in order to succeed with creating an appropriate IS/IT-architecture to support the processes.

One employee mentions the following situation as a problem:

> *"A technician comes and specifies the systems requirement, goes away for a couple of months, and returns with a solution, but, the requirements have changed since the specification was made and the system is not adequate to the new situation. This problem occurs since systems developers and users do not speak the same language, and therefore do not communicate during the development process."*

Another risk is that the importance of a unitary terminology is forgotten when the IS/IT-architecture is developed. Several interviewees expressed an agitation that this would happen in the process oriented organization, and that the result would be conflicting definitions of information and data elements, which would reduce the ability to exchange information.
Lack of a unitary terminology can also cause problems when requirements should be specified that involve several functions/departments of the organization (something that will happen in a process orientation). The risk that is seen here is that it would be difficult to create a process oriented IS/IT-architecture because of a diverse terminology.

A *new way of thinking* is required, and this is something that may cause problems according to some of the respondents. For example does the process orientation lead to less contact with your closest superior manager (compared to the functional structure), and this in turn may lead to trouble knowing where to turn for information, directives, etc.
One respondent also mentions that management (both business and IS/IT) have to change their perspective and not only focus on "their" process, i.e. they must *think globally and act locally*. Without this new perspective, there is a risk for sub-optimization and choice of solutions that may fit the actual process, but that has great shortcomings in a wider and more long-term perspective.
Another obvious problem, also connected to sub-optimization, that some interviewees talk about is the difficulty with introducing and establish the idea of processes instead of functions throughout the organization.

Compatibility between technologies/solutions is also one of the problems that many employees mention. When moving from functions to processes, a need for integrating solutions occurs, and with a systems portfolio that is too diverse, this becomes a serious problem. One respondent refers to object integration, e.g. CORBA, as a solution to the problem. Another respondent though, mentions the following situation as an example of the problem with compatibility:

> *"…it was decided that COTS should be used, but when systems where chosen, it was done with too much focus on functionality, and not on compatibility. The result was very poor due to the difficulties with systems integration."*

An *unenthusiastic user community* is mentioned as a source to problems. That is, the users become a major problem if not engaged and inspired with enthusiasm. As an example was mentioned the problem with implementing a system over former functional boundaries. Without being involved, the users may feel being run over, and since the system is not specific for a certain department, the users may not have confidence in it.

Lack of definitions and methods are problems that seem to worry many respondents. For example, there is no company policy/common method for systems development, and especially not for systems development in a process orientation project, and this is seen as a major problem. And what is even stranger for many of the people we interviewed is the fact that there is no common definition of a process on either corporate or company level (i.e. neither a formal definition of the concept, nor a model to illustrate a specific process). Instead, almost everyone has his/her own definition.

Some other problems that were put forward are these:
- *IS/IT projects are not" in line" with the process development:* This is something that one employee has observed, and considers an obstacle for a process-oriented organization.
The situation is that process development is "technology driven" (see fig. 23 below) and this leads to IS/IT solutions that may be out of date before the process is developed, alternatively, that IS/IT solutions with too short life-cycle are created, due to poor coordination with process development.

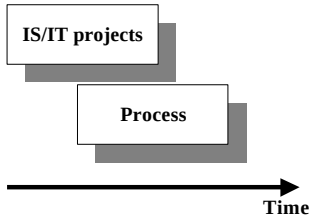

Figure 23. *Technology driven process development* (source: own construction).

- *The risk for" information islands"*: One interviewee told us that there might be a lack of confidence for information created by other departments, and that this

would create information islands since the information would remain within the department/function where it was created. It is not possible to think in terms of information owner if the information should be used effectively throughout the processes, and not be stopped by functional boundaries. This would be a very serious problem in a process oriented IRM-architecture.

- *IS/IT personnel tend to be too involved in process orientation project*: This is a problem that was observed by some people, and an example that was given is the Business Simulation project (see part 4.3) which included almost only IS/IT personnel and technicians. Obviously, the problem is the fact that solutions do not reflect user needs enough.

- *The IS/IT-architecture is not discussed on an early enough stage, i.e. the architectural issue drags behind the business development:* This opinion was expressed only by one respondent, by if this is the case, it is a serious situation.

- *Decisions about the IS/IT-architecture are not based on the processes which it should support.* These decisions are instead made only from an economic perspective.

- *Trouble finding the necessary resources*: This mainly refers to the difficulties in finding the appropriate competence. Of course it is possible to use consultants, but most interviewees seem to prefer in-house competence.

Critical Success Factors
The view of critical success factors where quite widespread in the company. Some of the CSF´s were IS/IT related and some were organizational.

Area of responsibility
One of the areas that were mentioned in most of the interviews was *roles* and *responsibilities.*
This is quite natural since a process cuts over different organizational boundaries, cutting across different boundaries also means cutting across different areas of responsibility. It is inevitable that this will create a conflict between the different areas of responsibility. It was considered very important that everybody has a clear apprehension of their area of responsibility. It is therefore necessary that one have in advance clarified who is responsible for what and where, and how they should cooperate before the process is implemented.
It was also considered important that a process owner and a process manager were appointed. This to guarantee that someone always is responsible for the process. A univocal ownership in the company was also sought after. A large amount of the interviewees thought that a univocal process ownership was important when introducing process orientation in the company.

One respondent emphasis how important it is for the *system owners* that it is clear to them what their area of responsibility is. There could otherwise be conflicts about who should take action in certain situations.
One way to illustrate this is to use the following picture (see fig. 24).

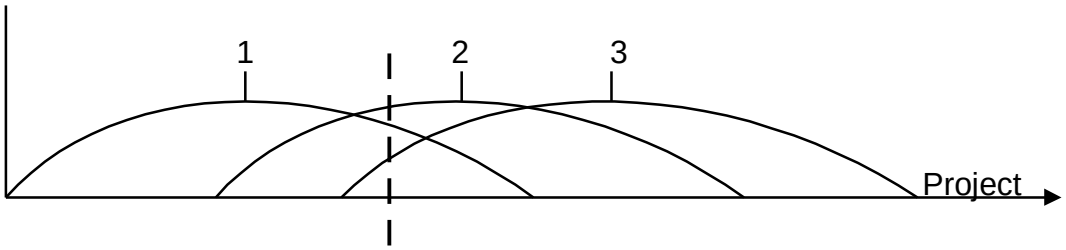

Figure 24. *The different areas of responsibility of the system owners* (source: an idea from an interviewee).

The horizontal line is a project and number 1,2 and 3 are systems owners and their areas of responsibility. If a problem occurs at the dotted line, system owner 2 has the overall responsibility (i.e. his "responsibility curve" is higher than the other two).
In another project, the areas of responsibility for the system owners could be completely different, but with this system there is always one with overall responsibility.

Sometimes people have different views about what their responsibilities really are. One person has one view of what the area of responsibility is, while another employee has a completely different. This situation is illustrated in figure 25.

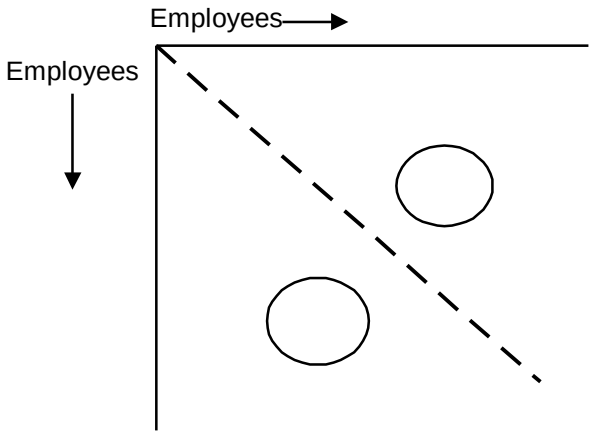

Figure 25. *Unclear areas of responsibilities.* (Source: own construction)..

These differences between comprehended responsibilities create empty areas, here illustrated with circles. Since there are different opinions about the responsibility in these areas, they do not generate any value. All employees must have the same view of what their responsibilities are. (The dotted diagonal is of course of no interest, since it represents the same individual on both axes).

