Organizational Learning and Information Systems

The Case of Monitoring Information and Control Systems in Machine Bureaucratic Organizations

Fons Wijnhoven

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ORGANIZATIONAL LEARNING AND INFORMATION SYSTEMS:

THE CASE OF MONITORING INFORMATION AND CONTROL SYSTEMS IN MACHINE BUREAUCRATIC ORGANIZATIONS

PROEFSCHRIFT

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door
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Dit proefschrift is goedgekeurd door de promotoren:

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Prof. R.K. Stamper, Faculteit der Technische Bedrijfskunde, Universiteit Twente.

For Carolyn

Preface

This book is the result of a six-year part-time study on organizational learning and information systems conducted at the School of Management Studies of the University of Twente. The study was enabled by the research position I received in the Department of Information Management.

Before the start of this project, I taught government organization at the School of Public Administration of the University of Twente. Specifically I would like to acknowledge prof. Chris L. Menting, head of the Government Organization Group for introducing me to many aspects of organization analysis. In that group I acquired my interest in organizational learning.

In 1987, I started work as assistant professor in information management at the School of Management Studies. In 1988, I started this project under the supervision of professors P.A.E. (Lisa) Van de Bunt and Ronald K. Stamper. Prof. Van de Bunt recommended to me various papers and books about organization studies from the large diversity of perspectives that exist in that field. To these he also added his own practical experience. This led to a broad perspective for this project, and a close connection of the subject with actual trends in world economy, as discussed in chapters 1 and 2 of this book. Prof. Van de Bunt also convinced me to focus the study on organizations with the greatest learning problems (machine bureaucracies), and on the information systems that are most criticized from the organizational learning perspective (monitoring information and control systems). Arguments for this choice are explained in chapters 5 and 6. Prof. Stamper's erudition together with an interesting and unique approach to the field of information management formed excellent additions. One of his major ideas, semantic analysis, is applied in chapters 4 and 7, while trying to organize the many and confusing concepts and ideas related with organizational learning. His view on semantics has been guiding the conceptualization and operationalization of MICS. Prof. Stamper is also acknowledged for the considerable effort he took to manage the EMIR (Effective Management of the Information Resource) research programme, within which this project was carried out. I particularly appreciated his effort in being my harshest critic.

Many other colleagues and friends should be mentioned here. I will keep the list short as the book has become long enough already. Specifically I want to mention dr Tinus van Drunen, Ir Cees van Slooten, drs Arjen Wassenaar with whom I had many discussions about the concept of information system and the importance of my study for management studies and information management. In contrast to what is most common in computer science, I decided on basis of these discussions, to define information systems as technical and social systems, and thus not limited to hardware, software and data.

During this project organizational learning was becoming increasingly popular as a theme in organization and information science. This was particularly the result of work done by Peter Senge at MIT and A. De Geus at Shell Planning. Both authors stressed the importance of constructing 'The Learning Organization'. I felt very uncomfortable with the concept of 'The Learning Organization' because of the unconditionality of the knowledge thus gained, like a carpenter who thinks that the world exists of nails only. Therefore, I developed the concept of organizational learning needs, to introduce a contingency element in my approach of organizational learning. This idea is briefly expressed in chapter 4, and is described in more detail in chapter 5, where the organizational learning of four types of organizations is linked with the learning needs of these organizations. This idea was also strongly supported by two of my M.Sc. students, Mark Hafkamp and Stephan Kordelaar, who contributed substantially to this project by helping me with the data collection in the five cases studied in chapter 8. These cases enabled me to further work out the contingency approach to organizational learning.

I also want to thank other M.Sc. students who created important contacts with business companies, which later on where willing to participate in this project.

Thanks to my friends dr Geerten Schrama (now at the Center of Environmental Management at the School of Public Administration) and dr Timo Saarinen from the Helsinki School of Economics for commenting on a previous manuscript. I also want to express my appreciation for professors B. Hedberg (Stockholm Business School), C.L. Menting, E. Spoor (Free University Amsterdam) and O.A.M. Fisscher (School of Management Studies, University of Twente) for acting as members of my promotion committee and reviewing the work. Thanks also to Ms. K. Emmett, who carefully checked my English.

Finally, I want to thank my wife Carolyn Karthaus, and my children Kim, Jules and Armelle. They all gave me the support needed to continue.

Before starting to read this book, the reader might find the following notes useful. Chapters 1, 2 and 3 are about the design of this project and its research methodological basis. A reader interested solely in the concept of organizational learning can skip these three chapters, and start reading chapters 4, 5, and 6. Readers interested in the empirical case studies should carefully read chapters 1 to 7. Chapter 8 might be incomprehensible without reading all the preceding chapters, because these demonstrate the basic concepts, hypotheses and goals of the case studies. Chapter 9 is a concluding chapter, based on all insights gained in the previous chapters. The basic conclusions might be read, however, without reading the preceding chapters.

Hengelo, December, 1994

Chapter 1: Changes in Machine Bureaucracies and the Role of Information Systems

1.1 *Trends in Business*

Mechanized factories evolved from craft technology in the 18th century, manufacturing cheap goods on a large scale. Features of these factories includes high capital intensity, low labor skills, and large and expensive production installations that are difficult to subdivide. This normally leads to specialisation of tasks, hierarchical leadership, and many rules (formalization). Mintzberg (1979) calls this organizational ideal type a *machine bureaucracy*. The production of these machine bureaucracies was increasingly aimed at *anonymous customers* on a large-scale market. Market principles were supposed to function as the means of coordination between producers, traders and consumers, via the free functioning of demand and supply (Smith, 1776/1975). The basic historic causes of this trend were the liberalisation of trade, which involved a reconsideration of labor (labor as a commodity), improvements in the technology of trade (money, banking, law etc.) and distribution (especially transportation, decline of feudal protectionism), and innovations in transformation technology (steam power and mechanical devices) (Stearns, 1975, pp. 77-82; also cf. Bell, 1979).

The application of steam power and mechanical devices, called mechanization, made possible the production and distribution of *large quantities* of goods at low cost, making craft technology uneconomical in many industries. To illustrate this statement consider table 1.1.

Minutes of Effort to Assemble	Late Craft Production, Fall 1913	Mass Production, Spring 1914	Percent Reduction in Effort
Engine	594	226	62
Magneto	20	5	75
Axle	150	26.5	83
Major Components into a Complete Vehicle	750	93	88
Source: Womack et al., 1990, p. 29, figure 2.1			

Table 1.1: Craft Production in 1913 versus Mass Production in the Assembly Hall: 1913 in 1914.

The emphasis on *cost reduction* was the basis for investing in more machinery. According to Zuboff (1988), at the start of this mechanization process in the 18th and 19th centuries, it was not at all clear that manufacturing would be cheaper than craftsmanship. According to Ashworth (1975), coal consumption and steel production, both essential for mechanization, did not increase to a level suitable for manufacturing before the 20th century.

The second half of the 20th century, however, led to a new era, often called the post-industrial society (Bell, 1979), in which fabrication was replaced by the processing and recycling of services as the dominant mode of production. The manufacturing companies that stayed in existence had to tranform from output-driven to market-driven organizations. The most successful machine bureaucratic forerunners of this society are the Japanese manufacturers that capitalize on their abilities to meet three market trends: quality, flexibility and innovation.

Trend 1. Quality demands

In the 1960s, cost issues were increasingly replaced by higher demands for *quality*. Japanese car manufacturers became particularly successful in meeting these demands, as is illustrated in table 1.2.

	GM Framingham	Toyota Takaoka
Gross Assembly Hours per Car	40.7	18.0
Adjusted Assembly Hours per Car	31	16
Assembly Defects per 100 Cars	130	45
Assembly Space per Car	8.1	4.8
Inventories of Parts (average)	2 weeks	2 hours
Note: Gross assembly hours per car are calculated by dividing total hours of effort in the plant by the total number of cars produced. The researchers have adjusted this score for differences in the products, so that the products have become comparable. Defects per car are considered a good estimate for product quality. Assembly space (measured in square feet per vehicle per year) and inventories of parts are both important determinants of production and product costs.		
Source: Womack et al, 1990, p. 81, figure 4.1. Based on IMVP World Assembly Plant Survey		

Table 1.2: General Motors Framingham Assembly Plant Versus Toyota Takaoka Assembly Plant 1986.

Often it has been suggested that better products should be more expensive. However, the evidence seems to contradict this statement (Womack et al., 1990, p.92 and 93), as low quality is in fact an important cost driver (especially restoration costs).

Trend 2. Flexibility demands

In the 1970s, customers were demanding quality products, which suited their individual preferences and were also cheap. Companies tried to solve the *tension between flexibility and cost* by offering clients more influence over production processes (co-makership) and utilizing the opportunities of large-scale economics. This was done by developing modular products, so that specific components of products could be produced in large series or bought from a supplier, and thus profit from the economies of scale. The components could be assembled in a large variety of ways, thus enabling some customization of the final products. Information technology was also introduced for optimizing production and market demands (MRP, Aggerwal, 1985) and improving the flexibility of production devices (for instance with flexible manufacturing systems and CAD/CAM, cf. Kerr, 1991). This situation differs considerably from the philosophy of Henry Ford, who stated that clients could buy any car, so long as it was a T-model and black. Nowadays the number of car types is much greater than that available in the heyday of mass production, as is illustrated in table 1.3.

	1955	1973	1986	1989
Products on sale	30	84	117	142
Sales/Product (000s)	259	169	136	112
Share of Market Captured by 6 largest-selling products	73	43	25	24
Source: Womack et al., 1990, p. 125, figure 5.5				

Table 1.3: Fragmentation of the American Auto, Van, and Light Truck Market, 1955-1989.

An important issue for product flexibility is the potential of suppliers to react to changing demands by assemblers. Some data are presented in table 1.4.

Averages for each region	Japanese in Japan	Japanese in America	Americans in America	All in Europe
Die Change Times (minutes)	7.9	21.4	114.3	123.7
Lead time for new dies (weeks)	11.1	19.3	34.5	40.0
No. of daily JIT[1] deliveries	7.9	1.6	1.6	0.7
% of parts delivered JIT	45.0	35.4	14.8	7.9
Source: Womack et al 1990, p. 157, figure 6.1				

Table 1.4: Cross Regional Comparison of Suppliers.

Trend 3. Innovation potential

[1]JIT is the acronym for Just-in-Time. JIT-deliveries imply that inventories can be kept extremely low, without the risk of being out of stock.

In the 1980s, companies also started competing on the basis of their *innovation potential*. Especially in the 'high tech' line many new products were launched (cf. Hamel and Prahalad, 1990). At that time, information technology opened the way to new forms of competition, that especially affected information-intensive service industries such as banking and insurance (Cash et al., 1992). Many product innovations like Automatic Teller Machines and home banking emerged in Western Countries. Mergers among insurance companies and banks aloowed for a broader services portfolio, leading to synergies[2], and improved client services (so-called total financial service, to optimize the customers' added value). Also, flexibility was improved by providing clients with a 24 hour access to services. At the end of the 1980s many I.T. competitive differentiation opportunities were exhausted and *I.T. became a necessary evil*. Many financial service companies had financial troubles and started a low price strategy to increase their share of the market (and thus reduce overhead costs per client) (Porter, 1985). Low cost was thus introduced after quality and innovation in the service sector. Mergers continued with the aim of reducing production and marketing costs by the principle of economics of scale. At the same time, many services were 'industrialized' to lower the production costs through increased mechanization (Grönroos, 1991).

Innovation of products and the innovation potential of automobile factories can be illustrated by measuring characteristics of the production development process, measuring development lead times, and the number of product models that are launched within a time period. Evidence on both issues is given in table 1.5.

	Japanese Producers	American Producers	European Volume Producers	European Specialist Producers
Average Engineering Hours per New Car (Millions)	1.7	3.1	2.9	3.1
Average Development Time per New Car (in Months)	46.2	60.4	57.3	59.9
Number of Employees in Project Team	485	903	904	904
Number of Body Types per New Car	2.3	1.7	2.7	1.3
Average Ratio of Shared Parts	18%	38%	28%	30%
Ratio of Delayed Products	1 in 6	1 in 2	1 in 3	1 in 3
Die Development Time (months)	13.8	25.0	28.0	28.0
Prototype Lead Time (months)	6.2	12.4	10.9	10.9
Time From Production Start to First Sales (months)	1	4	2	2
Return to Normal Productivity After New Model (months)	4	5	12	12
Return to Normal Quality After New Model (months)	1.4	11	12	12

[2]In the U.S.A. these collaborations in one business sector were not permitted under anti-trust legislation.

Source: Womack et al., 1990, p.118, figure 5.1

Table 1.5: Product Development Performance by Regional Auto Industry, mid 1980s.

Womack et al. (p.120) also gathered data about the number of models and average age of models. Clearly, Japanese producers outperform American and European manufacturers on this aspect of innovation potential.

1.2 *Organizations and Organizational Learning in the Post-Industrial Society*

The evidence of section 1 indicates that machine bureaucracies can differ substantially in their production performance. This is obviously the result of learning processes, which are much better in the lean organizations than in most of the American and European manufacturers studied by Womack et al. Quite frequently, however, organizations behave counter to their learning requirements, by using defensive mechanisms against competitors. The traditional European car manufacturers did not analyze their problems effectively, but:

1. Used their governments and the European Community to impose import quotas on Japanese cars.
2. When option 1 failed, they dismissed a large proportion of their work force.
3. They saw their problems as having their roots outside the company (taxes, high wages, increased competition, low work motivation etc.), and failed to respond internally by improving efficiency, quality, flexibility and innovativion potential.

They found excuses not to learn, not to change their basic way of thinking. This reaction is understandable, because changing the mind-set can be a very hard job in large and complex organizations (Weick, 1979). In the USA, the car industry had less government protection, and therefore had to learn more quickly. This process was complex and painful, but unavoidable.

Countries that try to exclude themselves from the world market, such as until recently the East European states, are an excellent demonstration of what happens when learning is inhibited by control. When market principles dominate the distribution of wealth, people are forced to think for themselves. When people are only expected to follow commands, as was the case in the command economy, most become intellectually lazy. The collapse of the command economy therefore not only changes the system of distribution, but also demands a change of habit of people that have been made intellectually lazy and are unused to responsibility. The frustration that can occur in these situations can lead to the causes of problems being sought in minority groups instead of in the lack of personal effectiveness. The solution would be to improve learning and encourage initiative.

Third World countries are also exposed to the principles of the market for wealth distribution. They could gain a strong competitive advantage, because the main principle for competition in the future will be intellectual creativity. Some

Third World countries have invested heavily in their intellectual capital, by investing in higher education for the local population (Porter, 1990, p. 466). Additionally, they are developing their own internal markets, by making very cheap products that may not qualify for Western standards, but suit local needs. Many Third World countries have competitive advantages over for instance Japan: they have more space and cheaper energy resources. They can learn from Japan that the main advantage to be gained when use is made of both body *and* mind. This opportunity has never been made use of by the colonial industry, which only sought to exert control, thus keeping the minds of the workforce lazy as in a command economy.

Organizational learning was already an essential feature of ancient civilizations. The Egyptians could not have constructed their pyramids without a well-developed body of knowledge about construction and organization. For instance, the pyramid of Cheops covers thirteen acres and contains 2,300,000 stone blocks, each weighing an average of two-and-a-half tons. Their construction is estimated to have taken over a hundred thousand men a period of twenty years (George, 1972, p.4). The Chinese Empire, the Roman Empire, the Dutch colonial company (East Indies Company, a multinational founded in 1602) all required large bureaucracies to control and coordinate activities among the many people involved. On other words, organizational learning in large organizations was connected with the development of bureaucracies. Bureaucracies are often dominated principally by control, leading to an internal command economy with the dysfunctional impacts as mentioned earlier.

The post-industrial society, also called the information age (Bell, 1979), introduces new ways of management based on:

1. Organizational perestrojka: the introduction of organization internal market principles and democracy (Ackoff, 1992; Peters, 1992).
2. Removal of many middle management positions whose tasks could be carried out more efficiently by a computer or a datacommunication network (Leavitt and Whisler, 1958).

These organizations are better learners because of their increased ability to connect and process ideas and data, and their improved efficiency in communication (Douma and Schreuder, 1991; Gurbaxani and Whang, 1991). Computers can make a significant contribution to learning, because they can reduce the costs for distributing ideas and data, and can reduce the costs and capacity for data storage and analysis. The added value of computers is, however, not always obvious. Often there are cases of bad use, non-use and negative impacts of computers (Jayaratna, 1990; Williams, 1991). Under what conditions then are computers useful and under what conditions are they damaging to organizational learning? The answer to this question requires a broader perspective of information systems than computer-based systems (Stamper, 1973), because organizational learning makes use of more ways of data processing than that carried out by the computer (cf. Nonaka, 1988).

Let us study these questions by focusing on bureaucracies that have developed large stores of knowledge in the past by developing good working principles. Let us also focus on organizations that apply the simplest computer tool for management learning, called Monitoring Information and Control Systems, systems that give regular reports for developing insights about how things are going.

1.3 *Organizational Learning and its Problems in Machine Bureaucracies*

Classic machine bureaucracies developed as large, complex organizations, with a high capital intensity, in stable environments. This market stability is essential, or else it would not be profitable to invest so much in the accumulation of knowledge in this form. The knowledge consists mainly of rules, procedures, a complex division of labor, and the application of expensive machinery. This type of organization, however, fails to deliver efficiency plus high quality, flexibility and innovation. Thus, important organizational changes are required. Whereas machine bureaucracies produce large quantities for low prices in simple and static environments by exploiting order and structure, they incorporate learning limitations as well. This is evident from general considerations: the ideal typical classic machine bureaucracy:

1. ... focusses on *control*, keeping the machinery going without disturbance (such as strikes, supply problems and machine break-downs). The management and employees react defensively to most changes;
2. ... emphasizes its own *internal rationality and logic*, and therefore discourages new ideas that deviate too strongly from the existing organizational paradigm (Hedberg, 1981). Behavior is supposed to be accountable according to the existing organizational rules and norms. Accordingly, people behave *defensively;*
3. ... *punishes* its people when they make mistakes. Experiments are not allowed because they risk disturbing the process;
4. ... separates decision functions (management), thinking functions (staff experts, R & D people, technostructure) and operating functions. This makes the *relation between these functions complex*, leading to ideas for products that are almost impossible to implement and require long lead times from product development to actual production. Here, the system has difficulty adapting;
5. ... sometimes puts a lot of effort in *individual learning* by sending people on training, but nothing learned individually is put into practice because implementing the newly learned knowledge would disturb the status quo.

However, not every machine bureaucracy fails to learn. Especially in Japan, as mentioned at the beginning of this chapter, a new kind of manufacturing organization, in which large-scale production is organized in large, complex, mechanized and formal organizations, has been established since the 1950s (Womack et al., 1990). This new style of machine bureaucracy, which is extremely effective in organizational learning, is called lean production. Its key features can be summarized (based on an interpretation of Womack et al., 1990) as follows:

1. Intrinsic interest in improving what one is doing (called 'kaizen' in Japanese).

2. Decentralization of management tasks, so that more people think about the problems the organization has to face, and people are better utilized.
3. Improved organization of product design, by giving the project team and its manager the authority to change the organization as well. These teams not only bring in the knowledge for design, but also monitor the product through its entire life cycle.
4. Suppliers are not in competition, but strive for a relation in which all can profit when they learn. This requires a large exchange of information and access to each other's knowledge.
5. Clients are not just buyers, but are included in a system for communication between the organization and its market, so that changes in the market can be quickly and reliabily detected.
6. Financing of the company is not based on short-term demand-and-supply principles, but on an understanding of the organization one is investing in for a longer term perspective.

American and European car manufacturers now seem to have learned these lessons by introducing principles of business re-engineering, which is organizational learning about the organization's tranformation processes (Davenport and Short, 1990; Hammer, 1990). In applying all six of the lean machine bureaucracy principles, information is an essential factor besides the many organizational structural and cultural issues. A classic machine bureaucracy could use information technology to help transform itself into a lean bureaucracy, by improving its information processing capacities to augment its performance. In this case IT is regarded as a necessary, but not sufficient condition to make the breakthrough to this new kind of organization (Keen, 1991; Nolan, 1992; Peters, 1992).

One may conclude from the above evidence that, from a learning perspective, classic machine bureaucracies are poor while lean ones are effective. We will now investigate the role played by information technology in supporting organizational learning.

1.4 *The Role of Information Systems*

Information systems are often defined as:" *...an integrated, user-machine system for providing information to support operations, management, and decision-making functions in an organization. The system utilizes computer hardware and software*; *manual procedures*; *models for analysis, planning, control and decision making*; *and a database* (Davis and Olson, 1984, p.6). Management information systems can only realize their purpose, i.e. informing managers so they can make the best decisions, when the organization is changed as well. Research and practice in the area of management informations has therefore shown that it is much wiser to define an information system as a social system consisting of models for analysis, and rules for information handling, that are possibly served by information technology in the form of computers and data communication (Mumford, 1983; Stamper et al., 1988). Information systems thus include social and technical issues, and can be described in six semiotic layers. These layers are:

1. Physics: about the computer hardware, network hardware, but also other physical means for data storage and retrieval, like filing cabinets.
2. Empirics: about the variety and randomness of information, that could be counted in terms of bits and bytes and a coding and signalling structure.
3. Syntactics: about the complexity of the structure of information. This is met by rules that apply and that form a structure that corresponds in complexity to the variety of the environment (Ashby's law on requisite variety). In information technology this leads to complexity of the software.
4. Semantics: about the understanding of the world. Problems in this area can be found in informal discussions and the practical use of concepts.
5. Pragmatics: about possible ambiguities over responsibilities. Solutions can be found in re-structuring business procedures.
6. Social: about goals, values and norms that people have. Problems in this area require changes in organizational culture and structure.

The first three issues concern the *technology* aspects of information. The other three layers concern the *social and organizational* aspects of information systems.

Because of dramatic price and performance developments in information technology, information systems include increasingly more computer applications. Also, many machine bureaucracies have developed, installed or applied, IT-based learning methods. Table 1.6 gives an overview of these in relation to major learning issue.

Trends and Learning Issue	Learning methods
Cost • How to improve cost-effectiveness? • What causes cost overrun, and what can be done about it?	Cost • Financial monitoring and control. • Operational (logistic) planning for minimizing costs and achieving synergies.
Quality • How to improve product and process quality? • Where are process quality problems to be found? • How do clients perceive quality?	Quality • Quality monitoring and control (e.g. by quality audits, quality circles, market information systems). • Management of norms and responsibilities.
Flexibility • How to improve flexibility? • Consequences of flexibility demands for products, processes and production devices.	Flexibility • Development of factory lay-out, production engineering. • Use of CAD/CAM, production planning and manufacturing knowledge.
Innovation • How to improve innovation. New products and services design.	Innovation • Getting and trying out ideas. • Developing and managing several core

• Launching new ideas and learning about their feasibility. • Designing new processes.	competencies. • Information and communication systems for flexible knowledge and sharing of ideas.

Table 1.6: Trends, Learning Issues and Devices

Information technology has a prominent role in many of these learning methods, by the application of hardware, software and procedures with a specific function in an organization, called Management Reporting System (MRS), (Group)Decision Support Systems (DSS) and Executive Information Systems (EIS). MRSs are developed to create standard reports for (junior) management. DSSs are developed to make advanced quantitative analyses of data and simulations of possible events and consequences of decisions. EISs are developed to provide senior managers with a flexible tool with which they can satisfy their information needs themselves (McKeown and Leitch, 1993). Despite these many applications, it is not at all clear that information technology for management support really pays off from the perspective of organizational learning. Just a few studies have tried to indicate a relationship between the use these systems and management effectiveness. These are briefly described below.

1.4.1 Management Reporting System and Innovation and Control

Lee and Guinan (1991) tried to find an answer to the question: what are MRSs contributions to the managerial task. More specifically they tried to measure the influence of an MRS on the management's ability to control and innovate the organization (two basic factors also of organizational learning) in one specific company. In operationalizing control, they discovered two types of control that were linked with competing theories. The first, called managerial control, is about a manager's effectiveness in influencing organization members to behave according to organizational directives. The second type, called self-control, is about organization members' own ability to increase organizational effectiveness. Self-control is particularly important when task complexity increases (Hersey and Blanchard, 1982; Galbraith, 1973). The researchers found several variables that define scores for control and innovation in the organization, listed in table 1.7.

Variables of control and innovation
Managerial control • Task Clarification • Work Assignment • Procedural Specification (like standard operating procedures)

These variables were used to measure subjective beliefs about the relation between control, innovation and IT-use. The data showed that especially the planning and control scores were believed

Self-control
• Ability (for instance by providing data)
• Information Support (for instance: analytical support tools)
• Intrinsic Motivation
• Task Feedback
• Unambiguous Procedures
• Collegial Interactions
Innovation
• Information Support
• Motivation Support
• Resource Support
• Specialization
• Decentralization
• Standardization
Source: Lee and Guinan, 1991, pp. 241-252

Table 1.7: Control and Innovation Variables.

to be affected positively by the MRS. Contrary to the opinion of authors such as Pierce and Delbecq (1977) and Hage and Aiken (1967), IT was beleived to also have a positive impact on innovation! A check on the relation between the self-control and managerial control variables revealed that these measures of control correlated strongly in this case study, which indicates that they are complementary for an effective control process.

The study indicates that IT impacts are closely related to the *organizational norms*. An identical system studied by Lee and Guinan would probably show a different impact if the high amount of self-control that was measured in the organization was replaced by managerial (hierarchical) control. In that case IT would be used as an instrument to support the authority and power of managers, and thus be mainly used for planning and control, decreasing the amount of self-control of the employees (the Pierce-Delbecq and Hage-Aiken hypothesis). This study thus suggests that, in that case, organizations would not profit from all the opportunities of MRS.

1.4.2 DSS Impact on Managerial Performance

A DSS is intended to be used by one or several people and contains a computer system which processes a database and one or more models, included in a modelbase. The data and model are supposed to form a valid representation of reality. Learning is supposed to occur in the process of decision-making and can be measured by comparing the quality of a sequence of decisions made by the same decision-maker or decision-making group. It is however clearly constrained by the representation characteristics of the DSS.

One empirical test of the impact of DSS was carried out by Sharda, Barr and McDonnell (1988). The authors tested 5 hypotheses on DSS effectiveness, some with clear relevance for organizational learning, in a laboratory experiment with 8 trials and groups using a DSS constructed by the researchers. Their conclusions are described here, with the hypotheses in italics.

1. Hypothesis 1: "*DSS aided groups will show higher performance than non-DSS aided groups* (p.145)". This hypothesis was significantly statistically supported. This

could indicate some learning, when for instance the users' understanding of reality had increased. This could be checked by looking at the number of alternatives considered.

2. Hypothesis 2: "*DSS aided groups will show less variance in profit performance than non-DSS aided groups* (p.146)". This means that there is more certainty about the outcomes of decision processes, which is an indication of learning. "*On the other hand, less variability in performance also may not be desirable. The decision aid may be limiting risk taking by encouraging uniform decision processes and outcomes. Given the significant differences in net earnings between the two groups, however, more stable performance would appear to be preferable* (Sharda et. al., p. 153)".
3. Hypothesis 3: "*DSS aided groups will take less time to reach a decision than non-DSS aided groups* (p.146)". This is an indication of learning and probably also speeding-up of communication. Sharda et al.'s study however did not find significant statistical differences among DSS users and non-DSS users regadring time.
4. Hypothesis 4: "*DSS aided groups will consider a greater number of alternatives than non-DSS aided groups* (p.146)". This is also a very substantial indication for learning. However, even though DSS supported groups reported that they had investigated more alternatives than the non-DSS supported groups, the differences were not statistically significant at a .05 probability level.
5. Hypothesis 5: "*DSS aided groups will report greater confidence in their decisions than non-DSS aided groups* (p.146)". This could indicate learning, i.e. improvement of memory contents and retrieval. Sharda et al.'s study however did not show statistically significant differences between the DSS users and the non-DSS using group.

Van Schaik (1988) carried out a second study on the impact of DSS, in which he assumed that a DSS does not impact on decision-making quality, but that a decision-making strategy does. This statement is often implicit in DSS-usage and DSS research. To test this statement he created four experimental groups, among which he varied the use or non-use of a DSS, and the use or non-use of a decision-making strategy. His findings are summarized in table 1.8.

	No DSS	*difference*	DSS
No Strategy	4.80 (1.33)	not significant	4.84 (1.42)
difference	significant at $p < 0.05$		significant at $p < 0.06$
Strategy	6.55 (1.09)	not significant	6.57 (1.48)
Mean scores of experimental groups (standard deviations in brackets), after 7 trials. Source: Van Schaik, 1988, exhibit 4-11, p. 121.			

Table 1.8: Research Results of DSS-impacts.

Table 1.8 clearly reveales that decision-making improvements are more the result of a well chosen *decision strategy* than the result of DSS usage. These findings imply that Sharda et al.'s results could possibly be a consequence of research artefacts.

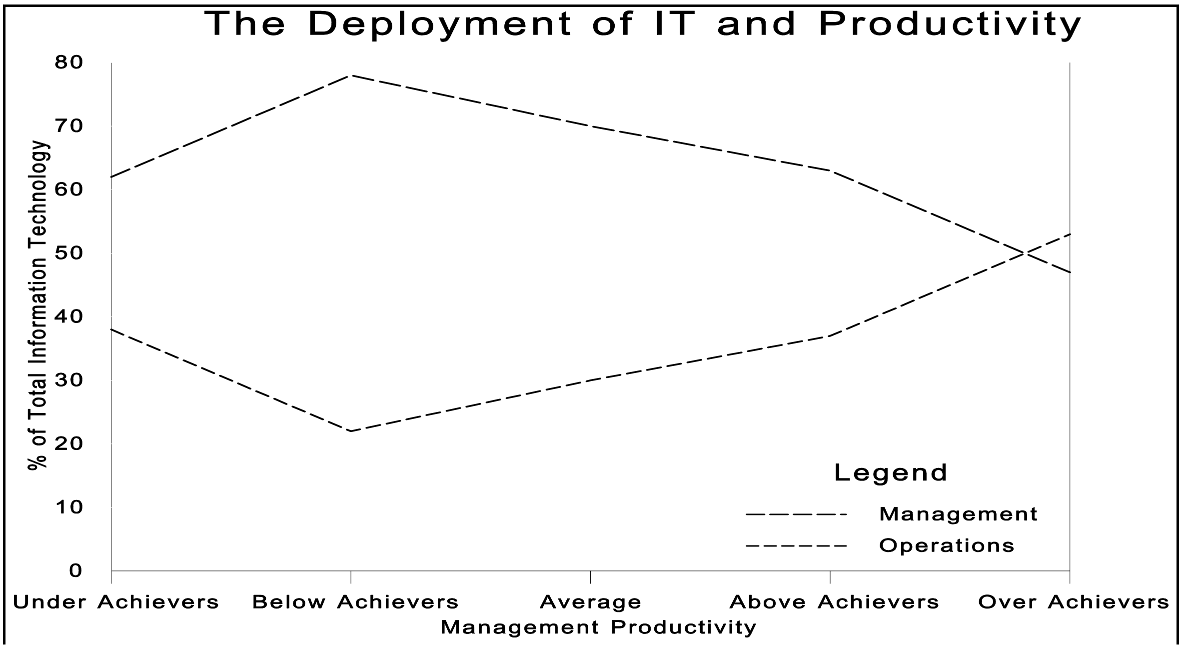
From neither study may it be deduced that a DSS contributes to organizational learning in non-laboratory environments, because, for instance, management style, interpersonal behavior and organizational norms were not modelled.

1.4.3 Business Value of Computers

A serious attempt to overcome the external validity problems of laboratory studies was made by Strassmann (1985 and 1990). Strassmann stated that the main task of management is to add value by improving the organization, thus developing new insights and implementing them. The management value added can be computed by removing from the net income the capital value-added (equity). The net return-on-management is computed by subtracting management costs (salaries of managers, plus additional support personnel and facilities) from management value-added. Table 1.9 shows that U.S. and Japanese (lean) companies on the average substantially differ on return-on-management.

$ Millions	US Companies	Japanese Companies
Sales	123,895	118,291
Purchases	28,000	72,867
Operating Costs	16,974	7,689
Management Costs	63,682	29,809
Taxes	6,566	3,785
Net Income	8,673	4,140
Capital Value-Added	9,129	2,300
Management Value-Added	(456)	1,840
Return-on-Management (Management Value-Added/Management Costs)	-0.72%	6.17%
Source: Strassmann, 1990, p. 442, table 18.1. Quoted by Strassmann from Electronic Business Magazine, April 1, 1987, p. 72. From P. Doe, U.S. versus Japan in The Year of the High Yen.		

Table 1.9: Comparing Productivity for Top Electronic Companies



Strassmann related the return-on-management scores with the amount spent on information technology for management and operations (non-management functions). The results are shown in figure 1.1. The conclusion is that organizations with high returns-on-management ('over-achievers') put relatively more of their computer resources into operations, and so do not use it as overhead. Related with the ideas stated before about lean production, management has less of an overhead function in the lean organization because it is an integrated part of operations. The few management jobs that are still left in these lean organizations are very well supported by IT in the highly achieving organizations. Information technology is used less for the reduction of the number of staff needed for production (they are already very productive) but for making the organization as a whole more effective. This consideration also leads to the conclusion that MRS, DSS and EIS do not necessarily require high investments (one could even talk about lean information sysems) to improve return-on-management. In lean organizations the close connection between managerial and operational jobs also implies that management support information systems should be accessible to a larger group than those who are traditionally labelled as managers.

1.4.4 Information Systems for Organizational Learning

Markus (1984) identified and described some information systems from the perspective of their role in organizations, as shown in table 1.10.

Information Systems Type	Design features	Examples

Operational system	Work rationalization and routinization to support and automate operational processes.	Letter of credit; administrative transaction processing systems, automation of production processes.
Monitoring & Control System	**Norms, standards, measures, evaluation, feedback, reward, to control and motivate operational processes.**	**Productivity measurement systems. Cost and quality performance control systems.**
Planning & Decision System	*Models and data manipulation facilities, model building tools, to support complex decision making.*	*Planning models, decision support systems, Production and inventory planning systems. Computer Aided Design and Manufacturing.*
Knowledge Based Systems	*Knowledge base and inference mechanism (logic), to support the storage and retrieval of knowledge and experience.*	*Expert Systems, Assistant Systems.*
Communication systems	*Communication procedures, standards, to support the creation and distribution of messages containing e.g. ideas to be reacted upon (facilitating electronic conversations).*	*Teleconferencing, office systems, e-mail, CSCW.*
Inter-organizational system	*Procedures for interorganizational transactions and communication.*	*Order entry systems, EDI; also interorganizational e-mail and conferencing.*
Based on Markus, 1984		

Table 1.10: A Typology of Information Systems

MICS is the focus of our study, and will be treated in the following subsection. Operational Systems are not systems for learning. Four other types of information systems, not investigated in this study, could support organizational learning. These are: knowledge-based systems, planning and decision systems, communication systems and interorganizational systems.

Knowledge-based systems are intended to routinize knowledge available in different parts of the organization so that one could do without the expert or support the expert on routine matters. MICS should support the development of new insights for efficiency and control or fundamental improvements, not by experts but by managers and employees, and thus realizing a learning loop. According to Coats (1992), knowledge-based systems are most valuable during the period of their development because this requires the elicitation of knowledge (a very interesting learning exercise), and for the distribution of codified knowledge in and between organizations.

Planning and decision systems are important as well for realizing effective organizations (JIT etc.). They could contribute significantly to organizational learning when they allow experimenting without disturbing reality (Senge, 1990a). They can help to make design teams more effective by facilitating the connection of the members' knowledge, insights and ideas: a true example of organizational learning.

Communication systems can support organizational learning and are now creeping into organizations via E-mail, Electronic Conferencing, GDSS, CSCW. Communication systems are, however, still mainly at the laboratory stage (Greiff et al., 1988; Stamper et al., 1991). Executive information systems also spread among organizations, and offer executives electronic communication opportunities to allow for joint decision-making (Mintzberg, 1973; McAuliffe and Shamlin, 1992).

Interorganizational systems are mainly of two types: interorganizational transaction processing systems and interorganizational communication systems. The first systems do not impact on organizational learning, except, of course, in the systems design process that must lead to a reconsideration of the relations with business partners. The second type has the same impact as the previously discussed communication systems, with the addition that they are intended to support communication between organizations. This could improve the connection between the organization and the market. For instance, the process of product design can be carried out more quickly and more effectively when the design process is a joint process involving clients and producers. This also increases the flexibility of the organization.

1.4.5 Monitoring Information and Control Systems (MICS)

The classic machine bureaucracy seems to inhibit innovation, but might be quite good at making the existing process more efficient. *Monitoring Information and Control Systems (MICS) are very important in signalling issues for efficiency improvement.* This implies a restricted way of organizational learning, within the constraints of pre-set targets. Lean machine bureaucracies seem to be intrinsically interested in improvement, which suggests the possibility of using MICSs to provide incentives for more fundamental problem solving. Because of their relatively simple character (a database and some predefined reports), these systems are widely spread. Their opportunities for control as well as for the fundamental analysis of problems make them fit closely to the management style and culture of machine bureaucracies (a further explanation for this statement is given in chapters 4 to 6). An essential feature of MICSs is that they provide data for critical evaluation by means of data that are compared to fixed targets. Depending on the organizational context this *critical evaluation can lead to three types of behavior*:

1. *Doing nothing*, as when:
   - people lack the means to make sense of the data.
   - people lack the behavioral opportunities to act (lack of time, money, motivation, difficulty with problem solving etc.).
   - the data show that everything is on target, so there is no reason to act (of course one should hope that the system is not misdirecting attention in this case).
2. Giving *rewards and punishments*. The system then acts as an extension of the internal competitive environment. It can easily lead to lack of learning because people are not willing to share knowledge. If these political problems cannot be

settled by an overarching idea, power principles govern decision-making (March and Simon, 1958). This means that organizational learning is not a relevant issue for decision-making (individual persons and groups however can learn how to obtain the greatest influence in decision-making processes. This political learning however is not learning at the organization's unitary system level).

3. Using the system to understand how well or badly things are going and pointing out opportunities for improvement. This idea is close to the essence of organizational learning, which presumes that an *organization (as a group of people) could become smarter than its individual participants.* This basic idea of organizational synergy should be the motivation to collaborate, adding to the synergies of the division of labor and economics of scale (Barnard, 1936), which is also applicable to organizational learning.

It is these behavioral consequences that make a MICS a technical and social system. One specific issue in this respect is the tension between the improvement of the rationality of the organization as a unity (having its own goal (survival)) and the rationality and interests of the individual participants that make up the organization (Argyris, 1972 and 1977; Lawler and Rhode, 1978; Kirsch and Klein, 1978; Kling, 1980). This discussion goes back to the most basic discussions about rationality in organizations and the tension between individuals and the organization as a unitary system (Taylor, 1911; Simon, 1976), which are connected with two main streams in organization analysis: the *systems or cybernetics perspective* and the *parties or conflict perspective* (Lammers, 1987; Mastenbroek, 1982; Burrell and Morgan, 1979). Because both perspectives are valid and complementary to each other, both must be studied to gain a fuller understanding of MICS in relation to organizational learning.

1.5 *Organizational Learning and MICS*

From the discussion in this chapter we conclude that organizational learning is essential if classic machine bureaucracies are to compete with the lean machine bureaucracies, that are already effective learning organizations in many respects. MICSs have four features that make them important for organizational learning:

1. MICSs give their feedback information to the management, who can then check the validity of the assumptions and hypotheses. One major issue of this research is therefore management knowledge, that can be elicited and formalized in an explicit management theory.
2. MICSs provide data to *reduce the gap between operating norms and performance*, and possibly *reconsidering the assumptions* of the management theory (consisting of norms and performance measurement instruments).
3. MICSs support the interpretation of performance data and the development of new behavior and policies. This is a social process in which people *communicate*

about ideas which converge to decisions.

4. MICSs can provide an electronic means for storing data and other parts of the organizational memory. In this way they can support learning about recurring problems, and prevent the organizations having to re-invent solutions.

MICSs, which are social as well as technical systems, can include all these four basic features, and are available in most machine bureaucracies. This makes the choice of this specific type of information system for this study very practical and relevant.

Previously, it was asserted that organizational learning is vital for machine bureaucracies in order to adapt to their environment. Knowledge however is lacking about the *circumstances* under which MICS leads to *effective* organizational learning. We have been able to find almost no research on this issue, nor attempts to combine knowledge from the disciplines of organization analysis and information management on this subject. Therefore the theoretical investigation will address:

1. Organizational learning and its features (cf. chapter 4).
2. Machine bureaucracies, especially the distinction between lean and classic (chapter 5).
3. The role and value of MICS in classic and lean machine bureaucracies in relation to organizational learning (chapter 6).

Chapter 2: Investigating MICS, Machine Bureaucracies and Organizational Learning

2.1 *Approaches to Organizational Learning and MICS*

This study is based on three approaches for the study of organizations and information systems. The first approach is cybernetics, that introduced the term organizational learning (Bateson, 1972) to improve understanding of organizational control. The second approach is organization development, that reformulated organizational learning by emphasizing the human, interpersonal and political aspects and preconditions for organizational learning. The third approach is semiotics, that defines the nature of information and therefore gives insight into the features of MICS. These approaches are used to define the major scientific problems associated with information systems and organizational learning. A more detailed theoretical analysis of the approaches is given in chapters 4 and 6.

2.1.1 Cybernetic Analysis of Organization and Business

The term cybernetics originates from the Ancient Greek word 'kubernetes' meaning 'steersmanship'. It was introduced into the modern language by Norbert Weiner (1952) to describe the study of steering missiles to hit moving targets (like planes in World War II). The problem this application of cybernetics initially wanted to solve was that missiles are not able to catch planes without the constant input of information about the target's movement and factors that could influence the movement of the missile itself (like wind direction and speed). On the basis of this information, deviations from the target are measured and corrective actions taken. An everyday example of a cybernetic system is the house thermostat, by which the temperature of a room can be kept at a constant (the target) despite changes in temperature of the environment.

Garreth Morgan (1986, p. 86-87), summarizes the features of cybernetic systems in relation to communication and learning as follows:

> " *First, that systems must have the capacity to sense, monitor, and scan significant aspects of their environment. Second, that they must be able to relate this information to the operating norms that guide system behaviour. Third, that they must be able to detect significant deviations from these norms. And fourth, that they must be able to initiate corrective action when discrepancies are detected.*"

These four features define an organizational learning process in its most elementary form. The corrective actions initiated from learning can be reactive response, behavioral adaptation, or organizational changes to improve the organization's adaptation abilities. Therefore in *organization analysis* many authors stress the difference between behavioral adaptation and organizing.

Behavioral adaptation aims at keeping organizational performance within a certain required range. Data from the environment are used to make an assessment of the situation the organization is in, from which adaptive actions are concluded (Cyert and March, 1963). This entails two things: equilibrium and stability. If the output is within the specified target range, then the system is deemed to be in equilibrium. The ability of an organization to maintain its equilibrium, or regain it once it has been lost, is defined as its stability (De Raadt, 1991, p. 31). It is evident that the organization needs a memory about the set target and must have a short-term memory of the data. These make up the input of the cybernetic system. Corrective actions can be based on the memory content.

Organizing (Weick, 1979) is the adaptation of the organization's structure, culture, style etc. to enable the organization to survive, by improving its capability of effective behavioral responses and knowledge (Duncan, 1972; Mintzberg, 1979; Hannan and Freeman, 1977 and 1984). The organizational memory that is required for learning is of a long-term type, and contains two sets of knowledge: knowledge of the way people should interact and share a culture, and knowledge about the basic identity of the organization (mission statements).