Authority
Authority is also a factor that has to be considered. In a process-oriented environment where the information is available to a major part of the employees, it is important that it is made clear who has the authority to change or alter the information in the database. There have to be certain log in procedures and log files to ensure that the data is valid and could only be altered by authorized personnel.

Terminology
Since IS/IT personnel and business personnel work jointly, it is very important that they have the same terminology. The business and the IS/IT people must have the same conceptual framework, otherwise there will be lot of misunderstanding. This is however something that is not only valid in a process environment, it is also valid in a functional organization, but it is nevertheless important to consider.

Knowledge about the business
To be well informed about the business was also considered to be a critical success factor, this is particularly important to the person who is responsible for a process (i.e. a process owner).
The IS/IT personnel must have a in-depth understanding about the process and how it works, this is crucial because they are modeling the process, the business people should on there hand be able to describe their needs in technical terms so that misunderstanding could be avoided.

Definition
There does not exist any unitary definition of what a process is today, and this was seen as a problem. To have a common definition of the process concept over the entire company was seen as an important success factor by a major part of the respondents.

Process chart
It was considered important to get a general view over all the processes, there has to exist a process chart or map. On this map one should be able to identify the different processes and how they cooperate and communicate with each other. If one does not establish how the processes/systems will cooperate, there is a risk that redundant systems are being developed and that they will not be compatible with each other. Therefore one should construct an IS-chart over the information systems that are supporting the processes, on this chart one should clearly be able to see what systems support the processes and how/if they communicate with each other.

Process and value
There are a number of different processes in a company, all of them generating value to the organization. All of the processes are not generating the same value, therefore one should try to identify which process is generating most value and then allocate the resources to that specific process.

The Architecture
A critical success factor for the *architecture* is that it should support the process all the way, one should not think in terms of departments, like clinic or pre-clinic. The architecture must be unbroken and be able to support the process all the way through, from start to end (see fig. 26).

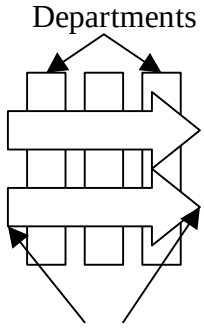

Figure 26. *The architecture has to be just as long as the process* (source: own construction).

Decisions about the IS/IT architecture should therefore be lifted to a more overarching level where one have a more comprehensive view over the situation. If it is done on departmental level it could be a risk that the architecture will be sub-optimized. There could also be a risk that parts of the architecture are incompatible and can not communicate with each other.

Another important factor of the IS/IT-architecture is that it is*flexible*. The environment and the processes change continuously, therefore the IS/IT-architecture has to be able change with the process.
One way to cope with these changes is to have an architecture that is modularized. This means that different modules should be able to be connected or removed without influencing the rest of the architecture.
One respondent argued that it was important to estimate the capacity, i.e. one have to judge what new needs the process orientation demands, for example bandwidth or data storage.

Standardization
Strong standardization depending on a common infrastructure was considered being a success factor. When so many systems should support the processes, it is crucial that one could narrow down the number of platforms. The reason for this is that it is hard to guarantee that the different systems could communicate with each other, it also requires a broader competence among the IS personnel to manage a diverse portfolio of systems/hardware.

Information storage
One respondent vindicates that the information should be a stored in a central database. The different departments could have their applications, but the information should be stored centrally. To have the information stored on several information systems could result in bad transparency, i.e. it could be hard to find the needed information.

Centralization or Decentralization?
The general view is that the platforms and information processing could be both centralized and decentralized. Decisions about protocols, standards and ciphering should be made on a central level. The cooperation between the processes and the planning of the infrastructure must also be centrally managed. The infrastructure concerns several different companies, so it has to be lifted to a corporate level.

When it comes to information that only concerns the process itself, the opinion among some of the respondents was that it should be managed by the process it self. Non technical information that only contains research results should be decentralized and not be controlled by any rules (this to prevent any restrains on the creativity). The purely technical information could on the other hand be centrally stored. However if the information is used by several processes it has to be managed on a more central level so that all processes can have access to the information.
This view was however not shared by everyone, some believed that all the information should be centrally stored and managed, whereas some of the respondents believed that only key information should be stored centrally so that it could be easily reached by management.

Centralization is considered to be slow and does not encourage any innovative solutions. Decentralization provides access to information a lot faster, it is more flexible than centralized systems. The problem with decentralized systems was that they could create information islands, and then there would be no coordination or flow of information between the processes.

Standardized Interface?
Since there are a quite a big variation of programs in the Astra environment there are reasons to standardize the interfaces. It seems to exist two schools in this case. One is the "Apple school", the Apple school advocates a standardized interface on every program. The purpose is that all the programs should have a fairly equal interface. In this way the user should be familiar with all the programs he or she uses, and the user would be able to learn the new functions in the programs both quickly and easily.

Some people were against this type of thinking. They argued that one should adapt the interface depending on who uses the program. The argument was that a experienced user has different demands on the interface than a novice does.

Standardized Platform?
The most common opinion among the interviewees was that there should be a standardized platform thinking. A standardized platform could increase the functionality, for example since it becomes possible to synchronize the catalogs in Microsoft Schedule or Exchange.
With standardization one do not have to invent the wheel every time a new project is started. It also facilitates training and maintenance when standard equipment is used. The number of standardized platforms will also provide economies of scale, the company could get a better deal from the vendors when purchasing a larger amount of software/hardware.
It is an advantage with standardized platforms when constructing new applications, i.e. one knows that the system will work in the current environment.
There should be some freedom of choice when choosing platform, as long as it is not to many of them. The gist of it all is that the platform portfolio should be rather thin, especially when one considers the competence that is needed to maintain a large platform portfolio.

Top Management Involvement in IT-management Issues.
The opinion of many respondents is that it is important that the management is involved in IT questions. A major part of the interviewed people thinks that the management on Astra Hässle is not involved enough. Some of the employees said that it is a big step forward with the new CIO position. To have a CIO who is responsible for all IS/IT issues and are reporting directly to the topmanagement, was seen as big step forward.

It is very critical that the management realizes the importance of IT questions, they should not just see IT as purely technical, they also have to realize the soft issues and possibilities that are a part of IT-management.

Reuse of Exiting Code?
There are no routines for recycling existing code. Attempts have been made to construct routines for reuse, but when the routine was ready the technology was out of date.
There is also a certain predilection among the IS/IT personnel to use the latest technology, and this does not exactly boost the motivation to reuse old code.

What Characterizes a Good IS/IT-Architecture?
An architecture which purpose is to support a process orientation should most of all be flexible. The environmental change presupposes an IS/IT-architecture that is able to change with the processes as they change. This constant change will result in new demands on the IS/IT-architecture.
Despite the increased demands for flexibility, the IS/IT-architecture still has to be stable so that there will not arise any other complications instead.

When designing an IS/IT-architecture one have to consider that it should be useful for a longer period of time. This means that the architecture has to be designed so that it could be changed along the way. The IS/IT-architecture has to be built by modules that could be implemented or removed without affecting the rest of the architecture. There must also be a clear consistency in the architecture (for example specifications) so that it is easy to get different applications to cooperate with each other, or to implement new applications or remove old ones.

The degree of ability to change should vary depending on what level the IS/IT-architecture should support, different parts of the architecture should be connected to different parts of the organization. (See fig. 27).

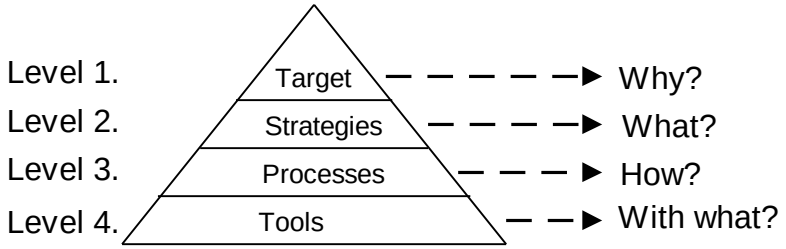

Figure 27. *Different levels of the organization that the architecture supports* (source: adopted during an interview).