Adaptation can lead to too much internal instability because of the loss of precious knowledge, experience, and skills (Hannan and Freeman, 1977 and 1984). Viable organizations therefore should not only adapt (the evolution approach) but also select. The selection process allows organizations of certain types, which enable *and* limit certain ways of adaptation, to survice. To understand this close relationship between selection and adaptation, the understanding of organizational knowledge and memory is essential.

An example of the working of the adaptation and selection principles is the Roman Catholic Church, an organization that has already existed for about 2000 years. To some extent it adapts to its environment, because it connects its activities and policies to new social problems. For instance in the 1950s the Dutch Roman Catholic Church preached high birth rates because this was important in the social and political emancipation process the catholic part of the population was trying to achieve against the then dominating protestant part. Nowadays the Pope tries to influence the attitudes of catholic people against issues such as homosexuality, and divorce, and has an ethical view on subjects such as unemployment, social security and many other politically and socially important issues of the 1990s. The Church nevertheless does not want to adapt a number of its more basic forms of identity, such as male priesthood, despite the fact that in The Netherlands the Church is suffering from declining interest in celibatarian male priesthood. The philosophy behind this policy is strongly related to ideas about celibacy and asceticism and the place and role of women in our society. It is evident that the inertia of basic identity principles on the one hand lends strength and solidity, which are important for the continuation of the organization, but on the other hand it also can lead to people leaving the Catholic Church in the Netherlands (cf. Lijphart, 1968; Windmuller, 1976 for interesting further reading on Dutch politics and the role of the Church).

The subject of adaptation and organization in organizational learning theory has often been discussed under the headings of single-loop and double-loop learning.

Single-loop learning is about adapting to changing inputs, within the existing pre-set norms. *Double-loop learning* is about the change of the pre-set norms themselves, as a reaction of the ineffectiveness of the existing norms. In our example of the Catholic Church a double-loop learning process could result in the removal of celibacy for priests. There is always a tension between single-loop and double-loop learning, and the management must decide how many single-loop or double-loop learning efforts are required. Besides, the management must support a successful single-loop and double-loop learning process. Both these management issues are about organizations learning to learn, called *deutero learning* (Argyris and Schön, 1978). Very often changing environments are difficult to understand, and knowledge gained soon becomes obsolete. This means that in highly dynamic environments organizations must be particularly good at double-loop learning. Organizations that do not allow for this high level of double-loop learning, such as many classic machine bureaucracies, will be selected out. This has motivated some authors incorrectly, e.g. Swierenga and Wierdsma (1990), to equate organizational learning with double-loop learning. Single-loop learning has also led to important competitive advantages without inhibiting double-loop learning, as will be shown later on in the case of lean organizations.

From the cybernetic paradigm, I have found some important issues to investigate about organizational learning:

1. An essential characteristic of organizational learning is the reception of signals about the organization's environment, so that organizational actions can be initiated that make the organization head straight for its (moving) targets.
2. MICS should be developed and be available, so that (negative) feedback loops are established that make critical evaluation and steersmanship possible.

Additionally, I think that although many traditional management information systems were of this monitoring and control type, they were not effective because they *lacked the behavioral connections that are important in order to obtain the correct interpretation of the monitoring data and allow the convergence of the conclusions to action* (Ansari, 1977). These behavioral issues of organizational learning are discussed in the following section.

2.1.2 Organization Development

Mastenbroek (1982) described organization development as the management of four types of relations (pp. 67-71), namely: instrumental relations, socio-emotional relations, power relations, and negotiation relations.

The *instrumental relations* allow the people in an organization to act as each other's means of production. Instrumental relations are technical in nature, which means that they are about ways of achieving goals by machinery, human or other. This is concretized in the formal structure of the organization (division of labor, responsibility and authority), patterns of communication, procedures for decision-making and coordination, division of space, design of production flows, and the rational use of technical instruments. This means that organizational learning from this perspective is of a technical, substantive kind aimed at increasing existing technical knowledge and skills. Information systems could be useful for shortening lead times, making problems visible and analyzable. Machine bureaucracies are good examples of human machines, as they are constructions of rules and procedures that should work independently of whoever applies the rules. This approach links up perfectly with the cybernetic approach, because cybernetics also applies machines for achieving goals. These cybernetic machines have information systems as an essential component. In fact the bureaucracy does not differ on this issue, because it precisely describes procedures for communication and information supply (cf. Weber, 1964).

The focus on *socio-emotional relations* emphasizes the fact that most organizational learning is done by a group of people. Effective communication between the participants is essential for increasing the group's learning potential. For effective communication it is necessary that members of the group be loyal to each other, and disclose their minds so that everyone profits from the group's success. According to Argyris and Schön (1978), however, many organization members do not disclose themselves and have egoistical attitudes that in the end are counterproductive for the group. Much consultancy in this area is about teaching team members to disclose themselves, accept criticism, and training people to have effective confrontation meetings. This means that organizational learning can be inhibited when groups do not have effective socio-emotional relations. Information systems can provide data that give opportunities for instrumental learning, but will not be of any use when the group is not able to discuss these data and find acceptable solutions that lead to new behavior.

Power relations are mostly difficult to observe in organizations, because they have a longer term perspective and demand a tacit way of operating. The aim of these relations is to improve opportunities of influencing the behavior of other organization members. Organizational learning can be blocked by the existing power relations when some people have the power to not allow certain issues to be discussed. When trying to implement new ways of working, it is necessary to find commitment for this project among the people who have access to the required money, time and motivation. Organizational learning, therefore, is restricted or supported by commitments that are based on the use of power in the organization.

Negotiation relations are about decisions in organizations with respect to scarce resources. This means that negotiation relations are much more explicit than power relations, because it is necessary during negotiations to specify claims, to give arguments and motivations, and respond to proposals. Organizational learning can be restricted by negotiations because the group of bargainers must decide on what to do and put priorities on the right actions. However, organizations can also learn to negotiate, so that negotiations can be performed more quickly, more efficiently, and the chance of dissatisfaction with the decisions is reduced by using certain

procedures. Information technology could be used as support for negotiations (Jelassi, 1987; Teich, 1991).
From the organization development paradigm, I infer that organizational learning is not only a systemic problem, but affects human emotional, power and bargaining problems as well. It includes systemic *as well as* behavioral issues (Ansari, 1977), which means that effective MICSs should be *socio-technical systems.* This view will be discussed in more detail in chapter 4.

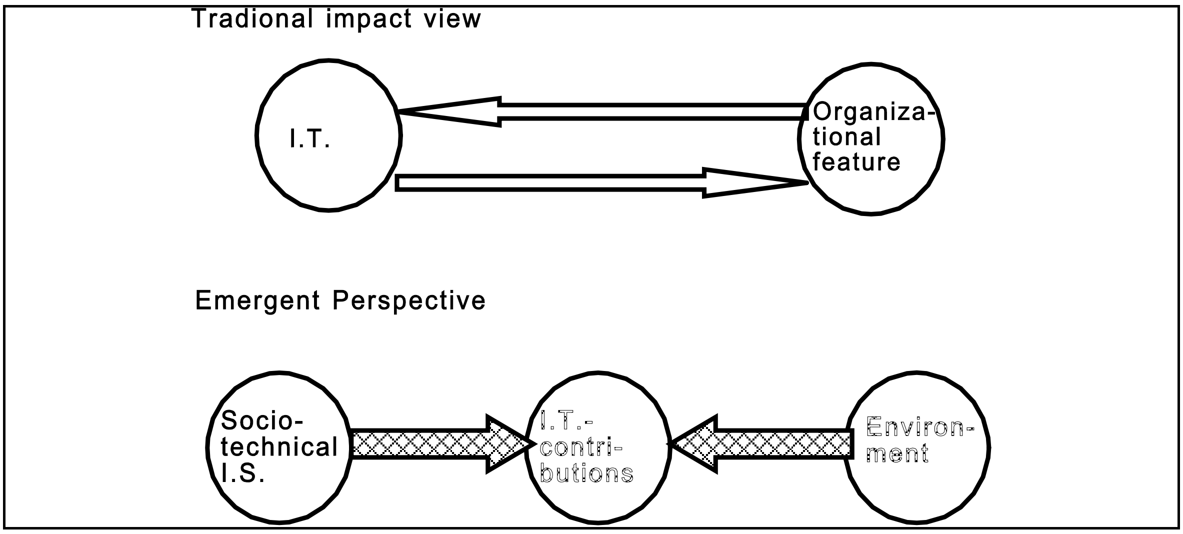
2.1.3 Semiotics and Information Management

The cybernetic as well as the organization development approach share an interest in information as a main component for organizational learning. The cybernetic approach views information as input signals, that could possibly be processed by machines, which automatically generate the correct feedback signals. The organization development approach views information as messages that influence human behavior and attitudes. It is clear that the way both approaches define information differs but that both perspectives are useful and complementary to each other. When studying information it is important to recognize the multiple meanings the term information has. Stamper (1973) therefore prefers to use the term sign instead of the rather vague notion of information, and thus uses a semiotic approach to the study of information. This led to the six layers of information systems that were described in chapter 1. Each of these layers represents some aspects of the concept of information. From the previous discussion about cybernetics and organization development, it is clear that cybernetics only studies information as signs at the syntactic and empirical levels. It also deals with how computers can enable a machine-physical way of handling signs. The organization development approach restricts its discussion about signs to the semantic and pragmatic aspects, and aims at influencing business. The study of MICS and organizational learning requires that both approaches be combined, as otherwise only half of the subject is described.

2.2 *Linking Organizational Learning with Information Systems*

Because this study is about the contribution of information systems to organizational learning, while information systems themselves are regarded as part of the social system, some clarification is necessary to avoid tautological reasoning. Here Markus and Robey's (1988, pp. 585-587) three approaches on impact research are very illuminating. The first approach they describe is called the *technological imperative* which views technology as an exogenous force determining or constraining the behavior of individuals and organizations. The second approach, called the *organizational imperative*, reverses the technological imperative by assuming almost unlimited choice among technological options and almost unlimited control over the consequences. The third approach, called the *emergent perspective*, states that the technological and organizational imperatives are both incomplete, because it is the interaction between the systems and the organizational features that cause certain impacts. The latter approach emphasizes the inseparability of organizations and systems in leading to joint impact. Impact is itself not a static moment but a learning process in itself that could lead to inertia/reinforcements of the status quo (single-loop learning) as well as important changes in mind (double-loop learning) or even the development of a culture of continuously searching for improvements and innovation (deutero learning). The best term to use as independent variable is therefore *socio-technical* monitoring information and control system. This reasoning is also consistent with the literature on MICS that emphasizes a 'broad sense' systems definition which includes computer-based systems (Flamholtz, 1983; Lawler and Rhode, 1976; Ansari, 1977).

It is obvious that the third approach is very similar to our concept of information systems. The emergent perspective also does not have unrealistic expectations of information systems and IT. It also does not say that information systems are useless in learning activities. The emergent perspective poses the question of under what conditions MICS-type systems can be useful for supporting organizational learning, and states that the creation of MICS and its conditions is a learning process in itself. The adherence of the emergent paradigm leads to a causal structure that deviates from the one-directional relations that one would expect when using the concept of impact, see figure 2.1.



The focus here is on the contributions of MICS to effective organizational learning by managers at the operational and tactical business levels. The reason for this restriction is that the study of systems for organization strategy support is very difficult, as the researcher must venture among the many complications of power relations that dominate at this management level. The impact of tactical and operational systems on *effective* organizational learning depends not only on systems and organizational features, but on environmental conditions that impose learning needs as well.

Before completing this section on MICS and impact research, it is useful to mention some alternative ways in which one could study organizational learning and information management, namely by:

1. ... studying developments in other computer applications than MICS, that provide managers with opportunities to understand their business much better (e.g. Decision Support Systems, Expert Systems; cf. Huber, 1991);
2. ... redefining systems development processes as organizational learning processes (e.g. Vennix, 1990; Business Reengineering, cf. Hammer, 1990; Davenport, 1993);
3. ... applying systems impact studies, which study the problems in the systems development process for learning from them, and learning from actual use (Chew et al., 1991; Saarinen and Wijnhoven, 1994; Wijnhoven, 1992b).

The value of organizational learning as part of information management, is that it provides an integral approach to information management and business administration, and gives emphasis to knowledge development, the prime business mover in post-industrial, knowledge-intensive service oriented, society (Quinn, 1992). As a consequence, information managment must change its traditional perspective on managing data, in managing knowledge. For information management this will require the acquisition of new competences and a change in its organizational structure (Burrows, 1994).

2.3 *Problems in Organizational Learning and Monitoring Information and Control Systems*

One of the main reasons why we know so little about the I.T.'s role in relation to organizational learning is the obscurity of the term 'organizational learning'. Additionally, information, information system, information technology, management and organization should be clarified in their mutual relationship. Knowledge in these areas is missing because of:

1. *The ambiguity of the concept of organizational learning*, which is caused by its many roots in disciplines such as psychology, economics, management science, social science, and cybernetics. This means that communication is difficult. Even within one paradigm or research field there is much ambiguity about the meaning of this concept. To improve this situation, a working definition of organizational learning should be introduced. This definition is that *organizational learning is learning about organizational problems by individual organization members via the interpretation of data about these problems in connection*

with an existing frame of reference (knowledge). This happens in the organizational context containing structures, procedures, norms, culture and information systems (formal-informal, automated or manual when available). The result is a change in organizationally shared knowledge. Linked with the practical problems of production in large organizations, the subject of learning can be reduced to the development of insights about the transformation of goods and services. In chapter 4 this definition is further explained, and the concept is operationalized in chapter 4 and chapter 7.

2. *Ambiguity about the connection between I.T. and organizational settings* (including learning settings) is the second major problem and a subject for chapter 6. Systems design is still mainly regarded as a definition of requisites for computer-based systems (e.g. McKeown and Leitch, 1993; Lundeberg et al., 1981), whereas MICSs are socio-technical systems and therefore should involve defining the social issues as well (for instance the ways of acquiring data, ways of communicating about data for sense-making, decision-making processes) (Aquilar, 1967; Mumford, 1983). Often the connection between the technical and the social aspects is neglected and thus leads to information systems that produce voluminous reports which are not used or of which people sometimes do not even know the existence. For developing effective MICSs it is as important to have clear database and report definitions as to design effective targets and management communications. Thus systems development must be defined as political processes as well (Ansari, 1978; Dobson et al, 1994; Hofstede, 1981; Lawler and Rhode, 1976).
3. *Organizations differ enormously in learning needs and information technological applications*. This makes *generalizations very difficult*, which inhibits developing knowledge in the area. A further reduction of the subject to MICSs and machine bureaucracies therefore is absolutely essential. The choice for monitoring information and control systems has already been argued. The reason for choosing machine bureaucracies is based on the idea that these organizations are notorious for their problems with learning, as has often been repeated by authors in the organizational learning field (Argyris and Schön, 1978, and Mintzberg, 1983). This does not mean that other organization types are better learners but that many machine bureaucracies encounter problems with their clients and markets because they learn in a *specific* way. A good example of this reasoning was (again) provided by Womack et al. (1990), while studying the initial reactions of the American and European car industries to the increasing Japanese competitiveness. Instead of trying to figure out why Japanese companies were so competitive, they reacted in two classic ways described in the beginning of chapter 1: dismissing staff to cut costs (especially in the US), and closing the market for Japanese products by forcing the government to impose quotas for Japanese imports (especially in Europe).

On the basis of Mintzberg's insights into organization types, the following relations between organization types and learning problems can be defined:

Organization type	Learning problem
Simple structure	Acquisition of internal expertise
Machine bureaucracy	Rigidity, meaning reinforcing of existing trends and difficulties with unlearning; making sense out of data (interpretation); sharing insights among functions.
Professional bureaucracy	Problems with introducing professional management and business science innovations and the loss of managerial autonomy of professionals. Balancing professional quality versus organizational efficiency and effectiveness.
Divisional forms	Problems of knowledge sharing among strongly differentiated organizational units.
Adhocracies	Preservation of knowledge and experience; establishing continuity and efficiency.

Table 2.1: Mintzberg's Organization Configurations and Related Learning Problems

Alternatively, one can also state that the time for machine bureaucracies is over as a result of new competitive environments. This is probably correct to some extent, nevertheless, *large organizations contain an enormous potential because so many people contribute labor and knowledge. The problem is, as stated before, how to make optimal use of them*. When well organized and managed, especially by managing its knowledge carefully, a big organization can profit substantially from its size.
These statements about research topics refer to some important scientific problems, which should be solved. In this study, I will select the following question:

"Under what conditions can computer-based MICSs contribute to organizational learning in machine bureaucracies (lean and classic)?"

This question should result in data for the construction of an explanatory theory that might also be valuable in evaluating a MICS on its contributions to organizational learning. Chapter 3 discusses the consequences of this approach.

2.4 *A Model of MICS and Organizational Learning in Machine Bureaucracies*

Organizational learning problems evolved in the evolution of organizations. Machine Bureaucracies, for instance, invested much in rules, procedures, principles for work, and often also in machines. This was necessary for producing large quantities efficiently, and for optimizing the use of expensive machinery. This led to low cost mass products (important in markets in which cost leadership is a necessary competitive strategy). Downtime for a machine implies the loss of opportunities for production and profit. However, the relation between profit (or turnover) and production quantities is not a direct one, in periods of an unlimited market this relation is almost 100%. Therefore, the basic organization principle is related to the optimized use of expensive production capacities, which means that all materials, supplies and people should be there in the right quantity, shapes, quality, and moment. Formal planning is necessary to accomplish this. Also, a clear definition of tasks, responsibilities and authority is necessary to have an effective well-organized social system related with the technical production process.

Since the second world war, machine bureaucracies have had to face increasing demands on quality, flexibility and innovation of their organizations. To cope with these demands the organizations had to increase their internal and external complexity. Competition on quality for instance demanded regulations for preserving the quality standard required. This led to the production of quality handbooks and certification procedures (Garvin, 1987; Evans and Lindsay, 1993). Behaving according to these rules is supposed to be a necessary condition for realizing quality standards. At the same time this increased the demand for bureaucratization via the development of formal communication routines, inventory procedures, machine maintenance rules etc.

Allowing for flexibility in the production process required in many instances the implementation of flexible manufacturing systems. The effective use of these systems required again many rules about the availability of data and resources at precisely the right time (Kerr, 1991). Besides, machine bureaucracies had to think-over their production or value-addition technology. Dependent on market characteristics (especially specificity of customer and dynamics in demands), continuous production (leading to stock sold) is not always optimal (stock has large opportunity costs). Many machine bureaucracies, therefore, are series producers, but some are even batch and discrete unit producers. This has large consequences for the managerial knowledge needed (especially at the tactical and operational decision levels) and thus for the learning problems as well (cf. Van Rijn, 1985; Hill, 1982). Besides, as a consequence of modern competition, service industries are forced to optimize the relation between output versus input, but must especially focus at optimizing their relations with clients and markets (cf. Kotler, 1988). These issues, therefore, must be considered in detail in the rest of the study.

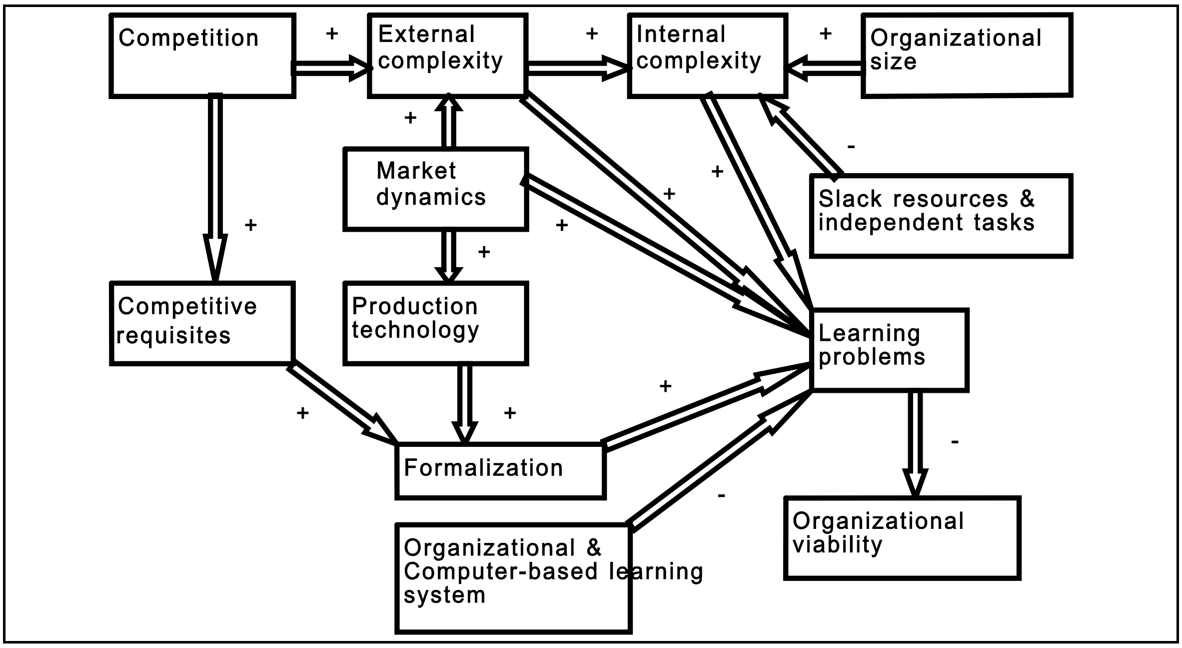
Innovation requires a certain amount of de-bureaucratization, because it demands the free flow of ideas among people (Hamel and Prahalad, 1990). The impact of the formalization process described earlier led to a significant problem in adapting to changing market environments. This means that many a company, in trying to be a perfect company from an efficiency, quality and flexibility perspective, dug its own grave at the same time (Lammers, 1985).

Another problem with bureaucratization was the reinforcement of complexity. The larger the organization, the more complex its internal processes and the more difficult it is to manage as a whole. Hence, in the 1980s a reconsideration of the use of being a single organization was initiated and many organizations introduced vertical decentralization and even introduced outsourcing of departments and divisions (e.g. Philips Electronics; also cf. Wissema, 1987). Also, external complexity

grew enormously because many new products and new suppliers entered the market. Liberalization of trade (GATT-discussions, European Market etc.) complicated competition even more.
The issues relating to the growing internal and external complexity and market dynamics changed the ways in which organizations could form a strategy. In bureaucracies, people improved learning in a specialized way, but lost the opportunity to create synthetic views. These increasing learning problems were met by cognitive complexity reduction and an increase of organizational learning capacities (cf. Galbraith, 1973). Cognitive complexity reduction techniques consist of the creation of slack resources and the creation of independent tasks. Improvement of organizational learning capacities can be realized by:

- ... reorganizations consisting of the development of matrix and project organizations, and specialized intelligence groups and/or,
- .... the use of computer-based information systems for developing new ideas (especially DSS) and analyzing existing ways of operating (MICS).

Both strategies for increasing organizational learning are dealt with in this study. The results of these considerations are summarized in figure 2.2.



The main focusses of this study are on the dependent variable 'organizational learning' and the independent variable 'socio-technical learning system' (MICS). In chapters 4, 5 and 6 these theoretical constructs are described in more detail and made accessible for empirical research. Chapter 3 describes the methodological problems involved.

Chapter 3: Methodology and Research Design

3.1 *Definition of the Problem*

Chapter 1 described the growing importance of learning in modern organizations. Especially for machine bureaucratic organizations, the implications of studying learning are high because they are reputed to have typically poor learning habits (cf. Swierenga and Wierdsma, 1990, p. 61-68). Machine *bureaucratic organizations* are placed as number one on the research agenda, and specifically we are interested in knowing if MICS could contribute to making the classic machine bureaucracies leaner. This study faces two major problems. The first problem, as stated in section 2.2, is the complexity of singling out the impact of MICS on organizational learning in machine bureaucratic contexts. This requires the generation of an explanatory and predictive theory. The second problem is the ambiguity of the organizational learning concept, mentioned in section 2.3, thus requiring an explicit formulation of the concept, and much effort in operationalizing it for empirical research and MICS evaluation purposes.

Information systems are supposed to be important instruments for helping organizations to solve their learning problems. Nevertheless, no theory exists at the moment that clearly explains the contributions (if any) of information systems to organizational learning, and the organizational prerequisites to augment learning with MICS. Studying the use of MICS is even more important when I.T. impacts are damaging to organizational learning, e.g. by increasing the amount of formalization and rigidity.

The basic problem, therefore, can be formulated as the *absence of knowledge about the circumstances under which monitoring information and control systems can contribute to organizational learning in machine bureaucratic environments*.

3.2 *Aims of the Research*

This study aims at providing clear concepts and a theory. This implies two activities: concept formation and theory construction.

3.2.1 Conceptualizing Organizational Learning

Problems of Conceptualizing Organizational Learning

Conceptualization of organizational learning has not yet led to a consensus on basic assumptions yet in the field. Many complex theoretical constructs are used to define organizational learning, often exacerbating the problems of comparing insights and research results. Some authors for instance regard organizational learning as confirmation or rejection of organizational theory-in-use. These discoveries are then embedded in organizational memory (Argyris and Schön, 1978). Other authors stress the importance of creating scientifically valid action-outcome theories for management (Duncan and Weiss, 1979), whereas others think that the coherence of views among organization members (shared mental models) is even more important (De Geus, 1988). One other major discussion has been the question of whether organizational learning can be more than just the sum of the learning of the individual organization members. Hedberg (1981) for instance states that organizational learning indeed occurs through the individual members, but that in some way organizations preserve certain behaviors, mental maps, norms and values so that organizational stability is maintained despite the fact that organization members come and go and leadership changes. Alternatively, Kim (1993) proposed a stronger link between individual mental models or maps and organizational mental models. He stated that despite some formal changes in an organizational mental map, organization members could keep behaving in the old way, following their personal mental models. But when a substantial part of the organizational membership leaves, it is most likely that the organization's mental model will also change.

Often the ideal of a *learning organization* is discussed. A learning organization should facilitate the learning of all its members and continually transform itself (Garratt, 1987, p. 77). Peter Senge uses the terms 'organizational learning' and 'the learning organization' in a much broader sense than the cognitive psychological one that dominated the previous definitions. He explicitly regards organizational learning as a cognitive (theory, memory, and views) and a behavioral issue. The following quote is illustrative of his view:

> " *...in everyday use, learning has come to be synonymous with 'taking information'. (...) Yet, taking in information is only distantly related to real learning. It would be nonsensical to say, 'I just read a great book about bicycle riding - I've now learned that.' Real learning gets to the heart of what it means to be human. Through learning we re-create ourselves. Through learning we become able to do something we never were able to do. Through learning we reperceive the world and our relationship to it. Through learning we extend our capacity to create, to be part of the generative process of life. [...] This, then, is the basic meaning of a 'learning organization' - an organization that is continually expanding its capacity to create its future. For such an organization, it is not enough to survive. 'Survival learning' or what is more often termed 'adaptive learning' is important - indeed it is necessary. But for a learning organization, 'adaptive learning' must be joined by 'generative learning', learning that enhances our capacity to create"* (Senge, 1990a, pp.13-14).

I shall not summarize all these definitions to a single all-inclusive definition that satisfies all these authors. Such a definition is dangerous in that it may exclude some important issues. Besides, an all-inclusive definition neglects the richness of theoretical constructs that are connected with world views and ways of theorizing. Therefore, I shall approach the problem *not as a definitional problem* but as a problem of *concept formation*.

A Method for Conceptualizing Organizational Learning

The conceptualization of organizational learning is especially complex because of the nature of conceptualizing phenomena for scientific purposes, which frequently requires the use of *theoretical constructs.* These concepts have a role in theoretical frameworks, to explain and predict phenomena, but are difficult to observe. Organizational learning is a typically good example of a theoretical construct. Observing it is not possible without further theorizing about what we mean by organizational learning. This situation is very different from the observation of things like 'chairs' or 'balls', that are directly and unambiguously connected with things and therefore called *concreta*. This situation also slightly differs from *abstracta*, which define a class of directly observable things that belong together, and exclude other things from this class (e.g. furniture defined as tables, chairs, sofas, but excluding beds). Abstracta can be defined by genus and differentia. In this way organizational learning can also be defined, because organizational learning = learning (genus) by organizations (differentia) (Stamper, 1973, p.88). The problem, however, is that 'learning' and 'organizations' are not concreta and thus cannot directly be observed. Conceptualizing them as abstracta gives us a very incomplete understanding of what organizational learning is about. Another type of concept often mentioned in the research methodological literature is called *illata* which can be observed without detailed theorizing, but are not observable without the use of specially constructed instruments (e.g. microscopes for observing bacteries) (Boesjes-Hommes, 1970). Many illata, however, are theoretical constructs that have been defined and operationalized in a precise way so that measurement instruments can observe characteristics of these theoretical constructs. Many examples of this kind exist in the natural sciences (e.g. electric current, molecular motion, certain types of light). It is often said that the natural sciences are about the physical world, and thus describe mainly concreta, abstracta and illata, whereas the social sciences are about virtual reality (opions, attitudes, motivations etc.) and apply concepts that have their meaning in the context of theories (thus theoretical constructs). A closer study of the conceptualizations in the natural sciences has been done by Thomas Kuhn (1962/1970) and shows that this presupposition is not correct. The development of a method for conceptualizing theoretical constructs thus could be favorable for both sciences.
The conceptualization of theoretical constructs involves the following steps:

1. Think over the *purpose of the concept* (explanatory and predictive value) within the larger theoretical perspective and functions it should have. With respect to organizational learning, the concept should be linked with the management of

modern organizations *and* the development of monitoring information and control systems. This implies the identification of the causes and impacts of organizational learning. Besides organizational learning, machine bureaucracy and MICS are also theoretical constructs. Organizational learning will be discussed in greater detail than the other two constructs, because it describes the dependent variable and the main source of criteria for MICS-assessment. Machine bureaucracy has, fortunately, already been conceptualized adequately by Mintzberg, and the conceptualization of MICS has already led to some consensus among information scientists (cf. Davis and Olson, 1985; Ansari, 1977).

2. Give a *working definition* of the concept, as a first demarcation of the object of research. Also try to detect the basic assumptions that are implied (possibly tacitly) in the definition.
3. Explain the *different perspectives, paradigms* or meta-theories that are relevant when studying the phenomenon of organizational learning. This is necessary for a clearer understanding of the organizational implications of the phenomenon. It does not mean that only one perspective should be adopted, because *understanding a social phenomenon frequently requires the use of multiple perspectives* (Morgan, 1986).
4. Define the *main dimensions* of the concept. This means describing the most important aspects from the perspectives defined previously. Besides, one should also define the relations between the different dimensions of organizational learning. This implies the investigation of demarcations between the dimensions found and especially the study of possible relations between these dimensions, for instance in terms of cause and effect or means and goals. This study is important because it could assist in the systematic investigation of phenomena. The observation of one kind could then be used for predicting possible phenomena of another kind. In this way a procedure for investigating organizational learning is developed, based on a theory and hypotheses that are theoretically and empirically valid.
5. *Operationalizing* the dimensions into concretely observable units, for instance by the development of questionnaires, scaling and measurement methods. This last issue enables an empirical test of the hypotheses to be carried out. Statements about the validity and reliability of the observations are a theory in themselves, and therefore must be refutable as are all other types of theories (cf. Popper, 1959; Kieser and Kubicek, 1978, part 1).

This method is further applied in chapter 4.

3.2.2 Developing a Theory about MICS and Organizational Learning

Theory construction is a major concern in the philosophy of science (Hempel, 1965; Popper, 1959; Denzin, 1970). A summary of the different stances for the social sciences has been made by Burrell and Morgan (1979). These authors stated that the main discussions about the *nature of social science* (and therefore the development of social theory as well) can be organized along the subjective-objective dimension. Typically, scientists adhering to an extreme *subjectivist approach* emphasize the nominal nature of 'reality', meaning that 'reality' as such does not exist outside the mind of people and their language. They therefore believe that one cannot objectively measure and investigate 'reality', but should try to understand it by developing insights into the mind-set and culture of the people. On the contrary, extreme *objectivists* are convinced of the fact that the world is real and factual. They therefore think that scientific research could lead to objective and universally true laws about the nature of society. Subjectivists state that this is not possible because people have their own free will, which can lead to undetermined actions, and conclude that people's behavior therefore should be explained and studied in its idiosyncratic conditions. Both extreme positions probably have many variants. It will suffice here to state that the subjectivist vision is typical of organization development and the objectivist view is typical of cybernetics.

The objectivist and subjectivist approaches are mostly presented as polar extremes between which a researcher has to choose (cf. Burrell and Morgan 1979). My epistemological position is however *pragmatic*: science and theories must meet the *functions* they should have for their user. Depending on the specific context, objectivism and subjectivism are both useful. Some basic functions of social theory are explanation, understanding, prediction, description, construction and assessment (cf. Bernstein, 1976). Let us explain these functions, and choose what is required to fulfill our research objectives.

- *Explanation*. The resulting theory must provide explanations for the success and failure of MICS in concrete business organizations. Because no validated theory in this area exists at the moment, it is not the generalization of the theory over a large sample that is our concern here. What we aim at is an understanding of MICS's influence on organizational learning in concrete business organizations so that a theory can be generated.
- *Understanding*. Understanding is a type of explanation that emphasizes the possibility of the scientist or analyst having empathy with the subject(s) under investigation. The explanation therefore is not primarily based on measurements, but on communication and interaction between the informant and the investigator. Understanding is essential for creating organization theory, especially in under-researched areas like the intersection of organizational learning, MICS and machine bureaucracies. The reason for this is that a language that deviates from everyday life must add considerably to knowledge, otherwise it is a nuisance. This means that in an early stage of theory development, concepts must be close to everyday language. This is a major strength of grounded theory that in its substantive phase uses everyday concepts. The value of a theory, however, increases when it has a broader

application area than just the idiosyncracies of the observed case. Therefore generality of insights must be strived for. This is achieved via the formalization of substantive theories, gradually introducing more academic jargon (Glaser and Strauss, 1967).

- *Prediction.* According to positivism, theories must have universal validity, meaning that the relations found are valid in the past and present (explanation) and future (prediction) (Hempel, 1965). This statement is of course only valid under identical (ceteris paribus) conditions and therefore hard to test empirically (Kieser and Kubicek, 1978, part I). Prediction is also a more ambitious target of theory construction than explanation, because many yet unknown and maybe even non-existing facts can falsify a prediction, as is often the case (cf. Etzioni-Halevy, 1985). It is therefore useful to distinguish between the explanation and the prediction function. Of course many theory users might be more interested in predictions, so that they can predict 'what would happen if...' An example is an investigation of the impact of the lowering of a bank discount rate on inflation in a country. Other theory users might be more interested in explaining why certain things happen. For instance an organization might be interested in the question why some projects were a failure and others were a success, while developing new knowledge about project management.
- *Description.* Some theories have a primarily descriptive function. This means that they have a consistent set of issues to describe a case or phenomenon for other purposes (explanation, understanding, prediction etc.). Often ideal types are constructed for this purpose. Some examples of these types are Max Weber's typology of 'Herrschaft', Jung's classification of psychological types, and Mintzberg's organizational configurations. Description and its possible functions are, however, closely connected, as Jung's typology can serve to improve a therapist's understanding of his client, and Mintzberg's typology can aid in the diagnosis and design of organizations.
- *Construction and assessment.* If we can describe, explain and predict phenomena, then we also have opportunities to find out whether certain policy proposals will work or not. This means that one can assess the effectiveness and ineffectiveness of policies (such as using MICS for management learning) and offer suggestions for improvement (e.g. finding leverages to augment the effectiveness of MICS).

In this study, cases were used to obtain reliable data for the generation of an explanatory theory, which could also be used for the evaluation of MICS. The analysis will use principles of grounded theory construction, emphasizing the importance of analyzing evidence from cases that, from a theoretical point of view, are significantly different but comparable. The objective is not to find statistical regularities, but to find new concepts and how they are related in order to reach an explanation.

3.3 *The Main Questions*

The general question *"Under what conditions can computer-based MICS contribute to organizational learning in machine bureaucracies (lean and classic)?"* is reformulated in the following more concrete questions:

1. What are the basic dimensions of organizational learning, as a cognitive and organizational process? The answer to this question gives a detailed description of the dependent variable and solves major conceptual problems.
2. How do machine bureaucratic organizations learn? The answer to this question gives a contextual flavor to the general description of organizational learning. It is the basis for understanding circumstances under which specific types of learning can occur. Machine bureaucracies are taken as a case for heuristic purposes, because learning problems are expected to be most overt in the classic, and mainly solved in the lean, machine bureaucracies.
3. Do lean and classic machine bureaucracies differ significantly in their way of organizational learning? This question is most important in order to increase the variety on the independent variable, so that we can generalize about the research findings.
4. What is the influence of MICS on organizational learning in machine bureaucratic contexts? The answer to this question provides a synthesis between the general problem of organizational learning, machine bureaucratic features and information systems features, by defining the concept of a socio-technical learning environment. Also hypotheses will be stated about the possible impacts of I.T. on organizational learning.
5. How can one observe the impacts of the monitoring information and control systems in machine bureaucratic environments? This question requires the assessment of the model which results from the theory developed, with particular regard to its use for making important managerial observations and inferences from a theoretical and practical perspective.

3.4 *Research Design and Plan*

3.4.1 Research Plan

The previous discussions emphasized the importance of studying machine bureaucracies. Two different types of machine bureaucracies are distinguished in chapter 1: the classic and the lean type. The first assumption is that these types of *organizations differ significantly in the way they learn and use monitoring information and control systems*. A second assumption is that *organizations have learning norms (that differ among the four machine bureaucracies) that explain the differences in how they learn*. A third

assumption is that organizations have learning needs and that *organizational effectiveness depends largely on the match between learning norms and learning needs*. The fourth assumption is that MICS *consists of a set of organizational learning norms that can add to or inhibit organizational learning performance*. Many supporting theoretical arguments are given in chapters 5, 6 and 7, while chapter 8 provides empirical evidence via comparative case studies.
The research design is a comparative study among four classes of machine bureaucracies, distinguished by organizational leanness and organizational transformation process (service versus manufacturing) that are supposed to explain organizational learning performance. Chapter 6 further explores MICS as a variable, and the consequences for the theory involved.
The study has an exploratory nature, to develop theoretical insights, because theories in the area are lacking and conceptualization of a major variable is very ambiguous. In these types of study, knowledge is not yet far enough developed to lead to effective survey studies. Research methodologists then recommend comparative case studies, and stress the importance of theoretical insights gained from observations (called 'grounded theory' by Glaser and Strauss, 1967) (Yin, 1984; Glaser and Strauss, 1967). The cases studied are not selected randomly from the population of machine bureaucracies, but are chosen on some indications that would make the case appropriate for one of the classes described above[3]. Additionally, the individual organization under investigation must be prepared to cooperate in the study. This is sometimes not so easy because it demands time and effort on the part of the organization, whereas the benefits are not all that clear in advance.
The participating organizations are briefly described in table 3.1, and selected on the basis of insights we gained from the organization at the beginning of the case studies. The organizations are anonymous. Cases 1, 2, 3 and 4 were selected in the beginning of the study. Later on, High Tech Manufacturing Plant (Hitec) was selected as a case, because it very clearly can be identified as a lean organization, whereas Chemical Plant and Health Co were not yet lean in the strict sense of the word, as we found out after completion of these cases studies.

Types of Commercial Machine Bureaucracies		Leanness	
		Classic	Lean
Organizational transformation	Manu-facturing	1. Classic Manufacturing: A Cardboard Manufacturer, called *Cardboard Co.*	2. Lean Manufacturing: A Chemical Manufacturing Plant, called *Chemical Plant* 5. A High Tech Manufacturing Plant, called *Hitec*

[3]This way of selecting cases is called 'Theoretical Sampling' by Glaser and Strauss, 1967.

	Service	3. Classic Service: A Mid-European Commercial Bank, called *The Bank*	4. Lean Service: A Health Insurance Company, called *Health Co.*

Table 3.1: Theoretical Sample of Cases

3.4.2 Reliability and Validity Problems

This cross-case comparitive study has elements of an experimental design, because it varies the independent variable (experimental factor) machine bureaucracy type. MICS is regarded as an intermediate variable between machine bureaucracy and organizational learning. As an alternative hypothesis, variation in machine bureaucracies is supposed to influence organizational learning in a direct way as well. Data gained from interviews were used as cues to more objective data sources such as archives and databases. Data from different data sources were checked to improve the data reliability. When only interview data could be obtained, answers from different respondents were compared, but we used archive material as much as possible to increase the reliability of the data (cf. Blau and Schoenherr, 1971). Additionally, the reliability of the data was checked by comparing interviews about the same topics where possible. The study aimed at exploring a theory by drawing upon existing theoretical notions in the field. This implies the need for a literature study and case studies. The literature study aims at developing hypotheses and concepts that will be tested in an empirical investigation. The case studies check the validity of the hypotheses and theory developed thusfar, and aim at improving them on the basis of empirical observations. The testing of the preliminary hypotheses thus has heuristic purposes in this theory exploration[4].

Some alternatives for testing theory were considered as well, namely experiments, surveys, historical studies and archival analysis (Yin, 1984, p. 17). We did not choose for controlled experiments because they require a very precise and well-formulated theory in advance, which was not available, and because many experiments suffer from a low external validity. A survey study was not conducted because it requires a greater clarity about the basic concepts, which again was not available (the concept of organizational learning in particular suffered from much ambiguity; see chapter 4). A historical study was feasible in theory, but also would have lacked external validity because the issues of organizational learning and information systems have gained importance since the 1990s. Archival analysis (as done by e.g. economists) was not considered feasible, because no databases exist about organizational learning. But when one of the companies of our case studies has data of its own, then these were explicitly used as additional data sources.

[4]This heuristic is also called 'analytic induction' by Glaser and Strauss (1967). The reader is kindly referred to these authors for further clarification of 'analytic induction'.

When applying the case study strategy, some important general *methodological problems* must be dealt with: construct validity, internal validity, external validity and reliability. Construct validity is about establishing correct operational measures for the concepts being studied. Internal validity is about establishing a causal relationship, whereby certain conditions are shown to lead to other conditions, as distinguished from spurious relationships. External validity is about establishing the domain to which a study's findings can be generalized. Reliability is about demonstrating that the operations and analysis of a study (such as the data collection procedures) can be repeated and will lead to the same results.
These requirements can be met in several ways in the case studies. Table 3.2. column 3 describes how this study treats these methodological problems.

Tests	Case study tactic	Research in techniques and tactic used
Construct validity: allowing controlled observation	Use multiple sources of evidence	Data collection. Evidence is found by interviewing key persons, study of archives and other documents.
	Establish chain of evidence (also observations etc.)	Data from multiple sources are checked for inconsistencies and corroborations.
	Have key informants review the work	Drafts are send to informants for review, and feedback meetings are planned with each company.
Internal validity: allowing controlled deductions	Compare predictions for a case with empirical data	Data analysis based on score card matching (Patterns are hypothesized in chapters 5, 6, and 7.
	Do explanation building	Data analysis for applying the theory and exntending the set of hypotheses.
	Do time-series analysis	Analyse time-series only when suitable archives are available.
External validity: allowing generalization of findings	Replication in multiple-case studies.	Express theory in a research design. Test after each application, modify to make the theory more robust.
Reliability: allowing controlled observation	Define case study protocol	Checklists and measures were used by the three members of the research team who collected the data for the five cases. Much interchange of experiences occurred within the team.
	Make case study database available	It is available for experts to control the quality of the study, but is treated confidentially.
Source: Yin, p. 36, table 2.1 and Lee, 1989		

Table 3.2: Case Study Tactics for Four Research Design Tests.

This means that most of the recommended tests are explicitly part of the research strategy followed here.