On level 3 and 4 the architecture has to be quite flexible since processes and tools change quite frequently. On level 1 and 2 the need for a changeable architecture is not that big. Data models, targets and strategies do not change so often, and this is the reason why the architecture must be both flexible and stable.

The length of the architectures life cycle should be just as long as the application/organizational part it supports. If thearchitectures life cycle is longer than the applications/organizational parts, it could be an obstacle or slowness in the organization. The length of thearchitectures life cycle will vary depending on what it is supposed to support, tools, processes, strategies, or target.

The architecture should also support on-line accessibility in both time and room. To have accessibility in time means that it should be just as easy to retrieve old information as new one. Accessibility in room means that it should not matter where you are, the information should always be available.

Problems Today
The architecture today does not support the demand on accessibility in time and room.
For example, it is difficult to access older information (accessibility in time). This is a problem since it is sometimes needed to find specifications about several year old projects. As it is now, it takes huge amount of resources to find the information. It is also a question about areas of responsibility, for example, who is responsible for information about Losec that was generated in 1988?

Another problem is the flexibility. It is today difficult to change different parts of a system because there has not been any modular thinking when the IS/IT-architecture was designed. The parts within the system are tightly connected to each other. This problem does however not exist between the systems. They communicate with contracts and messaging etc., but the system itself is very tightly integrated, which makes it harder to change.

Another problem that surfaced was that when a process changes it also changes the IS/IT-architecture. There is a problem when the process changes in the middle of a project (see fig. 28).

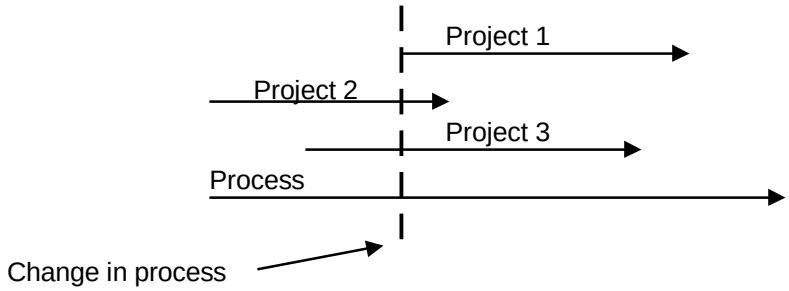

Figure 28. *How the process change raises problems for the project.*

In fig. 28 one can see that project 1 is not affected by the change in the process, project 2 and 3 however are affected.

The projects could be affected negative by this sudden change, so the question is, how could IS/IT support this kind of problem?

How Should IS/IT Solutions be Delivered; Adoption, Adaptation, or In-house Development?

Obviously, the answers to this question were given with a process oriented organization in mind, and the scope of the process orientation is either intra- or inter-organizational.

There is a great variety in the answers, but one common thing is that no one advocates in-house development solely.

About 30% of the respondents advocate almost exclusively standard systems (i.e. adoption). And the reason for this is mainly the opinion that Astra´s core business is drug development, and not systems development. An argument is that the expertise does not lie within systems development, and neither does the competitive advantages (referring to the huge costs and revenues generated by the drug development process). Another statement is that in-house development tends to fail after the first version, that is, when it comes to upgrading. The argument for this is that needed competence may have left the company, and also that it is not so motivating to upgrade as it is to develop new solutions, which would in turn lead to a poor solution.

Those savings that in-house development may generate, compared to buying a standard system, are infinitesimal in comparison to the losses that the core business would suffer from in case of a delay in the upgrading of a system.

Another, completely different, viewpoint (also about 30% of the respondents) is that adoption only should be used within administrative functions. The argument is that solutions for the core business always should be “tailor made”, since standard systems never fit the processes to one hundred percent, and therefore no competitive advantages can be generated. Adaptation may also be an option as long as the commercial system is very flexible and adaptable to the specific situation.

As opposed to the above statement, one person argued that standard systems is indeed an option, even for core business, due to the increasing number of systems available, i.e. there is a system for every need on the market today. But, in order to adopt a prepackaged solution, or even to use adaptation, a thorough knowledge of the business different needs is required, and hence this strategy should only be applied on mature parts of the organization.

For newer areas, such as data mining and knowledge management, this respondent suggests in-house development.

Another good thing with standard systems that one person mentions is (since some BBS features such as separate components and modules now are becoming parts of the standard systems idea) that you have a totally integrated solution at the same time as you have a wholeness in the process (as compared to several smaller systems). The result is a comprehensive view over the information, and at the same time flexibility to exchange components within the system.

A slightly different view that was put forward of some people was that all three

choices (adoption, adaptation, and in-house development) are equally possible, since it is only a matter of money. If, for example, necessary competence for in-house development is not available, it can be bought. One respondent said:

> *"The only thing you have to do is to calculate the revenues versus the expenditures, since it is important to be able to show that you have chosen the best alternative…ROI is of course dependent on the expected effect from the investment, if it is all right to replace the system after a couple of years, etc.".*

Worth mentioning here is that those advocating standard systems are people with their expertise within the pharmaceutical field, whereas those advocating in-house development are mostly IS/IT-personnel.

IRM or BBS in a Process Oriented Organization?
Astra Hässle has had some kind of BBS philosophy since early 90´s, but there is no real consensus regarding which design philosophy is the most appropriate for process orientation. No one agrees that there is pure BBS today, and one respondent even means that there is some kind of IRM architecture today.
Almost all interviewees mention some situation that requires either one of the two concepts. But, what is interesting though, is that there is a high degree of consensus about this (i.e. which situation requires which concept).

Some respondents argue that there are two situations that require IRM, namely:

⇒ High demands on accessibility and continuously updated information (real time).
⇒ Certain key data must be centrally stored (an authority requirement).

Other situations that call for a BBS solution are:

⇒ High demands on speed.
⇒ Information that is only used within the local process can/should be stored locally.

There were some arguments questioning the appropriateness of BBS, and one interesting point is that more and more systems are developed for the web (Internet/intranet based solutions), which leads to difficulties in clearly demarcating systems (as BBS suggests).
Another weakness that several persons mentioned was that BBS has poor transparency, i.e. in comparison to a totally integrated system, it is more difficult to find and retrieve information.

One interviewee argues that:

> *"If BBS shall work, it has to be adapted to the process lifecycle instead of to the specific functions. BBS is good for creating flexibility, ability to switch systems, and still have clearly defined boundaries".*

Another one says that BBS is the most appropriate in a process oriented organization, but:

> *"There must be an organization for common components, infrastructure, etc…".*

Still another says that BBS is the better concept, but meta-data has to be centrally stored.

How are Processes/Sub-processes Coordinated?
This is an interesting question since the need for coordination of activities increases due to the fact that work tasks occur over former organizational boundaries.

In order to decide how information shall be transferred between processes/sub-processes, it was made clear that the following factors had to first be considered:

⇒ Have clearly defined sub-processes, i.e. what do they do and how are they connected?
⇒ Define input and output.
⇒ Maintain an updated process map.

After this, it is then possible to decide how the actual coordination shall be achieved, i.e. how to coordinate the activities.
One respondent mentions objects, and suggests that it is the objects within the process, and the changes in their conditions, that should guide the information flow (the coordination).

When it comes to choosing between IRM and BBS, the opinions differ. About half of the interviewees suggest IRM, with the reservation that this requires routines for data management, and one person advocates *concurrent engineering* as a solution when the IRM concept is used.
The others consequently recommend BBS and messaging as the best way to coordinate activities in and between the processes. In order to make the messaging work, a *message contract* shall be established between those parts that are to be coordinated.

No matter how the coordination is done, there should be a "process description" which explains how coordination occurs and is maintained.

IS/IT Personnel's Role in Process Orientation Projects?
Some interviewees talk about how business- and IS/IT personnel have to create a common competence and common tools. For example, there is currently no way to describe a process in a unitary way.

IS/IT personnel have to know the core business (as well as business personnel have to know IS/IT). One respondent illustrates this, and how it can be achieved, with the following example:

> *"Federal Express solved this situation by assigning the IS/IT department to within one year, reduce the company's total expenditures by 10%. This forced the IS/IT personnel to learn about the other parts of the business".*

The common apprehension seems to be that IS/IT personnel have too much influence in the projects, i.e. process development projects withinAstra are generally technology driven.
Since there is no clear coupling between business & IS/IT, the result is often technology driven projects. IS/IT tend to transform process orientation projects into systems development projects. One person mentions a specific project (CACIS) as an example of this. The project resulted in the system AMOS, and the rest, i.e. the intended process development, "ended up on a book-shelf."