3.5 *Layout of this Book*

Chapter 1 and 2 have explained the motivation to this study and the major problems and questions. Chapter 3 discussed the research design and some methodological problems involved. The following step is to describe the concept of organizational learning, in chapter 4. Chapter 5 clarifies the term machine bureaucracy. This concept has been studied extensively in the existing literature on organizations, and has led to a conceptual concensus. Additionally, the way machine bureaucracies learn is examined and some hypotheses are defined that indicate a distinction in learning among four types of machine bureaucracies. Chapter 6 relates organizational learning, specifically in machine bureaucracies, with the role and influence of MICS. These theoretical chapters are then followed by empirical chapters. The theoretical and conceptual findings first need some further elaboration to an operational language, so that it is easier to guide the data collection and analysis of findings. This means that the hypotheses need very precise formulations. The conceptual ambiguities that possibly still remain must be solved. This is part of chapter 7. Chapter 8 presents the results of the five case studies. In this chapter the results of the first case study is taken as input to the analysis of the second etc. In this way the analysis proceeds by accumulating insights and further formalizes the theory. Chapter 9 finally puts together all the results and discusses a further elaboration of the theory and observation instruments.

Chapter 4: Concept of Organizational Learning

4.1 *Introduction and Working Definition*

This chapter addresses the conceptual ambiguity about organizational learning by applying the concept formation methodology described in chapter 3, that prescribed the following sequence of activities in conceptualizing theoretical constructs:

1. Think over the purpose of the concept. This has already been done in the previous chapters, to illustrate the importance of research for organizational learning and the broader theoretical perspective the concept should be part of. It is not our intention to describe organizational learning in a psychological way, but to show the genus and differentia; section 2 also describes a psychological perspective that has been quoted many times in the literature on organizational learning.
2. Write down a working definition. This definition is given later on in this section.
3. Describe the theoretical perspectives. Sections 3 to 7 describe the perspectives of organizational learning.
4. Describe the dimensions. The dimensions of organizational learning are described in section 8.
5. Operationalize. An operationalization of organizational learning, which is important for carrying out the case studies, is given in section 9.

The following working definition is used in this chapter:

Organizational learning is learning about organizational problems by organization members via the interpretation of data about these problems in connection with an existing frame of reference. This happens in an organizational context containing structures, procedures, norms, culture, organizational memory and information systems.

This definition is chosen because of the following assumptions:

1. Organizational learning is about the way organizational *experiences* are processed. These experiences can be about organization internal problems (e.g. decision-making and conflict settlement) or external problems (e.g. increase of competition). This is of course essential for staying in business.
2. Learning is *done partly by individuals*. Individual people must be motivated to learn, should have the intellectual capacities to understand problems and solutions, and must be willing to change behavior and attitudes when necessary to improve performance.
3. Individuals require *frames of reference* in order to learn to understand what is going on and what should be done. These frames of reference can be tested and changed as well.

4. Organizational learning is done also by *people together* and thus is a social process. This is because people basically learn things from each other, by face-to-face communication, writing or other means of communication, and sharing a frame of reference.
5. Management should facilitate the learning process by organizing, planning, financing, tooling, controlling and improving it.
6. Organizational learning, when it leads to a change of behavior, attitudes, organization structure and policy, can have a severe impact on organizational relations, and therefore requires not only a *cognitive capacity* (accumulation, update or removal of knowledge in organizational memory) but capacities for *organizational change* as well.

4.2 *A Psychological Perspective: David Kolb's Experiential Learning*

Organizational learning, regarded from a psychological point of view, emphasizes an individual's *change of knowledge and behavior*. The statement of the psychologist David Kolb (1984) is particularly interesting here, because it is firmly based on insights from major writers and philosophers in the field of learning (John Dewey, Kurt Lewin and Jean Piaget) and has been applied to organizational learning frequently. Kolb defines learning as (1984, p.38) *"... the process whereby knowledge is created through the transformation of experience"* and calls his theory *experiential learning*. His approach is relevant from an organizational learning approach, as it emphasizes the importance of learning from experience rather than class-rooms and textbooks. This means in many cases that organization members should be responsible for creating an adaptive and viable organization. The experiential approach makes the following assumptions:

" *First is the emphasis on the process of adaptation and learning as opposed to content or outcomes. Second is that knowledge is a transformation process, being continuously created and recreated, not an independent entity to be acquired or transmitted. Third, learning transforms experience in both objective and subjective forms. Finally, to understand learning, we must understand the nature of knowledge, and vice versa*" (Kolb, 1984, p. 38).

The definition as stated above needs clarification on some points:

1. The term of '*knowledge*' in the definition is still rather ambiguous. According to Kolb, knowledge can be two-sided: a collection of concrete experiences, or a set of abstract conceptualizations. The concrete experiences consist of stories, feelings, data and opinions about what someone has observed. The abstract models consist of general theories, perhaps gained from textbooks or lectures. Abstract models can be science, containing laws, theorems and procedures that are accepted as being valid knowledge, or judgement, containing workable knowledge in the form of policy rules, probabilities and heuristics (Earl, 1994,

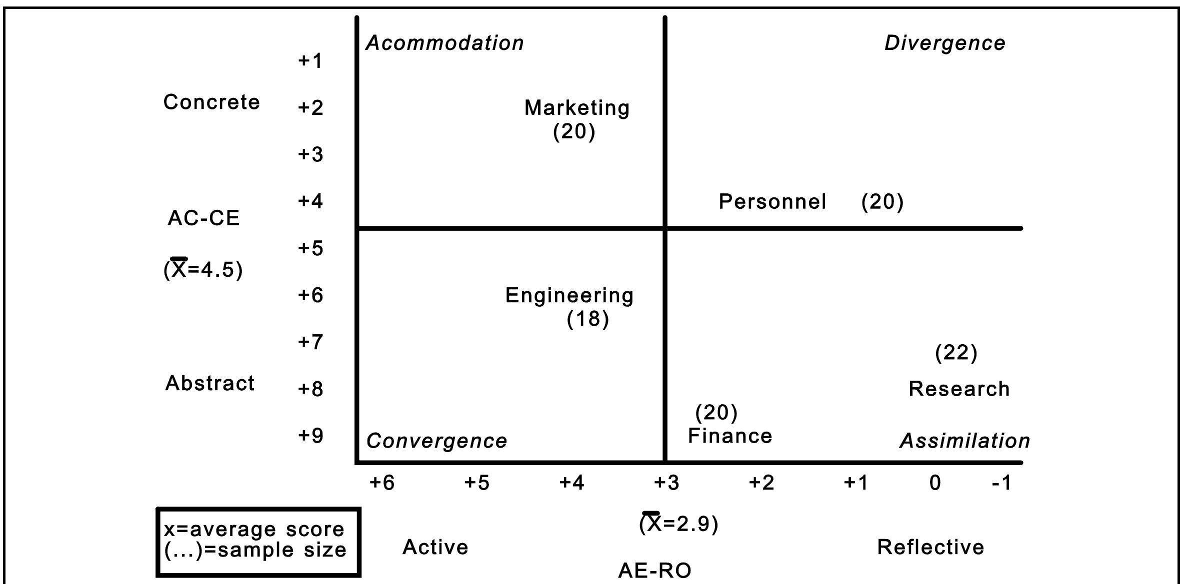
pp. 55-59). A substitute for the term knowledge in a management context is the term '*management theory*' which is a combination of science and judgement. Management theories thus contain goals, purposes and the way managers think they could achieve them, possibly formulated in some hypotheses about means-goals relationships, explanations and predictions of events. A management theory, for instance, could state that decentralization leads to better motivated personnel who process information from the environment more effectively, which leads to a higher organizational performance. This theory consists of several hypotheses that are open for refutation. The concept of management theory looks simple; however, in practice it is difficult to observe. This is because of the often hidden and tacit aspects of management theories. Argyris and Schön (1978) therefore distinguished espoused theories, containing a person's public explanation of why he does what he does, from theories-in-use, which give a 'genuine because reason' for his behavior. The latter is often only partially espoused for political and cognitive reasons (Schutz, 1939, for a classic account of the methodological problems involved in observing these). Tacit knowledge is particularly important when there is a close connection between knowledge and action. In that case, concrete experience is a more important motivator to action than the application of explicit abstract models. Craft technology is based on the application of implicit knowledge because of the low task analyzability (Perrow, 1967; Mintzberg, 1983). Sometimes a layman can ask very fundamental questions, and initiate organizational learning by elicitating everday used organizational knowledge (cf. Coats, 1992). Another example is strategic planning, that often results in documents that never lead to concrete actions. The authors of these plans often lack sufficient understanding of the practical situation and such intangibles as socio-political involvements (Ansoff, 1988). An organization has many concrete experiences as well as abstract conceptualizations. The learning process should be developed to connect both and to guide the organization's energy and resources in the right proportion to the development of prehension.

2. The concept of '*process of learning*' is also vague. Kolb suggests distinguishing between two processes: *reflection and experimentation*. These processes are most interesting from a managerial point of view because they correspond with two basic management activities: analyzing the situation and developing new ideas (reflection), and testing ideas (experimentation) and learning from that experience (a new reflection). Management learning, however, is not divorced from political processes, which even sometimes take more energy than the learning processes. For instance, Kumar (1990) found in his survey of IT-project evaluations, that only in 18% of the cases was evaluation motivationed by: "*The use of evaluation results, as a feedback device for improving future development and project management methods and for evaluating (and improving) the systems*

development project personnel..." (Kumar, 1990, p. 210). The main motivation for evaluation, according to Kumar's findings, was 'project closure', by demonstrating that the objectives of the project are achieved and that appraisals can be provided to members of the project group.

Kolb developed a *learning styles inventory*, that measures a person on the dimensions of the organizational learning construct: concrete experience (apprehension), abstract conceptualization (comprehension), active experimentation (extension) and reflective observation (intention). This results in four dialectically opposed forms of adaptation to the world. Mostly, people tend to specialize in a certain kind of knowledge and learning activity, called a learning style. The convergence learning style relies primarily on the learning abilities of abstract conceptualization and active experimentation. The divergence learning style has the opposite learning strengths, emphasizing concrete experience and reflective observation. The assimilation learning style has the dominant learning abilities of abstract conceptualization and reflective observation. Finally, the accomodation learning style emphasizes concrete experience and active experimentation. A person's learning style is measured via two uni-dimensional variables: AC-CE (the abstract conceptualization minus concrete experience score) and AE-RO (active experimentation minus reflective observation score). According to Kolb these two-dimensional variables can be reduced to uni-dimensional variables, because of the high correlation between AC and CE, and between AE and RO, thus possibly measuring two underlying constructs (Kolb, 1984, p. 75). Weisner's study (1971) of a Midwestern division of a large American industrial corporation is particularly interesting here. Weisner applied the learning style inventory to the five major functional groups (marketing, engineering, personnel, finance and research). About 20 managers of each group were rated. The results are pictured in figure 4.1.

It is evident from these data that organizational learning can easily lead to organizational differentiation, which allows for specialization, meaning the development of specific expertise by specific people. The close connection between organizational learning and differentiation was already mentioned by Lawrence and Lorsch who defined differentiation as:"*...the difference between cognitive and emotional*



orientation among managers in different functional departments" (Lawrence and Lorsch, 1967, p.11). Many problems can occur because of differentiation and specialization. Kolb is well aware of this fact and proposes a third learning process. In Kolb's theory, after an initial period, people start specializing in the behavioral, symbolic, affective or perceptual dimension of personal development, and later also learn to synthesize these. Kolb interprets development as a process of the development of human personality, from an infant to an adult. This interpretation is less applicable to organizational learning, also when we conceive organizational learning as the learning of individuals in organizations, because most organization members have already reached the stage of adulthood. The theory is more applicable when we perceive development as a process of initial development of experience and conceptions, the further development by specialization (which can lead to highly specialized knowledge, cf. Weber, 1921/1964), and integration (connecting pieces of knowledge in the organization and the development of a shared body of knowledge (cf. Senge, 1990a).

Because organizational learning takes place via its individual members, the possibilities and limitations of organizational learning are linked with individual abilities to innovate and improve their understanding of reality. Increased complexity and dynamics make important demands on the indivual's ability to absorb new ideas, data and knowledge. Psychological limitations in this regard are important to know. Education, socialization and culture are important influencers of these abilities, as proposed by Berger and Luckmann (1967) and by the empirical evidence of Kolb (1984). The reader is also referred to the work of Lessem (1991), who provides many other interesting suggestions for research in 'organizational' learning from the psychological perspective. The emphasis in this study is, however, on the *organizational* aspects of learning in organizations. This means that the insights generated must be added with insights from organizational perspectives in order to achieve organizational learning.

4.3 *A Classification of Organizational Perspectives to Organizational Learning*

Chapter 2 stated the relevance of cybernetics and organization development as two basic paradigms for understanding organizational learning. The first is about structural and technical properties of social relations. The second is about socio-emotional relations, bargaining and negotiations[5]. The subject of organizational learning is about the development and use of knowledge within a social setting (organization). The best way to organize perspectives of organizational learning therefore is to relate them with *paradigms of knowledge, and paradigms of social reality*.

[5]The semiotic paradigm was also described in chapter 2. This paradigm is relevant for describing MICS, and is explained in chapter 6.

Two paradigms of knowledge were defined earlier: subjectivism and objectivism. Subjectivism states that knowledge is connected to an individual's mind and has no objective law-like nature. Additionally, people have a free will which cannot be described in mechanistic terms. This perspective is also typical for the organization development school, which developed as a reaction to scientific management and from experience with empirical social research (cf. Daft, 1991). The Hawthorne studies in the 1930s, conducted by Mayo and his colleagues, are particularly famous in that they shaped the human relations movement and its later organization development movement. Mayo et al. tried to test the influence of the amount of light at a workplace on worker performance. What happened was that whether the amount of light was increased or reduced, performance improved in all cases. The researchers concluded two things:

- The fact that people were observed was a research artefact that led to unreliable measurements.
- The human factor in the end has a much greater influence on performance than any physical factor. This was a falsification of the scientific management thesis that stated that work should be regarded as a technical process, and performance is the result of engineering the technology to which people have to adjust.

This research of Mayo was part of the so-called human relations school in industrial sociology emphasizing the management of interpersonal relations, personal and group motivation, and organizational culture as means for achieving effective organization. Related to these findings, Argyris also criticized behavioral research for its focus on superficial phenomena that can be easily measured and described in questionnaires. To find people's genuine theory-in-use one has to seek below the surface of what they espouse.

The cybernetic perspective demands precisely described procedures and data, so that knowledge can be created in a mechanistic way. Research from this viewpoint searches for objective and quantitative knowledge and scientific laws. Mathematical analysis is also applied in order to develop insights that go beyond the notification of facts. An example of this perspective is Cyert and March's (1963) book: 'A Behavioral Theory of the Firm'.

The nature of social reality also has two main paradigms, one based on order and regulation, and a second one based on conflict and radical change. These two paradigms and their features are summarized in table 4.1.

The sociology of regulation is concerned with	The sociology of radical change is concerned with
The status quo	Radical change
Social order	Structural conflict
Consensus	Modes of domination

Social integration and cohesion	Contradiction
Solidarity	Emancipation
Need satisfaction	Deprivation
Actuality	Potentiality
Source: Burrell and Morgan, 1979, p. 18	

Table 4.1: The Regulation-Radical Change Dimension.

Cybernetics is related to the sociology of regulation. Organization development has a larger scope because it discusses the socio-emotional issues involved in organizations. It nevertheless belongs to the sociology of regulation, because no attempt is made to change power and material value distributions. Some authors in this area, such as Argyris (1970 and 1971), therefore state that organization development too often is focussing on improving management skills, without talking about the basic problems. For instance, a manager trained in personnel motivation will not be able to solve motivation problems when the basic reasons for the problem are not understood and worked on. Motivation problems can have social-emotional roots, but sometimes the problems are rooted in the power relations among the managers. To solve this last problem sometimes requires an internal revolution.

Based on these two two-dimensional factors, four ideal typical perspectives for the study of organizational learning exist. These are described briefly in table 4.2. The perspectives differ on four organizational learning issues:

1. Basic *definition of the concept* of organizational learning (process and purpose).
2. Basic *requirements* for organizational learning (data, views etc.)
3. Definition of *learning actors* (a group or an individual, a specific elite or all organization members).
4. Definition of the *field of learning* (that changes under the influence of learning).

Reality Knowledge	Order	Conflict
Objectivism	Cybernetic perspective. 1. O.L[6]. is discovering objective reality and is conceived as a learning process. 2. Requires: data and models. 3. Individualistic developing and testing of knowledge. 4. Field of learning is the production or transformation process.	Scientific Management. 1. O.L. is change in conflicts and power relation, via the devlopment of 'objective' knowledge. 2. Requires detecting sources of conflict, and latent dysfunctions. 3. Learning is mainly done by the power elite. 4. Field of knowledge is technology of domination and manipulation.
	Soft Systems.	Organization Development.

[6]O.L. is short for Organizational Learning

Subjectivism	1. O. L. is understanding perceptions that motivate behavior in specific social contexts and is frequently organizational change as well. Removing unlearning problems. 2. Requires: feeling with 'reality', possibly organized through soft modeling[7]. 3. Individuals interacting with each other in a specific social context (culture). 4. Fields of knowledge are e.g.: attitudes to work, collaboration and leadership, and understanding cause-effect relationships in reality.	1. O. L. is understanding dysfunctions caused by routine processes and the problems of change. 2. Requires: open communications, mutual feelings of trust and willingness to change. 3. Social and individual: people interacting in a specific social setting (power relations). 4. Knowledge is about social and political issues influencing organizational processes and thought, and leading to the development of organizational equilibrium necessary for getting resources together.

Table 4.2: Perspectives for the Study of Organizational Learning.

The four perspectives are further described in the following sections.

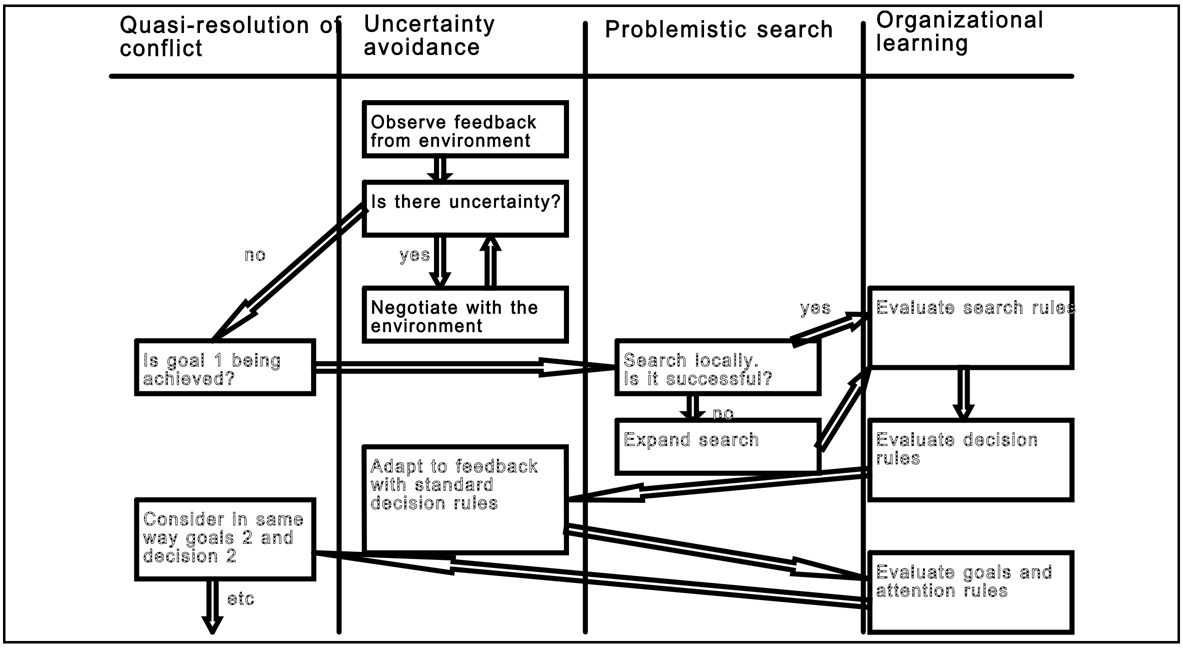
4.4 *The Cybernetic Perspective of Organizational Learning*

4.4.1 The Origin of the Organizational Learning Concept

[7] To be explained in section 4.6.

The first explicit account of organizational learning in the literature known to me, was given by Cyert and March in their classic volume: '*A Behavioral Theory of the Firm*' in 1963. The authors described organizational learning as a part of the decision-making process in an organization, and as consisting of four major activities:

- Quasi-resolution of conflict. Goal conflicts can be solved by constructing one consistent set of goals (the organizational objective). Often, however, it is not possible nor required to do so. Different and conflicting goals can coexist in one organization by keeping them separated in discussions, and by keeping the defenders separated locally, or by paying sequential attention to the different goals.
- Uncertainty avoidance. Organizations often cope with uncertainty by avoiding "*...the requirement that they correctly anticipate events in the distant future by using decision rules emphasizing short-run reaction feedback rather then anticipation of long-run uncertainty events* (p. 119)" and by avoiding:"*...the requirement that they anticipate future reactions of other parts of their environment by arranging a negotiated environment. They impose plans, standard operating procedures, industry tradition, and uncertainty-absorbing contracts on that environment*" (p.119).
- Problemistic search. Searching for s solution is a motivated search for solving a specific problem. It is usually based on a simple model of causality; however, the learning process can increase its complexity. Finally, it is biased by the experience, education and goals of the participants in the search process.
- Organizational learning. Organizational learning is: "*...adaptation with respect to three different phases of the decision process: adaptation of goals, adaptation of attention rules, and adaptation of search rules. We assume that organizations change their goals, shift their attention, and revise their procedures for search as a function of experience* (p.123)".

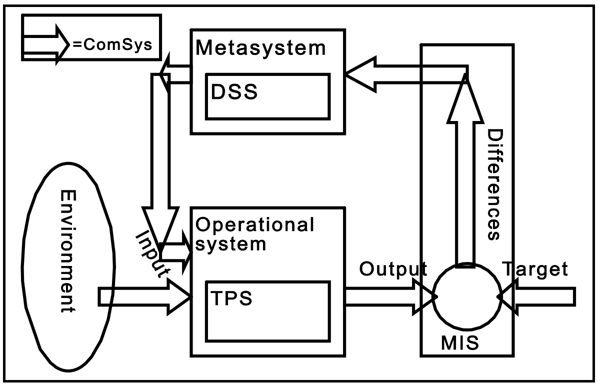


These four activities are assembled into a model of decision-making by describing the information flows among them. This is illustrated in figure 4.2.

4.4.2 Control and Information

According to the cybernetic perspective, organizational learning is a way of processing data to construct knowledge for effective control and decision-making. The role of a well-designed information and communication system is essential for an effective control system. This information system should feed back on the norms and goals that exist in the organization. Sometimes the system feeds back on the means by which the goals are strived for. In other cases the goals and the information and communication system are the subject of critical evaluation. Therefore, an effective learning system should contain:

1. Data from the environment the organization is in.
2. Processes acting on these data and receiving management input about how to act.
3. Targets, as norms about the course an organization should aim for.
4. A comparator relating information about the results of the process with the targets and sending information about deviations between actual performance and targets to a meta-system called management.
5. A meta-system that decides what action demands must be communicated to the process system.
6. Information subsystems, that process data for transactions (TPS), compare data (MIS), aid decision-making (DSS) and allow communication between the environment, the transformation process, and the management (ComSys).



A MICS includes the MIS (deviation measurement) and communications (ComSys) that are necessary for making adjustments to actions and theory (DSS). A transaction processing system (TPS) can be part of the operational system and generates data that are further analyzed for managerial purposes. De Raadt conceptualized a cybernetic system in the following figure (see figure 4.3).

Information systems are regarded as essential for reducing the uncertainty management phases while trying to keep everything under control. The definition of the requisite information should then be the first step in information systems development (Weiner, 1953; Galbraith, 1973). De Raadt applied these principles to a cybernetic study of an insurance company. The insurance company wanted to increase the amount of premium payment by increasing the number of policies sold. The sales are influenced by sales agency's incentives, which can be expressed in terms of \$ available for bonuses and commissions. Additionally also economic environmental variables have an influence on this sales goal variable, which is not under the influence of the salesmen. A statistical analysis of goal data (P), incentive data (I) and economic variables (X), revealed the following structural equation:

$$P = 19 + 8.92I + 10X$$

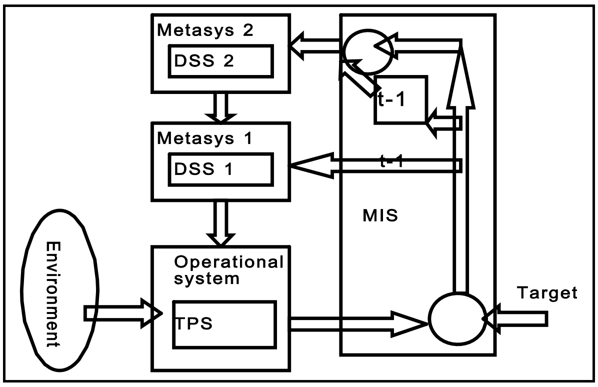
A manager can optimize the amount of incentive spending by relating it to the additional number of policies sold, divided by 30 to correct for the costs of the policies. The relevant equation is then:

$$dI = -(P-P')/30$$

(Where: dI is the additional money for incentives; P' = target number of policies sold; P = actual number of policies sold.)

When economic factors change, the number P might decline, requiring new incentives to keep the system within the target range, which is important for covering fixed costs. This means that from the previous equation a new optimal incentive system must be found. This is typically *single-loop learning: error-controlled regulation.*

It might be that the impact of the new incentive system is slow, and leads to mis-steering. This can have negative influences on the whole system. To solve this problem, the meta-system requires information about these impacts, and has to look for new principles that might improve the working of the single-loop. The related



double-loop is described in figure 4.4[8]. Many other recursion cycles can be described by defining the meta-system 1, 2 and the operational system as an operational system II and defining a meta-system II (etc.). Operational system II could be about the division life insurance. Meta-system II is the board of CEOs that manages the corporation and other divisions as well to some extent. A vital question in modeling these systems is: what information is required for managing the organization and its parts? Systems analysis therefore is an essential part of the organization's facilitation of organizational learning processes (of the single- or double-loop type). Improving systems analysis and design is, from the cybernetic point of view, most urgent for improving learning in the organization, and a major issue for learning to learn (deutero learning).

4.4.3 Equipping the Learning Process

The cybernetic perspective emphasizes the ability to explicitly design an organization's learning capabilities.

Organizing for Organizational Learning

[8]De Raadt does not make a distinction between double-loop and deutero learning. This distinction is discussed in the section 4.5 (on organization development). It suffices here to state that the term double-loop learning refers to learning about the basic assumptions of the management theory used in single-loop learning processes. Deutero learning is about the way the organization facilitates learning by e.g. the development of openess and creativity, encouragement of innovations, quality circles etc. The deutero learning is specifically an organization development subject, because it is about issues like interpersonal relations, power relations, and cultural change.

Why can people be better learners within organizations than without this social context? This question is basic for motivating people to learn in organizations, and very close to the subject of organization design (including the development of structures, systems, procedures and policies). Herbert Simon (1976, pp. 102-103) answers this question by describing five principles (premises) that transform individual behavior to organizational behavior. These principles are: the division of work, the establishment of standard practices and work procedures, the transmission of decisions via systems of authority and influence, the provision of channels of communication, and the training and indoctrination of organization members.

The *division of (learning) work* allows people to concentrate on specific problematic topics, analyze them and try to find solutions for the organization. It is also possible that people are connected to jobs that are the input for the learning process (for instance data gathering and storage), and manage this in a very careful and professional way. For instance, it is quite unlikely that someone can be an excellent problem analyst, solution constructor, implementor of the solutions, and manager of a department all at the same time (applying all relevant abstract conceptualizations). Therefore, the division of work and allocation of learning tasks are essential for having effective learning systems in organizations.

Because of the division of work, people need clear *standard practices and procedures* so that the separate tasks in the learning process are well connected. A classic problem here is that data providers use different meanings (semantics) for data than the information system's end users. Multinationals, for instance, often cannot tell how well or badly they are doing internationally, because the data are defined in different ways in the separate countries. They therefore require expert studies to give the CEOs a useful, consolidated, body of knowledge. Executive Information Systems projects therefore require (re)formulation of the data definitions, so that the interpretation of the data can be done automatically. Via this standard practise and procedure, the delay between problem occurrence and problem identification is shortened, and the CEOs have tools to make intelligent analyses themselves.

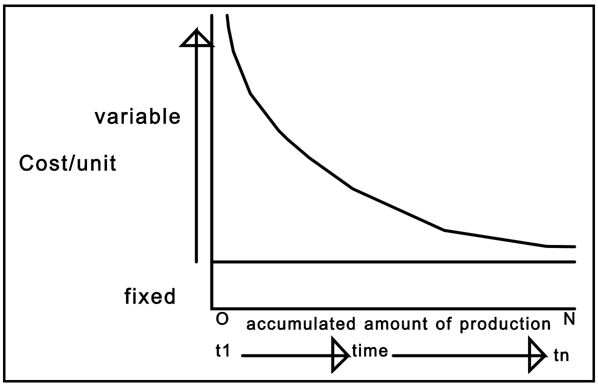
Transmission of knowledge and ideas occurs via *systems of authority and influence*. These systems can be authoritarian, which means that the manager thinks for the organization, and organization members only have to obey or act accordingly. In the case of a paper mill studied by Zuboff (1988), changing the information transmission processes implied a change in the authority and influence structure. This change was resisted by the middle management, who feared the loss of any reason for existence of their jobs. Nevertheless as a consequence, feedback cycles were shortened, leading to less loss and higher performance. Also, more people were engaged in problem-solving by adding insights from their own specialization and attention focus. For this heterogeneous group to become effective, personal power was replaced by skills of communication and group interaction.

Channels of communication are very important in the cybernetic paradigm for starting learning. It is not only the computer-based information system that supports these communication channels, but also the formal and informal communication systems that must be made easier.

Training and indoctrination aim at the internalization of basic norms and knowledge. The double-loop learning process challenges these internalized norms and knowledge, which is very important for not getting an organization of unthinking people.

A Method for Learning: Using Learning Curves

The learning curve describes the costs of a product unit through time. The assumption of this perspective is that in doing a certain job recurrently, a learning process is started up by which the *cost per unit* product decreases. (See figure 4.5).



Knowing the precise shape of this slope is extremely important for business, because it improves the cost estimation of a product considerably, and is an indication of the price competitiveness of a company. According to Yelle (1979) the first decades of learning curve research (1935-1969) were dominated by a 'classic industrial engineering' perspective, with as the main topics: shapes of the learning curve, parameter estimation, industrial engineering applications such as setting time standards and incentives, classic cost control, and purchasing and bidding functions. Since the 1970s, topics have moved to business policy-making, and public and service-related issues, which indicates a double-loop learning process. One of these modern issues is e.g. the relation between the learning curve and the product life cycle.

Argote, Beckman and Epple (1990) also posed the question: how does learning happen through time, and how can knowledge be transferred between organizations and departments? With respect to the first issue, the researchers found that after a period of steady decreases, production costs start to increase. This is explained from the fact that organizational knowledge is often not well adapted so that it *depreciates*. This explanation is also consistent with results in psychology on the lack of persistence of individual learning. Concerning *knowledge transfer or distribution*, Argote, Beckman and Epple found in their empirical study on World War II US navy ship building, that:

> " *The initial gain in production may have been due to learning by doing in the design and construction of shipyards and the equipment used in them as well as to learning by doing in the construction of ships. Once shipyards began production they did not benefit from learning at other yards (p. 151)"* (whereas the ships they built were almost

identical).

In a case study in a multinational, multi-plant electronics firm, Adler (1990) was more successful in finding evidence for a learning curve as a result of knowledge transfer among departments. This empirical study analyzed knowledge sharing between the Development and Production departments of the company, knowledge transfer from an initial location to a newly set up plant, and ongoing knowledge transfer between different production locations. Adler concluded that from this case, called Hi-Tech, that apparently much learning curve research has been on the wrong track, because of the focus on capacity utilization. Adler concluded:

> " *It is primarily 'learning,' the accumulation of knowledge in the form of manufacturing knowhow, rather than capacity utilization, that accounts for the rapid productivity growth rates by Hi-Tech*" (p. 939).

To create effective knowledge transfer it is important to use a communication medium with appropriate richness (Daft and Lengel, 1986). As many organizations are strongly differentiated, a very rich medium is required or otherwise a strong codification of the knowledge transferred must be realized (Boisot, 1986). Some cases illustrate the effectiveness of this last perspective (c.f. CSC Index, 1990).

4.4.4 Problems with Organizational Learning

Many problems can easily arise in learning processes according to the cybernetic view. Eight of these are listed below.

1 *Role-constrained learning*. This occurs when people have discovered new insights but are not allowed to change their behavior according to these new insights. This means that the relation from insights to action is blocked. This is very common in organizations after training sessions (Van der Vegt, 1973).

2 *Audience learning.* This happens when the coupling between individuals' actions and the organization's actions are weak. This happens for instance when some individuals initiate a change that is not taken over by other organization members. This is often the case in situations where excellent ideas are obstructed by other organization members who are afraid of losing power.

3 *Superstitious learning*. This occurs when individual actions are followed by organizational actions, but for which the coupling between organizational actions and environmental responses are ambiguous. For instance, the success of a company can be attributed to the choice of a correct management theory, but it could also be good luck. Also, organizational failures cannot always be blamed solely on mismanagement.

4 *Learning under ambiguity.* This relates to problems with coupling environmental responses to individual beliefs. The problem is that often there is not one single and objective explanation of an outcome. Different people might all have a different view about success and failure. A management theory might help in discussing the interpretation of reality, but everyone could still in principle

question the validity of a theory, by definition. The practice in a company is then often: "*A leader or dominant coalition selects one of these interpretations and provides legitimacy by referring to a world view that lends meaning and structure to the situation*" (Hedberg, 1981, p. 11).

5 *Situational learning.* This happens when individuals forget or do not codify the learning for later use. The link between individual learning and an individual's mental model is then severed.

6 *Fragmented learning.* This happens when individuals learn and also codify the created knowledge, but the organization as a whole does not learn. The cause of this phenomenon could be that knowledge is not disseminated, or that other people just do not understand the created knowledge. It can easily occur in very decentralized organizations.

7 *Opportunistic learning.* This happens when the shared organizational mental models (organizational knowledge-base) are bypassed to respond quickly to environmental needs and opportunities. The result is that an accumulation of the shared knowledge is achieved or that the organization does not profit from the large investments it has put into an organizational knowledge-base.

(The first four problems were described by March and Olsen, 1976, and Hedberg, 1981, and the last three were discovered by Kim, 1993).

8 An additional problem of learning is the *use of obsolete memory contents.* Two subproblems can be identified in this class: one is the fact that conserved knowledge can become out-of-date and thus misdirect action. The other subproblem is the difficulty of removing obsolete knowledge, called unlearning. Unlearning activity is easy when knowledge is just a piece of writing, but can be extremely difficult when knowledge has become second nature and thus part of our implicit understanding (Berger and Luckmann, 1967).

4.4.5 Limitations of the Cybernetic Perspective

The cybernetic perspective also has some limitations that are listed below:

1. The cybernetic perspective mainly focuses on the *quantitative* aspects of information: but there is in principle no reason why information systems should not contain qualitative and subjective information as well. Mathematics, however, cannot be as easily applied in that case, and another epistemology must be integrated in the approach.
2. Information systems are sometimes difficult to describe in terms of TPS, MIS, DSS etc. Sometimes it is difficult to define and recognize the systems that manage the organization. *Informal information systems* exist as well, that can have changing collections of individuals participating in the discussions and thus contributing their knowledge and information. It is then hard to find out which people contributed what information in such a 'garbage can'-like decision-making process (Cohen, March and Olson, 1972).

Cybernetics therefore requires the addition of an approach on organizations that stresses the working of (informal) groups. The objective rational epistemology often does not work in these cases (Van Gunsteren, 1976). Also De Raadt is well aware of this fact, when at the end of his paper, he states:

" *Thus, while the insurance company (...) responded by developing some of the necessary meta-systemic functions, they were not accepted by the predominant culture. (...) The outcome of this conflict led to political instability and the organisation eventually became prey to another insurance company. The old management was lucratively rewarded with retirement and those who composed the meta-systemic DSS were consigned to exile. It was part of the etiquette of ancient kings to have the messengers who bore ill news executed*" (De Raadt, 1991, p. 47).

4.5 *The Organization Development Perspective of Organizational Learning*

4.5.1 Organization Development's Reformulation of Organizational Learning

Argyris and Schön (1978) developed hypotheses about the prehension and transformation of knowledge in organizations, as well as about the development of learning, which therefore neatly complements Kolb's insights[9].

The prehension part is discussed in terms of *theory of action*, clearly linking cognition with action. From their experiences in observing organizational learning, they stress the importance of the distinction between theory-in-use and espoused theory. Theory-in-use is frequently mainly tacit, and sometimes even tacit for the individual that uses it. This type of theory is what really motivated individuals' actions. Argyris and Schön (p.16) note that every organization member can have another theory-in-use. During interactions people can adjust their theories-in-use, and even form shared knowledge. Organizational knowledge can be presented in public maps, and therefore becomes overt and espoused theory. In contrast to the theory-in-use, the espoused theories frequently lack a clear connection to the individual's actions. Sometimes well-written policy statements diverge strongly from actions.

Learning is described as follows by Argyris and Schön (1978, p. 18):

" *When there is a mismatch of outcome to expectation (error), members may respond by modifying their images, maps, and activities so as to bring expectations and outcomes back into line. They detect an error in organizational theory-in-use, and they correct it. This fundamental learning loop is one in which individuals act from organizational theory-in-use, which leads to match or mismatch of expectations with outcome, and thence to confirmation or disconfirmation of organizational theory-in-use.*"

[9] Argyris and Schön did not mention Kolb's vocabulary of transformation and prehension. The connection between the two authors is made by myself.

Argyris and Schön propose (after the cybernetician Bateson, 1971) that organizations learn in three ways: single-loop, double-loop and deutero. These terms were already mentioned in the discussion about the cybernetic perspective, but the differences in use are essential.

1. <u>Single-loop learning</u>:

" *...members of the organization respond to changes in the internal and external environments of the organization by detecting errors which they then correct so as to maintain the central features of organizational theory-in-use*" (p.18). It is an important feature of organizational learning that the "*...learning agent's discoveries, inventions, and evaluations must be embedded in organizational memory. They must be encoded in the individual images and the shared maps of organizational theory-in-use from which individual members will subsequently act. If this encoding does not occur, individuals will have learned but the organization will not have done so*" (p.19).

So no organizational learning will happen without individual learning and change of organizational memory!
This type of learning is consistent with the way we have defined organizational learning in the cybernetic sense, but we have added are the involvement of human action and a description of organizational memory that is not only formal but also contains tacit knowledge and memory as part of an organization's culture.

2. <u>Double-loop learning</u>

Single-loop learning is oriented towards effectiveness, meaning: how best to achieve existing goals and objectives, and how best to keep organizational performance within the range specified by existing norms. In some cases, however, it is required that the organizational norms themselves be modified. This double-loop learning process easily leads to conflicts between parties that still support the old theory-in-use and parties that want a fundamental change in organizational norms. A good example is Alvin Toffler's remark on Bell Company that they should no longer strive for their main goal "every citizen a telephone, of any color as long it is black" (theory-in-use) but replace it by the norm: "give the client what he really wants, telephones of different types and colors, additional telecommunication products." When Toffler presented this idea to the Bell Company, nobody responded for three years. Nevertheless, people were busy changing their mindset (individual memory and theory) and after three years the consequences were well enough understood and people knew what had to be done. Argyris and Schön defined double-loop learning as follows:

" *We will give the name 'double-loop learning' to those sorts of organizational inquiry which resolve incompatible organizational norms by setting new priorities and weightings of norms, or by restructuring the norms themselves together with associated strategies and assumptions* (p. 24)".

Some further remarks are necessary to compare the concepts of single-loop and double-loop learning:

" *...it is possible to speak of organizational learning as more or less double-loop. In place of the binary distinction we have a more continuous concept of depth of learning"* (p.26).

The change of norms, targets and theories thus implies political considerations. According to Argyris and Schön, double-loop learning therefore is more difficult than single-loop learning. The main problems for double-loop learning are lack of openness in communication (because of a strife for uni-lateral control) which blocks fundamental understanding of business problems (Argyris, 1970). The true reasons for this attitude are often concealed, and are typical for the theory-in-use in most western organizations. Argyris and Schön call the theory-in-use that emphasizes domination of some people over others, win-lose situations and many tricks in communication to protect one from being hurt and evaluated negatively, 'model I'. This set of learning norms inhibits double-loop learning and therefore leads to organizational ineffectiveness in the longer term. Argyris and Schön proposed to replace model I by a model II theory-in-use that emphasizes the dispersion of valid information (also when it can be negatively evaluated), free and informed choice instead of control by a superior authority, internal commitment to choices made, and careful monitoring of its implementation.

This problem statement and suggested solution differs widely from the cybernetic view, in which learning inhibitions were supposed to be rooted in a lack of data, restricted information processing and incomplete reasoning. Here we see sharply the differences between the subjective and objective epistemologies and the order and conflict views on organizations.

3. Deutero learning

Deutero learning, often also called second order learning or learning to learn, is about organizations learning to carry out single-loop or double-loop learning.

" *When an organization engages in deutero learning, its members learn about organizational learning and encode their results in images and maps. The quest for organizational learning capacity must take the form of deutero-learning; most particularly about the interactions between the organization's behavioral world and its ability to learn"* (p.29).

Often organizations learn how to perform single-loop learning perfectly, but without being at all capable of carrying out double-loop learning. Hopefully for them this also reflects on the organization's learning needs.

According to me, these definitions of single-loop, double-loop and deutero learning are confusing, because no concrete operationalization of learning activities is given. The use of the term 'norm' in the definition of double-loop learning leads to further confusion, because this term can mean almost anything in organizational situations, including norms that form 'model I' and 'model II' and the operational norms that are applied in single-loop learning. As a consequence it is often difficult to state when an organization is single-loop learning, double-loop learning or deutero learning. The vagueness of the terms makes them easily applicable in situations of process consultancy, where they can be used to help people move to a new paradigm (double-loop learning), and even learn to do so without the continuous presence of a process consultant (deutero learning). For research into the way organizational learning occurs and is supported by MICS, this terminology is too vague, and must be operationalized further (cf. sections 4.8 and 4.9 for more details). My proposal is to use the term '*norm*' in this organizational learning context exclusively for norms that govern learning activities in a single-loop (within fixed standards and objectives) or double-loop (creation of standards and objectives). The deutero learning process creates the norms that govern single-loop and double-loop learning. This proposal is further elaborated in sections 4.8 and 4.9.

4.5.2 Processes of Organizational Learning and Organizational Memory

The concept of organizational learning can be made more concrete by defining ways in which it can be realized. Levitt and March (1988) describe four ways.

The first way of learning is called 'learning from direct experience'. With respect to this learning type, a possible problem is the *competency trap*, which concerns the situation in which organizations have invalid or incomplete knowledge which make them believe incorrectly that they are on the right track. So, the organization might be improving in the wrong direction. Another competency trap is that the acquired knowledge is counterproductive to long term results.

Despite the dangers of competency traps, it is important to reflect in a systematic and thorough way on one's experience. In Japanese management this has resulted in the idea of *Kaizen*, meaning continuously thinking and improving by reflecting on experiences. The Toyota company institutionalized this learning type by demanding that employees think 5 times 'Why'. This means that everything that is experienced as normal and fact, should be questioned. Answers to these questions should be questioned as well, and so forth until what is actually happening or perceived has been questioned to the fifth level[10].