The general apprehension is that there should be a project leader with technical background that coordinates necessary IT resources, although the process orientation project should be managed by people from the core business.

Only a minority thinks that IS/IT personnel are excluded from process orientation projects, and their argument is that *"it is difficult, as an IS/IT employee, to identify ones role in the project"*.
There are no management directives about what IS/IT´s role in process development should be.

How is the Process Concept Defined withinAstra?
There is no such thing as a common definition of a process within the organization. One respondent thinks that it would be difficult to establish a common definition, but almost all interviewees say that they consider it a weakness to not have this definition.
One person actually mentions one specific project where the functions became too strong (i.e. there were problems breaking down the functional boundaries), probably because there were no common process definition to focus upon.

How Does One Know that the "Right" IS/IT-architecture is being Created?
This question does not focus on the completed architecture and how this is evaluated, instead it means how one can know that progress is made in the "right direction".
Some of the things that were mentioned are:

⇒ Use a complete, and updated, process map as the starting point, and adopt a business led development.
⇒ Important to prioritize, i.e. what shall be done first, secondly, etc.
⇒ Use "milestones" so that you know how the project proceeds.

⇒ Make sure that the IS/IT-architecture becomes cost effective. If the functionality is good, but the economy is poor, then it is not a good architecture.

Business needs must be a part of the planning process. It is also important to be aware of what is happening in terms of new technology, so that right solutions (with respect to upgrading, compatibility, etc.) are chosen.

SUMMARY

As a summary, systems integration and roles and responsibility were mentioned most during the interviews. Standardization and a common terminology were also seen as crucial factors for succeeding with a process oriented architecture. IS/IT and business people have to understand each others domains, and one also have to consider whether to centralize or decentralize the systems. There was an expressed need for a process map over all the processes. How to access and authorize the information has to be considered as well. Support from both management and users must not be neglected either, and finally, sub-optimization and reuse of code were also factors one have to deal with.

These were the most interesting opinions and facts that we discovered during our interviews. They constitute an important source of experiences and knowledge, which we need in order to reach a conclusion. That is, a conclusion that is based not only on theories, but also on real-life situations.

5.4 Analysis

In this part, we discuss the situation at Astra, according to our findings, and relate it to the theoretical framework, i.e. conduct an analysis.
It is of interest here to, not only analyze the situation with respect to what other theories suggest, but also to question why things are the way they are, and try to explain this with support from established theories.
Therefore, we decide to make this part twofold, i.e. first we analyze the different elements/factors that are of special interest to us and to Astra, and then we discuss what might be the reason to the specific situation.

Part 5.3 resulted in that some factors/elements were mentioned more frequently than others, and to illustrate this, we use a frequency diagram (see below). This diagram, which displays these different topics, and their corresponding frequency (i.e. the importance of each topic according to the interviewees), is then used as a basis for our analysis. Within these topics lies all problems and CSF´s identified in part 5.3, which later will be used as the basis for our conclusion.

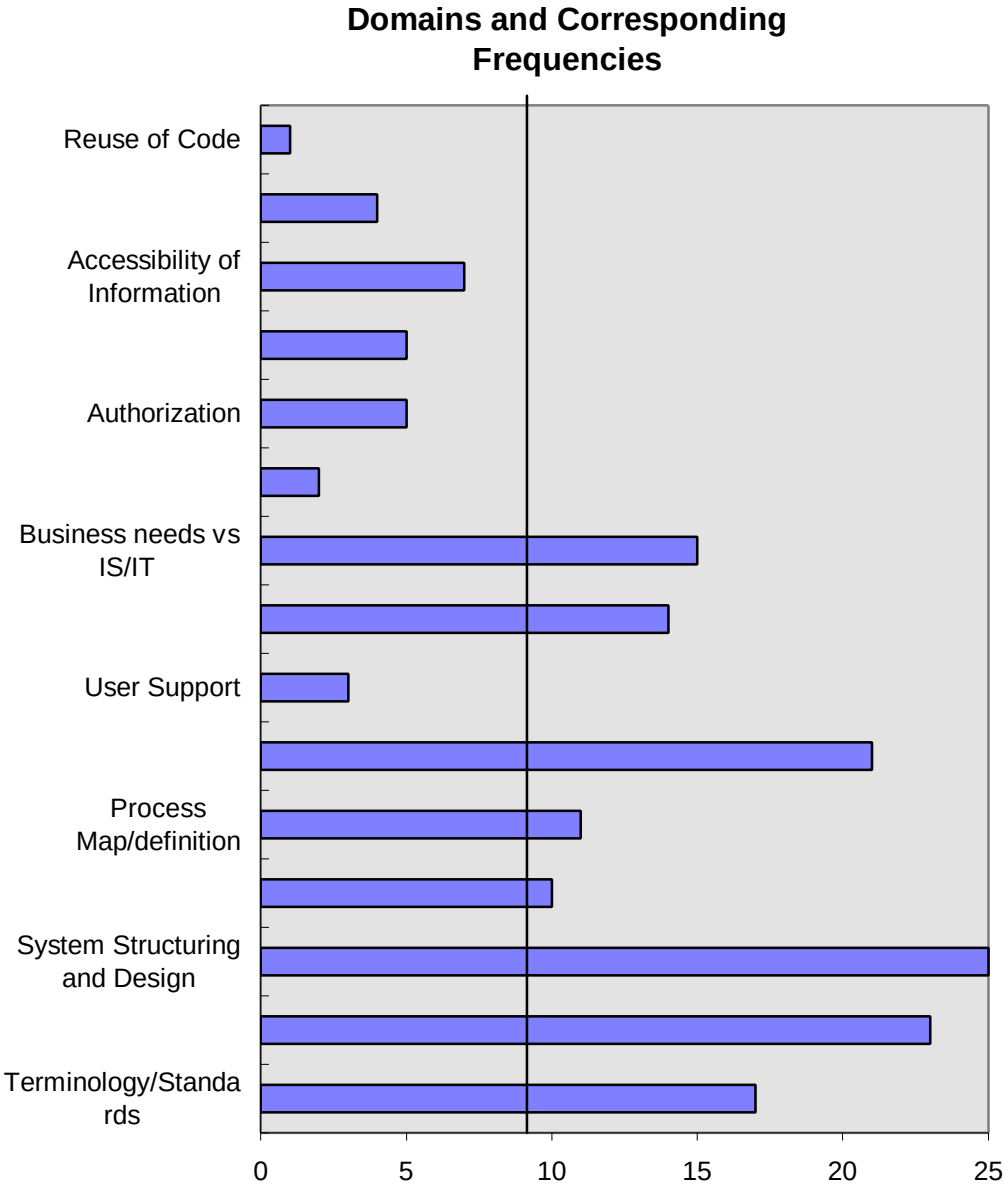

Figure 29, Frequency diagram.

The first part, the analysis of those elements/factors of special interest, is based upon frequency, i.e. how many times a specific topic has been mentioned during the interviews.
In order to decide which elements/factors to focus upon, i.e. to focus on in our conclusion, we choose to discuss those above the horizontal line more thorough. These are the topics that were mentioned by a large portion of the employees, and consequently also constitute the most conspicuous problems and critical success factors identified by the personnel at Astra.

The second part, the discussion about why a certain situation exists, is based upon the shape of this diagram, i.e. why are some factors considered very important whereas others receive much less attention among the employees.

PART 1

Roles and Responsibilities

This is a subject of major significance mentioned by almost every interviewee as being a source to problems as well as a critical success factor.
It is quite easy to realize that roles and responsibilities are indeed subjects of great importance in a process-orientation since, (as mentioned in the theoretical framework) authors like Davenport (1993, p. 5), Hammer and Champy (1993, p. 35), Keen and Knapp (1996) all include the word *activity* in their definitions of the process perspective. All activities require someone responsible for them in order to be effective, and therefore this becomes highly relevant.