The second way of organizational learning is 'learning from the experience of others', often also called vicarious learning (Chew et al. 1991), and was also emphasized in Argote's study. Within one organization we could think that *diffusion of knowledge* is a positive asset for the organization as a whole, because the costs of knowledge creation are shared, and procedures, ideas and knowledge are standardized. Frequently, however, knowledge is a strategic instrument and a source of power. The diffusion of knowledge must then be controlled by the knowledge owner (e.g. via patents). Some

[10]The problems involved are similar to the problems of learning under ambiguity, which stresses the problematic nature of interpreting facts. It is also similar to superficial learning, which refers to the incompleteness of knowledge.

professional organizations, such as accounting firms, however, sometimes support the diffusion of their knowledge because by this they can gain a larger amount of recognition and hence competitiveness.

One aspect of learning from others is the possibility of effective knowledge transmission. The size of the audience you can serve is then dependent on the standardization of the language used (called cosification, Boisot, 1986) and the *content of the message*. This content can be descriptive, prescriptive and evaluative (Stamper, 1973). Also, combinations of these are possible. This means that people will evaluate, accept, or refuse a message, because it can have important normative and political implications. The free passage of messages, therefore, is under the influence of organizational norms and political intentions. The importance of the normative aspect of communication is the basis for developing effective learning systems. Quite often people who bring bad news are removed from the scene by some powerful persons who fear to face reality. Messages therefore are transformed into an acceptable form, and the receivers must interpret the message not only from a technical but also from a social-political frame of reference.

The third way of learning is not about receiving information, but about the development systems with which information can be interpreted. Data and experience do not lead to knowledge by themselves. For this interpretation process knowledge in the form of theories, paradigms and models must be developed. The lack of well-articulated knowledge of this kind will lead to the use of tacit knowledge, which is often not well validated. When this interpretation knowledge is not shared, much confusion and misunderstanding can occur. At the same time, however, pluriformity in interpretation knowledge can make the organization very creative and succesful.

Creating and using organizational memory is the fourth way of organizational learning mentioned by Levitt and March. *Organizational memory* has only recently received the attention it deserves in the literature on organizational learning (Levitt and March, 1988; Walsh and Ungson, 1991; Huber 1991). Also Simon (1976) emphasized the possibility of organizations having, at least in theory, more knowledge than its individual members because of the synergistic impact of organizing. Simon here refers to the fact that organizations have cognitive structures consisting of task definitions, goals, means, and intentions, which are not known entirely by any single member. Organizational memories are very important but often:

> " *Organizations do quite frequently know less than their members. Problems in communication, such as filtering, distortion, and insufficient channel capacity, make it normal for the whole to be less than the sum of the parts*" (Hedberg, 1981, p.6).

How then do organizational memories work so that their possible benefits can be gained? According to Levitt and March (pp. 327-329), an effectively operating organizational memory requires *recording, conserving and retrieval of experience*. The knowledge inferred from the experiences can be recorded in documents, accounts,

files, standard operating procedures, organizational structures and relationships, in standards of good professional practice, in organizational stories, and in shared perceptions of 'the way things are done around here'. The experiences and knowledge gained can be distributed among organization members, which makes the organization less vulnerable to the effective functioning of a single person's memory or the risk of losing knowledge during personnel turnover. Written rules, oral transcriptions, and systems of formal and informal apprenticeships are vital in this knowledge distribution process. The storage of knowledge also requires an effective retrieval system. Retrieval costs are low when the stored knowledge is re-used frequently (in routines), the knowledge is created recently or strongly linked to organizational responsibilities.
The development of organizational memories enable an organization to become smart, but also conservative, which might make it ineffective in the longer term. One reason for the conservative nature of organizational memory is that it provides solutions and insights to current or future problems with knowledge created in the past. The second reason is that organizational knowledge can only be stored and retrieved when it is closely connected to existing organizational practices and routines (called 'organizational proximity', Levitt and March, 1988, p. 329). This means that past routines and ways of thinking led to the selective storage of specific knowledge (and the possibility of neglecting other knowledge elements) and that people consider selecting specific parts of organizational memory only through routines developed in the past. Hence, organizations should not only develop their memories but should also be capable of changing their paradigm. The organization development perspective to organizational learning includes this fact and considers it more difficult to change existing organizational memory than to add to the memory. Organizations increase their performance by balancing single-loop and double-loop learning effort via the creation of an optimal set of organizational learning norms, called 'the learning organization'. This optimum is not the same for all organizations, but is dependent on the learning needs of the organization itself.

4.5.3 The Problem of Creating a Learning Organization

Deutero learning is about learning to learn. In other words it is about the creation of conditions that optimize single-loop and double-loop processes. Argyris and Schön constructed Model II as a blueprint for organizations that are most successful in organizational learning. It emphasizes the following values: least defensiveness and public testing of theories. Model II also encourages, supports and rewards learning through the provision of a culture of openness, a management style supporting critical thinking, and an organization structure that facilitates the easy flow of ideas and data at all levels in the organization. It accepts and appreciates disconfirmable statements (new insights) and double-loop learning when needed. The concept of 'the learning organization' as proposed by e.g. Senge, is a further operationalization of

Model II. An important variable then is the set of organizational norms that enables organizations to learn effectively. The identification and implementation of these norms is not at all an easy process. Two authors have become reknowned for their proposed 'solutions', Tom Peters and Peter Senge.

Peters' Solutions

To demonstrate the practical way in which deutero learning processes work from an organization development perspective, Tom Peters provides two interesting cases: Electronic Data Systems (EDS) and Asean Brown Boveri.

EDS is a huge 'system integrator' with about 72.000 employees, operating in about 28 countries for over 7000 clients, organized in 38 strategic business units. A most remarkable feature of EDS is:

> " *Boil down any SBU and you'll find projects. In fact, EDS is one big collection of project teams. The number of people on a project can vary greatly throughout its life. The norm is 8 to 12 EDSers, working together for a period of 9 to 18 months*" (Peters, 1992, p. 24-25).

Because the greatest emphasis is placed on the project teams, the big problem is how to connect people in EDS with each other, and specifically how to know which people can participate in specific projects. Therefore, EDS has to learn to leverage its skills (mainly connected with individual persons), and must develop a base containing information about these skills. Additionally EDS has 'Centers of Service', that set some people free for fundamental research on a particular new skill or subject (e.g. imaging technology). These Centers of Service are temporary organizational units, and have to earn their income by motivating project groups to adopt the developed knowledge. EDS has thus explicitly been designed to augment and store knowledge and make this knowledge into a shared organizational memory via its procedures, systems and structure.

Asean Brown Boveri is a huge company operating in power plants, power transmission, power distribution, transportation, environmental control, financial services, and other types of business such as metallurgy, process automation, robotics and superchargers. In 1991 they booked $28.9 billion in revenue in 140 countries. CEO Sune Karlsson of the $1 billion revenue Power Transformers Business Area gives an illustration of how this giant organization is managed:

> " *Our most important strength is that we have 25 factories around the world, each with its own president, design manager, marketing manager, and production manager. These people are working on the same problems and opportunities day after day, year after year, and learning a tremendous amount. We want to create a process of continuous expertise transfer. If we do, that's a source of advantage none of our rivals can match*" (quoted from Harvard Business Review, in Peters, 1992, p. 51).

Additionally Karlsson tries to create *internal competition* by providing detailed monthly information on the performance of all 25 units.

" *But Karlsson is well aware that such competition must be constructive; he insists (...) that the key task is creating a 'culture of trust and exchange'* (p. 51).

But..

" *Sharing of expertise does not happen automatically (...) People need to spend time together, to get to know and understand each other....People must also see a payoff for themselves (....) We have to demonstrate that sharing pays - that contributing one idea gets you twenty-four in return"* (according to Karlsson, quoted in Peters, 1992, p.52).

Not only knowledge storage and dissemination are important for organizational learning, but people must be motivated to participate and create open communications as well. Both cases clearly have developed model II characteristics. Information technology has a prominent role in the construction of these modern organizations, by the creation of electronic highways, knowledge and skills databases. The following motivational and leadership features are even more basic than the construction of these (infra-)structural arrangements:

1. Internal market principles, that give people direct feedback to their performance and provides strong incentives for high performance.
2. Decentralized organizations and reduction of bureaucracy. This empowers people and does not frustrate initiatives and creativity.
3. Developing expertise as never before. (Something that might look contradictory to the decentralization trend, but isn't when the organization connects smart people together, e.g. by means of EDS's Centers of Service, or connecting with research institutes).
4. Management's support staff must contribute to these three principles. They must change their bureaucratic sense in which knowledge is power. Top management must not use its support staff for control and the support staff must not slow down the decision-making.
5. "*The essence of an effective KMS*[11] *is advertising, marketing, packaging, incentives, big travel budgets, and the psychodynamics of knowledge management*[12]*. The crux of the issue is not information, information technology, or knowledge per se. It's how, for example, you get busy people in those miniature ABB units to want to contribute to the KMS. The answer turns out to lie more with psychology and marketing (...) than with bits and bytes*" (Peters, 1992, p. 384).

Senge's 'Solutions'

Senge states, in line with Argyris and Schön, that organizational learning is not only a

[11]Accronym for Knowledge Management Structures, Peters' term for learning organization.

[12]Italics from Tom Peters.

cognitive activity but often requires a change in power relationships and attitudes. Many of the norms that inhibit learning are tacit and private, and must be well analyzed for their organizational impacts, so that true learning can occur. Senge describes five disciplines as basic for effective organizational learning (Senge 1990a, p. 5-13):

- *Systems thinking* by which people learn to understand the patterns and linkages that exist among phenomena.
- *Personal mastery*: Defined by Senge as: "*...the discipline of continually clarifying and deepening our personal vision, of focussing our energies, of developing patience, and of seeing reality objectively. As such, it is an essential cornerstone of the learning organization - the learning organization's spiritual foundation*" (p. 7).
- Mental models:"*....deeply ingrained assumptions, generalizations, or even pictures or images that influence the world and how we take action*" (p.8). Many of these theories-of-action are tacit and obstruct organizational change. By understanding these models we can change them and provide basic conditions for innovation.
- *Building shared vision.* This is the discipline of translating individual visions about a wishful future to a joint sense of destiny in an organization.
- *Team learning*. The strength of a team is that it can discover insights that none of the members would have discovered alone. This can only happen, however, when a free-flow of meaning is created among the members. This is not something that happens by chance but must be learned and teams can learn to become more effective by a constant process of improvement in this discipline.

It is essential, according to Senge's theory, that these five disciplines are developed as an ensemble, which he calls '*The Fifth Discipline*'. Senge presents a substantial number of ideas to support his fifth discipline concept and is extremely normative. Senge does not concretely explain why an organization requires these five disciplines and does not describe how organizations in specific contexts must learn these disciplines. The theory underlying his thought is therefore obscure and not open for academic research. Nevertheless, it is part of the organization development tradition because of its strong emphasis on tacit processes, personal and interpersonal development and change. In fact Peters' ideas are more concrete because he describes concrete and measurable organizational arrangements that should be made, given the context of large organizations. His approach is however weaker than Senge's on the psychological aspects of learning.

4.5.4 Limitations of the Organization Development Perspective

The strength of the organization development perspective with regard to organizational learning is its commitment to the human consequences and social dynamics in learning processes. The learning processes are however almost completely reduced to the deutero process, the construction of new norms for organizational learning. For the deutero learning process not much more knowledge exists than what is gained from organizational change studies. Precise prescriptions of what the organization should look like exist, but how to change organizations to reach these ideals is a blind spot. This means that the informative content of this perspective is very limited. Learning to learn is an interesting term, but how should it proceed and what should be the result? Additionally, no operationalization of the connecting thought between an organization's environment and the way an organization should be designed to facilitate learning is made. Thus, a major issue of the organization literature, termed contingency theory, seems not to have affected the organization development perspective. Finally, the most dominant learning approach in organizations seems to be single-loop according to the authors. Nevertheless, this remark must be taken with care. There is no survey study that validates this opinion. No attempt has yet been made to measure for instance the learning activities and efforts in organizations on single-loop, double-loop or deutero learning via a survey. This book will not provide the data to qualify statements about single-loop learning effort and the learning needs. It will, however, provide some basic conceptualizations and suggestions for measurement.

4.6 *The Soft Systems Perspective of Organizational Learning.*

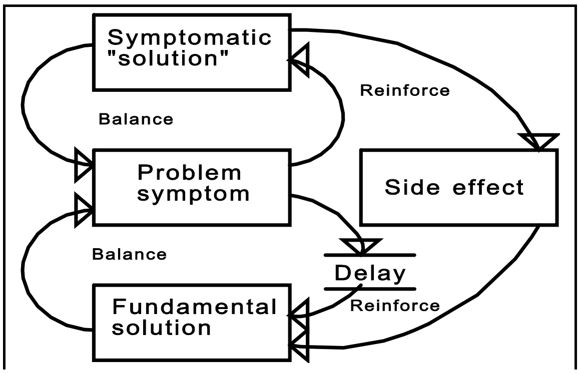
4.6.1 Soft Systems Modelling

This perspective combines elements of systems thinking (an essential element of cybernetics) with the subjective epistemology typical of organization development. It tries to model reality in a subjective way by emphasizing the *mental models* people use. It is a regulation approach, because it stresses the opportunities for *shared* mental models.

An important representative of this perspective is (again) Peter Senge, who states:

> " *...What we carry in our heads are assumptions. These mental pictures of how the world works have a significant influence on how we perceive problems and opportunities, identify courses of action, and make choices"* (Senge, 1990b, p. 12).

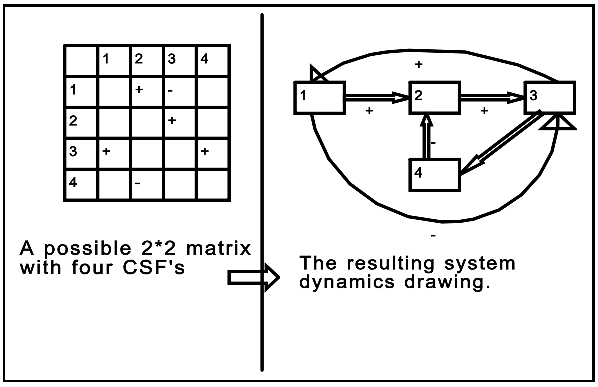
Organizational learning results in these mental models. This is often difficult, because many of our assumptions are tacit and hence difficult to test. The elicitation of mental models is therefore an essential step in learning. A good model in Senge's view not only explains our reactions to events, but explains it by understanding some deeper lying systemic structure. Senge has developed so-called system archetypes, some general ways in which systems are supposed to behave, that simplify the model elicitation and the detection of systemic structure. One of these archetypes is 'Shifting the Burden', explained as follows:



" *...A short term 'solution' is used to correct a problem, with seemingly happy immediate results. As this correction is used more and more, fundamental long-term corrective measures are used less. Over time, the mechanisms of the fundamental solution may atrophy or become disabled, leading to even greater reliance on the symptomatic solution. Classic examples: using corporate human resource staff to solve local personnel problems, thereby keeping managers from developing their own interpersonal skills"* (Senge, 1990b, p. 7). See figure 4.6.

In 'The Fifth Discipline' Senge mentions 9 additional archetypes. I do however hesitate in using them, because they can lead to too much pre-conceptualization. This could lead to people trying to see their problems in terms of a chosen archetype, and lacking the creativity to make a model that might better suit their situation. Hence, I developed a software tool that supports the creation of models by means of Critical Success Factors, called CSFmatrix. An essential assumption of CSFmatrix for organizational learning is that models for organizational learning are used not as individualistic models, but as shared knowledge. This implies several things:

1. Specific pieces of the model's puzzle are brought together by participants in the model development process, for example by selecting specific topics. This can be done by naming them in the group and a facilitator writing them down on a whiteboard. One can also use hexagons and attach them on a (magnetic) board (cf. Morecroft and Van der Heijden, 1992).
2. The participants must agree on a clear understanding of the meanings (semantics) used in the expressions mentioned under number 1. Participants must find a common vocabulary in which they can understand each other. This also can lead to a considerable reduction of topics.
3. Participants also need to agree on the importance and validity of each other's statements. To have an effective third step, people must pay enough attention to the first two. The result should be a list of not more than five or seven critical success factors (cf. Rockart, 1979).
4. The participants now connect the major issues with each other, in terms of possible negative or positive causal relationships. They can do this in a group discussion to reach a shared vision. The result is a filled-in n*n matrix.
5. CSFmatrix now can automatically generate a system dynamics model (with reinforcing and balancing relationships). The facilitator presents this model to the group which then discusses the results, and possibly comes up with some modifications. It is my experience that participants, especially in this phase, get a strong 'Aha Erlebnis' (suddenly seeing the light). Often they want to go back to adjust the list of critical success factors and relations. See figure 4.7.



Although this approach stresses the finding of shared mental models, it can be used for analyzing conflictual situations as well. For instance, participants can learn to understand the basic assumptions of the conflicts they are in. Lee, Courtney and O'Keefe (1992) and Acar and Heintz (1992) also developed computer-based tools that support the analysis of incompatibility between models. Both publications have found methods to solve conflicts when the models are complementary. When the models are not complementary, a synthesis is required to construct a joint model. A suggestion for an information system that could cope with model incompatibility is given by Hedberg and Jönsson (1978), but hardly elaborated yet.

4.6.2 Limitations of Soft Systems for Organizational Learning

The soft systems perspective does not exclude the possibility of objectivism. For instance, a group can find sources of ineffectiveness and the means for a more effective control of an organization. The results of this analysis can be used as input for the design of a MICS. In principle the soft systems perspective only provides a tool that can be used for modeling objective (cybernetics) or subjective (OD) reality. The technique when used in the case of order must lead to one model that relates all important issues. In the case of the conflict view it leads to several subjective models. For further reading in the soft systems perspective we recommend: Rosenhead et al. (1989) and the special issue in the European Journal of Operational Research on modelling for learning (Morecroft and Sterman eds., 1992). Both publications use a subjective epistemology, but differ in their approach. The first places emphasis on *conceptualizing* how we talk about problems. The second stresses the importance of describing major *variables and their interrelations* in systems dynamics models. In my opinion conceptualizing preceeds modeling, however, several interations between modelling and conceptualizing will improve both. Soft systems modelling does not always have to be followed by system dynamics modelling. Many other techniques can be used to further define vaguely defined problems (for instance PAM, Stamper et al., 1988; Kolkman, 1993) When reality is clearly defined, soft systems lose their value, and hard modeling techniques are more relevant (Wijnhoven, 1992a). Also when major conflicts about problems exists, soft modelling will not solve them. It then depends on how the actors in the political arena want to regulate their conflict. Precise data about possible outcomes are more valuable then and hard models are also required (Coleman, 1972; Teich, 1991).

4.7 *The Scientific Management Perspective of Organizational Learning*

4.7.1 Scientific Management as Organizational Learning

This perspective introduces an objectivist epistemology, and an explicit handling of conflict. The objectivism in this perspective is well demonstrated by the term 'scientific'. Frederick Taylor, the founder of 'scientific management' in the beginning of this century, mentioned two ways of industrial success: the initiative of the workmen, that can be managed by an incentive system, and the development of a scientific approach to the design of tasks. Managers have important roles here, as follows:

" *First. They develop a science for each element of a man's work, which replaces the old rule-of-thumb method.*

Second. They scientifically select and then train, teach, and develop the workman, whereas in the past he chose his own work and trained himself as best he could.

Third. They heartily cooperate with the men so as to insure all of the work being done in accordance with the principles of the science which has been developed.

Fourth. There is an almost equal division of the work and the responsibility between the management and the workmen. The management take over all work for which they are better fitted than the workmen, while in the past almost all of the work and the greater part of the responsibility were thrown upon the men" (Taylor, 1911, pp. 36-37).

(...)

" *The development of a science, on the other hand, involves the establishment of many rules, laws, and formulae which replace the judgment of the individual workman and which can be effectively used only after having been systematically recorded, indexed, etc. The practical use of scientific data also calls for a room in which to keep the books, records, etc., and a desk for the planner to work"* (Taylor, 1911, pp. 37-38).

These quotations not only demonstrate Taylor's belief in an objective epistemology for organizational learning, but also give some interesting description of responsibility, procedural and action norms, for achieving effective learning processes.

In the past, Taylor's approach received a lot of criticism, because it was regarded as an instrument for an improved exploitation of the employees, and the loss of work content and job satisfaction. In Taylor's view, however, his approach leads to more prosperity for the employees, because higher wages can be earned. He illustrates this by the results at Bethlehem Steel, after three years of working under scientific management principles (see table 4.3).

Issue of Evaluation	Old Plan	New Plan
Number of yard laborers	400 & 600 down to about	140

Average number of tons per man per day	16	59
Average earnings per man per day	$1.15	$1.88
Average cost of handling a ton of 2240 lbs.	$0.072	$0.0033
Source: Taylor, 1911, p. 71		

Table 4.3: Results of Scientific Management at Bethlehem Steel after Three Years.

4.7.2 Time and Motion Studies

A more modern version of Scientific Management is labeled 'Labor, Time and Motion Study'. Niebel (1982) explains this approach in his book 'Motion and Time Study'. He states that the total time of operation can be broken down into a part of work that is done ineffectively and the total work content. The ineffective part has as causes:

1. Shortcomings of the management, including poor planning; poor material and tool inventory control; poor scheduling; and weak supervision, instruction, and training.
2. Shortcomings of the worker, including working at less than the normal pace, taking excessive allowances.

Additionally, the total work content (time spent on working) consists of three parts:

1. The minimum work content of the product. This could be reduced by carrying out methods engineering and time studies.
2. Work content added by defects in design or specification of products, including material specification, geometry specification, tolerance and finish specification.
3. Work content added by inefficient methods of manufacturing or operation, including processes of manufacturing, setup and tools, working conditions, plant layout, and motion economy.

The learning process in this approach is about reducing the causes of ineffectiveness and reducing time spent on work. Historically, these studies were regarded as not purely technical and objective, but as instruments for improving management control over the work force (Braverman, 1974). The result of these studies can contain some performance norms for the labor force or departments. This knowledge must be carefully reviewed and adjusted when necessary. In one high tech company, I met the situation of the use of a norms system developed in the beginning of the 1960s. It is very likely that these norms are not effective for the 1990s. It is often not in the interest of employees to mention this problem, except when they can profit financially from it, or when by not improving the norms the company's survival (and hence employment) would be at stake. By applying individual incentives, the management can try to break up the solidarity within the group of employees, so that group knowledge about inefficiencies is communicated to the management.

Since the end of the 1980s, scientific management (including the later Time and

Motion studies movement) has been expanded with a new method, called *business re-engineering*. Business re-engineering is about the redesign of business processes. This is done first via an accurate analysis of existing processes, especially in terms of costs and benefits, and by comparing the processes with business bench marks. After this, a design of a new process is made. In this design transaction processing information systems often have a vital role as business levers (Hammer, 1990; Davenport, 1993). The business re-engineering movement therefore basically aims at reducing business costs and optimizing the process-demands relationships in technical ways. The authors on business re-engineering state that human involvement in the re-engineering process is vital, but do not clarify how it should be organized (Kennedy, 1994). Business re-engineering is regarded by the latter as a necessary evil for organizational survival to which employees have to adjust. Some authors regard business re-engineering as a revolutionary process (Hammer and Davenport), others regard it as an incremental process (Davenport and Short). Business re-engineering however often implies more than changing the organization's transformation processes. The possible changes that could be made are listed in table 4.4.

Subject	From	To
Work units	Functional departments	Process teams
Jobs	Simple tasks	Multi-dimensional work
People's roles	Controlled	Empowered
Job preparation	Training	Education
Focus of performance measures	Activity	Results
Advancement criteria	Performance	Ability
Value	Protective	Productive
Managers	Supervisors	Coaches
Organizational structure	Hierarchical	Flat
Executives	Scorekeepers	Leaders
Source: Personal conversation with prof. P.A.E van de Bunt, October 1993		

Table 4.4: Possible Organizational Changes as a Consequence of Business Re-engineering.

4.7.3 Limitations of the Scientific Management Perspective

When order is the dominant philosophy, models of reality will not conflict. This means that generally accepted variables are measured and accepted norms applied. A cybernetic system thus can be constructed, with a MICS that creates accumulating insights into reality when confusion about variables, norms and measures are removed. However, when the conflict model is valid, then these models will be disputed. If a MICS is implemented, its output will be object of political discussions instead of it resolving disputes about reality. The limitations of scientific management and the time-motion studies are therefore not that they only support single-loop learning, because they can indeed detect major problems in working efficient and effective. Their limitations are rather that they are disconnected from the social requisites to make them successful. Taylor himself fought a continuous battle against his opponents not because his method was considered incorrect, but because the social and political consequences were not effectively disputed.

4.8 *Dimensions of Organizational Learning*

The preceding discussions generated a large number of concepts describing organizational learning. This section tries to organize these concepts by placing them in the major dimensions of organizational. These dimensions are created via semantic analysis. In semantic analysis special attention is paid to possible synonyms, subclassing relations (generic-specific and part-whole) and the possibility that a term requires the logical existence of other terms (e.g. the term 'driving' requires a 'driver' and a 'vehicle'). The result of this semantic analysis, that conceptually closely related with Osgood, Suci and Tannenbaum's term of semantics (1957) athough it is non-statistical, is summarized in a semantic chart (Stamper et al., 1988).

4.8.1 Description of the Semantic Analysis Technique

The semantic analysis technique was developed for disentangling the conceptual confusion that often appear when using theoretical constructs. The technique is described in the following products of semantic analysis (Stamper et al., 1988 and Stamper, 1987):

- Describing generic-specific structures. For instance: the generic 'components' can have 'parts' and 'materials' as specifics. Specifics are placed in a box with the generic term at the top of this box. This kind of relationship can also be represented by an arrow from the specific to the generic, as in the case of a component of a good, which is itself a kind of good.
- Describing part-whole dependencies. For instance a good consists of several parts. This relation is graphically represented via a line with a dot in the middle between the part and the whole.
- Role names can be given to a line for referring to a term with a meaning that is about the relation between the two connected terms.
- Some terms can be described in more detail. In order not to make the scheme too complex, a number is allocated before the term, referring to the number of the chart describes the term in more detail.
- When the connected term is a sign, this can be expressed by placing it between brackets, or connecting it via a broken line.
- Particulars (for instance European Community, an organization name) are

represented by capital letters. Universals (for instance: organization) are written without capital letters.

- The result of a semantic analysis is a semantic chart that gives a graphical picture of the relations between the terms. This graphical picture starts with a root, which could be the drafter of the graph.
- A universal name can start with a #, meaning a determiner which is something like a measurement.

4.8.2 Basic Terms from Different Perspectives

Terms from the psychological perspective

Two major terms are explained in the psychological perspective: knowledge and learning process.
Knowledge is regarded as the subject that is transformed via reflection and experimentation in the learning process. Three types of knowledge are described: science, judgement and potential knowledge. Science is public and accepted knowledge. Judgement is uncertain, often private and not tested knowledge. Science and judgement both constitute 'management theories' which are explanations or means-goals theories used for action in organizations. These theories are to some extent espoused and to some extent tacit. They can be more or less abstract when measured in terms of Kolb's AC-CE variable. Potential knowledge is about experience and data. This does not mean that they always speak for themselves. Often a large amount of abstract knowledge is required to make an interpretation of these data, as for instance in case of interpretation of macro-economic figures that requires some knowledge of macro-economics and politics.
A *learning process* is a set of activities that improves or adapts knowledge. According to Kolb this can occur basically in two ways. The first way is reflection, which is thinking over experience for constructing models, theories and concepts. The second way is experimentation by which people test the quality of the gained abstractions in practical situations. Via their education, socialization and work experiences individuals develop a learning style in favor of a certain type of knowledge (abstract or concrete) or learning process (experimentation or reflection).

Terms from the cybernetic perspective

The cybernetic perspective distinguishes three processes of learning: *single-loop*, *double-loop* and *deutero learning*. Single-loop learning is about controlling existing systems, via the statement of its targets, measurement of its targets, comparison of targets with data found, and the provision of necessary feedback information to correct deviations from the norms. To accomplish this process communication and information systems are vital. These systems are organizational (formal or informal) and can be computer-based in some cases. The double-loop learning process questions the targets, the attention, and the search rules. At a higher recursion level, it also considers the assumptions of the control system and the function it has in the quasi-resolution of conflict and uncertainty avoidance. In order to accomplish these single-loop and double-loop learning tasks, a cybernetic system must not only analyze data (comparison function), but also store them in organizational memory, in order to analyze the impact of different policies during a certain period. From the learning curve studies it is known that organizational memories must be well *adapted*, because (re-)use of depreciated knowledge leads to declining effectiveness. Organizational *learning norms* must be developed to govern required activities for communication, analysis and decision-making. These organizational norms result from the deutero learning process. Learning is not a trivial activity, because organizations can easily draw the wrong conclusions from the knowledge acquired. How an organization should learn depends on its learning needs, and this in turn depends on the amount of uncertainty the organization faces. The learning needs can be decreased by quasi-resolution of conflicts.

At the deutero level, learning norms are the field for organizational learning processes. These norms concern responsibilities of organization members in the learning process (responsibility norms), the actual use of data and theories stored in the organizational memory (action norms), and the means of communication in the learning processeses (procedural norms). Information technology is part of these procedural norms. At a higher recursion level one can conceive norms that govern the creation of these norms which are called learning policy norms.

Terms from the organization development perspective

The organization development perspective distinguishes also between single-loop, double-loop and deutero learning processes, but puts most emphasis on the last two. According to Arygis and Schön's view, organizations mostly use the model I learning system: a set of norms that discourages double-loop learning. Effective double-loop learning therefore requires the removal of defensiveness in organizations, and a willingness to create shared mental models and shared vision, called model II. This also demands a willingness to *remove obsolete knowledge* (unlearning). The learning norms for effective (double-loop) learning, are not only applicable to interpersonal relations, but also to organization design in general. Infra-structural arrangements, introducing internal market principles and the destruction of bureaucracy are some of the learning policy norms that could enable organizations to become much better learners because it encourages learning motivation and increases the capability for effective *knowledge dissemination*. In my view, learning policies should not be a dogma, but should match environmental demands. Learning policies also determine the learning effort that an organization puts into single-loop and double-loop learning.

Terms from the soft systems perspective

The soft systems perspective uses the subjective epistemology. It provides some techniques by which people describe a *theory* of their perceived reality. The critical success factor concept can be used to acquire the basic concepts. System dynamics provide a logic in which the relations among these concepts can be defined. System dynamics also supports the detection of deeper lying systemic structures, that explain unexpected and dysfunctional impacts of current behavior. Soft systems techniques are especially useful when a group of people want to define a shared mental model. Sometimes differences of opinion become more clear and can be solved by finding common opinions. It is, however, more problematic when the models are incompatible, which means that they cannot be reconciled. In this last case, soft systems cannot do more than map the different views.

Terms from the scientific management perspective

Scientific management contributes a lot to the development of scientifically correct norms. These norms are the goals that must be pursued via labor and capital application. This means that *management theories* of the technology type (means-goals) are constructed, fine-tuned and adapted in the learning process. Business re-engineering provides a new trend in scientific management, not looking at separate jobs, but at the level of the business process. This means that the *learning fields* shift to a more aggregate level, and that learning is often an inter-organizational process as well.

4.8.3 The Semantic Chart and its Consequences

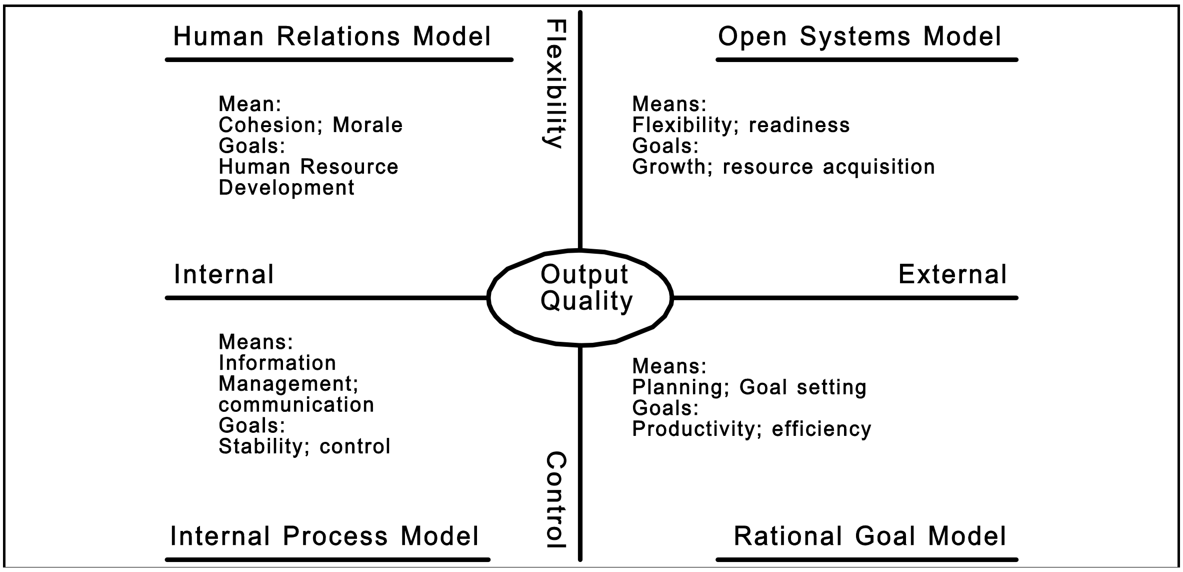
The generic term 'learning processes' has three specifics: single-loop, double-loop and deutero learning. Single-loop learning consists of the following: use or re-use of existing management theories and data, the dissemination of such knowledge, and its storage and adaptation. The storage process is a logical antecedant for organizational memory. Another antecedent for organizational memory is the existence of organizational knowledge and learning norms that can be stored. Double-loop learning also includes the removal of obsolete theories, which is a synonym for unlearning. Deutero learning is an antecedent for learning norms. This also implies that the concept of management theory is distinguished from the concept of learning norms (but both are organizational knowledge). Some authors are not clear about this distinction, but if it is not made, the distinction between double-loop learning and deutero learning becomes irrelevant.

Organizational memory stores contain three types of knowledge: data (potential knowledge), management theories (science and judgement), and learning norms. Management theories are distinguished according to purpose: explanation and technology (knowledge about means and goals). Explanations and technologies can be tacit and/or explicit. Four types of organizational learning norms are distinguished: learning policy (including infrastructure for learning), procedural, action and responsibility norms. Individual learning norms are called learning style.

The generic '*learning field*' has not been clearly defined so far. Learning fields are, however, essential for knowing what learning is about and what it must achieve. Policy norms define what are regarded as important fields of learning. Because solving learning problems should add to organizational effectiveness, learning fields are defined in terms of organizational effectiveness. Quinn and Rohrbaugh found three dimensions of the organizational effectiveness:

- Structure. This dimension has two extreme values: flexibility and control.
- Focus. The extreme values here are: organizational internal and external.
- Means-goals relationships. The extremes are an emphasis on means and an emphasis on goals.

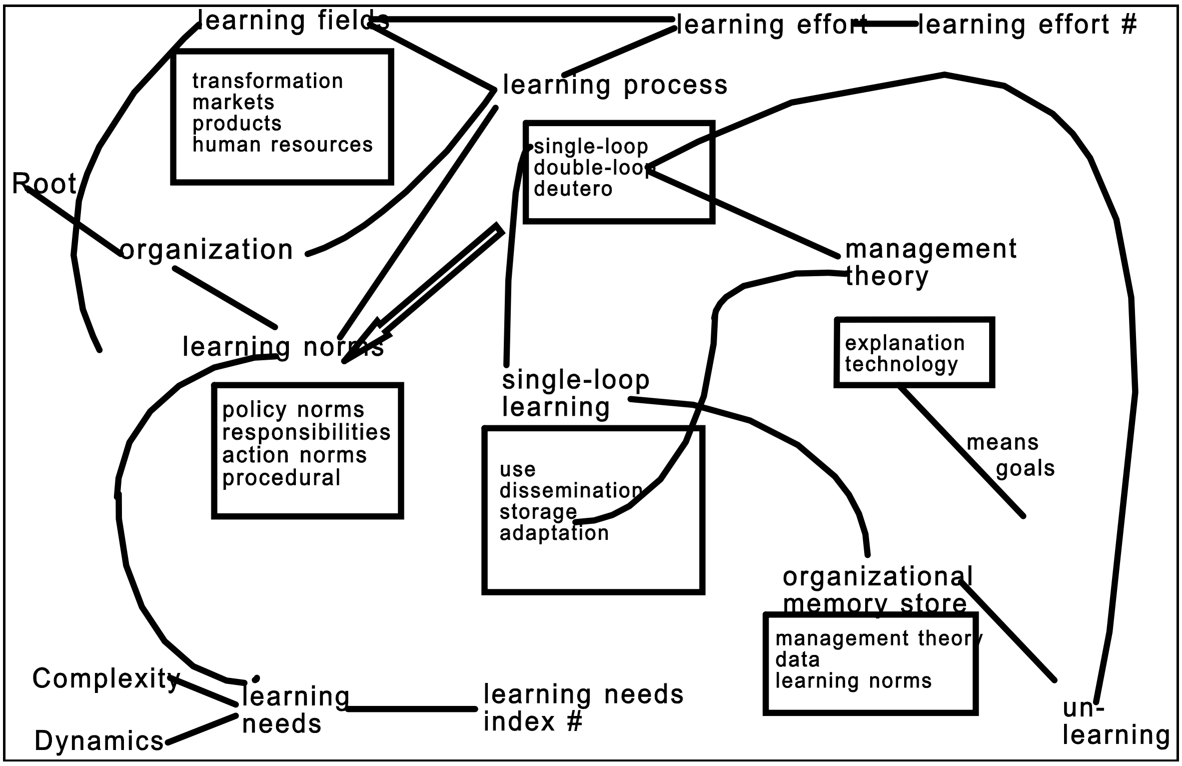
Output quality was found to be a possible dimension on its own, but the authors are not very clear about it. The results confirm existing distinctions among paradigms of organizational analysis, as presented in figure 4.8.



The learning effort concept is mentioned infrequently in the literature, but should be defined as a combination of learning fields and learning activities. This means that, when more fields are the subject of learning, more learning activities are undertaken and the greater the learning effort. In chapter 7, this definition is explained further.

It is also particularly interesting to note that the Human Relations and the Open System Models emphasize differentiation, spontaneity and flexibility (Quinn and Rohrbaugh, 1983, p. 374), which fit neatly into the Organization Development perspective of organizational learning. The Rational Goal Model and the Internal Process Models emphasize integration, formalization and control (Quinn and

Rohrbaugh, 1983a, p. 374), the main issues of the cybernetic perspective of organizational learning. This leads to the following fields of organizational learning: human resources, markets (referring to the open systems nature of organizations), transformation processes, and products (referring to organizational goals).
Finally also *learning needs* and *learning ability* are mentioned in the literature. Both terms are not clearly defined. The learning needs term is regarded as synonymous with the term 'uncertainty' that has two dimensions: organizational complexity and dynamics (Duncan, 1972). Hence, in this study will not look at specific learning needs (e.g. knowledge to solve a specific problem in an organization) but at an index which provides a score for the extent of the learning needs of an organization or organizational unit. In the analysis of organizations and machine bureaucracies (chapter 5) a further description of these terms is given. From an analysis of learning needs and learning abilities a deutero learning process can be initiated to define new learning norms.
These conceptual investigations result in the following semantic chart that pictures the main terms and their meaning here. A further analysis must make these terms



operational for empirical observations. This is done in chapter 7.

4.9 *Operationalization of Organizational Learning*

This section operationalizes the main dimensions of organizational learning by answering the question of *how the defined learning processes should be managed.* I.e. it points out the main issues, but does not give measures yet.

4.9.1 Deutero Learning: Designing Norms that Govern Single-loop and Double-loop Learning

Deutero learning consists of the connection of the organization's learning capabilities with the organizational environment from a longer term perspective, via the construction and implementation of a learning policy, responsibility, action and procedural norms. The single-loop learning activity 'storage', stores these norms in organizational memory and so develops continuity of existence of the norms.

1. Creation of Learning Policy Norms

The learning policy is typically a CEO responsibility. These CEO statements are about:

- The development of an organizational *learning infrastructure*. This infra-structure could consist of electronic communication highways (E-mail, Group Decision Support Systems, Design for Manufacturing as a collective effort of marketeers, production engineers and clients). Also the making of a more transparent organization structure is one of these infrastructural objectives, that can be arranged by expressing commitment to and initiating the development of a corporate-wide database about people's engagements, experiences, knowledge and skills. An excellent example of the creation of transparency in a company was given by Peters in his EDS-case.
- The development of a policy about *core competencies* (Hamel and Prahalad, 1990). The CEO must consider what portfolio of competencies is required in order to achieve the company's objectives and make it viable in the longer term. Therefore, knowledge must be used as an asset. Knowledge and expertise can be used for pilot purposes (to find out if some idea can lead to some improvement in the future), for synergy purposes (for instance a car company that buys an electronic engineering group, to develop electronic features for its current car product portfolio), or for harvesting (buying a group of chemical manufacturers that make products that fit in the existing product portfolio, and can be easily sold via the existing marketing channel of the buyer). Core competencies can be developed not only by taking over other companies, but also by selling them and developing the competencies themselves by investing in people's training, evaluation of experiences etc. An interesting example of competency development was also given by Peters when discussing the Service Centers of EDS.
- A learning policy must also describe the *basic organizing principles* in the company that impact on the learning process. Some of these principles can be caught under the term 'organizational perestrojka' (Ackoff, 1992), meaning the development of an organization that is non-bureaucratic, encourages free and

open debates among its members, and encourages people to think creatively and take initiatives. People should be empowered to do so, by being given responsibilities and authority if necessary, and the organizational incentive system should reward people that behave according to organizational perestroika.

- A learning policy finally requires from CEOs that they take charge of major projects to redesign the way business is done, and create major procedures. This frequently requires *management revolutions*, that also are known under *the name of business re-engineering projects* (e.g. Davenport and Short, 1990; Walker, 1992).

The learning policies must be implemented in more concrete learning norms, about responsibilities, actions and procedures.

2. Description of Learning Responsibilities

Learning *responsibilities* must be well established, as otherwise learning might not occur effectively in relation to the learning needs and policy. Taylor (1911) proposed to organize learning responsibilities in such a way that a clear division of labor in learning is established. We, however, think that it is often not wise to have a concentration and specialization of learning responsibilities in such a classic bureaucratic sense. A description of learning responsibilities might even result in a statement that learning is everyone's responsibility (as for instance in Leonard-Barton's learning factory case). However, by not allocating responsibilities, it is not organized, and the organization cannot profit from the possibilities of dividing learning work.

3. Description of Action Norms

Learning *actions* are not only based on people's responsibilities but also on *incentives* to act on the basis of the insights found. It is one thing to know how badly or well things are going, and another thing to put that knowledge into action.
Incentives for organizational learning are a very under-researched topic. For instance, Argyris and Schön stress the importance of openness, removal of defensive routines etc. But why do people behave against these basic principles of effective learning? Why should, for instance, a software specialist of EDS disseminate his knowledge of clients, their problems and the solutions, when he can improve his financial position by simply not doing so? Was this also not the reason why professionals are difficult to manage according to Mintzberg (1983)? The solution therefore is to create win-win situations for all, by appreciating the added value of learning.