Focus within Astra seems to be on systems owner versus process owner, since these two, as figure 22 illustrates, are closely related.
Worth thinking of is the situation where one system is used by more than one process. Which process owner does have the overall responsibility? How should the systems owner know whom to report to? If the areas of responsibility are not clearly defined, this would be a serious problem.

One interesting thing is that there seems to be a quite clear conception of what a process owners responsibilities are, but at the same time, this role is mentioned as a potential source to problems. Some people feel that the role is not properly defined and might also include some responsibilities that are actually not suitable for a process owner, since they relate to areas that a process owner normally do not possess any knowledge about.
An example of this is the need for meta-information. It is quite clear that this is the process owner's responsibility, but nevertheless, there are no routines for how this information should be managed. Zeibig (1995, p. 655) is an author that talks about how important this meta-information is in order to coordinate the processes activities and workflow. Since this is the situation, it seems that a major critical success factor would be to design the IS/IT-architecture with the flow of meta-information in mind. On the other hand, a major problem would be if the process owner can not receive this information, or does not know what to do with it.
One has to wonder why this is the case. That a role can, on one hand be very clearly specified and put into context, and on the other hand be considered as a potential problem.
One possible conclusion is that this situation exists due to a combination of poor communication and lack of interest, i.e. interest for the concept of processes. The fact that there is no established way to communicate and get acceptance for the process concept was actually mentioned as a shortcoming at Astra, and could hence at least partly explain this.
To avoid the situation with unclear responsibilities it is necessary to be aware of roles and responsibilities all from the beginning. Tozer (1996, p. 220) is an author that acknowledges this, and he argues that the business model, which is the foundation for the IS/IT-architecture, must include areas of responsibility.

Standardization

This is an issue of great interest, and there are many arguments both for and against standardization ranging from purely economical to functionality, e.g. compatibility

between technologies. In the study by Smith *et. al.* (1995, pp. 612) it was discovered that IS/IT executives consider both infrastructure and functionality as well as interfaces to be subjects for standardization. Also at Astra, the discussion included such diverse areas as the infrastructure, i.e. platform, applications, and user interfaces.

As mentioned in part 5.3, an interesting thing is that a majority of the IS/IT personnel advocate non-standardized solutions, whereas people from the core business believe in standardization. But, this difference exists more when it comes to applications. On the platform level there is, if not total concordance, at least a majority of the employees that believe that platforms should be standardized.

A standardized infrastructure is something that several authors agree upon. For example Magoulas, Pessi (1998, pp. 70-83) also suggest a homogenous infrastructure in order to avoid incompatible solutions, information islands, and the difficulties in supporting a too diverse infrastructure.

If one consider figure 27, which suggests that level 4 needs a high degree of flexibility, it becomes clear that the platform should be standardized, since it, in case of a need for change, would be a lot more difficult to change a diverse infrastructure than a standardized. The reason for flexibility is mainly the fact that changes in infrastructure occur frequently due to rapid development in technology.

Consequently, it is easy to understand the unanimity regarding a standardized platform, but why is there such a difference when it comes to applications?

Well, one explanation is simply because personnel from core business consider IS/IT to be a support function that does not generate any significant value, and therefore is not worth the extra effort of developing in-house. That is, they follow Allen, Boynton´s (1991, pp.436-442) "the high road".

Another explanation can be that since IS/IT personnel, as Smith *et. al.* (1995, p. 612) suggest, view IS/IT as a "crucial enabler" in a process orientation project, and therefore believe in the possibilities with new technology (i.e. to develop "tailor-made" instead of buying a standard solution). People from core business on the other hand do not have the same faith in new solutions, and they argue that any competitive advantages are generated within the core business, i.e. the pharmaceutical field.

Even if it may appear that people from core business are narrow minded and do not understand possibilities with IS/IT, one must remember that Greenbaum (1993, pp. 36-44) strongly suggests that a number of factors, e.g. programming skills, cost, risk of failure, etc, be considered before deciding to carry out an in-house development instead of buying prepackaged.

The question about standardization or not is a tricky one, but if one assumes that there are so many standard applications on the market today that it is possible to find a solution for every business need, and therefor the risk with compromises that do not fit anyone is eliminated, this instead becomes choice of how to best ensure flexibility. If a process orientation is to be successful, it has to be supported by a flexible IS/IT-architecture, and one way to ensure this is to think in terms of "plug-and-play" modularity, as Zeibig (1995, pp. 658) discusses.

This need for flexibility is illustrated in figure 28, which shows how an IS/IT-architecture has to be flexible an adapt to changes within the process so that the projects can still be supported by IS/IT after a sudden process change.

And also, as Ponce-de-Leon *et. al.* (1995, p.205) argue, the decision to buy, adapt, or internally develop IS/IT hinges not only on the capabilities of the organization but also on the available time, costs, risk preferences etc.
Consequently, all factors must be considered when planning for the IS/IT delivery strategy, and this is something that can be difficult as long as IS/IT personnel and core business personnel have such different viewpoints on this matter. So again, what is needed is a dialogue between these two groups, so that they can see the whole picture and base the decision on this.

Process Map/Definition
There is no one questioning the importance of maintaining an updated process map and to have clearly defined processes, in terms of inputs, activities, and outputs. Even though this is a critical success factor, it was still mentioned as a major problem. For example, there are no common method for illustrating a specific process, its activities, and how processes and systems should cooperate, and this is a serious problem since an updated process map was put forward as a critical success factor.
Without a proper overview over the processes, it could be difficult to ensure the situation illustrated by figure 26, namely that an IS/IT-architecture that is "just as long as the process" is created. On the question about how coordination between processes and sub-processes is established, the common answer was that an updated process map was required in order to decide how information shall be transferred between processes/sub-processes.
Since this is the situation, it is strange that there are no routines for such a process map/ definition. Maybe the answer again, as with roles and responsibilities, is lack of both communication and interest for process orientation.
Another problem with not having a process map or defined activities is the question about necessary resources, i.e. how should one know that the process receives enough resources when its activities are not defined. This is actually also connecting to the issue about roles and responsibilities since it is the process owners responsibility to ensure that the process is supplied with adequate resources. But, if inputs and outputs are not defined, this responsibility becomes very complicated. Within this lies also the risk for sub-optimization, since without a complete process map that illustrates how the different processes/sub-processes and their corresponding information systems should interact, it might happen that the process owner focuses too much on his/her "own" process.
Still another problem with not having a common way of defining a process regards the evaluation of each process. This is the process owner's responsibility, i.e. to evaluate and decide the effectiveness of the process. But, since there might be several occurrences of the same process such an evaluation becomes ineffective because there is no way to compare the different occurrences with each other, since they all are defined in their own way. That is, the results of the evaluations can not be compared.
A poorly defined process, or process map, is also against Hugoson´s argument about how IS/IT projects must be coordinated with the processes (see figure 7). This, since such a coordination is dependent upon clearly defined processes to use as a starting point (the information flow shall be based on these defined processes). Hugoson even argues that IT-management partly is about documenting the business!

Business Needs vs. IS/IT

This is an important matter of several dimensions. For example, business people have to understand IS/IT and vice versa. Since it is IS/IT people that deliver the technical support to the processes, they must be able to model the business, and business people must on the other hand be able to express their needs in technical terms. A risk with, for example IS/IT personnel not understanding the business needs is that in a process orientation project, IS/IT tends to focus too much on their own area of interest. The result of this is a technology driven project, which is something that was put forward by some employees as a problem withinAstra.
Another side of this issue is that in order for an IS/IT-architecture to be appropriate, it has to support and reflect the business needs. It is rather obvious that this interdependence between business and IS/IT exists, especially if one considers Inmon´s business model, which is the foundation for an IS/IT-architecture. But, in order to be useful, this model must be able to address both business- and IS/IT-people, so it is hence crucial that these groups understand each other.
The ultimate illustration of this relationship between business needs and IS/IT is figure 25. This figure shows how certain parts of the IS/IT-architecture reflect and support certain parts of the organization. In order to create such architecture, it is absolutely necessary that business needs and IS/IT are coordinated.
It is rather strange though that, although many interviewees mention the importance of coordination of business needs and IS/IT and also realize the risks with no coordination, there is no IS/IT representation in the process steering committee (see fig. 20). Is this not a potential source to problems and misunderstanding between business and IS/IT?
Markus, Robey (1995, pp. 604) argue that by knowing each others areas, i.e. needs and possibilities, the chances of developing appropriate IS/IT support for the processes are increased significantly. It also reduces the risk for sub-optimization, which could be the case if, for example, IS/IT optimizes the systems without considering the actual needs of the core processes.

Terminology and Standards

The respondents considered terminology and standards as quite important since it was mentioned frequently. When we discuss standards, we mean standardization of protocols and communication, not software or platforms. The reason why we put these two in the same category is that it is just as important that the information systems could communicate as it is for the employees to understand each other.

One can see a parallel between a common terminology as a critical success factor and business people and IS/IT people not understanding each other as a problem. One of the reasons that business people and IS/IT people do not understand each other is that they do not have the same conceptual framework or terminology. These views about how important it is to have a common terminology get theoretical support from Zebig (1995, p. 655). He argues that when a company is moving from functional to cross-functional process orientation, the IS/IT architecture will show some inadequacies:

⇒ Conflicting definitions of information and data elements.

⇒ Incompatibilities of technologies i.e. lack of standards.

The lack of common terminology could result in conflicting definitions.
Further on he also argues that a process-oriented environment must comply with technical *standards* and compatibility of components/applications.
Inmon (1986, p. 4) suggests that one should use a business model which should result in an IS/IT-architecture. Some of the characteristics the architecture should posses are:

⇒ Data keys are defined globally.
⇒ Compatibility at critical interfaces.
⇒ Ability to communicate from one process to another.

These three characteristics support the opinion that the different departments must have a common terminology in order to avoid conflicts in definitions and standards. Since a process operates over department boundaries, the employees are forced to cooperate with other areas of the business.
This increased cooperation between the departments will increase the demand on a common terminology at Astra Hässle. Since one has to deal with many different business areas of the company one have to share the same conceptual framework in order to understand each other.
The same problem exists for the information systems. In a process oriented environment there is an increased need for communication between the information systems. In order to make sure that all systems can communicate with each other, one need to have a common standard on communication and protocols.

Systems Structuring and Design
How to structure the systems was one of the areas that were mentioned most. There were quite different views about which design philosophy that was best suited for a process environment. About half of the interviewees choose IRM architecture and the other half advocated BBS. One interesting thing that we noted was that it was the business people, and especially those at a higher level, that advocated the IRM strategy, the IS/IT people preferred the BBS strategy. One reason for this phenomenon could be that the business people want the information to be centrally stored, so it could be easily accessible and managed, i.e. they want more control over the information. The IS/IT people on the other hand consider things like flexibility and speed as more important when designing the architecture. One respondent thought that it was too difficult to build a huge database for the whole organization, and that it was too rigid to change with the environment. It seems that the IS/IT staff at Astra has a more technical view when deciding what strategy to choose, they consider questions like what is the easiest way to construct an architecture from a technical viewpoint instead of from a business viewpoint. Some of the criticism from the respondents towards the BBS strategy is that it has poor transparency. Their opinion is that it is hard to know where to look for the information.
Magoulas, Pessi (1998, p. 70-83) discuss several factors that, in order to create an adequate IS/IT architecture, have to be considered. One of them is that one should not create information islands. Since there is bad transparency, there could be a risk that one is creating information islands when using the BBS strategy.

Especially people higher up in the organization expressed this opinion.
For example, one of the drugs that Astra provided was accused of causing cancer. The top management needed accurate information fast to be able to respond to the accusations. This is one example why management prefer a more centralized approach like IRM.

Astra is gradually moving away from the BBS strategy towards an architecture more like IRM, and one reason for this is the increased usage of webb technologies. It is harder to judge where the business/system boundaries are when using these new technologies. If one does not know where the boundaries are, it is hard to use the BBS strategy, since this strategy suggests that systems are clearly demarcated and within a certain business area. Thanks to the new webb technologies, Astra seems to start using an architecture more like IRM

Roles of the IS/IT personnel
Every one agrees that the IS/IT- people have an important role in the development of process orientation. There are however some different views on what role they should have. The major part of the interviewee's opinions is that the IS/IT people have too much influence on the projects. Some of the respondent's opinions were that the IS/IT people have an ability to turn process orientation projects into systems development projects.
According to Marcus, Robey (1995, p. 593), IS/IT people are left out, or involved too late in the project, and some of the reasons for this are:

⇒ They do not understand the business and cannot describe technological issues in business terms.
⇒ They try to turn process orientation projects into systems development projects.

But, when they do get involved, they tend to take over the projects.

One of the reasons why IS/IT people tend to turn the process project into a systems development project could be that they try to optimize there own specialty, believing that it will make the most contribution to the performance (i.e. sub-optimization).
To avoid these situations, Marcus, Robey (1995, p. 606) have a number of suggestions that the IS/IT presonnel should posses, and two of these suggestions are:
⇒ Communication skills, i.e. ability to listen and to describe technologies in business terms.
⇒ Knowledge of the business, i.e. familiarity with the industry and the firms business strategy.

One way of dealing with the communication skills is to make sure that everybody has the same terminology as discussed in a previous section. If the business people and IS/IT people could have a discussion on the same level, it might reduce the risk of turning the project into a systems development project. The IS/IT people have to understand the business needs, an issue that was also discussed in a previous section, *Business needs vs. IS/IT*. If the IS/IT- people understand what the business needs are, maybe the risks of sub-optimizing will be reduced.

An interesting observation here is that, on one hand, there is an opinion that IS/IT people have too much influence on process projects, i.e. they cause a technology driven development process. But, on the other hand is IS/IT not represented in the central steering committee (see fig. 22), which suggests that they would not have much influence at all!
How can this situation be possible?
One possibility could be that decisions about projects are made centrally, and then the responsibility is turned over to IS/IT people, which continue the project with a technology focus.
If this is the case, there is probably no communication between top management and IS/IT during the project. Instead they are responsible for one part each.

Centralization vs. Decentralization
When studying the answers from the interviewees, one gets the impression that there is a consensus that it should be a mixture of centralization and decentralization of information. There seems to be a concordance that all issues that concern all the processes should be managed on a central level. Protocols, standards, ciphering etc. have to be decided on a central level to ensure that all systems could communicate with each other. Decisions about architecture and infrastructure must also be decided on management level, otherwise there could be information islands and bad coordination of the information systems. This is also something that has to be avoided in order to establish a good IS/IT-architecture according to Magoulas, Pessi (1998, p. 70-83).
Goldkuhl (1998, p. 51) also argues that decisions about the information architecture should be handled by someone in the management team, there could otherwise be misunderstanding and differences between the system owners.
Maybe this is the idea with having a steering committee and an overall process owner on corporate level (see figure 22).

There were some conflicting opinions about how one should manage the information in the company. There were basically two different opinions:

⇒ All research information should be managed by the process itself, only technical information could be centrally stored.
⇒ All key information should be stored in a central database and the process should manage information that only concerns the process.

Considering these two alternatives, it seems that the second one is preferable. The reason for this is the example whereAstra was accused that one of its drugs caused cancer, as mentioned earlier. The management needed the information fast, and one way to solve this is to have a database where all key information is stored. It is also easier to control the information and make sure that it is updated and accurate. By using a central database for key information, one might avoid information islands, and by letting the information that only concerns the process be locally managed, one can ensure a fairly good flexibility.

PART 2

Why does this specific situation exist?

One could wonder why some of these domains were not mentioned more often in this survey. For example, *user support, sub-optimization, reuse* and *support from management* were not mentioned so often. Nevertheless, those who actually did mention them considered them very important.

One reason could be that domains like *roles and responsibilities, terminology* or *process definition* involve more people, and therefore where mentioned more often. Not too many people are involved in questions like authorization and reuse of code.

We do not try to prove with the diagram that the domains that were mentioned most are more important then the others. Those who are mentioned just a couple of times could be of outermost importance as well. But relatively spoken, they are not as critical as the more frequent factors (i.e. according to the majority of the interviewees).