4. Description of Procedural Norms

Procedural learning norms concern the dissemination and handling of information for organizational learning. The procedural learning norms influence the actual use of information systems and communication media so that an organizational learning process is established and based on available data. Not only the IT-issue in terms of

computers and telematics is important here, but also the way data are obtained, the management of data quality, and the need for some specialists to extract information and knowledge from the data.
The issues of deutero learning are listed in table 4.5 in the form of questions that can be used when wanting to start up a deutero learning process.

Deutero learning norms	Issues
Learning policy	Who are we as an organization? How should we think about our environment? How important is learning to our identity and survival? What learning infra-structure is required? What core competencies do we need? Which organizational culture do we want? Do we want business re-engineering projects?
Responsibility norms	Who are responsible for single-loop and double-loop learning? What is the role of management in learning (facilitator or dictator)?
Action norms	How should people behave towards each other in the learning process (openness vs. defensiveness)? When and how should knowledge adaptation decide on the removal of a management theory and trigger a double-loop process? How are people motivated to participate in the learning process (rewards and punishments or the complete absence of either)? What priority does learning have in the organization (expressed in time made available, priority in relation to other jobs)? What kind of education, training is required? Is knowledge from outside the organization used (consultants, text books etc)?
Procedural norms	How should performance be measured? How can signals be interpreted as incentives for single-loop or double-loop learning? What should be the frequency of feedback information? How should feedback information be discussed with the people involved. What data and what systems are required?

Table 4.5: Norms for the Deutero Learning Process

4.9.2 Explanation of Single-Loop and Double-Loop Learning Processes.

This subsection operationalizes the dimensions of single-loop and double-loop learning.

<u>Dimension 1. Development</u>
This dimension is about activities by which a management theory is constructed by scanning the internal and external environment of the organization. Important in this step is the additional use of frames of reference, consisting of a mixture of tacit knowledge (beliefs, norms) and explicit knowledge (obtained by internal or external

training, education, and by experience in the same or a related problem field). The result is an explicit theory, containing goals and methods for achieving them. In this area soft modelling is widely acknowledged as an effective method. Some computer supported tools are also available (e.g. 'PAT', Kolkman, 1993; 'CSFmatrix', Wijnhoven, 1993; Acar and Heintz, 1992; 'I Think' from High Performance Systems Corp.). The output of soft modelling consists of a collection of yet imprecisely defined terms, by which an understanding can be made of a yet under explored area. Because of the volatility and complexity of many managerial situations, especially those faced by the strategic apex, it is often not worth the effort to make these models more precise. In less volatile situations, for example in the case of route planning, it can be extremely valuable to make the model mathematically and logically precise and to test the hypotheses that underly the models with the data available (e.g. Wijnhoven, 1992a). So in the theory development process two sequentially related phases can be defined: the development of a soft model and the development of a hard model. Additionally, the models must be implemented, which requires the explicit knowledge that was acquired, becomes integrated with tacit knowledge of the practice field (Hedlund, 1994).

Dimension 2. Use and Re-use

Discovering the truth is one thing, making it applicable is another thing. Very often, plans in organizations fail to become connected with actions (Ansoff, 1988). For instance Ansoff, a well read author on strategic business planning, felt it necessary to write a book on 'implanting strategy' after having completed his famous book 'Strategic Planning' in 1965. Plans are clearly management theories, however, not always operationalized into specific actions; hence, hypotheses about means and goals often end up stored away in the managers' offices and are never put into action. The use step, therefore, is not simply the application of a piece of knowledge, but an important learning process in itself, frequently disregarded, but essential for practical managers. The activities in this dimension connect the theory developed in dimension 1 to specific actions and behavior.

Dimension 3. Dissemination

It is important that the management itself believes in what it thinks, but it is also essential that other people are convinced as to why things must be done in the way prescribed. Effective communication in the semantic and the pragmatic sense is vital. The first sense concerns understanding the relations among the variables in the management theory. Large bureaucratic organizations mostly have a large amount of differentiation among departments and organization members, which complicates unambiguous communications, and leads to more successful intragroup learning than learning of the organization as a whole. The semantic problems involved lead to misunderstandings about some concepts. The resulting subcultures and professional groups with different jargons is a well-known problem in larger and complex

organizations. By standardizing language in the organization, semantic problems can be reduced (the result is often jargon that, however, can make communication with outsiders more difficult) (cf. Thompson, 1967; Lawrence and Lorsch, 1967). The second communication problem is about the motivations and appeal the theory has on the behavior of the receivers of the messages. These pragmatic communication problems can lead to negotiations and bargaining about what is the real problem in the company and what should be done about it. Groups are led by their interests in these conversations. Organizational learning in this context is especially a process of redesigning intentions, culture and power relationships. Goal integration and creation of commitment are important for reducing these communication problems.
Information technology can support the communication process to solve physical, empirical and syntactical problems in information handling (Stamper, 1973) by:

1. Providing the hardware for transmitting messages in a fast and technically reliable way, to solve the physical problems involved.
2. Distribution of messages according to some rules that can be programmed in message distribution software like E-mail, Groupware, EDI to solve the empirical problems involved.
3. Providing a set of clear codes that can be controlled, to improve the effectiveness of the message distribution so that interpretations are possible to solve the syntactical problems.

The semantic and pragmatic problems however cannot be solved by means of information technology in the machine-like sense of the word. They require instead the improvement of mutual understanding and agreements (cf. chapter 6 for a further discussion of information technology).

Dimension 4. Adaptation

During the process of plan formulation, the business reality may have changed. Hence, there is a basic need for adjustment of the management theories, and this should be based on a test of elements of the earlier theory (e.g. the actions prescribed). Managers could make use of a range of insights from scientific methodologies. The adaptation can result in a refinement of the theory, but also in the detection of the need for a complete revision. Thus a double-loop trigger could also be the result of adaptation. From learning norms, concrete management theories for learning processes can be derived. For instance, as part of the procedural norms, management could decide to develop a decision support system. This information system is a field for adaptation when its efficiency for the learning process is evaluated. Changing the procedural norms, however, can also involve the replacement of the decision support system by a group-decision support system to encourage interactions of learners in a learning lab under the support of a facilitator. The change of this norm is in fact a deutero learning process and must be evaluated in relation to the organization's abilities to meet organizational learning needs.

Dimension 5. Storage

This issue is not well treated in the general discussion on management life cycles, but yet is a basis for organizational learning. Knowledge can easily become forgotten or distorted when not well documented (cf. Yelle, 1991). In order to realize a learning loop in complex environments it is essential to write down what the operational goals are, and the performance criteria for people involved in the project and work process. Only then can they become effective guidelines. If they are not well documented it is not clear how evaluations should take place, and the learning loop is not closed (cf. Peffers and Saarinen, 1993).

Traditionally, the storage of knowledge was achieved through individuals' memories, organizational myths and stories, symbols and many tacit norms that form the basis part of the organization's culture. The development of administrative organizations led to a first instrument for systematic storing management theories, especially in terms of finance and resources. Formal planning techniques can also be used as tools for storing organizational knowledge. Administrative organization and formal planning techniques were instruments for management used in all great projects in history. Nevertheless, the rise of the large machine bureaucracies (beginning of this century) would not have been possible without the development of organizational memory and knowledge storage procedures and techniques. Universities had an important role in these developments, as is illustrated by the rise of business schools at universities.

Information technology led to a larger and more powerful organizational memory, by developments in:

1. Databases that allow for the efficient and reliable storing and retrieval of data.
2. Modelbases that allow for the management of several models represented in a mathematical way. These models can be stored, accessed, developed, used and improved when required.
3. Knowledge-based systems and expert systems provide opportunities for storing qualitative knowledge, by means of the use of formal logic. This is possible when the management theory is made explicit and represented in logical chains. Knowledge rules can be connected to simulate a human reasoning process.
4. Integration of these IT-opportunities (e.g. Kerr, 1991).

Dimension 6. Removal or Unlearning of Management Theories

The life cycle metaphor presupposes a start and a finish of life. This also applies to management knowledge. Removal of knowledge is important when it becomes obsolete and misdirects attention and actions. This aspect of the organizational learning process is maybe the most difficult one, because:

1. People are committed to existing knowledge, because of their effort to acquire it.
2. When well implemented, management theories become part of the tacit way of

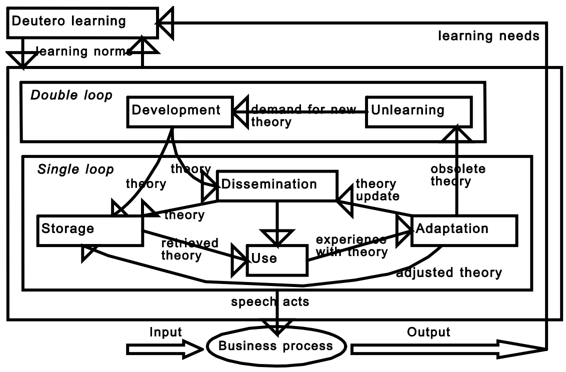
thinking and the informal parts of an organization's culture. Therefore, removal of management theories means a change in organizational paradigm which is difficult to accomplish.

3. People gain their status and position from the existing management theories. When this theory is removed people could feel that an important source of subsistence is endangered. They will only collaborate when the new theory would improve their position, something which is not always possible.

It is the 'management knowledge removal' process that is the start to double-loop learning. Mostly it requires strong external forces to win from the forces obstructing unlearning. Some organizations are good at double-loop learning, because they have learning norms encouraging change. Machine bureaucracies have been shown to be notoriously bad at double-loop learning, and also have a slow process of single-loop learning. Until recently this was not a problem because the environment did not necessitate much learning (Mintzberg, 1983 and chapter 5 for further evidence and explanation). The need for double-loop or single-loop learning is, however, dependent on the *learning needs* of the organization.

4.9.3 A Flow Diagram of Organizational Learning

The learning dimension can described in mutual relations as illustrated in the following flow diagram (figure 4.10).



The flow diagram only describes activities that can be formally described and managed. One should however not underestimate the importance of informal processes in organizational learning. Brown and Duguid (1991) give an account of how to conceive informal organizational learning. The first point they made is that in informal learning practices, knowledge is seen as understanding practice and may never be detached from practice. Abstract knowledge (called canonical practice by the authors) can blind the organization to the fact that it is the practice of the organization members that determines the success of the company. In many cases, abstract knowledge is written down in handbooks and documentations, but is such that when it is applied precisely, it is in fact more difficult to perform successfully! Although these documentations try to reduce improvisation and informal working practice, they often require many more improvisational skills to accomplish a task successfully in terms of client demands. The informal work practice also shows that accomplishing a job is not only a technical activity, but essentially the maintenance of a social setting. This is very evident in the case of machine repair services. Of course the technical problem must be solved, but doing so requires a problem-solving process in which several actors (end users, management, technicians, experts) are involved in a story-telling process. In the words of Brown and Duguid:

" *Ultimately, these stories generated sufficient interplay among memories, tests, the machine's responses, and the ensuing insights to lead to diagnosis and repair. (...) Through story-telling, these separate experiences converged, leading to a shared diagnosis of certain previously encountered but unresolved symptoms. (...) They (...) increased their own understanding and added to their community's collective knowledge. (...) A story, once in the possession of the community, can then be used - and further modified - in similar diagnostic sessions"* (Brown and Duiguid, 1991, p.44).

What matters in organizational learning is not the development and learning of abstract models that are separated from practice. Additionally, learning is not instruction or training, but becoming member of a community and behaving effectively in that community.

" *For example, learners learn to tell and appreciate community-appropriate stories, discovering in doing so all the narrative-based resources (...). As Jordan (1989) argues in her analysis of midwifery, 'To acquire a store of appropriate stories and, even more importantly, to know what are appropriate occasions for telling them, is then part of what it means to become a midwife'* (p.48)."

" *Learning is fostered then by fostering access to and membership of the target community-of-practice, not by explicating abstractions of individual practice. Thus central to the process are the recognition and legitimation of community practices* (pp.49-50)."

It seems as if organizational learning is something that comes from itself. On some occasions this is true. On many other occasions, management must give clear guidelines and facilitate it actively (for instance via infrastructures and reward systems). This depends on the typicalities of the environmental organizational learning needs and the learning abilities of the organization. Learning abilities and learning needs of the machine bureaucracies are discussed in the following chapter. The final chapter will reflect on learning practices in five companies, that differ on the learning needs index, so that more insight is obtained about the norms for organizational learning.

Chapter 5: Organizational Learning in Machine Bureaucracies

5.1 *Why Study Organizational Learning in Machine Bureaucracies?*

The term bureaucracy has its origin in the writings of Max Weber, who defined it as a *legal* way of excersizing command and control over people. The basic categories by which bureaucracy exists are summarized by Weber (1921/64, pp. 331-332) as follows:

" *(1) A continuous organization of official functions bound by rules.*
(2) A specified sphere of competence. This involves (a) a sphere of obligations to perform functions which has been marked off as part of a systematic division of labour. (b) The provision of the incumbent with the necessary authority to carry out these functions. (c) That the necessary means of compulsion are clearly defined and their use is subject to definite conditions. (...)
(3) The organization of offices follows the principle of hierarchy; that is, each lower office is under the control and supervision of a higher one. There is a right of appeal and of statement of grievances from the lower to the higher (...).
(4) The rules which regulate the conduct of an office may be technical rules or norms.[13] *(...)*
(5) In the rational type it is a matter of principle that the members of the administrative staff should be completely separated from ownership of the means of production or administration.(...)
(6) In the rational type case, there is also a complete absence of appropriation of his official position by the incumbent. (...)
(7) Administrative acts, decisions, and rules are formulated and recorded in writing, even in cases where oral discussion is the rule or is even mandatory."

The rules led to routinization and standardization and served to make output predictable and reliable. This is important for modern government and business. It also became a major issue in the quality movement in the 1980's (Garvin, 1988; Evans and James, 1993).

[13]Henderson and Parsons, the translaters of Weber's original German book, state (1964, p. 331): "By a 'technical rule' he probably means a prescribed course of action which is dictated primarily on grounds touching efficiency of the performance of the immediate functions, while by 'norms' he probably means rules which limit conduct on grounds other than those of efficiency. Of course, in one sense all rules are norms in that they are prescriptions for conduct, conformity with which is problematical."

Many of Weber's ideas for efficient control were taken over in business administration, with legitimacy based more on the efficient handling of resources than on its legality. Henry Fayol pleaded for a rational setup of management, by separating it from the primary functions of the company (technical, commercial, financial, security, and accounting activities). The management function is then responsible for realizing optimal principles: division of work, authority, discipline, unity of command, unity of direction, subordination of individual interests to the general interest, remuneration, centralization, scalar chain (line of authority), order, equity, stability of tenure of personnel, initiative, and esprit de corps (Fayol, 1916/1949, p. 19-20).

Researchers saw many negative effects of bureaucracy. For instance, Merton (1948) states that bureaucratic organizations give higher priority to organizational structure and processes than to organizational goals and their social-economic function. This can lead to a very inflexible organization, which loses a sense of its environmental function. Bureaucracy also leads to under-utilization of human potential, because people become slaves of the routines that are prescribed for the work process (Maslow, 1970; Mayo, 1945). It is particularly important for nongovernment bureaucracies that often machinery is applied that demands the strict application of certain rules. It therefore requires the suppression of informal organizational processes. The importance of informal processes and informal communication networks was however made evident by research of the so-called human relations school of management (e.g. Mayo and Herzberg, 1938). Additionally, modern researchers found out that the growing complexity and dynamics of organizational environments demanded less formalized and constrained organizational behavior (Argyris, 1970; Beer, 1981; Galbraith, 1973; Simon, 1947). The introduction of machinery, however, often increases the need for formality in organizations. The resulting classic *machine bureaucracies* therefore have large problems with formalization, under-utilization of human resources and inflexibility in coping with changing environmental business conditions (Woodward, 1965). This trend was reversed in the 1950s by the development of lean machine bureaucracies in Japan.

Classic machine bureaucracies are supposed to have large problems with organizational learning, because they have strategies, structures, cultures and information systems as defined below.

- Classic machine bureaucracies have longer term, reactive and cost-leadership oriented strategy. This is because of the long pay-back period of machine investments, and a strong focus on optimization of designed processes for realizing lowest costs. Increasing dynamics are difficult to match with these machine bureaucratic features, because they require longer and shorter term orientation, active and pro-active strategies (cf. Miles and Snow, 1978; Zahra and Pierce, 1990).
- The organizational structure of classic machine bureaucracies is not developed for organizational learning innovations (changing organizational knowledge),

but only for conserving the way of working. This is also a form of organizational learning, but it can mismatch with learning needs in dynamic and complex environments. Machine bureaucratic structures result in a very formal way of collaboration, strongly institutionalized in departments, and strict authority and responsibility allocations that govern actions. The organization usually has an efficiency objective, but can have an expensive hierarchical coordination mechanism (Galbraith, 1973; Gurbuxani and Whang, 1992). This is again mainly a problem of dynamics, because the complexity can be dealt with. The effective handling of increased dynamics often conflicts with the slow procedures of classic machine bureaucracies. Hence, a more organic organization type is required (Burns and Stalker, 1961).

- The organizational culture of classic machine bureaucracies is dominated by 'uni-lateral' control and defensiveness. It is the boss who thinks and decides, and his employees act (Argyris and Schön, 1978). This goes against demands for handling high levels of complexity, because a single manager has only one set of brains. The thinking and innovative process therefore must be a joint effort of many organization members.
- The increasing complexity of products, production processes, production series and variants, requires a more rational treatment of organizational knowledge. This is also done in classic machine bureaucracies, but mostly too slowly, as was shown by the lean car manufacturer examples in chapter 1. The environmental dynamics and complexity demand information systems that match perfectly with the working flexibility required. Additionally, these systems must be easy to adapt to frequently changing user requirements (Land, 1982).

We are not interested in the machine bureaucracies themselves, but in organizational learning and information technology. Machine bureaucracies are used as a source of case material to develop a substantive theory, that later can be formalized into a more general theory (cf. chapter 3). We will avoid using the buzz word '*the learning organization*' because it suggests that there is one best type of learning organization[14]. This study therefore describes several ways of learning in machine bureaucracies. These learning types are further linked with environmental needs (learning needs) and conditions (learning norms). A normative viewpoint is evident here stating that effective organizations have a learning needs-learning norms match. This reasoning is analogous to contingency statements in organizational design, which state that organizational environment influences the effectiveness of organizational structures and processes.

The factors in this study now are: organizational environment, organizational norms,

[14]It seems as if writers on 'The Learning Organization' (like Senge, 1990; Swierenga and Wierdsma, 1990; Garratt, 1987 and Garvin, 1993) have not understood the lessons from the contingency approach that propose the equifinality of organizational forms (cf. Mintzberg, 1983 and Dotte, Glick and Huber, 1993 for excellent reviews).

and transformations. These are described for the organization in general and for the organization's learning subsystem in particular in table 5.1.

Factors	Machine Bureaucracy	Organizational Learning
Environment	Complexity and dynamics	Learning needs
Norms	Structure and culture	learning norms (policy, action, procedural and responsibility)
Transformation	Transformation of goods and values	Transformation of knowledge via single-loop, double-loop learning, and of learning norms via deutero learning activities

Table 5.1: Conceptual Relation Between Machine Bureaucracy and Organizational Learning

It is important to state here that the lean-classic distinction in machine bureaucracies is a distinction in organizational norms (structure and culture), and that the service-manufacturing distinction is a distinction in transformation. This means that organizational learning norms have only to be studied in terms of the lean-classic distinction. It could however be that the organizations also differ in the way they learn in terrms of the service-manufacturing distinction. The insights concerning differences in learning among service and manufacturing organizations are however very meager. Hence, this study emphasizes the lean-classic distinction in its theoretical part (chapters 5, 6 and 7). The study will search for possible hypotheses in terms of the service-manufacturing distinction while comparing the results of the service and manufacturing case studies in chapters 8 and 9.
Section 2 describes machine bureaucracies in more detail, and section 3 describes organizational environments and the related configurations. Statements about the relations between machine bureaucracy types and organizational learning needs are described in section 4. This leads to improvements of the theory and ideas for measuring machine bureaucracies and organizational learning.

5.2 *The Concept of Machine Bureaucracy*

5.2.1 The Development of Machine Bureaucracies

Mintzberg (1983, p. 281) defines the machine bureaucracy as an organization with much specialization, little training and indoctrination, much formalization, mostly a functional type of grouping, large at the bottom, action planning, few liaison devices and limited horizontal decentralization. Machine bureaucracies have existed for a long time, but are particularly relevant since the upheaval of the industrial society. Lammers (1984, p.362-368) identifies a traditional organization type as the predecessor of the machine bureaucracy.

Organizations in general govern processes of cooperation that are enduring in nature. In traditional organizations there is no segregation between the organization and the broader social context in which it is embedded. Examples are the early English labor organizations in which contractors acted as linking pins between entrepreneurs and laborers, and small family owned and craftsmanship oriented organizations (Stinchcombe, 1959). In The Netherlands many of these companies still exist, providing 10% of the total Gross National Income in 1992 (when we take companies of less than 100 employees as a global indicator). The entrepreneurs are personally responsible for success, and frequently feel personally committed to the well-being of their employees. Traditional organizations have a simple structure, with management by direct supervision of the workers.

At the end of the Middle Ages, some organizations acquired a legal personality of their own. This meant that the company (not a natural person) was legally responsible for what happened, and had rights and obligations of its own. This implied a distinction between the family and the organization. Rules for selection of its members were formalized, internal differentiation and division of labor as well as coordination were formalized in rules and norm systems. This type of 'modern' organizations was a formally and rationally constructed system of norms, which equalled the development of machines. Especially in production organizations it required large capital investments, because of the application of expensive machinery. The machinery had to be run by engineers who gained management positions. Therefore, the term *machine bureaucracy* is applicable here.

Several types of bureaucracies have developed in the past.

1. *Government administration*. This type of organization is necessary to process the large volumes of data and services the government has to process for its increasing tasks and increasing population. Also the development of the modern state demanded that bureaucrats should be accountable for applying the rules, according to legal principles. The result was a growing need for rules to control and prescribe government officials. Furthermore, government tasks became more complex, requiring a specialization of officials, and therefore differentiating more clearly between the tasks and jurisdictions (Weber, 1921/1964). Government bureaucracies will not be studied further in this study about profit organizations.

- *Company administrations*. Especially in the larger companies, administrative offices have developed which have been influenced by the requests for accountability, reliability and accuracy of information handling, internally (e.g. for budget information, order administrations and stock-keeping) as well as externally (obligations for external reporting required by (tax) law) (Fayol, 1916/1949). These organization parts therefore developed as a social machinery, consisting of human components and organizational assembly rules. Because these organizations are not independent profit organizations, they are not included in our research population.

- *Manufacturing machine bureaucracies*. These organizations grew from the opportunities for producing for large (world-wide) markets in mass and large series (e.g. cars). People on the shop floor were regarded as handlers of machines and materials in a routine-like way, with the purpose of producing as cheaply as possible according to specifications. Specialist expertise was developed by production and manufacturing engineers (specialists), who developed the machines, practices, material routs etc. These engineers, because of their technical expertise, also gained dominant roles in the management of the company.
- *Service machine bureaucracies*. Most of the commercial organizations do not supply goods but services (Ginzberg and Vojta, 1981). Examples of these are banks, insurance companies and telecommunications suppliers (Schmenner, 1986). Here the same organizational and functional principles apply as in the manufacturing machine bureaucracies. The organization's technology is a combination of professional knowledge and commercial and machine-like handling of transactions.

In the last few decades, manufacturing organizations must deliver service in addition to their supplies, diluting the difference between the last two groups. For instance, some machinery manufacturers earn more money with services than with machinery supplies. Some service organizations have also gained an increasing manufacturing attitude (Grönroos, 1990). Nevertheless, service and manufacturing organizations differ strongly in their transformation technology. Most importantly the *transformation technology is a means of reducing organization members' discretion* in the realization of the goods and services. The manufacturing organization has *hardware* (machinery) as a source of discretion reduction. The service organization has *software* (rules, formal procedures and policies) as discretion reducer. The consequence for organizational learning is probably that opportunities for learning in manufacturing organizations are very limited, because of the constraints set by the machinery. In service organizations fewer machinery constraints exist, and rules, procedures and policies are possibly more easy to change within the environment of one organization, so that a closed learning loop can be implemented.

A recent trend that distinguishes machine bureaucracies from a learning perspective, was initiated by Japanese companies via their concept of *lean production*. The principles of leanness are concerned with the relative decrease of the number of people that are not directly engaged in production (cf. chapter 1). This means that huge support staffs and technostructures can be removed. Equally important are the cultural and organization structural differences between lean and non-lean companies (Leonard-Barton, 1992). Because of these differences it is obvious that lean and classic machine bureaucracies have different learning norms and behave differently in learning processes. Further reasons for this statement are given in section 3 of this chapter.

5.2.2 Classic and Lean Machine Bureaucracies

From the study of Womack et al. (1990), lean and classic (car) manufacturers are distinguished on the basis of 10 items described below.

- *Attitude to quality*

The lean organization has 'Kaizen' as a basic mind set. Kaizen is a Japanese term meaning an intrinsic motivation to improve quality. This means that learning about quality should come from within. In the classic bureaucracy, quality improvements start from a need to comply to market pressures. For instance, many companies start up quality programmes to receive a certificate, because no certificate often simply means no business. This sometimes leads to a further formalization and bureaucratization of the existing classic bureaucracy. In lean organizations these quality costs are far lower than the profits.

- *Level of decentralization*

Lean organizations allocate many decision responsibilities to the shop floor. This is done via vertical decentralization to improve the reaction speed when problems occur, and via horizontal decentralization to reduce communication difficulties among the experts and the shop floor. This means that the shop floor should be equipped with expert knowledge, and with a motivation to take responsibilities. Staff groups with expert knowledge are then small and mainly have coordination and facilitation tasks. In the traditional bureaucracy, large staff groups exist that do the thinking for the shop floor and to some extent for the management as well. People on the shop floor then only require a low educational level, and have no managerial responsibilities. In that case, there is a strong distinction between 'we' (the workers) and 'them' (the management). Research in the area of machine bureaucracies has shown that the number of people in administration and management versus people engaged in production (so-called administration/production-ratio) has been increasing relatively (Anderson and Warkov, 1961; Child, 1973; Indik, 1964; Parkinson, 1958). Parkinson even believes that this trend is based on immanent laws of machine bureaucracies, that can be described as follows: (1) an employee of a bureaucracy aims at reproducing subordinates and tries to avoid competitors and, (2) employees in a bureaucracy provide each other with work, mainly for coordinating and controlling each other's jobs. The lean organization starts from the opposite view, which could be described as: (1) regard each other as equals so that you can profit from each other's knowledge and experience and (2) try to reduce coordination costs by creating lateral relations instead of the slow and costly hierarchy.

- *Availability of lateral structures*

The classic machine bureaucracy manages its communication processes via hierarchies of command. When a problem occurs that a person cannot handle, he goes to his superior to ask for advice and support. When the superior cannot give this support directly, he contacts some of his subordinates. When the problem cannot be solved in that way, the superior goes to his superior etc. When the problem is rather complex and needs the collaboration of several people for a certain period, a project or task group is created, under the authority of the superior of all the people involved. This means that a number of people are taken out of the daily working process, to work for some time on the project. Two problems can now occur that are solved differently in classic and lean organizations:

1. When the project work and routine work come into conflict, the lean organization gives priority to the project work. The project leader (called 'shusa' in Japanese) has the authority and means to enforce the collaboration of the people involved. In the classic organization, the routine work mostly has priority above the project work.
2. When the problems are incidental, ad hoc contacts might solve them. In the classic bureaucracy it is very difficult to make these contacts because it requires the approval of superiors and the internal differentiation even makes it difficult to find out if the required expertise is in fact available within the organization. In the lean organization the hierarchical chain is very short and people are expected to find the required internal contacts themselves.

- *Relations with suppliers*

In traditional machine bureaucracies, suppliers are members in a negotiation process. The idea dominates that what you pay for supplies increases production costs and lowers profits, and hence you need a strong negotiating position and should apply all kinds of negotiation tricks (Mastenbroek, 1987). In lean organizations, the supplier is regarded as a partner in the value chain. This means that the quality of deliveries are essential for your own success. The supplier is therefore provided with information and expertise with which he could improve himself. In the classic bargaining situation suppliers and buyers will seal important information off or supply misinformation. In the mutual partnership relation co-makership is very likely. The buyer might even take shares and thus take responsibility for the supplier's success because he needs a continuous relationship.

- *Relations with clients*

In the classic organization, clients are regarded as the end of the production process. In the lean organizations they are regarded as the starting point of everything. To satisfy their needs is the ultimate goal of the lean organization. The classic organization strives for maximization of profits, minimization of costs, and increase of market share. It does not develop a clear picture of the environment, and has an internal focus. Market research is done occasionally, but the results are not always clearly communicated within the organization. Besides, market research mostly describes the existing trends in the market. The lean organization tries to create the market by having excellent contacts with buyers, constantly following them, so that new ideas can evolve in direct contact with clients.

- *Relations with employees*

In classic organizations, employees are regarded as sellers of labor, and laborers and management relations are mainly negotiations of the win-lose type. This can lead to hostile relations. An illustration of this is in the USA where a position is mostly seen as temporal and frequent job change is regarded as positive, because it demonstrates the sales value of a person's human capital. In lean organizations, workers are seen as essential for the company's success. They must be highly motivated and dedicated to give an excellent performance. The organization invests strongly in its employees by providing training and giving people life-long employment. In Japan the relation between the organization and the employees even goes so far that the families of the organization members are also regarded as part of the company (which gives these organizations a traditional flavor).

- *Financial decision-making structures*

In the classic organizations, banks invest on the basis of profits and other financial data, which are possibly compared with bench-marks from other organizations. In lean organizations financial data are not that important. Longer term expectations on qualitative issues such as the quality of the employee-management relations are valued much more. A strong 'we'-feeling in the organization will possibly contribute to the absence of strikes and the higher contributions of employees than can be expected from the hostile relations of the classic organization. In Japan, lean organizations are mostly part of larger conglomerates with an internal bank, called 'Keiratsu'.

- *Human resource management ideas*

In the classic organization an employee is attached to a specific position and may be promoted or receive another position, although this is not common. He is also expected to carry out uncritically whatever the management asks him to do. He must adapt well to the existing organizational culture and setting. The lean organization expects an open mind of its employees, and motivates people to bring in unconventional ideas.

- *People's motivation base*

In the classic bureaucracy people have an extrinsic work motivation, meaning that they work to receive a monetary retribution, and search for other jobs with better payment. The lean organization aims at optimizing intrinsic work motivation, meaning that people come into work because they are interested and gain great job satisfaction from the work intself. The life-long employment, offered by many lean organizations, also discourages looking for other jobs.

- *Sources of new ideas and R&D*

The classic bureaucracy suffers from a 'not-invented-here-syndrome', whereas the lean organization actively searches for all kinds of ideas that might be interesting to explore (Leonard-Barton, 1992).

The differences between lean and classic machine bureaucracies are thus summarized under the 10 items mentioned. Chapter 7 describes a proposal for an index of leanness of organizations based on these items.

Similar theorizing on lean organizations is also done by Hedlund (1994), while defining his N-form and M-form organizations, where N stands for 'new' and 'novelty', and M stands for 'multidivisional'. His publication, however, was done after our operationalization and case studies were completed. For completeness, we present one of his tables that gives a summary of his conceptualizations.

	N-form	M-form
Technological interdependence	Combination	Division
People interdependence	Temporary constellations, given pool of people	Permanent structures, changing pool of people
Critical organizational level	Middle	Top
Communciation network	Lateral	Vertical
Top management role	Catalyst, architect, protector	Monitor, allocator
Competitive scope	Focus, economies of depth, combinable parts	Diversification, economies of scale and scope, semi-independent parts
Basic organizational form	Heterarchy	Hierarchy
Source: Hedlund, 1994, p. 83, tabel 1.		

Table 5. 1: N-form vs. M-form

Most interesting is Hedlund's statement that 'new' is not always better. Table 5.2 lists several issues on which the traditional, M-form, organizations perform better than the N-form organizations.

N-form weaknesses	M-form strengths
Fundamental, radical innovation not achieved by (re)combination and experimentation only	Radical innovation through specialization, abstract articulation, and investment outside present competences
Long time to acquire fundamental new knowledge because of restrictions on senior recruitment and acquisitions	Rapid infusion and diffusion of drastically new prespectives through people, acquisitions, and spin-offs
Difficulty in coordinating very large projects because of reliance on small groups	Large systems design capability through complex articulation and tightly controlled complexity
'Competence traps' through too constrained development path	Risk management through 'competence portfolio'
Bias for internal exploitation of ideas	Freedom to use most effective mode, internal or external
Difficult to change overall vision because of internal management promotion	Change of basic direction and culture through external recruitment of top management
Strategic vulnerability through strong focus and	Strategic robustness through quasi-independent

interrelationship	parts
Source: Hedlund, 1994, p. 86, table 2	

Table 5.2: Where the M-form is Superior

We will not further discuss which form of organization is the best, but we will emphasize that the success of an organizational form depends on its environmental conditions. The conditions of the most interest here are the organization's learning needs (see further section 5.4).

5.2.3 Manufacturing and Service Machine Bureaucracies

The discussion about classic and lean organizations showed that machine bureaucracies are moving to new, more competitive forms that match with new environmental demands. At the same time, machine bureaucracies are changing in their products and transformation technology. Two trends are particularly interesting in this case. The first trend is *industrialization of services* (Grönroos, 1990). Services lose their classic interpersonal nature by lowering the labor intensity and degree of interaction (Schmenner, 1986, pp. 28-31). Cash dispensers are typical examples of industrialized services because they enable clients to take money from their bank accounts without direct interaction with a bank employee. The second trend concerns manufacturing organizations that increase their supply of services (Kotler, 1988, p. 476-493). For instance, a car manufacturer may develop a car lease service as a new business with synergy to manufacturing, and which is profitable in itself. Other examples are: machinery manufacturing companies that also sell consultancy, and computer manufacturers developing and selling software, supplying educational programs and free communication services via a Value Added Network that is otherwise used for user support and remote maintenance.

The importance of the distinction between services and manufacturing in our study on organizational learning, is that both types of business have different *types of transformations and products* that lead to different ways of organizational learning. Some evidence for this proposition was found by Mills and Moberg (1982, reprint from Bateson, pp. 152-153) in an overview of major research about the relation between technology (which is treated as a synonym of transformation in their study) and organization structure. Of the 26 *studies* reviewed, out of the 11 studies on manufacturing 10 seemed to have found a clear relation between transformation and structure. Of the 8 studies with a service sector sample, 5 showed relations between transformation and structure. Of the 7 studies with a mixed population, only 1 showed a relation between transformation and structure. This finding is especially important when organizational learning processes are regarded as a subtype of organizational transformation, and when organizational learning norms are regarded as a subtype of organizational norms. This would predict that the distinction between service and manufacturing organizations (as a distinction in organizational transformation) explains different ways of organizing organizational learning. Other reasons for distinguishing service from goods manufacturing in the context of organizational learning are provided by Quinn (1992), who stated that service activities:"*...usually rest on some special knowledge- base or intellectual skills. Increasingly, therefore, developing and managing human intellect and skills - more than managing and deploying physical and capital assets - will be the dominant concerns of managers in successful companies* (p. 439)".

An additional reason for studying services is that machine bureaucracies are traditionally linked with manufacturing organizations (like car producers), but the service sector in our economy is growing substantially and outnumbers the manufacturing sector in many ways.

Excursion: The Service Sector

Most national accounting offices define services as all output that does not come from the four goods-producing sectors: agriculture, mining, manufacturing and construction. The service sector embraces:

- distributive services, such as wholesales, retail trade, communications, transportation and public utilities.
- producer services, such as accounting, legal counsel, marketing, banking, architecture, engineering and management consulting.
- consumer services, such as restaurants, hotels, laundry.
- non-profit and government services, such as education, health care, the administration of justice and national defence.

(Ginzberg and Vojta, 1981, p. 23-24).

In the US economy, services have increased considerably in importance in the last decades. Table 5.4 gives Ginzberg and Vojta's data about changes in relative employment in goods-production and services:

	Goods-production	Services
1929	45%	55%
1948	44%	56%
1977	32%	68%
Source: Ginzberg and Vojta, 1981. Reprinted in Bateson, 1989, p. 25		

Table 5.4: Percent of Labor Force in US economy.

	Goods-production	Services
1948	46%	54%
1978	34%	66%
Source: Ginzberg and Vojta, 1981. Reprinted in Bateson, 1989, p. 26		

Table 5.5: Percent of Gross National Product in US economy.

Also in terms of gross national product, services outnumber goods-production (despite the many problems with measuring the value, of for instance, government services). See table 5.5.

The non-profit services are excluded from our research objective. Interestingly enough, many of these services are now becoming profit services, because of government retrenchment policies (for example, health care, pension funds, state computer facilities, railways). Because many additional services are now priced, and their volume can be more easily measured, the percentage of services in gross national product will rise in future statistics.

Ginzberg and Vojta also mention that services are becoming increasingly organized in machine bureaucratic configurations as is stated in next quote (Ginzberg and Vojta, 1981, pp. 33-34):

" *Since services for consumers have to be provided where the consumers are, economists have long assumed that the*

economics of scale characteristic of manufacturing could not be achieved in service enterprises. Services cannot be produced for inventory and cannot be shipped. That, however, is not the entire story. Improvements in communications, particularly in processing and transmitting numerical data, facilitated the growth of large service companies in the postwar decades by linking together in single enterprises large numbers of small service establishments. Major banks were among the first to develop worldwide systems of branches. Now multi-unit hotel chains, automobile-rental companies and fast-food-franchise enterprises have followed the example set by the banks.
The economics of these arrangements are based on the gains that the large service company can achieve through integrated planning, financing, accounting, marketing and similar functions. Even large producer-service firms in law and accounting have increasingly expanded overseas through the establishment of branches, partnerships or franchises. This development helps to explain the surprising fact that legal services have recently emerged as the largest export industry in New York City, outranking its apparel industry."

Service and manufacturing organizations can be distinguished by their output and transformations. Dimensions to rate the differences in *output* are: tangibleness of output, discreteness of output, perception of the output value, organization's output goal, and the role of measured output. Service output is less tangible and less discrete than the output of manufacturing organizations. This makes it easier for manufacturing organizations to have objective measures for output than it is for service organizations. The output goal of manufacturing organizations is therefore also easier to define in terms of profits and volumes, whereas service organizations more often apply immaterial criteria such as client satisfaction. It is therefore difficult for service organizations to use output measurement as a means for learning. The success of service organizations is much more indirect, and output control could even misdirect attention to the real causes of longer term success.
With respect to *transformations*, 8 items are proposed on the basis of Mills and Moberg's paper, that need consideration when distinguishing service from manufacturing. These items are briefly described in table 5.6.

M. B. Item	Service	Manufacturing
Materials and Equipment	Knowledge	Machines, physical materials and labour
Involvement of client in production	Client is ego-involved	Client has contact after production (sales) and sometimes before production (design and contracting)
Information processing	High, accurate and timely information from client is needed	Planned work
Responsibility for success	Client has joint responsibility for success	Responsibility for success lies with the producer
Description of process phases	Input, conversion and output are hard to distinguish	Clear distinctions between input, conversion and output (related with logistic stream)
Stocks and buffers	Stocks are impossible. Buffers are made by selection of clients, routinization of service and rationing	Stocks are possible (under certain conditions) and buffers are created by planning of the production stream

Systems boundaries	Operating core is open system (involvement of client), administration is closed system	Operation and administration are both closed systems.
Professionalism	Can be high or low.	Low (except in engineering)
Based on Mills and Moberg, 1982, pp. 154-161.		

Table 5.6: Eight Items for Describing Service and Manufacturing Organizations.

On the basis of these ideal typical considerations, chapter 7 defines a scale of the extent to which an organization can be called service or manufacturing.

5.3 *Other Organizational Configurations*

Besides the machine bureaucracy, Mintzberg constructed five other organizational configurations, that differ on environmental characteristics (dynamics and complexity) and their coordination mechanisms. This discussion is important because of our presumption that environmental changes have different learning needs and thus might require other learning norms. More or less deviating from Mintzberg's argument, the presumption is used here that an increase in dynamics and complexity does not necessarily require a new organizational configuration, because of the benefits of machine bureaucratic configurations in terms of efficiency and capability of producing certain goods and services. Only when these organizational features lead to strong ineffectiveness, and a certain critical value is passed, will an organization search for another configuration (also cf. Hage, 1965, p. 307). Let us explore organizational environments, coordination mechanisms and configurations further.

5.3.1 Environment and Coordination

Mintzberg found that several viable organizational configurations can be distinguished. They are not just fads and fashion (they sometimes are) but are effective organization types associated with certain environmental conditions. These environmental conditions are defined by four factors (Mintzberg, 1983, pp. 136-137):

1. *Dynamics*. In Mintzberg's words:

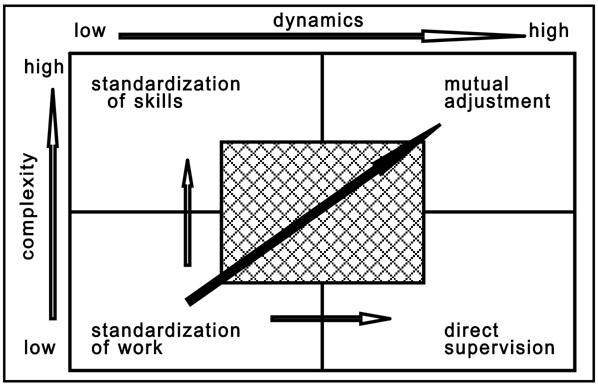
" *An organization's environment can range from stable to dynamic, from that of the wood carver whose customers demand the same pine sculptures decade after decade, to that of the detective squad that never knows what to expect next. A variety of factors can make an environment dynamic, including unstable government, unpredictable shifts in the economy, unexpected changes in customer demand or competitor supply, client demands for creativity or frequent novelty as in an advertising agencies, rapidly changing technologies as in electronics manufacturing, even weather that cannot be forecasted, as in the case of open theater companies. Notice that dynamic here means unpredictable, not variable; variability may be predictable, as in steady growth of demand.*"

2. *Complexity*. In Mintzberg's words:

" *An organization's environment (...) can range from simple to complex, from that of the manufacturer of folding boxes who produces his simple products with simple knowledge, to that of the space agency that must utilize knowledge from a host of the most advanced scientific fields to produce extremely complex outputs. Clearly, the complexity dimension affects structure through the intermediate variable of the comprehensibility of the work to be done. Note that rationalized knowledge, no matter how complex in principle, is here considered simple because it has been broken down into easily comprehended parts. Thus, automobile companies face relatively simple product environments by virtue of their accumulated knowledge about the machines they produce.*"

The two other environmental factors are *market diversity* and *hostility*. Increasing diversity may result from a broad range of clients, of products and services, or of geographical areas in which the outputs are marketed. Diversity therefore can be regarded as a part of the complexity factor mentioned previously. This is also consistent with the research and theory of Duncan, which we will discuss later on. Hostility is influenced by competition, by the organization's relations with unions, government, and other outside groups, and by the availability of resources. Hostile environments are typically dynamic. Mintzberg distinguishes hostility because *extreme* hostility has a special effect on organization structure. For our study this is less important, and therefore hostility is treated as part of dynamics.

Dynamics and complexity lead to the recognition of four coordination means. Stable environments make standardization of work and skills very valuable. Complex work can be coordinated much better when there is standardization of basic skills, and when several experts collaborate and put the pieces of knowledge they have together. When the problems are simple, the work process can be split up easily. In dynamic environments with simple problems, one never knows in advance what kind of problems must be worked on. The insights and experience of a supervisor are then important in order to have the job done well. In dynamic environments with complex problems, more expertise is required to figure out what precisely is the problem, and what different ideas exist to solve it. Here, coordination is not a supervision type, but depends on mutual adjustment. When dynamics and complexity increase, the machine bureaucratic configuration with its standardization of work becomes inappropriate. The research population of this study is confined to machine bureaucracies, which often have to move away from a traditional coordination mechanism because of increased complexity and dynamics. Figure 5.1 visualizes the research population.