We have just decided to delimit the study and focus the discussion on those domains that were mentioned most, and consequently also considered important by a majority of the interviewees.

Even though we made this choice, and that most employees consider some factors to be less important than others when designing an IS/IT-architecture in a process oriented organization, it can be interesting to see what other theories have to say about this.

It may seem very odd that user support did not get higher ratings among the employees, but this has to do with what perspective one have on the question of IS/IT-architecture and processes. It is true that user support is necessary when trying to implement a concept or a solution, but user support is*not* a critical part of, neither the architecture nor the process. So this might explain why this factor did not receive any attention. But, again, when it comes to implementation, user support is critical. For example, nowadays, even Hammer (1996) admits that this is necessary for a successful process orientation.

Regarding support/involvement from management, Magoulas, Pessi (1998, p. 45) talk about how important this is when they say that IT-management is characterized by an increased focus on business, and that IS/IT´s role has become more of an enabler of business objectives.

But, if this business focus should be maintained, top management must be engaged in IT-management. Otherwise, there is a risk that IS/IT decisions are not supported by sufficient authority, and instead of having this business perspective, IT-management focuses too much on technology and systems development. This actually also involves the question of sub-optimization, i.e. the IS/IT people optimizes their function without thinking of the process (the core business). This indicates that management support and involvement and sub-optimization are closely related. Without management involvement comes misuse of organizational resources and poorly supported processes!

Another way to avoid sub-optimization is to create what Markus, Robey (1995, pp. 604) calls *"a spirit of collaboration"*, which means that IS/IT people must learn to acknowledge other parts of the organization and to cooperate with the user community. This actually also relates to the need for user support.

The reason why management support and sub-optimization receive little attention within Astra might be because the steering committee does not include IS/IT. Therefore, this shortcoming is not visible, i.e. no one notices the need for top management's involvement in IT-management issues, and as a consequence neither is the risk for sub-optimization

Reuse of code and "building blocks" does not seem to be a very common occurrence within Astra, and this is quite notably since there are considerable advantages with established routines for reuse. For example, Smith *et. al.* (1995, pp. 612) found in their study that reuse was an important factor when developing an IS/IT-architecture for process orientation. The argument is that process orientation requires speed in IS/IT delivery in order to reach maximum effect, and this is possible by creating applications from pre existing designs.
So why is this not appreciated within Astra? One reason might be that there is no routines for coordination of IS/IT between processes (IS/IT has no representation in the central steering committee), and therefore will it be difficult to survey what building blocks and reusable parts that are available throughout the organization. Maybe the new CIO position can help with this?

Accessibility of information seems as not so important according to the diagram, but this is actually not the case. Issues about accessibility were often a part of the discussions about systems structuring. So therefore, the reason why this particular subject seems to be less important is probably just that most people include questions about accessibility with systems design issues.

SUMMARY OF THE ANALYSIS

- Roles and responsibilities are both a CSF and a problem, and the reason for this might be poor communication and little interest in the process concept. The role *process owner* is of special importance.
- People from core business seem to advocate standardization, whereas IS/IT personnel prefer non-standard solutions. Whatever the choice is, it has to be made with the need for flexibility in mind.
- An appropriate process map/-definition is needed in order to: *decide the need for IS/IT support, supply the process with necessary resources, avoid sub-optimization.*
- Coordination of business needs and IS/IT is crucial! Without it, sub-optimization and misuse of resources is likely.
- In order to avoid misunderstanding and incompatibility, common terminology and standards are absolutely necessary.
- People within core business prefer IRM since they want control over the information. IS/IT people on the other hand value flexibility higher, and argue for BBS. We notice a movement towards IRM.
- IS/IT people have too much influence, so a process orientation might be technology driven, i.e. turned into a systems development project. IS/IT personnel must understand the core business needs.
- Key information and decisions should be centrally managed, whereas local information should be managed by the process/function.
- *Management involvement/support, user support, reuse,* and *sub-optimization* are underestimated and ought to receive more attention within Astra.

6. Conclusion

After an empirical study and subsequent analysis, we are now able to identify a number of conspicuous problems and critical success factors that are important to consider when creating an IS/IT-architecture for a process oriented environment, and the table below displays these.

CRITICAL SUCCESS FACTORS	PROBLEMS
Roles and responsibilities	Unclear roles and responsibilities
Authorization	No routines for authorization
Unitary terminology	No unitary terminology
Knowledge about the business	No compatibility between technologies/solutions
Process map/definition	Unenthusiastic user community
Process chart	Risk for information islands
Standardization	Lack of definitions/standards
Flexibility	IS/IT personnel tend to take over process projects
Information storage	No representation of IS/IT in the process steering committee

Table 5. *Critical Success Factors & Problems* (source: own construction).

By using this table and our analysis as a reference point, we can now answer our research question, *"what is needed of an IS/IT-architecture to support a process oriented organization?"*

An IS/IT- architecture that should support a process-oriented organization needs the following characteristics:

⇒ *Flexibility*. Have the ability to adapt to the changing environment.
⇒ *Centrally coordinated.* Information that is common to all processes (key information) has to be centrally managed.
⇒ *Locally managed.* Information specific for a process should be stored and managed here.
⇒ *Standardization/non-standardization.* It is not possible for us to say which one is the most appropriate solution for a specific situation. This choice should most of all be based on flexibility, but also on factors like;cost, necessary resources, programming skills, and risk of failure.
⇒ *The IS/IT-architecture has to be based on an updated process map.*

The flexibility of the architecture could vary depending on what level of the organization it supports. On the lower level of the pyramid (see fig. 30), where tools and processes are used, applications and local information concerning only the process itself are managed. Since the applications and information are changing

continuously, there is a need for a flexible architecture here. As a result of these demands, the BBS strategy seems to be the most appropriate choice.

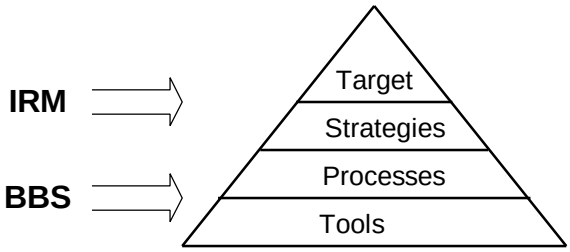

Figure 30, *Design philosophies and corresponding organizational parts* (source: own construction).

In the upper part of the pyramid, protocols, standards for communication, and information storage are managed. Standards for communication, protocols, and storage that are localized here do not change so often as compared to the lower level. Since this environment is fairly stable and the key information that is stored here has to be accessible by the whole company, an IRM strategy seems to be appropriate here. IRM is also needed in order to coordinate the processes effectively so that sub-optimization is avoided.

As a conclusion one should use a mixture of the BBS and IRM strategies (see fig. 31). An IRM architecture for the relatively stable environment at the top, and the more flexible BBS architecture for the frequently changing environment at the lower level.

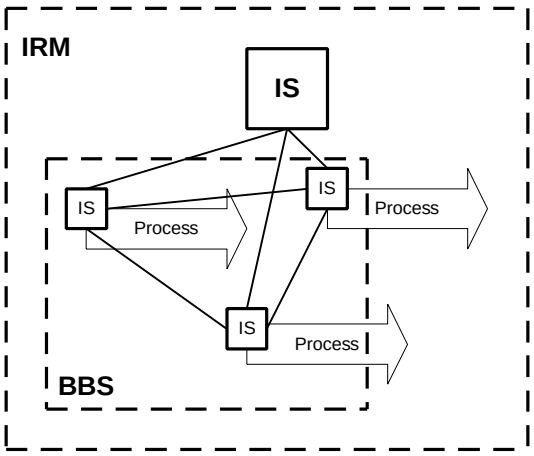

Figure 31. *Mixed IS/IT-architecture* (source: own construction).

We also believe that this conclusion is supported by other theories. For example, both Allen, Boynton (1991, pp. 436-434) and Ward, Griffiths (1996, pp. 33) talk about this combination of centralization and decentralization (see part 3.5.3. and 4.4 respectively).