The more the environment requires market diversification, the larger the opportunity for splitting up the company into separate business units and divisions. These divisions act rather independently from each other, and are only coordinated by output and performance indicators. The hostility variable influences the amount of temporal centralization and decentralization. In hostile environments, the top management must keep a close grip on all activities the organization is involved in.

Because an organization is a system of norms, one should not only look at the environmental issues of complexity and dynamics, but also at the extent to which norms are shared among the members. When there are strong commitments relating to goals and norms, e.g. in clans, organizations and individuals become strongly interwoven. This situation exists in some Japanese companies (Sullivan and Nonaka, 1986). Many western organizations, influenced by Japanese management, consider coordination via standardization, direct supervision, and mutual adjustment as too loose, and try to make their members more committed to common goals. Mintzberg calls this sixth coordination mechanism 'mission', which can also be applicable to all organization types mentioned before.

5.3.2 Organizational Configurations

Organizational configurations are defined by coodination mechanisms and the equilibrium among its interest groups. Mintzberg describes five interest groups:

1. The *strategic apex* (top management), tries to keep a grip on what is happening in the organization so that it is influenced from the view the top has about the identity and future of the organization.
2. The *technostructure* is involved with analyzing organizational processes, to make them more efficient, effective, controllable, and predictable. This frequently makes organizations more machine-like.
3. The *support staff* seldom has a dominant position in the machine bureaucracy. It mainly aims at improving administrative practices, and supports communication among members of the organization. They mostly influence the formalization of communication and information supply. Mostly information services (often called the MIS-department) are part of this support staff.
4. *The middle line*'s role is to execute tactical or operational management. Its position is often complicated, because it is in the fireline between the top and the bottom of the organization. It seeks political power and autonomy of

handling. This can lead to balkanization of the company, divisionalization and a source of power struggles.

5. The *operating core* frequently strives for autonomy and therefore wants to keep administrators, analysts (technostructure) and managers away. It promotes vertical and horizontal decentralization. Professionals are particularly effective with this strategy, because they have a specific and important expertise.

Table 5.7 relates organizational configurations with their key coordination mechanism, key groups involved and the type of decentralization.

Structural configuration	Prime coordinating mechanism	Key part of organization	Type of decentralization
Simple structure	Direct supervision	Strategic apex	Vertical and horizontal centralization
Machine bureaucracy	Standardization of work processes	Technostructure	Limited horizontal decentralization
Professional bureaucracy	Standardization of skills	Operating core	Vertical and horizontal decentralization
Divisionalized form	Standardization of outputs	Middle line	Limited vertical decentralization
Adhocracy	Mutual adjustment	Support staff/operating core	Selective decentralization
Missionary form	Ideology and indoctrination	Top and operating core	Horizontal and vertical decentralization
After Mintzberg, 1983, p. 153.			

Table 5.7: Organizational Design Configurations.

5.3.3 Criticisms of the Machine Bureaucratic Configuration

Three major criticisms relating to machine bureaucracies can possibly affect this study, and therefore must be commented on here. The first criticism is that, in contrast to Mintzberg's statements, machine bureaucracies[15] do not *match* the simple and stable environments in an effective way. The second criticism states that machine bureaucracies are not a *relevant* case to generate insights for a theory on organizational learning. The third criticism states that machine bureaucracies are *unpractical* in all cases and therefore are only the bad examples that must be removed. Let us comments on these statements before we proceed.

Comments on Match

[15] Doty, Glick and Huber (1993) make a most valuable distinction between organizational design configuration (structure and processes) and contextual configuration (described in terms of dynamics and complexity). Here, by the term machine bureaucracy we mean the organizational design configuration.

Doty, Glick and Huber (1993) stated that few theories have received so much attention with such meager empirical evidence as Mintzberg's organization theory. The authors especially reject Mintzberg's statements about the match between organization design configuration and organization environment. Table 5.8 shows results from a sample of 128 organizations. They found a very low correspondence between organizational design and environment.

Design Configuration ↓	*Contextual Configuration:* Simple structure	Machine Bureaucracy	Professional Bureaucracy	Divisionalized Form	Adhocracy	Total for Design Config.
Simple Structure	3	1	6	2	0	12
Machine bureaucracy	1	5	10	21	1	38
Professional bureaucrcay	2	1	11	16	2	32
Divisionalized form	0	0	0	10	1	11
Adhocracy	7	1	19	4	4	35
Total for Contextual Config.	13	8	46	53	8	128
Source Doty, Glick and Huber, 1993, p. 1217						

Table 5.8: Doty, Glick and Huber's findings about Contextual and Design Configurations

This evidence would falsify the statement that design and environment should match. Mintzberg however does not believe in a deterministic relation between environment and organizational design. In fact, he states that more frequently deviations of these statements exist. These findings also support our suggestions that machine bureaucracies are often confronted with more dynamic and complex environments than in the classic situation (low dynamics and low complexity). For Mintzberg's theory the situation however worsens when organizations that fit according to the theory do not perform well. The authors scored their sample on six effectiveness criteria (derived from Quinn and Rohrbaugh, 1983), and correlated these findings with the classification of each case in an ideal type, contingent ideal type and contingent hybrid type[16]. In all these cases the correlations are very low,

[16]The ideal type model is conceptualized as consistency across the relevant dimensions and is modeled as the lack of deviation from the one type. The contingent ideal type model defines a finite number of ideal

leading to a refutation of Mintzberg's theory.

types of contexts and a single ideal type of organization structure or strategy that is appropriate for each ideal-type context. The contingent hybrid type model allows hybridization among the initial ideal types and defines continua of contexts. A single hybrid type should then match a specific context (Doty, Glick and Huber, 1993, p. 1202-1203).

However, although many criticisms can be directed at the study of Doty, Glick and Huber, for instance that they used a non-random sample of only 128 cases, the study clearly indicates some problems with the Mintzberg theory. Because not many other tests of Mintzberg's theory have been carried out, and the theory is based on a volumious amount of research, summarizing most of the main stream of organization analysis from the beginning of this century till the beginning of the 1980s, it would be unwise to throw away this baby with the bath water. Nevertheless, important amendments to the theory are required. In this study for example we explicitly study lean machine bureaucracies.

Comments on Relevance

A hypothesis in this study is that many machine bureaucracies are confronted with increasing complexity and dynamics, which would remove them from the machine bureaucratic configuration. This is in many instances not possible, because of typicalities of the production process in that it *requires a strong technostructure that defines standard work processes*. The lean organization for instance cannot do without a technostructure, but makes better use of knowledge and skills available in the operating core. This leads to a closer relationship or integration between technostructure and core. Empirically this can look like decentralization. Many service organizations have made serious attempts to get away from the expensive professional way of service supply, and demand more standardization in work processes (Grönroos, 1990; Schmenner, 1986). The demand for more flexibility is realized by the extensive use of information technology and providing service specialists with easy access to client and product data.
The move of machine bureaucracies to simple structures is not relevant, because the simple structure lacks the knowledge, the division of labor, and the infrastructure to supply services and goods on a large scale for low costs. The move to divisionalized forms often occurs when the machine bureaucracies become part of larger organization conglomerates. This does not necessarily affects the stability and simplicity of the environment. It could however increase the organization's opportunities of access to knowledge and information from other business units that are part of the divisionalized form. Research has indicated that this does not happen often. Adhocracies are irrelevant for our research, because they are only viable in very dynamic and complex environments, and have only limited abilities for large scale production. Missionary forms, that use indoctrination as a major coordination mechanism are likely for religious organizations and political parties. Some machine bureaucracies, especially Japanese manufactures, also put *much emphasis on indoctrination*. This is also very relevant for lean organizations in addition to the other coordination mechanisms. By indoctrination, management costs can be kept low, which keeps the organization lean. This leads to the insight that organizational configurations are not only determined by their environmental context, but that

organizations also have the capability to adjust environments. This is especially so when we remember that organizations are open systems, and thus that much of their environments are more or less internal.

Comments on Practicality of Machine Bureaucracies

Some of the following criticisms of machine bureaucracies are mentioned in the literature on organization:

- Workers are regarded as stupid machines, and human intellectual potentials are under-utilized. This work environment leads to worker alienation, because people do not feel committed to their task, and often want to flee from it (McGregor, 1960).
- The machine bureaucracy is too specialized and becomes easily over-organized, which makes the management of processes extremely complex (Morgan, 1986).
- The machine bureaucracy leads to strong internal differentiation without enough compensating integration mechanisms (Lawrence and Lorsch, 1967). This leads to poor services because clients are asked to go through a whole building for just a small matter.
- The machine bureaucracy is organized hierarchically to coordinate the specialist activities from the top (employees are not invited to think about their own work). This leads to serious problems because important matters are sent to people lacking the knowledge to decide about them (Galbraith, 1973).
- The bureaucratic organization requires huge lead times from a new idea to a product on the market (for example Volkswagen took nine years to launch a new type of car).
- The bureaucratic organization is poor at making customized products. It does not have the flexibility to adjust standard products for specific needs.

Despite these many criticisms:

" *The essence of bureaucratic organization*[17] *is the production of standardized, predictable, replicable performance by many different people and/or groups. It is bureaucracy that makes every Big Mac the same, that ensures that a federal tax return filed in Chicago is assessed the same way as one filed in Miami, and that allows you to pick up a phone, dial a few digits, and call any other phone in North America within seconds. And in the case of mass production, bureaucracy results in the lowest costs. (....)....efficiency is the hallmark of the bureaucratic organization. So how do bureaucracies do this? Some of the basic parameters are centralized control, task specialization, functioning grouping, and internal standardization"* (Bushe and Shani, 1991, pp. 5-6).

The human relations movement of organization investigated 'solutions' for the human problems of machine bureaucracies. This was accomplished via suggestions such as:

[17]Here obviously the machine bureaucracy is impied.

- Job enlargement, and asking people to find a way of organizing this themselves.
- Flatter structures, with more decision responsibilities at lower levels (job enrichment). This led to so-called organic organizations, that demanded a considerable sense of responsibility of people on the shop floor, though it was still very formal in its working methods (professional bureaucracies). Some organic organizations also removed formal ways of working and thinking, and are mainly designed to solve unique problems (called adhocracies).

Many of these suggestions were adopted in the conceptualization of lean organizations (Womack et al., 1990) and 'The Learning Organization' (Senge, 1990a). These are discussed under the headings of responsibility norms, procedural norms and action norms.

5.4 *Consequences of Machine Bureaucracy for Organizational Learning*

5.4.1 Learning Needs for Machine Bureaucracies

Complexity and dynamics, are both determinants of the need for organizational learning. Both are individual or shared *perceptions* of internal and external environmental reality. After Duncan (1972), an organization's environment is split up into 8 components, further divided into several factors (see table 5.9).

Internal Environment	
1.	Organizational personnel component
a.	Educational and technological background and skills
b.	Previous technological and managerial skill
c.	Individual member's involvement and commitment to attaining systems's goals
d.	Interpersonal behavior styles
2.	Organizational functional and staff units component
a.	Technological characteristics of organizational units
b.	Interdependence of organizational units in carrying out their objectives
c.	Intra-unit conflict among organizational functional and staff units
d.	Inter-unit conflict among organizational functional and staff units
3.	Organizational level component
a.	Organizational objectives and goals
b.	Integrative process integrating individuals and groups into contributing maximally to attaining organizational goals
c.	Nature of the organization's product service
External Environment	
4.	Customer component
a.	Distributors of product and service
b.	Actual users of product and service
5.	Suppliers component
a.	New material suppliers
b.	Equipment suppliers
c.	Product part suppliers
d.	Labor supply

6.	Competitor component
a.	Competitors for suppliers
b.	Competitors for customers
7.	Socio-political component
a.	Government regulatory control over the industry
b.	Public political attitude towards industry and its particular product
c.	Relationship with trade unions with jurisdiction in the organization
8.	Technological component
a.	Meeting new technological requirements of own industry and related industries in production of product or service
b.	Improving and developing new products by implementing new technological advances in the industry
Source: Duncan, 1972, p. 315.	

Table 5.9: Factors and Components Comprising the Organization's Internal and External Environment.

The simple part of the *simple-complex dimension* deals with the degree to which their are only a few factors of relevance in the decision unit's environment, and these factors are similar to another in the sense that they are located in the same or a few components. The complex part indicates that the factors and components in the decision unit's environment are large in number (Duncan, 1972, p. 315). In complex situations the development of knowledge (e.g. in terms of action-outcome relations) is difficult, and needs highly specialized and educated people. Thus there is a direct impact of the complexity dimension on the needs for knowledge development activities, the dissemination of the relevant knowledge and the actual use of the knowledge. Duncan proposes to measure the amount of complexity by multiplying the number of decision factors with the square of the number of components.

The *static-dynamic dimension* refers to the unpredictability of the environment. It is measured via the frequency by which the factors of the decision unit's internal and external environment remain basically the same over time or are in a continual process of change. This dimension contains two subdimensions:

- The degree to which the factors identified by decision unit members remain the same over time, or are in a process of change.
- The frequency with which decision unit members take into consideration new and different factors in the decision-making process.

This obviously indicates learning needs because high dynamics requires the ability to update frequently and remove obsolete knowledge. Re-use of knowledge in this case will be small because conserved knowledge depreciates easily in highly dynamic environments, except when connected with more fundamental knowledge (double-loop learning). In more dynamic environments 'quick fixes' (single-loop learning) are not sufficient for an effective organization in the longer run.

Dynamics and complexity together determine the score on organizational learning needs. Especially the dynamic dimension contributes to the learning needs score, because complexity can be solved by developing a correct theory that is implemented in practices and machinery, and thus considerably reduces uncertainty and the need to learn. The dynamic factor constantly and directly increases the need for learning. In very high dynamic environments learning is very difficult, as Hedberg (1981) stated, and decisions must be based on incomplete knowledge. The organization in that environment requires a very flexible, team-oriented configuration, that is closer to an adhocracy or a professional bureaucracy than to the machine bureaucracy.

The organization literature (Buchko, 1994) has criticized this operationalization of dynamics and complexity as a measure of environmental uncertainty. It has, however, high construct validity as a measure of organizational learning needs because of its emphasis on generating insights in factors and their relations (management knowledge) (also cf. Duncan and Weiss, 1979).

5.4.2 Machine Bureaucratic Learning Norms and Deutero Learning

1. <u>Learning Policy</u>

The following issues for mission and policy norms were determined in chapter 4:

- The adaptation of organizational learning in mission and identity statements of the company.
- The development of an organizational learning infrastructure.
- The development and management of core competencies.
- Basic organizing principles that support learning..
- Management motivation for business re-engineering.

As shown in sections 5.2.2 and 5.2.3, machine bureaucracies can differ significantly on the lean-classic (organizational norms) and service-manufacturing (organizational transformation) dimensions. Additionally it was assumed that these dimensions strongly link to the way organizational learning occurs. Table 5.10 therefore describes how lean and classic machine bureaucracies differ on mission and policy norms.

MB: Learning policy:↓	Lean MB	Classic MB
Policy and mission	Learning is stated in the mission, especially in terms of continual improvement (Kaizen).	Stressing of volumes sold and produced, Return on Investment, market share, profits
Learning infra-structure	Lateral relations are encouraged. When cost-effective, data highways (computers and networks)	No lateral relations, top-down communication. Use of mainframes and information access for maintaining control. Non-transparent organization.
Development and management of core competencies	Top priority for high innovation potential	People are mainly providers of labor. Competencies are what one can do now. Human Resource Management and R&D have lower priority than marketing, manufacturing and logistics.
Organizing	Production teams, with high	Strong departmental and functional

principles	responsibility and availability of management information. Strong project teams. Organization is open system, with close relation with suppliers, banks and clients	differentiation, with strong line management. Large technostructures, with no clear influence on middle lines. Closed systems (to internal and external environments)
Motivation for business re-engineering	Emphasis on redesigning processes for maximizing client satisfaction and efficiency (is ultimate boss). Organization culture and structure must adjust to process requirements.	Optimize existing processes from efficiency perspective. Technostructure and middle line have expertise for optimization and dictate what happens at the work floor.

Table 5.10: Differences between Lean and Classic Machine Bureaucracies with Respect to Learning Policy Norms

The differences between both machine bureaucracy types are therefore huge on the learning policy side. Norms and transformation technology are however not unrelated. For instance a service organization puts much effort into an infrastructure for supporting communication, because communication is an essential technology for generating added value in services (Schmenner, 1986). This infrastructure is however not necessarily used for organizational learning. Because service organizations are mostly dependent on organization members' knowledge and skills, they will probably place more emphasis on the development and management of core competencies. They also require open systems, because it is the clients themselves who are the subject of the production process. Business re-engineering is an important issue in service organizations, because the number of services and service varieties is exploding, and the market demands dramatic reductions of production costs. Information technology has an important leverage potential here (Hammer, 1990). One of the most important reasons why services can more easily re-engineer than manufacturing organizations is the fact that most of their norms are implemented via software (in the broad sense of the term including computer programs, organizational written or tacit rules), whereas manufacturing organizations mostly have substantial large investments in machinery that is difficult to change or replace (hardware constraints).

These considerations suggest that it would be easier for service organizations to become lean than manufacturing organizations. There are however no data that clearly support my opinion. This study wil further explore some of the statements made about the service-manufaturing distinction in chapters 8 and 9, while comparing service and manufacturing companies.

2. Organizational Learning Responsibility Norms

Responsibility norms are close to what is called organization structure in organization analysis, consisting of a set of formal task descriptions, division of labor, responsibility allocations among persons and departments, lines of authority, hierarchical levels, and span of managers' control (Daft, 1989[18]). Classic machine bureaucracies are characterized by centralized authority, and some vertical decentralization of authority to the technostructure. Because of the increase in learning needs some interesting transformations of learning responsibilities can be predicted.

In situations of increasing complexity, decentralization is required because management is not able to understand and decide about all issues (Galbraith, 1973). Increasing dynamics requires fast decision-making lines as well, which are only realistic in situations of decentralization and delegation of authority.

In classic machine bureaucracies, division of labor is along *functional lines*, meaning that people are grouped together in departments by common skills and activities. This can lead to high expertise within separate departments and persons, but to severe coordination problems as well, when a more dynamic environment requires a flexible combination of skills and effective interchange of knowledge.

[18] Daft also mentions formal reporting lines and systems for effective coordination as part of organization structure. I prefer to see them as part of the organizational processes that are closely related to procedural norms to be discussed later on.

Several solutions are discussed in the literature on organization, to make more effective interdisciplinary collaboration. One of these solutions is the *divisional structure*, in which people and departments are grouped by similar organizational outputs. The division is created as a self-contained unit for producing a limited set of or a single product, or serving a specific market (region) or market segment (e.g. business and retail divisions in banks). The divisions must have all knowledge available to realize their purpose, thus: research and development, manufacturing, finance, marketing etc. This can easily lead to duplication of disciplines, and stronger coordination within the division than between separate divisions.

The second solution is the *matrix organization*, which combines functional and divisional chains of command simultaneously within one organization. This is an interesting design because it has the benefits of the functional organization (with its in-depth skills in separate departments), and the benefits of the divisional structure (with its ability to respond flexibly and adapt to changing environmental circumstances and demands). A disadvantage is the often complex two-bosses problem, which demands specific interpersonal skills of its organization members. In practice coordination is complex.

The third solution is the *team approach*. This concept implies strong decentralization and the development of multidisciplinary teams that can act rather independently. The main strength of this organization structure is that it breaks down the barriers between departments. Therefore this organization type is flexible but less good at solving problems that require high levels of specialist knowledge. An important additional disadvantage is that teams can close their eyes to the rest of the organization, leading to suboptimal solutions, and low coordination with demands from other parts of the organization. These task oriented-teams are common in functional, divisional and matrix organizations as well, to solve specific interdisciplinary problems. These teams are therefore temporal, and exist only during a specific project. I prefer the term *task groups* for these teams. Teams could also be a basic element for self-management in departmental units. The team then must clearly keep within stated targets and for the rest is free to decide how it achieves its goals. These teams I call *volvos*, because these principles of self-management have been exercised specifically within the Volvo motor company (cf. Adler and Cole, 1993).

An organization can also be split up into many temporary teams, put together specifically to serve a client. Some organizations, such as Electronic Data Systems, as described by Peters (1992), have temporary teams as the basic blocks. These teams have market resources for their survival, and are very loosely coupled to the rest of the organization. In this case the term *network organization* is used. As was shown in the EDS-case, service or expertise centers (also temporary teams) were created for the development of specialist knowledge, to be sold internally or externally. Three types of network organization can be distinguished. One, the internal organization, consisting of multiple persons, connecting each other on specific topics, to form agreements and collaborative coalitions (one example is McKinsey). Second, the organization as an ensemble of temporal task groups that serve clients independently (e.g. EDS). Third, a collection of independent companies that collaborate on a continuous basis, in order to realize certain purposes. One company acts as a broker to keep the network together (e.g. Air Bus). Finally, the term virtual organization is also gaining popularity (Hedberg, 1991). This 'organization' consists of markets that have a joint (information) infrastructure. Some examples are the Port of Rotterdam, a collection of companies that form an infrastructure; the international fund transfer system (SWIFT); and the health care business in the USA.

The final and fourth solution is called *parallel learning structures*, and is defined as:

" *...a generic label to cover interventions where: (a) a "structure" (that is, a specific division and coordination of labor) is created that (b) operates "parallel" (that is, in tandem or side-by-side) with the formal hierarchy or structure and (c) has the purpose of increasing an organization's 'learning'* " (Bushe and Shani, 1991, p. 9).

" *... in its most basic form, a parallel learning structure consists of a steering committee that provides overall direction and authority and a number of small groups with norms and operating procedures that promote a climate conducive to innovation, learning, and group problem solving. Members of the parallel learning structure are also members of the formal organization. Thus within the parallel learning structure their relationships are not limited by the formal chain of command. Some parallel learning structures are set up on a temporary basis, while others are intended to be permanent.*" (Bushe and Shani, 1991, p. 10).

These organization types can be rated on their ability to handle learning needs. Organizations' abilities to cope with increased *dynamics* are described below.

1. Functional organizations are often too slow in reacting to dynamics because their members have learned to behave precisely according to very specific rules, and therefore change is very difficult. Besides, departments involved with developing new products and manufacturing engineering are separated from the production department, which leads to a low interchange of ideas and under-estimation of problems in implementing new ideas.
2. Divisional organizations are much more able to react to specific environmental demands. Nevertheless, they are bad at joining forces with other divisions.
3. Matrix organizations combine flexibility (product orientation) with established knowledge and skills (functional orientation). The complexity of coordination that results, can make it a slow reactor, especially when large two-boss problems exist, involving enduring political conflicts.
4. Volvos are very useful for reacting quickly to specific problems. Their jurisdiction is however mostly limited to single-loop learning and quality management. Double-loop learning often requires inter-departmental task forces with strong top management commitment.
5. Network organization structures can be used in addition to make the many organization types more flexible. This implies a relaxation of formal structures and organizational borders. The network organization itself is however not

committed to learning, which is instead a strong feature of the functional as well as the divisional organization.

6. The parallel structure enables the questioning of the unquestionable and the proposing of the unthinkable. It is therefore particularly useful in highly dynamic environments.

The functional and divisional organizations are typical of the classic machine bureaucracies, whereas the matrix, teams and networks are typical of lean organizations. The parallel learning structure can be used both in lean and classic machine bureaucracies for initiating discussions about breakthroughs, and starting innovations.

The following organization types can be used to cope with increasing complexity in different ways.

1. Functional organizations organize knowledge in archives, education of personnel, rules and procedures (Weber). There is much specialist knowledge, but the specialists are not capable of transcending the sum of the parts of knowledge. In this case most teams are more stupid than any individual member of the organization!
2. Divisional organizations have very capable parts, but under-utilize the potentials of combining the competencies developed. Management therefore should *develop an explicit policy of utilizing and developing core competencies* (Hamel and Prahalad, 1990).
3. Matrix organizations are good at solving problems with divisional organizations, and can optimally exploit core competencies. This works best when instruments are developed that split through hierarchies, formal rules and procedures so that a bottom-up process of knowledge development and utilization is achieved.
4. Specifically volvos are useful for effective distribution, use and adaptation of knowledge. The team sees the problem, discusses it, and finds a solution, within the constraints of the volvo's targets and responsibilities. Research and Development task groups make the breakthroughs that are required for double-loop learning.
5. Network organizations can be very effective in responding quickly to client needs. The problem is the application and development of major new insights and knowledge. The use of expertise centers (that develop, concentrate and manage mature knowledge) is a solution here. When the network does not provide for expertise centers, it will have very low capabilities in coping with high complexity.
6. Parallel learning structures are most valuable when the problems are complex and multidisciplinary. The parallel learning structure then studies the problem in detail, and generates knowledge that the existing organization would not create.

The result of this discussion is shown in table 5.11.

	high	Network (independent companies)	Volvo's	Network (with expertise centers) Parallel learning structures
DYNAMICS	moderate	Divisional	Matrix	Task groups
	low	Functional		
		low	moderate	high
			COMPLEXITY	

Table 5.11: Match of Responsibility Norms with Learning Needs

The classic machine bureaucracy, with its functional organization, must move to divisional, matrix and even to team-based organization principles in a situation of growing learning needs. The lean organizations have already achieved a strong team-oriented organization. The service organizations can easily be transformed to the team-like structures, because they are often involved in highly interpersonal technology (except with the back office) and higher market dynamics provide stronger incentives to move in that direction. For manufacturing, the strong coupling between activities in the production process make it more difficult to create autonomous teams. The technostructure will have an important say in what happens.

3. Organizational Learning Action Norms

The organizational learning literature stresses the importance of learning not only as a cognitive activity, but especially as a behavioral activity, meaning one that changes people's behavior (Kolb, 1984; Argyris and Schön, 1978; and Fiol and Lyles, 1985). This means that effective learning requires norms that induce behavioral change when needed.

One of the most important, and possibly also most neglected, topics of learning action norms is their link with *reward and incentive systems*. Lawler and Rhode (1976) distiguish intrinsic and extrinsic motivation. Intrinsic work motivation is insensitive to changes in financial reward systems, because most satisfaction is gained from simply accomplishing the task and improving understanding of the task itself. Extrinsic work motivation is however very sensitive to the amount of payment. This means that reduction of payment will lead to reduced work motivation and that people will perform precisely what is rewarded most in the organization. In practice, intrinsic and extrinsic work motivation are both present in the motivation of a person. Professionals and academics are mainly intrinsically motivated, whereas non-professional workers are mainly extrinsically motivated (Hersey and Blanchard, 1982).

Punishment and reward systems are also essential for effective learning, because of the way they motivate participation in learning. Especially when information is an asset for power, and can be kept privately, the dissemination of information is carried out with explicit reward expectations. For instance communication about defects and problems is obscured when it leads to negative evaluations. In situations where *interpersonal trust* is very high, these kinds of group dynamics do not work. Argyris (1970) and Argyris and Schön (1978) however attribute most learning errors to a lack of interpersonal trust in organizations, so that the real causes of the learning problems of the organization are not discussed.

Knowledge and information are also often connected with the *status* people have. Removing the knowledge then leads to a change in power distribution, and therefore easily leads to resistance of change. Action norms also include statements about the importance of learning and change in relation to existing work. Simon (1976) therefore states that organizations do not try to achieve omniscient knowledge, but that organizations (and people) try to achieve a satisfactory situation. Simon is right here, however, this principle is difficult to evaluate because many different goals and values motivate people at any one time. As a consequence, evaluation of organizational learning needs should be based on a broader view of organizational priorities.

Finally, action norms concern the motivation of organization members to develop and adapt knowledge, or an organization's willingness to not do so, by buying the knowledge and skills elsewhere. This issue is an implementation of an organization's view of what must be regarded as its core competence in terms of concrete actions that must be taken to acquire the knowledge.

Table 5.12 sketches how action norms relate to organizational leanness.

MB: Action norms:↓	Lean	Classic
Incentives	Intrinsic	Extrinsic
Interpersonal trust	Openness	Defensiveness
Attitude knowledge removal	Positive	Negative
Learning priority	Relative amount of money (budget), time and authority in relation to operational tasks.	Idem, low.
Source of knowledge	External & internal sources Self development	Internal or external sources Buying knowledge

Table 5.12: Leanness of Action Norms

4. Procedural norms

Procedural norms relate to the way information is handled in organizations. Complexity and dynamics have a direct impact on the contents of these norms.

The traditionally stable environment of machine bureaucracies led to the

development of knowledge that was well conserved in procedures, structures and culture, and managed by managers and the technostructure together. Increased dynamics requires shorter communication lines between organization members. In section 5.2.2 I stated that task groups and networks (created for specific topics) in matrix organizations could be very useful here. In order to give direction to these teams and networks, the management should provide organization members with a vision and mission ('shared vision' in Senge's terms) for the future. This means that the delegation style should be complemented with a low relationship and low task management style, but with inspirational leadership at the top. Within these constraints and ideas, organization members should be invited to be creative and collaborative problem solvers. Organization members should be invited to experiment and try to find viable solutions among the many possibilities the organization is faced with (Hamel and Prahalad, 1991).
Feedback frequencies are one of the issues of procedural norms, and the dynamics of the learning environment in particular. The related hypotheses are described in table 5.13.

		Feedback from Environment (learning from experience)	
		Fast	Slow
Dynamics	High Risk Decisions (= high dynamics)	For instance in construction, cosmetics, movies, advertising.	For instance in aerospace, new ventures, research and development, capital-intensive projects.
	Low Risk Decisions (= low dynamics)	Fashion, marketing, consumer goods, electronics[19]	Government, utilities, insurance, financial services
Source: Deal and Kennedy (1982), pp. 107-127 and Daft, 1991, p. 81.			

Table 5.13: Dynamics and Required Feedback Frequencies

[19]Has recently changed. For instance Philips Electronics is now aiming for survival, and is taking part in a very competitive and risky business.

Feedback frequencies are particularly important for supporting learning. The frequency should match the dynamics of the environment. The classic machine bureaucracy has a much lower feedback frequency than the lean machine bureaucracy because of its slow communication and administration system. Additionally, the service industry must respond more critically to feedback, because its competitive position is related more strongly to the service level the organization can achieve at the particular moment the clients demand service (cf. Grönroos, 1990, talks of 'moments of truth' in this respect). The service level is closely related with the client's perception of quality and slight feelings of dissatisfaction must be coped with at once. This leads to the distribution of required feedback frequencies as shown in table 5.14.

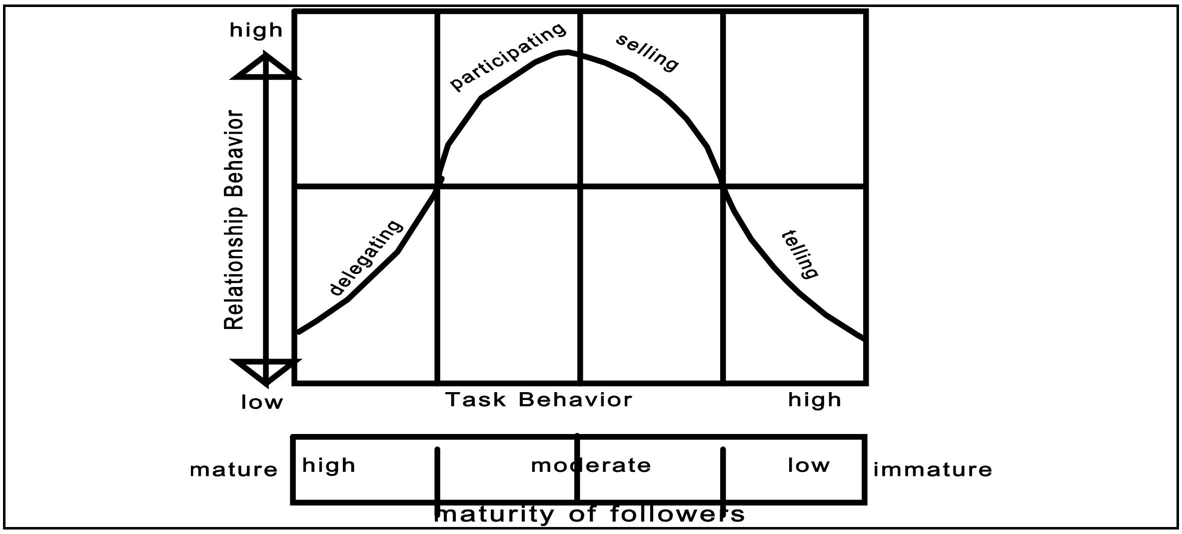
	Lean Machine Bureaucracy	Classic Machine Bureaucracy
Service	High	Moderately high
Manufacturing	Moderately low	Low

Table 5.14: Required Feedback Frequencies for Machine Bureaucractic Types.

Growing complexity in machine bureaucracies impacts on the way people communicate about management information. In the literature on organizational analysis, this subject is mainly treated under the term of management style. If complexity increases, the traditional machine bureaucratic solution is to acquire more knowledge in the technostructure that as a consequence becomes even more differentiated from the other departments. This approach confirms the traditional telling approach of management maintaining unequal power relations based on coercive power, reward power, legitimate power and expert power. Stated bluntly, employees are not considered able to think, but merely to carry out imposed tasks.

The development of super smart managers, technostructures and specialists is less necessary nowadays, because of increasing educational levels among employees. Nevertheless, some minimum 'critical mass' is needed to develop major breakthroughs and effectively manage knowledge (Nonaka, 1988).

When employees develop more expertise, they will develop a greater job maturity (Hersey and Blanchard, 1982). People low in task maturity, because of lack of ability or training, or insecurity, need high task management (telling). Those who are highly mature and have good abilities, skills, confidence, and willingness to work are difficult to manage on task and require a delegating management style. A telling style is unrealistic when no power is available for doing so and when the work is complex. In this situation a high task and high relationship style might be more effective as a managerial strategy. Nevertheless, an unstructured job can sometimes be redesigned into a structured one. When people have to work together in a situation of poor interpersonal relations, a managerial style of non-interference in a mature group might be very ineffective, and a high relationship (low task) style is required. Organizational learning in this case involves not only learning the job (task), but learning to manage persons and relationships as well (Hersey and Blanchard, 1982;



see figure 5.2).

An effective leadership style must encourage organizational learning by leaders and followers. The greater the complexity, the less a leader should be the only one to learn. Under the influence of increasing complexity, traditional telling or selling styles in machine bureaucracies must move to selling or participation. When professionalism in the organization also increases (which frequently happens in machine bureaucracies that are becoming high tech) a delegating style is required. This new style requires a transition of management styles that is sometimes difficult to achieve because the management style is closely linked with cultural values and power relationships. A good example is given by Zuboff (1988) in a paper mill. She found that plant operators demanded more autonomy and authority as a consequence of their increased sophistication. This clashed with the traditional power distribution between operators and management and the cultural values, especially held by the management, which stated that management should be in control on the basis of its knowledge, and that the management should know and the operators should act.
As a summary, procedural norms include the temporality of data flows, data access, number of items rated via the system, management style, feedback time, and distribution of expertise.

5.4.3 Machine Bureaucratic Single-Loop and Double-loop Learning[20]

[20]This study does not investigate the deutero learning process, which is about the shaping of the

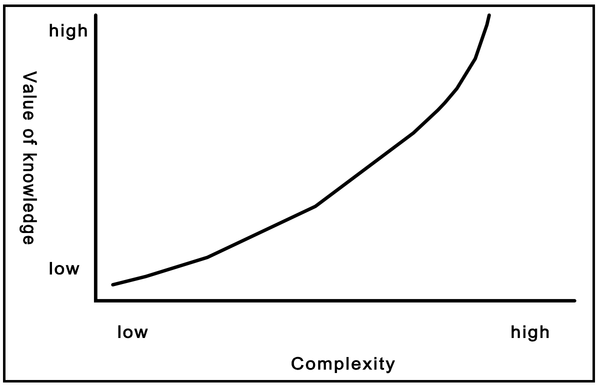
organizational learning norms. It takes its results (learning norms) as an internal contingency factor for analyzing the effectiveness of the single-loop and double-loop learning processes and the role and value of MICS. The reason for this limition is that MICS has no role in the deutero learning process, because MICS is part of the (procedural) learning norms itself.

This subsection explores the role of machine bureaucracies in the development and removal of management theories, their storage, use, dissemination and adaptation. These learning activities are labelled double-loop and single-loop learning.

1. Double-loop learning processes

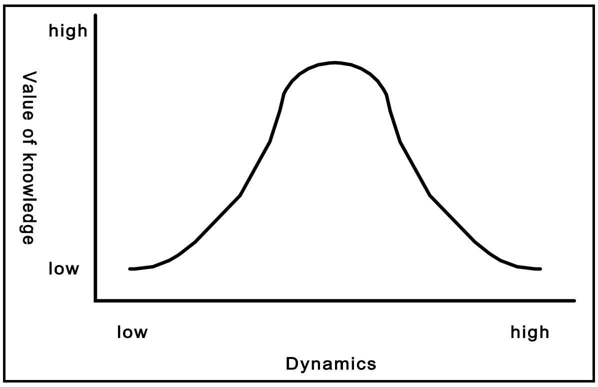
Development of management theories

Stable and simple environments do not require much double-loop learning. The development of knowledge is then often delegated to specialists in the technostructure (frequently organized in a Research and Development department), sometimes with the involvement of the management as well. For instance, in an insurance company I visited[21], the principle trend for managers was to delegate all knowledge development processes to specialists, even the most simple ones. Development of knowledge is done infrequently and has a low priority in simple and stable environments. Feedback comes slowly and irregularly, mostly organized in market research. In these studies potential customers express their opinion of products and services and their future demands when requested. The results of these studies lead to decisions about developing, manufacturing and selling new products. Because of the low complexity and dynamics the results are very precise, so that good calculations of costs and benefits can be made. The environment is low risk, and therefore demotivates the search for innovations.



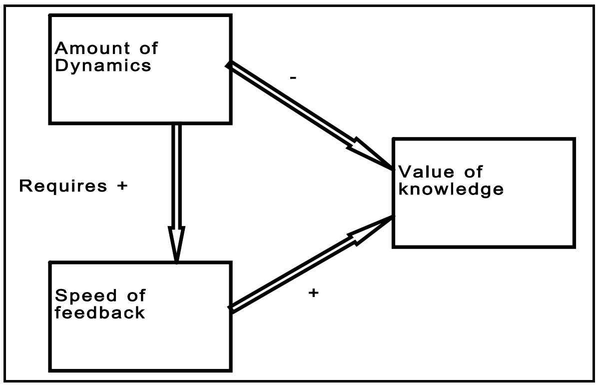
[21] Not the one that is described in chapter 8.

When the environment becomes more dynamic and complex a more active knowledge development approach is required. Besides, it becomes difficult for specialists alone. Often in machine bureaucracies problems are encountered in the manufacturing of new products because members from the production department were not involved in the product design (Hill, 1984). The risk also increases as the environment becomes more complex. Processes of critical evaluation must be speeded in order to gain relevant knowledge, because knowledge depreciation also speeds up. Knowledge development must also become systematic (e.g. explicitly asking clients about satisfaction, and actively searching for problems to be solved). When the dynamics of the environment is very high, knowledge depreciation is faster than the knowledge development process. In this case the value of knowledge declines rapidly, and management is either left over to good luck or beome able to avoid uncertainty by creating a negotiated environment (Cyert and March, 1963). Figure 5.3 shows that the increase of the value of knowledge is directly related with the complexity of the environment. Figure 5.4 demonstrates that the accumulation of knowledge is effective until the environment passes a certain level of dynamics. After that moment the depreciation of knowledge goes faster than its accumulation of value. Speeding up the feedback process can increase the value of knowledge, as is shown in fig. 5.5.



In case of high complexity and dynamics, a delegating style is appropriate, because very short communication lines are required and much knowledge is decentralized. The decentralization also leads to a restriction of the area that must be understood, and thus simplifies the problem. This can of course lead to suboptimization and dysfunctional effects in the longer run. It is typical of double-loop learning that it detects these suboptimization problems and solves them by generating an awareness of limitations, and the new insights that are required. Action norms (motivation to rethink the management theories especially in a broader perspective) and procedural norms (creating communications and activities to detect limitations and discover a wider perspective) must be set so that double-loop learning activities emerge.

Removal of management theories



The conservatism and reification resulting from the stability and simplicity of the organization's environment, makes the removal of obsolete procedures, rules, norms etc. especially difficult. Because an interchange of ideas and knowledge among departments in classic machine bureaucracies happens infrequently, at best only a few people can clearly assess the impacts of a knowledge shift for the whole organization. Resistance is likely to arise from political (position power), interpersonal and socio-technical (way of working) perspectives. Slow evaluation cycles do not motivate the removal of old ways of working, because people do not see what is wrong with the existing habits (everything is fine, until real problems crop up and the process of decline can no longer be reversed). What is perceived is the risk of losing things that are valued highly, and the fact that a major shift always bears the risk of failure. This is called 'reorganization risk' in the literature (Hannan and Freeman, 1977 and 1984). Perceived low risk could easily lead to neglecting the importance of action and up-to-date knowledge. The telling style could support the change and removal of old knowledge in an autocratic way (brute force strategies). The result of problems with unlearning is that a growing tension arises between knowledge needs and the available knowledge. Management then frequently becomes mismanagement, doing precisely the wrong things. What at first seems to be an improvement, later turns out to be a failure (dysfunctional effects). As a remedy to this way of thinking, Senge therefore proposes system dynamics thinking, emphasizing the analysis of (unexpected) dysfunctions of behavior.
The factors mentioned in table 5.15 thus influence the likeliness of double-loop learning in lean and classic machine bureaucracies.

MB: Removal and double-loop trigger issues:↓	Lean	Classic
Source of resistance to change	Much emphasis on details	Expert power and position power
Perceived urgency for double-loop learning	High urgency, perceived as essential for survival and continuation of the organization	Low urgency perception
Risk awareness on shorter and longer term	High awareness of longer term risk	Low awareness of longer term risk
Learning speed	Higher learning and critical evaluation processes, reducing knowledge	High discrepancy of knowledge when dynamics increase (theory

	depreciation in dynamic environments	vs. practice)

Table 5.15: Lean and Classic Impact on Knowledge Removal.

Definition of a Double-Loop Score

Many dimensions of double-loop learning are given in this subsection. We are concerned mainly with two double-loop learning activities: theory development and unlearning. In chapter 4 we found four basic fields of learning, namely: human resources, transformation (production processes), markets (for acquisition of resources and growth), products (as concrete field of productivity and efficiency). A double-loop score can now be defined as the *amount of theory development and unlearning that occurs related to the four learning fields, in organizations*.

2. Single-loop learning processes

Storage of knowledge

In stable environments knowledge once developed in the form of procedures, norms, rules etc., becomes a person's second nature. This implies a *separation between know-how and know-why*. I found an example of this in a Dutch bank, where a large system of norms had been developed relating to the flow of forms and information for processing payment services. The system became so complex that many people did not know why certain forms were used and should be passed over to other departments. A consultant found out that many forms were not even applicable anymore because payment services had changed enormously in the last decades.
Sometimes only the leader or a person from the technostructure knows the connection between know-how and know-why. This knowledge inequality is consistent with the telling style of some managers, and is a source of expert power. Growing complexity requires the dissemination of know-why knowledge besides know-how, because it is difficult for the management to know everything and instruct followers effectively. Besides, tasks often require the knowledge of several people, and individual job execution is rare. In cases of high complexity, knowledge storage increases the value of knowledge because problems can be explained better and treated more effectively. The knowledge storage process however can easily lead to a situation in which the value of knowledge *decreases*. This happens when an information overload is generated. Some 'solutions' to this problem are: create improved management theories that aid selection among valuable and invaluable knowledge, create new learning norms that improve the use of the knowledge base, and the removal of obsolete management theories.

When dynamics increases, the storage of knowledge is useful for creating continuity, but can also act as a brake on innovations. Stored knowledge can be used for learning from the past. A more interesting opportunity is that of innovation by connecting different *core competencies*. This requires a matrix organization structure or task force, because core competencies are generally not shared among departments or SBU, and an inspirational leadership that stimulates ideas and activities in the organization for connecting competencies that are seemingly very different and unconnected.
These considerations are generalized in table 5.16 that summarizes the use of conserved knowledge in lean and classic machine bureaucracies.

MB: Storage:↓	Lean	Classic
Acquisition	Much knowledge and data	Much knowledge and data
Retention	Less, because much removal when needed Closely connected with mind and motivation	Much In archives, formal rules and procedures
Retrieval	Much. Applied to problem solving	Less. Connected with procedures, indirectly linked with problems

Table 5.16: Differences in Knowledge Storage Between Lean and Classic Machine Bureaucracies

Use of knowledge

Ideal typical machine bureaucracies use knowledge developed in the past. It is therefore very conservative, but one could also think that change is not necessary because of the stability of the environment. Dynamic environments do require changes of knowledge, which is hampered by reification processes resulting from tradition. Using stored knowledge can also lead to competency traps, as was mentioned in chapter 4 (Kim, 1993; Levitt and March, 1988). Because the environment is simple, much knowledge is tacit. Making it explicit is sometimes very difficult but essential for reliable *reapplicability* of the knowledge.
The formal functional organization of machine bureaucracies leads to a very specialized use of knowledge, and even to knowledge ownership. This is not only the result of a political constellation that exists in machine bureaucracies, but also of problems in *applying* knowledge created elsewhere. The problem of the applicability of knowledge is linked with the fact that departments often lack a shared body of knowledge.

Dissemination of knowledge

Knowledge dissemination involves three major activities, that are particularly problematic in complex situations with low codification:

- Distribution of messages. This is the physical process.
- Mutual understanding. This is the semantic aspect of message dissimenation.
- Synchronization. This implies that people's understanding matches in time.

The first issues are standard problems mentioned in the communication literature (Stamper, 1973; Guetzkow, 1965). The synchronization issue is less well treated, but essential, because people must act in concert. When one organization member is still busy selling product X while other members have already found out that selling X only leads to losses and thus must be stopped, the organization is acting inconsistently because of the lack of a shared body of knowledge. This synchronization issue is well treated in the database literature (Rochfeld and Tardieu, 1986).

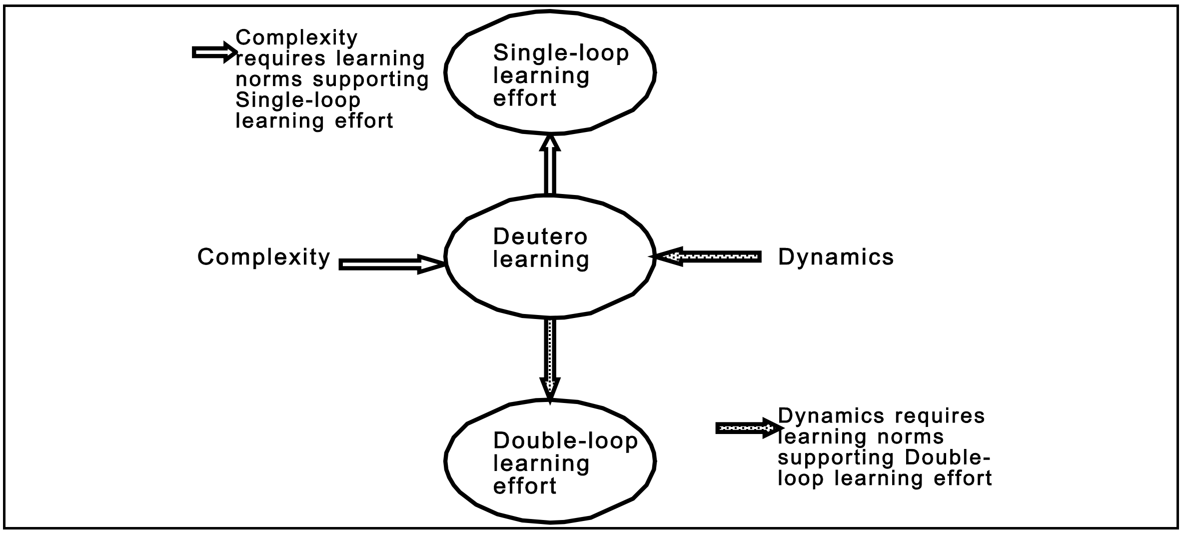
In stable environments, knowledge dissemination consists of regular reports and formal data streams. Low complexity environments can more easily create unambiguous information. Everybody receives precisely the data/information needed for his particular job and a precise data distribution schedule exists restricting synchronization problems. When environmental characteristics are very stable, speeding up knowledge dissemination by automation can be very effective. When complexity increases, standard reports no longer suffice. Dispersed knowledge must be connected to find solutions for complex problems (task groups) increasing the risk of asynchronous communication. Media richness should be increased to lower ambiguity and increase understanding (Daft and Weick, 1986). High dynamics demands faster communication channels too, and some delegation of responsibilities.

Adaptation of knowledge

Low complexity and a rather stable environment lead to slow and incremental changes in organizational knowledge. Actions in this situation are strongly motivated by *action plans* that have undebated models containing means-goals theories as their foundation. Not using these models can lead to actions that are not-legitimated. This can lead to severe sanctions when with hindsight these actions seem to have been ineffective. Adaptation of knowledge is mostly done by the person responsible for the knowledge. In the highly differentiated structure of machine bureaucracies this implies that knowledge adaptation is a specialist (technostructure) activity. Because feedback about mistakes is a slow process, adaptation is a time-consuming business, often leading to the implementation of knowledge that is already invalid. Additionally, the low risk of the environment demotivates organization members to start adaptation processes.

Performance control for evaluation and knowledge adaptation is often not done and not enough attention is paid to it. For instance in the Dutch high-tech company mentioned in chapter 4, at an assembly unit in 1992 production norms were used

that had been developed in 1968. In this organization (with fast moving dynamics because of rapid products and process innovations, this led to norms that are not applicable for the effective steering of the units. Strangely enough the organization has not changed its production norms in 14 years. Now that the company has come into a very hostile and competitive environment, it is being forced to reconsider its norms. This study is not being carried out by its own technostructure or management, but by one of my M.Sc. students! The rules, norms and procedures have reified the organization in such a way that it is not capable even of realizing a single-loop process.
The adaptation process can provide important triggers for double-loop learning. This happens when the complexity of the environment increases, so that the management theory cannot give a valid explanation or offer effective proposals, or when the dynamics has increased to such an extent that a theory must be found that improves understanding. Often uncertainty avoidance strategies are regarded as more effective than learning. In the longer run this could be untrue, as was shown in the case of lean production.



Definition of a Single-Loop Learning Score

The rating of learning activities can be done by noting the number of learning fields an organization is concerned with, and the number of activities undertaken as was done for the double-loop learning score. A further description of a scale for single-loop learning is presented in chapter 7.

5.4.4 A Note on Deutero Learning

Lean and classic machine bureaucracies have different ways of adapting to environmental changes. These approaches were already summarized in the previous discussion of learning norms. From these discussions we also know that in the case of high dynamics, double-loop learning (creation of new theories) is extremely important to overcome the risk of working with obsolete theories. This means that relatively more effort must be placed in double-loop learning activities. When the dynamics is low, but complexity is high, it is important to put a greater effort into single-loop learning, and specifically in the storage and re-use of knowledge to reduce learning costs. Double-loop learning is less necessary in that case, because the basic assumptions will still be valid. Learning norms govern the decisions on learning efforts (particularly learning policies) and are themselves the result of a deutero learning process. This is pictured in the figure 5.7.

5.5 *Summary*

In this chapter we presented the major factors describing the lean-classic and service-manufacturing dimensions of machine bureaucracies. The lean-classic distinction is defined by 10 items: attitude to quality, level of decentralization, availability of lateral structure, relations with clients, relations with employees, financial decision-making structures, human resources management ideas, people's motivation basis, and sources of new ideas. The manufacturing-service distinction is described by 8 items: material and equipment, involvement of client in production, information processing, responsibility for success, description of process phases, stocks and buffers, systems boundaries, and professionalism.

The term learning needs has become more concrete via the application of Duncan's list of environmental components and factors by which the dynamics and the complexity of organizations can be scored. In chapter 7 we will investigate how an index of learning needs can be defined.

The term deutero learning is made more operational in this chapter. Deutero learning can be described by its leanness and service-manufacturing nature. Responsibility norms can be described in 8 organization structures: functional, divisional, matrix, task groups, networks consisting of independent companies, networks with expertise centers, volvos, and parallel learning structures. Action norms are about incentives, interpersonal trust, attitude to knowledge removal, learning priority, and source of knowledge. Procedural norms are about feedback frequencies, but are not very concretely defined yet. This will be done in more detail in chapter 6 (about MICS).

Some hypotheses were defined about the value of knowledge given a certain degree of complexity and dynamics. One can state that increasing complexity leads to a higher value of knowledge. The value of knowledge increases until a moderate level of dynamics is achieved. Higher dynamics leads to a decrease of the value of knowledge.

Single-loop learning is linked with both the lean and the classic characteristics of organizations. For storage specifically, the focus is on acquisition, retention and retrieval of knowledge, in all cases very different in lean and classic machine bureaucracies (table 5.16). For the dissemination of knowledge, the focus is on distribution, mutual understanding, and synchronization of understanding. The adaptation of knowledge seems to be different for action planning and performance evaluation. In the following chapters we will often use the terms problem anticipation and critical evaluation instead of action planning and performance evaluation, to stress the importance of learning in these activities. Further arguments for the use of these concepts are also given in section 6.3.2.

In chapters 6 and 7 the dimensions of organizational learning will be further defined.

Chapter 6: Role and Value of Monitoring Information and Control Systems for Organizational Learning

6.1 *Introduction*

The organizational learning literature is full of contradictions about MICS' role and value. In her study of Texas Instruments' planning and control information system, Jelinek (1977) concluded that information systems contributed considerably to (institutionalizing) organizational learning. These results have been severely criticized by Mintzberg, because according to him the systems did not capture any knowledge and they failed soon after her book was published. Mintzberg therefore states (1989, p. 350):

> " *Texas Instruments' own fancy planning system was subsequently believed to discourage innovation. In fact, there never was any evidence that the company's success stemmed from anything more than a capable leader who knew how to learn and whose own energy and enthusiasm enabled him to attract good people and to invigorate them. Good people, of course, make for good organizations. They also design good systems, at least systems that are good for them. But remove the good people and the systems collapse. Innovation, it turned out, could not be institutionalized.*"

In another publication Mintzberg directly links MICS' abilities with machine bureaucratic environments:

> " *...in the tall administrative structure of the Machine Bureaucracy, information must pass through <u>many levels</u> before it reaches the top. Losses take place at each one. (...) The fact that the transfers are vertical - between people on different status levels of the hierarchy - means that intentional distortions of information also occur. (...) Probably a greater problem is the MIS's emphasis on 'hard' (quantitative), aggregated information. A good deal of evidence suggests that it is not this kind of information top managers need to make their strategic decisions as much as it is soft, specific information. (...) Often the MIS data are too late as well*" (Mintzberg, 1983, p.184).

Mintzberg's conclusion is that MICS contributes nothing.

Mohrman and Cummings (1989) are more optimistic about MICS use:

> " *High-performing organizations employ multiple systems for gathering relevant information, making appropriate decisions, and communicating responses to specific groups and departments. They often supplement sophisticated management information systems with less quantitative devices to ensure that information flows in all directions. For example, these include coordinating councils, customer focus groups, employee sensing meetings, cascading information sessions, and weekly videos of 'messages from the president'. These information-processing systems help organizations better scan their environment and integrate their subparts so they respond to complex and changing*

conditions cohesively" (p.9).

Other authors are less unconditional about MICS' value. For instance Argyris states:

" *If we define learning as the detection and correction of error, then learning is a core activity of any organization and any MISS*[22]*. (...) Control, in order to be effective, is designed in many organizations to be unilateral. Along with the unilateral feature, there tend to exist sanctions in order to make certain it has 'teeth' (1980, p.15).(...) Model I theories-in-use are theories of top-down, unilateral control of others in order for the actors to win, not to lose, and to control the environment in which they exist in order to be effective. But it can be shown that Model I theories-in-use lead to effective problem-solving, primarily for issues that do not require that the underlying assumptions of Model I theories-in-use be questionable; that is single-loop learning Model I theories-in-use do not make it possible for people to have problem-solving skills that question the governing values of their theory-in-use; that is double-loop learning*" (p.21).

To remove these contradictions the following questions must be asked. What can a MICS *contribute* to a group of 'good' people so that they can be more than just enthusiastic? What *role* could a MICS play in a group learning process? How can MICS lead to institutionalization of learning processes? If MICS really enables institutionalization of organizational learning, how should we evaluate this? To solve these questions, we must first understand more clearly what we mean by MICS. An additional question is, what is so specific about MICS in comparison to other types of information systems? Answering this last question is important in order to understand the domain of research. Like machine bureaucracies, MICS is used here as a heuristic case to develop a theory about the relation between organizational learning and information technology.

This chapter describes MICS from an organizational perspective, after having described information systems in general. The organizational description is done in two steps. The first step is a description of MICS' roles. The second step is a description of MICS' roles and values for organizational learning, and describes how MICS might be used in organizational activities.

6.2 *Information Systems: Technology and Organizational*

6.2.1 Technical and Organizational Aspects of Information Systems

[22]Argyris uses the term MISS for monitoring information and control systems.

Many times, the term 'information system' has been connected specifically to computer-based information systems. Although it is obvious that computer technology has contributed substantially to the creation of modern information systems, the major developments in information systems were not computer-based but social and organizational. A restriction to computer-based systems does not:

1. Include the many formal and manual systems that do precisely the same work and are often required in addition in order to achieve effective computer-based systems.
2. Include the many informal systems and norms that are also engaged in information processing.

Number 1 is exemplified by a case on flexible manufacturing systems. In order to manufacture a certain steel pressed product, a small company bought a flexible manufacturing unit costing over $200,000. This advanced system was, however, hardly used. People continued using the traditional construction tools, because the organization was not able to provide the required data input to manage the manufacturing process via the computers. As a consequence, an elaborate formal administrative organization had to be developed that was not yet in existence in this small informal organization.

Number 2, I encountered in a large insurance company that had developed an executive information system. The management problem was however not the lack of accurate information, but the organizational culture, not used to top executives having such an active approach to management and information gathering. This new way of management by open communications between executives and directors of the departments, meant a large change in work and culture.

An assessment of information systems thus not only requires an evaluation of their technical operation, but also an evaluation of their social function. This means that all six layers of information are necessary to evaluate the physics, empirics, syntactics, semantics, pragmatics, and social aspects (Stamper, 1973; also see section 1.4). The first three layers are about information *technology*, the other three layers are about *social and organizational* aspects of information systems.

6.2.2 Technological Aspects of Information Systems

One of the basic reasons for starting this study, and many other IT impact studies, is that information technology *can* change traditional ways of management and organization. This statement however, does not mean that one should use a technology deterministic view on impact, because impacts are a result of the interaction of organizational features and information technological opportunities (cf. chapter 2). This means that one must consider the formal and informal information systems as a broader environment in which computer-based information systems impact on the organizational environment. The basic computer technologies that have fuelled these discussions are: computer components technology (Tanenbaum, 1984), database technology (Date, 1982; McFadden and Hoffer, 1991), data communication and telematics (Tanenbaum, 1988), and knowledge engineering (Kerr, 1991). These technologies can be described by key terms at the physics, empirics and syntactics levels as summarized in table 6.1.

Technology: Semiotics:↓	Computer components	Databases	Telematics	Knowledge engineering
Physics	Processors, busses and screens	Storage devices	Networks	Processors and storage devices
Empirics	Processing capacities, processing operation	Amount of bits and bytes	Coding and decoding systems	Amount of knowledge rules
Syntactics	Virtual machines and operating systems	Data model, conceptual schema	Communication protocols	Principles (logic) of knowledge representation

Table 6.1: Features of Information Technology Described in the Technical Layers of Stamper's Semiotic Framework.

These technologies are based on the application of digital computers that consist of internal and external memories, control units, registers, and logical and arithmetic units (Tanenbaum, 1984). They serve as replacements for archives in the shape of paper files, personal files and memory that can have exactly the same function. The main question at the technical level therefore becomes: What is most cost effective: computers or the traditional technology? The answer to this question depends on the application field. In purely technological terms the answer depends on the cost of purchase and maintenance of the physical devices, the complexity of creating the software and procedures and technical problems with coding and storing. Each time of use would mean some (fictional or real) payback of the investments involved. If use is restricted to a specific period the payback is often not sufficient.

6.2.3 Organizational Aspects of Information Systems

Information systems can have several functions (roles and values) in organizations. Several approaches are valuable in describing these functions, such as:

1. Economic principles, for instance via description of the value chain and IT's contributions (Porter, 1985).
2. Organization design principles, by describing different coordination mechanisms and IT as an additional coordination mechanism (Mintzberg, 1983).
3. Management functions and IT's role. This is especially useful when trying to define user requirements for specific management functions (Davis and Olson,

1985).

4. Organizational transformation, which closely resembles the previously mentioned value chain, however with emphasis on the construction of products and delivery services as a transformation of inputs to outputs (e.g. Perrow, 1967; Hill, 1983). In that case information systems can have an important role in controlling, planning and checking production runs.
5. Planning principles by identifying stages in the development of the information supply by constructing a hierarchy of systems (Anthony, Daerden, Bedford, 1984; Porter, 1988).

Organizational learning focuses on management in the organization's context and therefore requires the *organization design and coordination perspective*. The management approach might be interesting as well, but requires the elaboration of a different conceptual framework.

The coordination approach states that a viable organization has an operating core, a middle line, a strategic apex, a support staff (including administrative services), and a technostructure. Organizations can differ tremendously in the number of people and amount of money spent on these five groups in the organization (cf. chapter 5). Information systems have organizational functions when supporting or replacing these groups. These systems generally have specific names (cf. Markus, 1984; and McKeown and Leitch, 1993), and are grouped in table 6.2.

Function group	System type
Operating core	Transaction or order processing systems. EDI (interorganizational). Expert systems for professionals.
Middle line	Monitoring information and control systems. Management Information Systems or Management Reporting Systems.
Apex	Executive Information Systems, or Executive Support Systems
Support Staff	Office Information Systems, Computer Support for Collaborative Work, Legal Expert Systems, knowledge-based systems
Technostructure	Decision Support Systems (DSS), Group DSS, some Expert Systems, Computer Aided Design and Computer-Aided Manufacturing.

Table 6.2: Organization Functions and Information System Types.

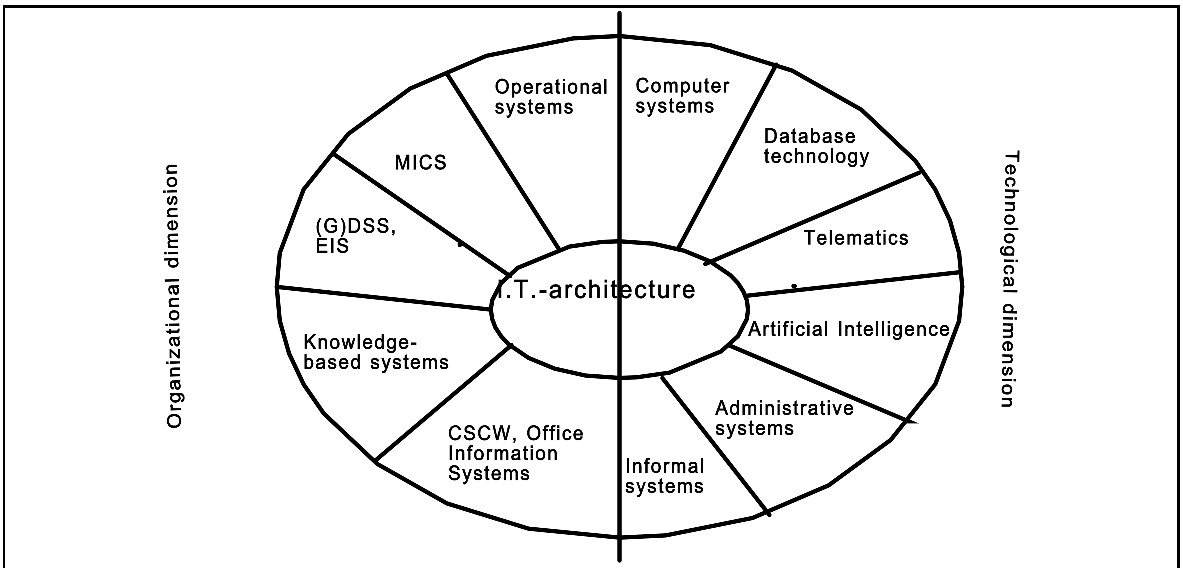
This study is about the MICS systems (often also called MIS or Management Reporting Systems). At the semantic level MICS systems must have data and models that are unambiguous for different users. This presumes a common understanding of reality described in shared management theories. The receiver of these insights and data is not a passive consumer of these messages, but checks its validity in relation to other insights and data. This involves an adaptation process, which requires a specific responsibility structure. At the pragmatic level the insights gained from new theories

and data must result in new behavior. It is therefore important that action norms are created that induce people to use new data and insights. The receivers of these data and insights also have opportunities for creating their own knowledge, so that the received messages are checked for their relevance. At the social level MICS' role must fit in a set of learning responsibilities and procedures. When for instance MICS leads to a possible change of power (as was the case with Markus' financial information system and Zuboff's paper mill, cf. Markus, 1983 and Zuboff, 1988) this must be foreseen and be part of its design. Also ways of disseminating messages, ways of communicating and decision-making can change and must be planned and implemented when required. MICS distinction from other information systems (such as operational systems, DSS, knowledge-based systems, and CSCW) is however only typological, and in practice not always easy to make. It does however focus attention on issues of importance for investigation.
An additional way of looking at IT can be mentioned: *IT-architectures*. IT-architectures are configurations of systems. This proposes interconnections between systems, which makes it sometimes difficult to talk about systems as having one function or one technology. The architecture concept also suggests the view of separate systems that profit from each other's data, models, and features (e.g. MICS using the database of the order processing system that is connected with an Electronic Data Interchange system using telematics, Earl, 1989). Because of increasing IT-integration, this is becoming more realistic and will pose major organizational learning questions in the near future.
Figure 6.1 gives a quick summary of the information systems typology found so far. In the following subsections, the technical and organizational dimensions of MICS are further described.

6.3 *MICS: Technological and Organizational*

6.3.1 MICS: The Information Technology Dimensions

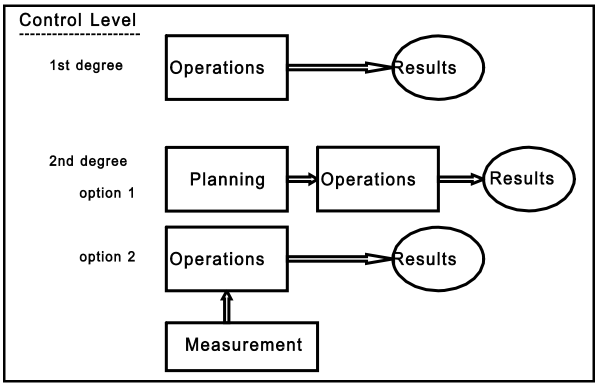
1. Physics



MICS has undergone considerable changes since the development of computer technology. Because of this technology it is much cheaper to apply database technology, by which files can be managed in concert. This improves the connections between more-or-less independent departments (such as manufacturing and marketing). Well-designed databases not only link dispersed data, but they also support the efficient management of data (reducing redundancies, reducing the chance of inconsistencies and safe-guarding against unauthorized use; cf. McFadden and Hoffer, 1991; Nijssen and Halpin, 1989). Of particular interest is the fact that decisions can be based better on facts instead of (political) convictions and power. Additionally, the increase of the computing power of personal computers aided the processing of user-friendly executive information systems which, when connected to an organization's information network, enable the executive to be much more knowledgeable about organizational events. From a management perspective, the organization then becomes more transparent. As a consequence, middle line positions exclusively for the purpose of information dissemination are becoming rare. This would solve many of the problems Mintzberg foresaw in the relation between machine bureaucracies and organizational learning mentioned at the beginning of this chapter. Being equipped with data about the rest of the organization via the Executive Information System and its network, enables managerial autonomy to be less risky and more effective than ever (Gurbaxani and Whang, 1991).

2. Empirics

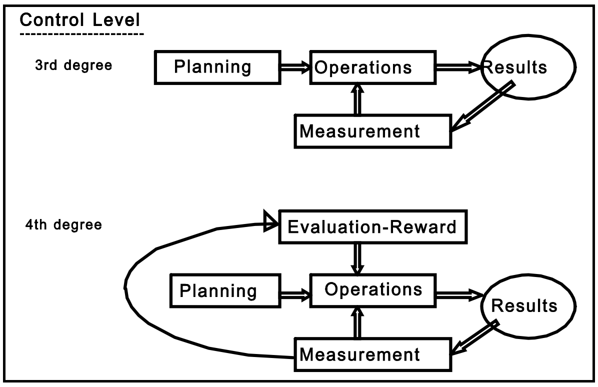
From an empirics point of view, MICS's require a specific kind of information flow. Depending on the way these data flows are organized, one can state that the organization has a different level of control.



A basic feature of all MICS is that data about operations' results are created and made available in the organization. This first level of control, as described in figure 6.2, leads however to interpretation problems, because:

- Norms are unknown, which makes it impossible to make comparisons with plans and this means that data about results are used as arguments for *and* against, depending on the interests at hand.
- Ways of measurement are unreliable, because no systematic measurement tools have been developed that are relevant from the managerial perspective.

Both problems are solved by developing clear standards of performance in the problem anticipation process and by developing measurement instruments. Often only one of these solutions is implemented leading to second degree control (cf. figure 6.2). Option 1 is the case of feedforward control, and option 2 concerns feedback control. Both are ineffective when not combined. The feedforward system does not evaluate and check its assumptions. The feedback system does not know why the operations were executed, and thus does not know the assumptions. When both systems of feedback and feedforward are combined a closed control loop is realized called third level control (Flamholtz, 1983; cf. figure 6.3). This closed control loop becomes a single learning loop when an evaluation and reward component is added, which motivates people to draw conclusions from the data (figure 6.3). In this case the technical information system and the human motivation system are connected, which is a basic requirement of any human learning system and the fourth level of control. The single-learning loop becomes a double-learning loop when the evaluation, measurement and planning subsystems become a field for feedback. This corresponds to the fifth degree of control. IT can support closed learning loops, because of its efficient, quick analysis, and fast dissemination of data. Lean organization possibly profit more from IT for learning, because of their higher awareness of data value (lower power play and more explicit mental models).



3. Syntactics

A fully developed MICS thus consists of six basic elements that form the MICS-structure (Flamholtz, 1983; Ansari, 1977):

- Standards and objectives.
- Measurement instruments.
- Source of data and order of presentation.
- Timing and frequency of data.
- Route of data flow.
- The extent of information sharing among potential users.

The cybernetic approach to organizational learning defines MICS in terms of its information flows (empirics) and its structure (cf. the discussion of De Raadt's cybernetic organizational learning concept in chapter 4). They do not bother about complications with understanding a system's output and how new insights should change behavior or organizational structures. This last concern is stressed by organization development authors, to which we owe much of the following description of semantics, pragmatics and the social aspects of MICS.

At the syntactic level MICS also should have some important features, as otherwise its usableness (and success) will be low. These features are:

- Man-machine interface quality
- Flexibility of databases, providing many entrances and opportunities of adaptation
- Quality of the administrative organization. The chance of poor data can be reduced by introducing rigorous procedures, and methods of checking quality

of data.

- Comparability of data structures, so that the chance of effective exchange of data is high.

6.3.2 MICS: The Organizational Dimensions

4. Semantics

Weick (1985, pp. 52-54) describes these problems as sense-making processes, with the following elements:

1. Effectuating: "*People learn about events when they prod them to see what happens. (...) People find out what's going on by first making something happen. (...) Since action is the major source of human perceptions and intuition, any assessment of the potential for sense making must pay close attention to action.*" The involvement of the people where the data are about in interpretation processes is therefore essential in sense-making.
2. Triangulating: "*People learn about an event when they apply several different measures to it, each of which has a different set of flaws. (...) These various 'barometers', each of which presents its own unique problem of measurement, begin to converge on an interpretation*".
3. Affiliating: "*People learn about events when they compare what they see with what someone else sees and then negotiate some mutually acceptable version of what really happened*". People not only want to have several sources of data (triangulating) but also want to discuss with other people how they perceive reality and want to bargain about what 'really' happened.
4. Deliberating: "*People learn about events through slow and careful reasoning during which they formulate ideas and reach conclusions*". This simply means that people need time to make up their minds about reality by means of interpreting data.
5. Consolidating: "*People learn about events when they can put them in a context*". Therefore people need more than simple data, but also a view by which they can relate data to interpretations of what happened.

Information systems, particularly MICS, are supposed to support making sense, therefore to support the *creation of information or mental models* instead of information processing capabilities (Nonaka, 1988). Weick is however not very optimistic about the potentials of information systems to support the sense-making process:

" *People using information technologies are susceptible to cosmology episodes because they act less, compare less, socialize less, pause less, and consolidate less when they work at terminals than when they are away from them. As a result, the incidence of senselessness increases when they work with computer representations of events*" (1985, p. 56).

In my perception the cosmology problem has its roots in a poor match of MICS with individual and organizational interpretation systems.

Individual interpretation systems concern the individual's way of understanding the world. Four types were identified on the basis of Kolb's prehension and transformation dimensions in chapter 4 (figure 4.1): accommodator (concrete experience and active experimentation), diverger (concrete experience and reflective observation), converger (abstract conceptualization and active experimentation), and assimilator (abstract conceptualization and reflective observation). MICS systems match well with the 'diverger', because these systems improve the sensing process by supporting the process of data gathering in organizations. The 'assimilation' learning type is mainly interested in developing and applying abstract models. In fact MICS develops models only in an incremental way. The data can improve insights in reality, but the MICS-application is not explicitly designed for improving or generating many alternative models. MICS contains a model of reality itself, that is difficult to change. EIS-applications have more opportunities here. Particularly Decision Support Systems are designed for developing models (c.f. 'I Think'; Wijnhoven, 1992b). E-mail systems, teleconferencing and Group Decision Support Systems are particularly designed to 'converge' insights that are available at different places and persons in the organization.

Especially in small companies, and in situations in which managers work independently, these psychological traits are important. If the decision-making process is of a more collective kind, it is more useful to stress the importance of culture and organizational structures and processes in understanding the interpretation of data. According to Daft and Weick (1984) organizational interpretation systems should be designed in line with the complexity of the environment, they call it analyzability, and the extent to which organizations actively search for interpretations themselves (learning effort in our terms). By applying both variables dichotomously, four interpretation systems are defined, presented in table 6.3.

unanalyzable	UNDIRECTED VIEWING Scanning Characteristics: 1. Data sources: external, personal 2. Acquisition: no scanning department, irregular contacts and reports, casual information.	ENACTING Scanning Characteristics: 1. Data sources: external, personal. 2. Acquisition: no department, irregular reports and feedback from environment, selective information.

	Interpretation Process: 1. Much equivocality reduction 2. Few rules, many cycles Strategy and Decision Making: 1. Strategy: reactor 2. Decision process: coalition building	Interpretation Process: 1. Some equivocality reduction 2. Moderate rules and cycles Strategy and Decision Making 1. Strategy: prospector 2. Decision process: incremental trial and error.
ASSUMPTIONS ABOUT ENVIRONMENT analyzable	CONDITIONED VIEWING Scanning characteristics: 1. Data sources: internal, impersonal 2. Acquisition: no department, although regular record keeping and information systems, routine information. Interpretation Process: 1. Little equivocality reduction 2. Many rules, many cycles Strategy and Decision Making: 1. Strategy: Defender. 2. Decision process: programmed, problemistic search.	DISCOVERING Scanning Characteristics: 1. Data sources: internal, impersonal. 2. Acquisition: Separate departments, special studies and reports, extensive information. Interpretation Process: 1. Little equivocality reduction 2. Many rules, moderate cycles Strategy and Decision Making: 1. Strategy: analyzer. 2. Decision process: systems analysis, computation.
	Passive ORGANIZATIONAL INTRUSIVENESS	Active
Daft and Weick, 1984, fig. 3, p. 291		

Table 6.3: Interpretation Modes and Organizational Processes.

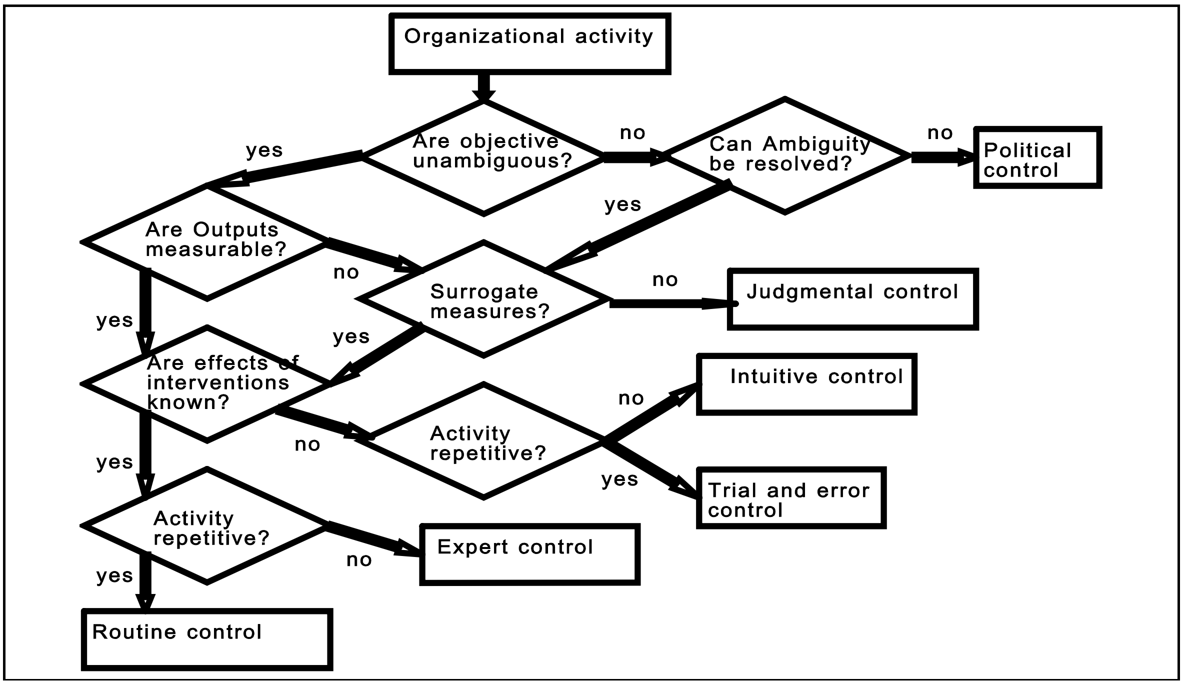
Computer systems could be usefully applied when the situation is analyzable and when large amounts of data must be processed. MICS is often used in organizations for supporting 'conditioned viewing'. This means the monitoring of processes by means of internal and impersonal (objective) data. This implies that the information output must lead to clear action proposals, which is only possible in closed loop learning situations. In lean organizations, the data from monitoring processes are however also used for a more active 'discovering' of what is at stake, and therefore a start to learning. Executive information systems are often mentioned as tools for supporting the 'enacting' process, which requires opportunities for processing data of an undetermined format. 'Undirected viewing' is only possible with very informal information systems (Hedberg and Jönsson, 1978). Computer-based information systems will possibly not pay off in that case.

The analyzability also requires different types of control. Hofstede found four basic questions that determine organizational control:

1. Are objectives unambiguous, or can ambiguity be resolved?
2. Are outputs measurable, or can acceptable surrogate measures be found?
3. Are the effects of management interventions known?

4. Is the activity to be managed repetitive?

When objectives are unambiguous, outputs can be measured, and if the activity to be managed is of a repetitive type, the situation may be called analyzable, and control systems can be used to support management effectively and efficiently when also large data processing is required. In all other situations there is low analyzability, and the use of computers is only useful for the generation of hypotheses (DSS-systems). Again there must be a lot of data processing, and reliable data at the basis of the system. By means of the following decision tree, one can detect the type of control (and thus the type of meaning of an MICS' output) (see fig. 6.4).



Political control situations have incompatible models of reality, which means that data can be interpreted in different ways to support conflicting interests. All other types of control, with the exception of expert control, refer to situations in which shared mental models are created, and therefore data lead to interpretations that support common interests.

As a conclusion, *three types of scores of MICS can be given at the semantic level*:

- *Learning styles of users and implicit learning styles of systems*. The thesis was that MICS mainly supports divergence and accommodation knowledge. If the organization (or situation) requires convergence and assimilation, MICS cannot cope.
- *Analyzibility and intrusiveness of organizations and match with MICS*. The thesis is that MICS supports 'conditioned viewing' and 'discovering' (both require shared mental models to make unambiguous interpretations), but is poor on 'enacting' and will not support 'undirected viewing'.

- *Control types and the extent of incompatibility of mental models that are the conceptual basis for MICS*. When outputs cannot be scored (also not with surrogate measures), MICS has little use. MICS cannot support situations that are characterized by political control. MICS will be particularly relevant at 'trial and error' and 'routine' control, because people can learn from data about processes that are repetitive. This can lead to a situation of knowledge saturation, thus 'expert' control.

5. Pragmatics

Pragmatics is about the question: what actions are evoked by the information made accessible to people? Studying this question it is necessary to understand that with MICS, managers and employees are involved in a negotiation and possible learning process. Lawler and Rhode (1976) suggested that some of MICS' elements have a severe impact on organization members' intrinsic and extrinsic work motivation. Their hypotheses are summarized briefly in table 6.4.

MICS-elements	Intrinsic motivation[23]	Extrinsic motivation[24]
1. Nature of Standards	A. Set by Person Being Measured B. Moderately Difficult	A. Joint Process between Person and Supervisor B. Moderate Achievement Difficulty
2. Characteristics of Sensor Measures	C. Complete D. Objective E. Influenceable[25]	C. Complete D. Objective E. Influenceable
3. Speed of Communication	F. Immediate	F. Fast
4. Frequency of Communication	G. Close to Time Span for Job	G. As Fast as allowed by time span of discretion
5. Recipients of Communication	H. Person Being Measured	H. Person with Reward Power as well as Person being Measured and others doing similar work.
6. Source of Discrimination	I. Person Being Measured or Other Credible Source	I. Joint Process between Person and other Trusted Person or Persons
7. Type of Activity	J. High Autonomy K. High Task Identity	J. Not a Crucial Factor

[23]Based on Lawler and Rhode, 1976, p. 81, table 5-1

[24] Source: Lawler and Rhode, 1976, p. 64, table 4-3.

[25] Meaning that scores should reflect a person's efforts.

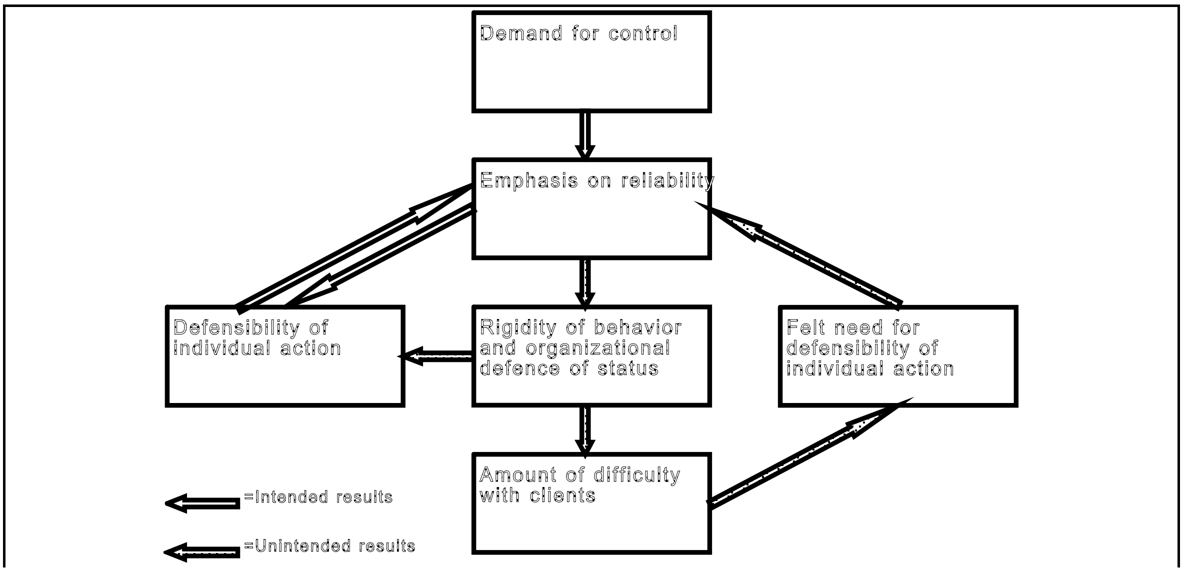
	L. High Variety	
8. Source of Motivation	M Improvement in Job Capabilities	K. Rewards that are important
Source: Lawler and Rhode, 1976		

Table 6.4: Values of MICS Elements that Produce Intrinsic and Extrinsic Work Motivation.

The MICS-elements list describes how the cybernetic approach would define a control system. The organization development approach would however emphasize how these information streams impact on actual behavior, motivations, understanding and possible conflicts.
Lawler and Rhode warn for possible dangers of dysfunctional behavior that can result from inproper application of control information systems. Dysfunctional behavior of control information systems is defined as:

" *...employees [that behave] in ways that look good in terms of the control system measures but that are dysfunctional as far as the generally agreed upon goals of the organization are concerned"* (p. 83).

This has been researched in the sociology of organizations since the 1930s (Michels, 1925/66; Merton, 1940; and Gouldner, 1950), and now has received considerable attention by Senge under the heading of 'systems thinking', meaning a way of conceiving the indirect and non-obvious impact of decisions in the longer run. A classic example is described by March and Simon (1958) in figure 6.5.



Lawler and Rhode describe four types of dysfunctional behavior in relation to MICS, namely:

- *Rigid bureaucratic behavior.* Figure 6.5 illustrates this type of dysfunctional behavior. The demand for greater reliability leads to an increase of defensiveness of behavior, thus to an increase of rigid bureaucratic behavior by a more strict application of rules. This can lead to dissatisfied clients, which in turn increases defensiveness and behavior led solely by rules.