Erudition during the thesis
In this conclusion we also want to include the importance of *communication.* Although this is not an architectural issue, and therefore not really part of our research question, it is still of outermost importance.

So, if we should mention a specific thing to learn from this study, it has to be that routines for communication are necessary.
Poor communication is the main reason for most shortcomings, such as, *unclear roles and responsibilities, non-unitary terminology, sub-optimization, etc.*

Consequently, what is needed is a working communication between *top-management, core business,* and *IS/IT!*

7. Discussion/Reflection

This thesis has dealt with "what" -questions, and not with "how" -questions. Therefore, our conclusion describes a desirable picture of an IS/IT-architecture in a process-oriented environment. Nevertheless, we are fully aware of the need for methods and technologies for how to create and implement this ideal solution. One can view the part not included here, i.e. how to create and implement, as consisting of two dimensions.
First, there is the technical dimension, i.e. how can this architecture be created. This includes such things as selection and implementation of e.g. servers, protocols, intranet, communication facilities, etc.
Then, there is the change management dimension. This dimension deals with how to implement the concept, i.e. how to merge from a functional to a process oriented organizational structure. This activity includes such things as establishing areas of responsibility, motivating the employees, tearing down the functional boundaries, etc.

What is interesting though, is that although the ideal picture of a process oriented IS/IT-architecture that we describe in our conclusion does not consist of anything new, there are still many companies that fails with similar projects.
For example did Cambridge Technology Partners conduct a study in which IT executives mentioned the most important reasons why companies fail in these projects.
It seems like many people know what an IS/IT-architecture should look like in order to support process orientation, but why do so many companies still fail to create the right architecture?
The answer is probably that it is the "how"-question that is difficult, that is, the two dimensions described above.

What we could have done differently
One could question if the number of respondents we chose was enough. The choices we made were based on recommendations from other people within the company, by studying the organizational charts, roles, degree of experience, participation in the CANDELA project, and finally, an aspiration to gather respondents from various departments and Astra units in order to get a wider and more reliable picture. All together by interviewing these people we received quite a comprehensive overview of the situation at Astra, so at that time, we did not see any reason to increase the number of interviewed people.

One reason to increase the number of respondents could be to interview people within several different departments. Since process orientation involves many different departments, perhaps we should have spread out the interviews over more departments. Instead of doing few, but deep, interviews we should have done shorter and more, spread out over the company in order to get more different opinions.

All the answers and opinions about what it takes from an IS/IT architecture to support a process oriented environment was rather theoretical since process

orientation is not implemented atAstra. We tried to contact an Astra company in USA that has implemented a process IS/IT-architecture, but we could not get hold of the responsible person. As a further research, we would like to study this subject within a company were it is already implemented.

Further Research

After having finished this thesis, the question of how to take this further arises. That is, how can the results of this study be used as a basis for further studies of IS/IT-architectures and processes.

Since we maintained a focus onIS issues throughout the study, it can perhaps be of interest to continue this research with more focus on IT instead.

Even though we chose to focus on IS is this not an indication that IT issues are less important for creating an appropriate IS/IT support for processes. The difference tough, lies in that IS issues are more time consuming and requires a larger amount of change since they affect the organizational structure, whereas IT usually does not bring about any major organizational changes. IT issues regard the infrastructure, which is not visible to the user community, and therefore these questions can be discussed at a completely different level than IS issues.

Because of this situation (i.e. that IS has the larger impact), and also because of personal preferences, we made this choice to focus on IS.

What can be of special interest to study are problems with compatibility, e.g. how to integrate the IT portfolio in a cross-functional environment so that data easily can be transferred between applications. Another interesting area is security, i.e. how can one be sure of that sensitive information has not been altered or duplicated when transferred between several databases and users.

Data storage and retrieval are two other critical issues when several systems are supposed to cooperate in a process-oriented environment.

These are areas that we have mentioned briefly, but indeed deserve more attention. Even if IS is the part that causes the most visible changes, such as areas of responsibility and systems structure, it is IT that constitutes the backbone upon which all architectural efforts depends.

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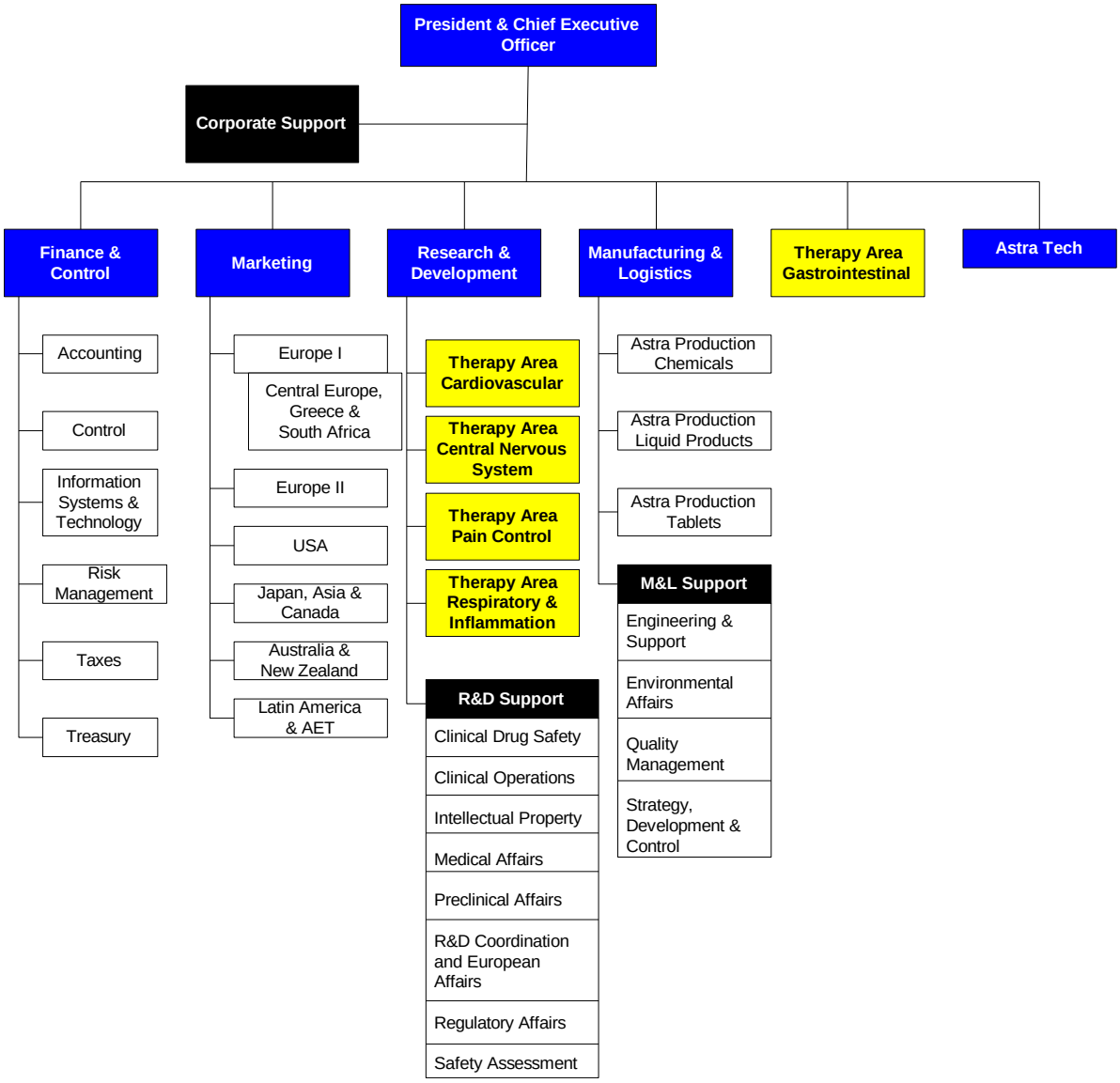
Appendix A.

ASTRA´S ORGANIZATION



* As a step towards improvement of R&D, all clinical research projects are organized under one of the therapeutic areas. Because of its strategic and commercial significance forAstra (primarily through the antipeptic ulcer drug Losec), it is the Gastrointestinal therapeutic area.