- *Strategic behavior*. This type of behavior is defined as: "*...altering behaviors for a period of time to make the control system measures look acceptable*" (p. 86). A classic example from the Sovjet command economy is the Kolomensk Machinery Works in Moscow County in 1940: "*...In the first ten days of every month it produced 5 to 7 per cent of the month's output, in the second ten days, 10 to 15 per cent, and in the third ten days, 75 to 80 per cent*" (Berliner, 1956, pp. 87-88, quoted in Lawler and Rhode, 1976, p. 87). This way of production probably led to serious under-utilization of people and capacities in the first periods, and over-utilization and exhaustion of production factors in the last period. These problems are also common to machine bureaucracies in western economies with insufficient market feedback.
- *Invalid data reporting*. Two types of invalid data reporting can be recognized. One, feeding invalid information about what has happened into the control system. This is obviously lying and can thus be detected, leading to punishment. This tactic is clearly very risky. The second way of invalid reporting is more common and difficult to detect, and concerns the process of underestimating revenues and overstating costs in budgetting processes (Wildavsky, 1974). It makes a lot of sense for managers to create slack in budgets in this way, because not staying within the budget could lead to punishment.
- *Resistance.* Many authors have stressed the possible negative impact in terms of resistance to control systems (Markus, 1983; Pettigrew, 1973; Argyris, 1971). The main explanations for resistance are as follows: (1) control systems can automate the expertise of managerial jobs, (2) control systems can create new experts and give them power (Pettigrew, 1973), (3) control systems can measure individual performance more accurately and completely (this can have positive results for a group whose performance was under-estimated, but at the same time can enforce a feeling of 'big brother is watching you'), (4) control systems can change the social structure of an organization (e.g. pay-incentive systems that turn colleagues into competitors instead of friends), and (5) control systems can reduce opportunities for intrinsic need satisfaction when extrinsic output measures are used for appraisal.

Of course MICS does not have only negative consequences. Scientific management in particular emphasizes the importance of the accumulation of knowledge about work processes. It is however often not clear what role MICS has in this. Learning processes have many informal characteristics guided by informal and tacit norms that do not apply to MICS. To my knowledge, no study has empirically found any convincing evidence about the impact of MICS-usage on performance. It could be that the effect was not found because the intermediating conditions influencing the relation between MICS-usage and performance, i.e. organizational norms, were not included in the research design (cf. our discussion of the study of Lee and Guinan in chapter 1).

6. Social

According to Mintzberg one should distinguish between two types of systems for monitoring and control:

- Performance control systems:

" *The purpose of performance control is to regulate the overall results of a given unit. Objectives, budgets, operating plans, and various other kinds of general standards are established for the unit, and its performance is later measured in terms of these standards and the results fed back up the hierarchy by the MIS"* (Mintzberg, 1983, p.75).

This means that performance control influences decision-making and action only indirectly by establishing the targets the decision-maker must achieve. Performance control information systems can contribute to understanding the company's activities when the organizational units rated are more or less independent. When units influence each other's performance a separate measurement system per unit could bias the results because some of the performance is not the result of the unit's own operation. The choice then can be to disentangle the units, or to develop a market-like pricing principle for inter-unit transactions, or to develop one performance measurement instrument for all the units together!

- Action planning systems:

" *Action planning emerges as the means by which the nonroutine decisions and actions of an entire organization, typically structured on a functional basis, can be designed as an integrated system. All this is accomplished in advance, on the drawing board so to speak. Behavior formalization designs the organization as an integrated system too, but only for its routine activities. Action planning is its counterpart for the nonroutine activities, for the changes. It specifies who will do what, when, and where, so that the change will take place as desired"* (p. 78).

Whereas performance control systems cannot really cope with the interdependences of functional units, action planning is typically used to solve this problem.

In relation with Mintzberg's organization types, planning and control information systems have different roles. This finding is summarized in table 6.5.

Organization Configuration: Design parameters:↓	Simple structure	Machine Bureaucracy	Professional bureaucracy	Divisionalized form	Adhocracy
Key coordinating mechanism	Direct supervision	Standardization of work	Standardization skills	Standardization of output	Mutual adjustment
Environment	Simple and	Simple and	Complex and	Relatively	Complex and

	dynamic. Sometimes hostile	stable	stable	simple and stable; diversified markets (esp. products and services)	dynamic; sometimes disparate (in admin. adhoc.)
Planning and control system	Little planning and control	*Action planning*	Little planning and control	Much performance control	Limited action planning (esp. admin. adhoc.)
Based on Mintzberg, 1983, p. 280, table 12-1.					

Table 6.5: Planning and Control Information Systems Related to Some of Mintzberg's Organizational Configurations.

In the social context of organizational learning, action planning is a search for *problems to anticipate*, and the design of activities to avoid these problems. During the course of this process, organizations create and apply predictive models. In this context performance control becomes a process of *critical evaluation* of what has happened. The intention is find explanations for problems. These explanations can then be used to improve problem anticipation. To realize problem anticipation and critical evaluation, all other levels of the semiotic framework must be dealt with effectively, so that the right data come to the right person(s), on time, and are interpreted correctly so that effective actions can follow.

As this study is about machine bureaucracies, we must take note of an interesting hint from Mintzberg, i.e. classic machine bureaucracies do not use critical evaluation control systems, and only use problem anticipation systems! This can be explained from the low learning needs of machine bureaucracies. When stability declines, the knowledge that is stored in action planning systems depreciates more quickly and becomes an uncertain source for planning. Therefore, evaluations of plans are required to adjust for possible errors. Complexity also demands a stronger emphasis on rationalizing the planning process. More information and knowledge must be processed to come to effective plans. Thus, in situations of increasing dynamics and increasing complexity a combination of problem anticipation and critical evaluation systems is required. According to my understanding of lean organizations, these organizations do indeed combine these roles of MICS, and in this they differ sharply from classic organizations.

6.3.3 Observing MICS

Table 6.6 summarizes the items that can be observed in MICS in empirical research.

Leaness: MICS:↓	Lean	Classic

Technical		
Physics	• Coupling of systems, via network and databases	• Functional systems. Islands of automation
Empirics	• On-line systems	• Offline systems, with period reports
Syntactics	• High quality user interfaces (easy understandable structure of software) • Flexibility of databases • High quality administrative organization • Compatible data structures	• Hard copy reports • Change of database on request and when feasible • Inconsistent data • Incompatible data structures
Organization		
Semantics	• Consistency with possible control type • Shared mental models	• Inconsistency with control type • Mental models are diverse and incompatible. They reflect stake holders' positions
Pragmatics	• Decisions are implemented in high speed and trust • Action based on theoretical understanding of practical problems	• Many complications in translating decisions to actions • Action based on past experience (routine) or command
Social	• Social networks of problem anticipation and critical evaluation are closely connected • MICS serves problem anticipation and critical evaluation	• Separation of problem anticipation and critical evaluation networks • MICS service problem anticipation, or punish-reward

Table 6.6: Differences of MICS in Lean and Classic MB's.

The following section discusses in more detail the roles of MICS for organizational learning activities (single-loop and double-loop), and what this implies for the value of MICS in learning processes.

6.4 *Role and Value of MICS for Organizational Learning*

6.4.1 Role and Values

In the preceding chapters a distinction was made between the role and values of MICS. The role of MICS concerns the way MICS aids and changes learning processes. The value of MICS in organizational learning terms is related to the contributions of MICS in single-loop, double-loop and deutero learning processes.

6.4.2 Role of MICS in Double-Loop Learning

Theory development in this context is a process of learning in which ideas and information are combined to form plans and principles about the way business should be conducted. Some of the results of this process are action plans for the coming month, a new way of handling material, guidelines for personnel allocation to projects and principles for deciding on make or buy. Some ways of theory development in which information is explicitly used and created are:

- The *development of industry standards* for performance, as cornerstones for developing internal standards. This approach is complex because it is difficult to interpret general data for the specific needs and situations of one company. It is more effective to use the standards for a first discussion about what could be possible (cf. Camp, 1989; Chew et. al., 1991; Walker, 1992).
- The *development of engineered standards*. This requires the use of methods for time and motion studies as discussed in chapter 4 (cf. Niebel, 1982). These standards require a lot of adaptation because they can easily become obsolete. Because standards also easily lead to performing to minimum expectations, and thus discourage higher ambitions and initiative, effective theory development could often do without any performance standards.
- *Work simulation.* This technique involves the definition of an ideal work situation, to support finding the gap between performance and ideal. It requires setting up a laboratory environment, or the development of a computer-based model of the ideal situation. The method also could be supported by decision support systems to predict the impacts of alternatives.
- *Analysis of work and business processes,* also called business re-engineering (e.g. Davenport and Short, 1990; Hammer, 1990). This contains an analysis of the tasks and activities that are needed for the organization's survival, and a clear description of how the activities should be conducted. An excellent idea is to have an outsider carry out this analysis, so that seemingly trivial questions can be asked that encourage the discussion of the basic assumptions of the business. CASE[26]-tools exist that can help the analyst to be more consistent and more productive in reporting. Business process analysis also could profit from CASE-tools containing some artificial intelligence so that the analysis can be much more profound.

[26]CASE-tool is short for computer-assisted systems analysis, and commonly used in the business analysis phase of information systems analysis and design. One widely spread CASE-tool is System Development Workbench, a trademark of CAP Gemini Pandata.

- *Comparative analysis*. This is a theory development method which requires data about different machines, departments, persons etc, so that explanations can be found for variations in performance. This can lead to rethinking existing ways of working. This method is interesting, but it is difficult to compare departments and people as they each have their own idiosyncrasies.
- *Complaints files*. These are absolute necessities for organizations wanting to improve their service quality. The information must be interpreted as symptoms of deficiencies of the theory that governs the processes and therefore are most valuable from an organizational learning point of view.
- *Waste analysis*. Some waste is clearly visible to the management: garbage. The amount of garbage is not always related to business performance. This could be done by measuring the amount of garbage in terms of costs, and in terms of its impact on longer term image and goodwill. Additional types of wastes are: defective products and scrap, rework (anything not done right the first time), amount of inventory costs and costs of work-in-process, time (downtime, setup time, delay time), and motion (efforts required to move materials and people). Some sources of waste are difficult to measure such as employees that lack the right tools and information, people without the skills to use the tools properly, people with skills that are under-utilized, and managers spending time on trivial matters. MICS could be used to gather and make available data on many of these subjects (Kaydos, 1991).
- *Market analysis*. Market analysis is a method to analyse a company's sales and customer satisfaction. This can be done by interviewing clients and prospects, but also by analyzing sales figures, by comparing sales with expected sales and the importance of several products in several submarkets and market segments. A useful technique for doing so is the Boston Consultancy Group grid analysis (Kotler, 1988).
- *Strategy analysis*. In strategy analysis the main aim is to compare a company with other companies. Bench marks can be used for several competitive issues (e.g. quality, costs, lead times, variety of products, client satisfaction, image). A quite famous method for this purpose was developed by Dow Chemicals in the 1960s and is now under the management of the Strategic Planning Institute (SPI) under the name of PIMS (Buzzell and Gale, 1985). The essence of PIMS is that companies deliver periodic data to the SPI. The SPI analyzes the data by means of an econometric model so that possible impacts of current strategies can be predicted. SPI advises the subscribers of PIMS (of course anonymously) about possible strategies.

These techniques support double-loop learning in several learning fields. Engineered and industry standards support learning about human resources by developing motivating and realistic performance criteria for employees. Work simulation, analysis of work and processes create knowledge about processes. Comparative analysis is a technique for developing human resources and processes. Complaint files, waste analysis and variance analysis are techniques to augment process and product quality. Additionally, complaint files are sources for the improvement of market performance. Market analysis results in insights into markets and their developments. Finally, the PIMS analysis results in insights into product, process and market innovations. These methods all require performance and planning data that can be provided by a MICS. Table 6.7 gives a summarizing list of the roles of MICS in the double-loop learning process.

Double-loop field	MICS' role
Human resource development	Data about required personnel skills and knowledge to meet new business standards. Data about investments in human resources in relation to payroll
Market development	Data about market and market segments, about profitability, short and long term scenarios
Product development	Data about product portfolio and profitability, short and long term scenarios Complaints data and analysis. Scenario analysis about consequences of new products for existing resources
Process development	Data about process and activity structures specifically about costs and quality compared to some preset standards or performance of competitors and other reference companies Waste data, linked with processes.

Table 6.7: A List of Some MICS' Double-Loop (theory development) Learning Roles

Table 6.7 only provides insight into roles for theory development. Unlearning or knowledge removal is a social process that cannot be supported in a direct sense by MICS. MICS can only show what would happen if no changes were made in all these fields.

6.4.3 Role of MICS in Single-Loop Learning

MICS in Adaptation

Single-loop learning consists of changes of the theory while keeping the basic norms unaffected. Adaptation of knowledge is about the assessment of existing theories and management principles, so that its working is improved. It is basically an application of the empiric cycle, which states that hypotheses should be tested and changed on the basis of empirical evidence. The adaptation process leads to minor changes in the theory, but also could initiate a request for a double-loop learning process.

The basic idea of the single-loop learning process is that predefined norms are used to control existing behavior. Many means for control exist that correspond to this idea:

- Training. People are taught to behave according to some principles in a specific situation. This training can be achieved by an external educational institution or in-house via an internal school and on-the-job training. Information systems are more often used for these educational practices, because they can provide students with standard responses to the questions and give quantitative feedback or hints about what to study. Games can be used during the instruction to help the students understand the mutual interdependence of activities and processes in the organization. This type of system is knowledge-based or DSS and is not further considered here.

- Indoctrination. Via indoctrination, people replace their own theories by someone else's. Here computers are not very effective, because they usually lack effective means to communicate the inducements that are required to overcome possible resistance. A higher media richness therefore is required (Daft and Weick, 1984; Kiesler, 1988).
- *Problem anticipation and critical evaluation.*

Problem anticipation systems are useful for control as part of *coordinative policies*. These policies are about the way people are expected to collaborate. This can result in task distributions and agreements about what people should contribute to each other. MICS can play a role in scheduling tasks and monitoring the progress of activities. Information about deviations from previously agreed targets can lead to a rescheduling of other activities. This type of problem anticipation system can be a module of a logistics tracking and scheduling system. The rescheduling and adjustments are typical adaptations of management theories that are operationalized in plans. The basic norms of the plan and the way of production are not disputed. In machine bureaucracies specialists of the technostructure develop the insights necessary to develop the problem anticipation system. This is a deutero learning process, that changes the existing way of scheduling and monitoring and thus affects the procedural norms. It is not the output of these systems that triggers double-loop learning, but the *idea* of having a system.

The learning process in the problem anticipation case is ex ante (before the activities take place) and in the *critical evaluation* case ex post. When applying Kolb's learning cycle, the problem anticipation uses abstract conceptualizations in practical situations. The learning cycles focus on the quality and applicability (active experimentation) of the concepts and abstractions. The critical evaluation systems reflect on concrete experience and behavior. It might easily lead to just giving feedback without clear additions of knowledge (abstractions) and therefore have a political nature. In Kolb's approach, problem anticipation and critical evaluation have different roles in the learning cycle. These roles can be termed 'constructing abstract models and experimenting with them' and 'concrete experience and reflecting about the experience'. Combined, they support a *closed learning loop*, the objective of MICS. MICS primarily supports single-loop learning, and provides triggers for the performance of double-loop learning activities. Cf. table 6.8.

Learning activity MICS	Single-Loop Learning	Double-Loop Trigger
Problem anticipation system (e.g. scheduling systems)	Improving schedules	Reflecting about organizational sense of existing planning procedures and norms
Critical evaluation system (e.g. complaint files, variance analysis)	Use of information for feedback	Developing new policies and ideas

Table 6.8: Monitoring Information and Control System and Single-Loop and Double-Loop Triggers.

The problem anticipation and critical evaluation control systems also have different owners, the technostructure and middle line respectively. This leads to *two different social networks for learning*. In machine bureaucracies these networks are socially separated and meet infrequently. The lean organization has procedural norms that connect them, thus enabling a closed learning loop.

MICS in Storage

Chapter 5 described storage as storing knowledge and enabling its re-use. More precisely, three organizational knowledge storage processes were described: acquisition, retention and retrieval (after Walsh and Ungson, 1991). These processes can be assisted by MICS.

- *Acquisition of knowledge and MICS*. By acquisition we mean the way knowledge (data, experience, judgement and science) enters into the knowledge storage activity. Frames of reference play an important role here because issues that cannot be given a place within them are kept out of the attention focus, and are thus regarded as irrelevant for storage. A double-loop trigger would recognize the inadequacy of the existing frame of reference, thus requiring its redesign by theory development. The sensory parts of MICS can play an important role in storing data that are relevant for creating science and judgement. It is important to note that the data themselves do not contain knowledge, but that a clear classification scheme related with a frame of reference can lead to easy interpretations that do result in knowledge.
- *Retention of knowledge and MICS*. Many media can be used for knowledge retention: individual memory and files, cultural elements (language, symbols, sagas etc.), rules and principles of transformation processes, organization structures, organizational physical layout and external archives. MICS can be a particularly good instrument for organizational knowledge retention, when the acquisition facility is well-designed. The problem is often however that much knowledge is based on heuristics that are difficult to elicit (Kerr, 1991), or that are not repetitively used and therefore not worth storing. This is not so with

operational information for scheduling and controling processes. Particularly useful data are those relating to costs, sales, quality and efficiency, that can often be collected as a by-product of manufacturing and services.

- *Information retrieval and MICS*. From information management we know the importance of retrieval related to storage (McFadden and Hoffer, 1991). This issue is very important because a poor retrieval system will make storage efforts futile. When effective, the frame of reference implemented in some concrete guidelines for gathering, storing and retrieving information solves this problem. This means that a frame of reference is not only a management theory, but also leads to rules for connecting formal information systems to organizational understanding. These rules can be described in software code, by which the automated search and retrieval of data is made possible. In principle MICS only has a standard reporting ability. A more flexible usage is often termed 'Executive Information System', especially when data sources can be flexibly accessed. In most organizations, executive information systems are not used at the operational-tactical management levels because of the high expenses involved and the still dominant idea that these levels do not need flexible tools.

MICS in Knowledge Dissemination

Knowledge dissemination concerns the distribution of knowledge, the development of a mutual understanding and making possible the access of knowledge sources to a range of people (cf. chapter 5).

MICS can play a role in *knowledge distribution*, by its opportunities to give people *access to data* via terminals or personal computers in networks or the interchange of databases on floppy disks. To create effective knowledge dissemination (at the syntactic level) the organization needs a common mode of interpretion. Effective use of MICS in knowledge dissemination therefore requires that a single set of data definitions be used, or that people are able to make translations. Because people in different places will probably view the data from a different body of knowledge and interests, they can come to different conclusions. It is however not true that misunderstandings always result from differences in definitions, because differences in the theories used might also explain the misunderstandings.

Knowledge dissemination from a semantic point of view would mean that *mutual understanding* in the organization is augmented. Projects of MICS development require some elicitation of the different kinds of frames of reference that are used in the organization. Usually only the systems analysts know precisely what these differences are. The best way to create mutual understanding is not via these professionals, but by creating direct interactions among the intended users of MICS, so that they learn to understand each other's way of thinking.

An additional role MICS could play is in the *synchronization of understanding*. By combining shared knowledge (which offers information about management theories) with shared data (which gives information about a specific moment in time), synchronization of understanding can occur. MICS can provide data that are more timely than the traditional manual bureaucracy. Automatic sensors could even lead to on-line information. The question is whether on-line information is required. This of course depends on the number of changes in the processes, and the consequences (risks) of reacting too late. In the process industry, where for instance chemical processes are controlled by computers, a late reaction can lead to a catastrophe, whereas in the banking industry late reactions to performance decline can lead to mismanagement but do not necessarily lead directly to a disaster.

MICS in Knowledge (re-)Use

Knowledge use has two big problems: *relevance* and *applicability*. Relevance is about the potential of knowledge for solving problems. Applicability is about the problems related to using the knowledge, for instance its complexity in relation to the organization members' ability to handle it. MICS makes knowledge easily available but is poor in the distribution of complex knowledge.

Knowledge re-use suffers particularly from two problems: *reapplicability* and *validity*. Reapplicability concerns the opportunities of re-using knowledge for solving recurring problems. The main problem is that problems do not always recur frequently enough to make knowledge storage cost-effective (cf. Hofstede, 1981). Another problem with reapplicability is that situations and problems sometimes might look the same but are not. Regarding one problem as being the same as a previous one might lead to a bias in perception that could lead to serious mistakes. The validity problem concerns the fact that theories and insights are only valid for a specific period. For instance, economic theory of the 17th century is probably invalid for understanding business in the post-industrial society. The solution to this validity problem is a constant validity checking of theories in the adaptation process. Connected with MICS, theories are mostly the basis for the definition of the norms and the measurements that are part of a MICS. This means that each time MICS is used, the underlying management theory is reapplied. MICS should be audited on the understanding of its basic principles by its users, and the validity of its underlying theory.

Although MICS' power in storing and retrieving data and experience has not yet been explored, it is important here to state some of the limitations of MICS as a computer-based information system. The following quotation of Kim defines these limitations:

" *... the mental models in individuals' heads are where a vast majority of an organization's knowledge (both know-how and know-why) lies. Imagine an organization in which all the physical records disintegrate overnight. Suddenly, there are no reports, no computer files, no employee records, no reporting manuals, no calenders - all that remain are the people, buildings, capital equipment, raw materials, and inventory. Now imagine an* *organization where all the people simply quit showing up for work. New people, who are similar in many ways to the former workers but who have no familiarity with that particular organization, come to work instead. Which of these two organizations will be easier to rebuild to its former status?"* (Kim, 1993, p. 44).

Kim's answer is the first. This answer provides an important insight into the relative importance of the social and technical side of the learning system. The question is however not what is most important, because hopefully the situation as described by Kim will never happen. What is important is what MICS can contribute to the broader social system, and what the social system cannot do without it!

Table 6.9 summarizes MICS' roles in single-loop learning.

Single-loop learning activity	MICS' role
Adaptation	Problem anticipation
	Critical evaluation
Storage	Acquisition
	Retention
	Retrieval
Dissemination	Distribution of knowledge
	Creating mutual understanding
	Synchronization of knowledge
Use	Applicability of knowledge
	Reapplicability of knowledge

Table 6.9: A List of Possible MICS-roles in Single-Loop Learning Activities

6.4.4 A Note about MICS' Role in Deutero Learning

Deutero learning is about the description of norms that govern learning processes. These norms are about learning policy/identity, responsibilities, and procedures of communication and message handling. MICS can play a role in deutero learning, because it is an implementation of some of the procedural norms. For instance, when an organization wants to change its informal way of learning to a formal one, MICS might play an important role because MICS requires clearly defined *responsibilities* (output expectations). MICS also makes it possible to measure and control people by defining measurable performance. This can lead to an organization type that emphasizes single-loop learning. The possible negative effects of this kind of control have been discussed earlier, and must be well considered while formulating policy norms. The impact of MICS on procedural norms can be described in technical and social terms:

- The technical parts of MICS are interesting from the deutero learning perspective because they demand clear definitions of data, which is sometimes very new for an organization and a major improvement in communication could emerge. Also, questions about what should be stored, how it should be stored and made accessible to whom are interesting questions that, when treated seriously, lead to major changes in an organization's learning abilities by providing a learning infrastructure.

- From the social perspective MICS plays a role in making information and knowledge (specifically aggregated information) accessible and can lead to a correct view of reality. The critical evaluation mechanisms that are enabled by MICS can motivate people to single-loop and/or double-loop learning. Socially MICS can tear down walls between departments, and combine activities and results from diverse sources.

These remarks all are about MICS' influence on learning norms. I will, however, not further investigate MICS' role in the deutero learning process.

6.4.5 Organizational Learning Value of MICS

The model of organizational learning used so far, is a descriptive model. On the basis of this model alone it is not possible to state how good or bad MICS is from the organizational learning point of view. If we want to make such statements, it is necessary to define the values of MICS in learning processes. Table 6.10 describes MICS' values in general.

Learning Process	Possible Values
Deutero	Changes of learning norms (policies, action norms, responsibilities and procedures) to improve their match with learning needs.
Double-loop	Innovation in human resources, processes, markets and products.
Single-loop	Improvements in adaptation, use, storage, and dissemination of knowledge.

Table 6.10: Learning Processes and Business Values

As deutero learning is not studied further, only double-loop and single-loop learning values are further defined here.

MICS' Value in Double-loop Learning Processes

Double-loop learning is rated by adding up the scores (-1, 0 or +1) on each cell intersecting learning fields (human resources, processes, markets and products) and learning activities (development and unlearning). MICS can add value to the eight thus recognizable learning incidents as follows.

- MICS' additions to human resources. MICS can provide data about human resources, e.g. about skills, motivation, strategic knowledge, costs and productivity. These data can be the subject for further analysis when connected with knowledge about strategic directions, market developments, forecasts etc. This can lead to a reformulation of human resource policies and action plans (training, change projects, changes in function remuneration etc.).

- MICS' additions to products. MICS can supply answers to questions about products such as: how many new products and product series have been launched within a period of time, how do competitors perform on this subject, what profit do the products generate, what trends are most likely in what markets, what are the costs of developing new products? These data have to be connected with less formal and precise insights, to make strategic decisions about product lines, series and trends. These result in new policies for research and development, and parameters for the longer term success of investments.
- MICS' additions to market insights and developments. MICS could provide data to answer questions such as: how many markets and market segments are served, what strategies are required for effective sales, how do competitors perform on important markets, is it profitable to diversify, to penetrate or to quit certain markets? MICS provides data that basically describe past trends. For strategic decisions, insights into possible future scenarios are important. Hence, intelligence information is often required (less formal and frequently tacit) added to scenarios about possible futures, e.g. constructed and understood by use of decision support tools (Galer, 1993).
- MICS' additions to process insights. Much organizational learning concerns changing the way products and services are established, so that the organization is able to adjust more easily to specific demands. For instance shorter delivery periods, more flexibility in colors and product features. A lot of learning is also related to redesigning processes to meet competition by decreasing the costs of transactions and coordination. This is not just a marginal change but a revolution in thinking and working to accomplish the same job. Before starting these redesigning projects it is often wise to do some bench-marking and have an accurate quantitative understanding of the existing processes (Davenport and Short, 1990).

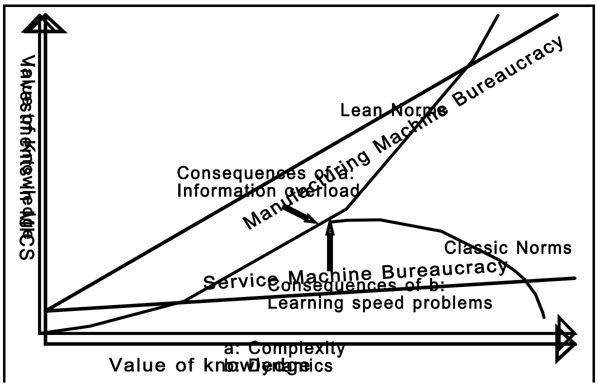
Table 6.11 provides a list of possible items for the theory development process.

Learning field	MICS' double-loop learning value
Human resource development	Insights into knowledge for developing HR-policies. Insights into cost-benefit relations of HR-investments.
Market development	Strategic insights and forecasts.
Product development	Informed decisions about product lines and series. Parameters for investments. R & D policies and investments
Process development	Bench-marks. Production norms.

	Insights into causes and effects of inefficiencies. Insights into process limitations and capabilities.
Remark: Only theory development issues are listed. Unlearning is removal of theories.	

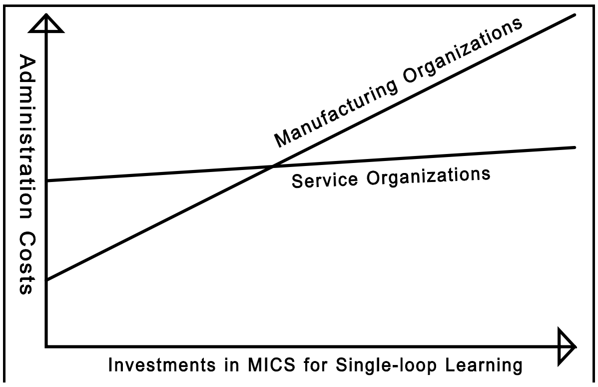
Table 6.11: List of Possible MICS' Values in Double-Loop Learning.

MICS' role and value in double-loop learning is mainly as a quick data supplier. Lean organizations have many and well-organized information sources to make the many connections between relevant databases. These databases may be spread among several organizational units, such as marketing, product engineering, manufacturing engineering and strategic business units. This means that classic organizations will have many problems putting the data together at the physical (access to databases), empirical (connections between databases and systems), syntactic (consistent data definitions) and semantic (creating interpretations from data between separate groups in the company) levels. The value of MICS therefore differs significantly between lean and classic machine bureaucracies. The classic machine bureaucracy will regard MICS as overhead and is not clearly aware of MICS' contribution. Lean organizations have lean information systems that are directly connected with the generation of value. Systems or system parts that are regarded as non-contributing are removed (cf. Van Nievelt, 1992). The problem of increasing information overloads that happen in complex environments with large databases and information processing (Ackoff, 1968), is managed in lean organizations by developing an explicit view of the business problem and information systems that are directly connected with these problems (Nonaka, 1988). This means that the chance of irrelevant and uninterpretable data is much smaller than in the case of classic machine bureaucracies. Additionally, the lean learning norms enable a higher learning speed because of their many lateral structures and decentralized learning procedures that relieve communication channels in the organization. The resulting value patterns of lean and classic machine bureaucracies in dynamic and complex environments are drawn in figure 6.7.



Most remarkably, industrialized service organizations have some advantages for learning with MICS, because their processes are mainly data-processing. This means that relatively few additional investments are required to generate MICS-systems on top of the transaction processing systems (McKeown and Leitch, 1993). It is the transaction processing systems that require large investments. These systems form a substantial part of the core of the service organizations. MICS requires only limited investments when it is an addition to the transaction processing systems, but it generates a substantial knowledge value for the management (cf. Earl, 1994). This is pictured in figure 6.8.

MICS' Value in Single-loop Learning Processes



The single-loop learning processes should result in improvements of products, processes, markets and human resources via storage, adaptation, dissemination and/or (re-)use of knowledge (data and management theories). Possible roles of MICS in the single-loop learning activities were discussed in section 6.4.3. MICS' values are mainly in the area of cost reductions and efficiency improvement, but are sometimes also negative. For instance, the storage of data requires an administrative organization, which means an increase in costs. These costs can be regarded as marginal in service organizations, which already have well-developed administrative branches. In manufacturing organizations this could require a substantial increase in overhead costs. The costs for manufacturing organizations are therefore more visible than in the service types. This leads to a more explicit demand for cost savings resulting from investments for single-loop learning in manufacturing organizations. Lean and classic manufacturing organizations differ sharply in their view about savings and benefits of single-loop activities. The lean organization is convinced of these savings, though it will also apply lean principles to MICS. The classic manufacturing organization requires a classic cost-benefit calculation. The result is that if the likeliness of a MICS for single-loop learning is rated from 4 (most) to 1 (least), lean-service is rated 4, lean-manufacturing 3, classic-service 2 and classic-manufacturing 1. The relation between administration costs and investments in MICS for single-loop learning is described in figure 6.9.

Finally, table 6.12 provides examples of MICS' values for learning activities. The examples are such that they apply for all learning fields.

Single-learning activity	MICS' value
Adaptation	Decrease of error costs Increase of theory applicability Increase of learning costs Accumulation of knowledge
Storage	Increased administration costs Reduction theory development costs Reduction of quality costs

	Steeper learning curve
Dissemination	Reduced coordination costs Reduced development costs
(Re)use	Reduced development costs Reduced costs of buying expertise externally Faster and improved problem solving.

Table 6.12: List of Possible MICS' Values in Single-loop Learning

6.5 *Summary*

The concept of MICS is described in this chapter by applying Stamper's layers of semiotics. For all these layers MICS has different features in the lean and in the classic machine bureaucracy. The role of MICS is analyzed in relation to the single-loop and double-loop learning activities. The results for double-loop learning are summarized in table 6.7. The insights for single-loop learning are summarized in table 6.9. The value of MICS differs in lean and classic organizations. Classic learning norms lead to information overload in cases of increased complexity, and to learning speed problems when dynamics increase. Lean norms are able to solve these problems to a large extent. As a consequence the value of MICS is higher when learning norms that are close to those of lean organizations are adopted. Service organizations profit more from MICS than manufacturing organizations, because MICS-information can be a by-product of their operations.

Chapter 7: Operationalizations and Method of Analysis

7.1 *Purposes of this Chapter*

This chapter first presents the key statements in the theory about organizational learning, MICS and machine bureaucracies that must be operationalized and tested for explorative purposes. Secondly, the theoretical concepts calling for observation are extracted from these statements and then it is shown how they are operationalized, a step which requires further elaboration of the theory.

7.2 *Statements about MICS and Organizational Learning*

The theoretical model summarized here consists of statements and conclusions. With a statement we mean a proposition. Some statements are hypotheses and thus are subject to empirical confirmation or falsification. To reduce the number of statements to be investigated, most statements are assembled via a syllogism to a conclusion. Some of these conclusions are hypotheses for the empirical research. In this chapter an 'S#' is placed before a statement, and an 'Con#' in front of a conclusion. For reasons of parsimony (Leege and Francis, 1974, p. 35), the number

of statements and variables is reduced to a minimum. This is done by removing statements that include redundant information in the theoretical framework, and keeping the number of concepts needed to a minimum.
Two of the statements that formed the basis for this study from the start, can be formulated as follows:

S1: *Machine Bureaucracies have strong controls.*
S2: *Controls inhibit innovation.*

Evidence for both statements was presented in sections 1.3 and 5.1., where it was shown that most (classical) machine bureaucracies are very slow in adapting to environmental changes. The following conclusion can be drawn from both:

Con 1: *Machine Bureaucracies are poor in innovation.*

This study does not enable a test of S1, because only machine bureaucracies are studied here. We can however make observations of control mechanisms in machine bureaucracies and see how they affect innovation and inertia, but we can make no comparison with other types of organizations. We also link this statement with organizational learning by assuming (on basis of Argyris and Schön 1978 and De Raadt, 1992) that:

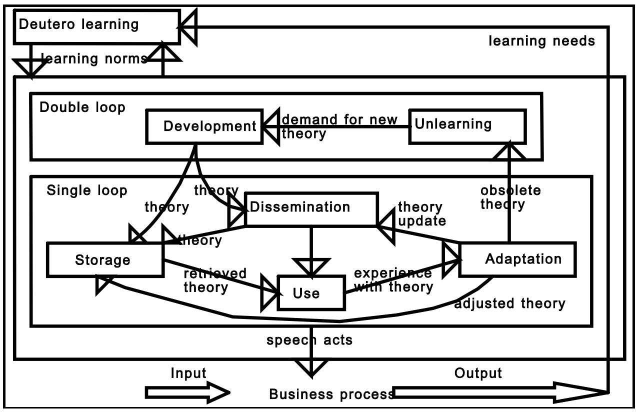
- the degree of control achieved results only from single-loop learning, and
- the degree of innovation achieved results from double-loop learning.

The literature is however very vague about the relation between single-loop and double-loop learning and how these activities relate to the learning norms in organizations. Two definitions of a degree of organizational learning are optional here, with considerable consequences for the theory as a whole. These are:

1. Organizational learning is a single variable, where double-loop learning (DLL) is a deeper form of learning than single-loop learning (SLL) (e.g. Senge, 1990; Hammer, 1990). In this *hierarchical model of OL*, the presence of DLL scores higher (say 2) than SLL (say 1). It might be argued in justification that, although SLL is possible without DLL the contrary is impossible. This does not seem entirely reasonable because DLL is not always more important or more complicated than SLL. For instance in any heavily capitalized manufacturing process only the incremental changes brought about by SLL are possible until investment in a new expensive plant is possible, so most of the time DLL is very limited while SLL is highly sophisticated. So we prefer to leave this hierarchical model aside.
2. Organizational learning is composed of a mixture of SLL and DLL which probably co-vary in ways that depend on the *learning norms* but can mostly be treated as independent. We could try to rate the effort devoted to each kind of organizational learning and treat them as a *vector measurement of organizational*

learning or perhaps attempt to justify some way of combining them (by simple addition, possibly). It may be appropriate to introduce a limit to the total *learning effort* so that more SLL leads to less DLL and vice versa. Learning norms however also could be such that the total amount of organizational learning increases.

The vector model of the organizational learning concept is chosen in this study and implies the following statement:



<u>S3</u>: *Organizations have learning norms that determine the effort an organization puts into single-loop and double-loop learning.*

Evidence for this statement was presented in sections 4.9.1, 5.4.3 and 5.4.2. and in figure 4.10 that is reprinted in reduced format in figure 7.1. This statement is heuristically interesting, but empirically incomplete because the *type of influence (inhibitor or reinforcer)* of the learning norms is not defined. Some indications for the type of influence can be inferred from the hypothesis that learning norms differ per type of machine bureaucracy. The following classification of machine bureaucracies was proposed: Classic-Manufacturing, Lean-Manufacturing, Classic-Service, and Lean-Service. This leads to the following set of statements (see table 7.1).

	Classic	Lean	Statements
Manufacturing			S3.1 and 3.2
Service			S3.3 and 3.4
Statements	S3.5 and 3.6	S3.7 and 3.8	

Table 7.1: Statements about Classic-Lean and Manufacturing-Service Differences Concerning Single-loop and Double-loop Learning Effort.

The following statements can be applied to the corresponding learning norms:

<u>S3.1</u>: *Classic manufacturing MBs put less effort into double-loop learning than lean manufacturing MBs.*

<u>S3.2</u> *Classic and lean manufacturing MBs do not differ regarding the amount of learning effort put into single-loop learning.*

<u>S3.3</u> *Classic service MBs put less effort into double-loop learning than lean service MBs.*

<u>S3.4</u> *Classic and lean service MBs do not differ regarding the amount of learning effort*

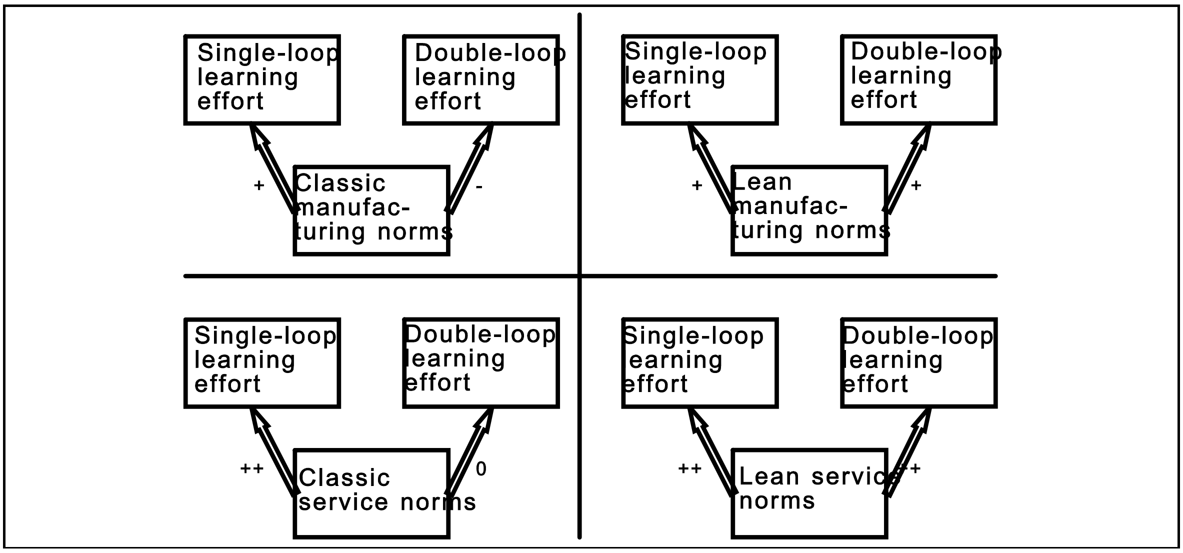
put into single-loop learning.

S3.5: *Classic manufacturing MBs put less effort into double-loop learning than classic service MBs.*

S3.6: *Classic manufacturing MBs put less effort into single-loop learning than classic service MBs.*

S3.7 *Lean manufacturing MBs put less effort into double-loop learning than lean service MBs.*

S3.8 *Lean manufacturing MBs put less effort into single-loop learning than lean service MBs.*



Statements S3.1 to 3.8 are based on our previous treatment of machine bureaucracies (chapter 5). The main conclusion drawn about the classic-lean distinction was that both machine bureaucracy types are organized for cheap production by applying many control mechanisms (single-loop learning), but that the lean MB was not only cheap but also much more innovative than the classic case. Additionally, all MBs are expected to invest substantially in single-loop learning via the construction of control mechanisms, rules and procedures. Service organizations are expected to invest more in these SLL-activities than manufacturing organizations, because of their shorter learning cycles and more direct contact with clients who can provide the organization with feedback signals. At the same time, however, it is expected that service organizations have more problems with constructing systems for SLL, because as their output is intangible it is more difficult to measure their performance. Therefore, service MBs may be expected to have more double-loop learning activities. According to these assumptions, the following patterns of values are predicted among the four types of MBs (see fig. 7.2).

Learning norms are supposed to influence the single-loop and double-loop learning processes. Learning norms themselves are however influenced by environmental circumstances (complexity and dynamics). This is expressed in the following two statements.

S4: *MBs face increased environmental dynamics.*
S5: *MBs face increased environmental complexity.*

The validity of statements S4 and S5 is widely accepted among academics and managers from most industries today, particularly in Europe since the 1990s, and has been treated extensively in chapter 1 (particularly in sections 1.1 and 1.2). Both statements therefore can be taken as axioms that will not be researched in our empirical investigation. It is more important for the empirical investigation in this project to explain the impact of dynamics and complexity on learning norms, because both form the organizational learning needs that must be coped with by a specific set of learning norms (cf. section 5.4, and Con2, S12.1, S12.2, S13 and Con3 later on).

S6: *Single-loop learning efforts counteract low environmental complexity and dynamics.*

This statement is based on theoretical and empirical research about error correction, which has been treated in section 5.4.2. A most important feature is that errors are detected via a performance measurement tool (Juran, 1964) and that the existing management theory can explain and handle the existing variety in simple and stable situations. The single-loop learning process is, however, restricted to solving problems that can be managed within the management theory and its related tools. Probems of huge complexity however often require the development of new management theories by specific research of a (interdisciplinary) project team, the R&D group or some outside consultants, that are typical of double-loop learning.

S7: *Double-loop learning efforts counteract high environmental complexity and dynamics.*

Evidence for this statement was presented in sections 5.4.1 and 5.4.2. This statement seems to be intuitively correct, and has been propagated widely by organizational development authors. A highly dynamic environment requires frequent major changes in the business; high complexity calls for high levels of knowledge, and the combination of high dynamics and high complexity multiplies the efforts required. An excellent example is the situation in which a television set producer is confonted by situations of increasing competition (dynamics), that demand reduced costs, improved quality and a greater variety of client's choices at the same time (increasing complexity). In that case the production process does not require simple improvements in existing procedures and technology, but also reconsiderations of what should be produced and what kinds of technologies are needed. If, however, these innovations are carried out in low dynamic and simple environments, the resulting learning process may lead to many inefficiencies by creating too many changes.

S8: *Double-loop learning involves reorganization and so entails higher risks than single-loop learning.*

Hannan and Freeman (1976 and 1984) suggested that double-loop learning also carries 'Reorganization Risks', which lowers the survival chances of an organization. This is obvious because it creates instability and the chance of dysfunctioning, which can lead to a loss of assets, loss of clients and markets, quality problems etc. This problem can be solved or reduced by developing procedures and norms that accompany organizational double-loop learning and that can guide the choice for single-loop or double-loop learning activities (Garratt, 1987). Many organization analysts and consultants therefore propose methodologies of change for reducing the risks of reorganization (c.f. Bushe and Shani, 1989 for an excellent example relating to machine bureaucracies). Also, project management methods have been developed in many cases for this purpose (c.f. Rogers, 1964, Franke, 1987). Evidence for S8 has also been presented in sections 4.9.1, 4.9.2 and 5.4.3.

S9: *Organizations create learning policies to reduce the risks of reorganization.*

These policies consist of change plans, prescriptions of reporting and communication lines (procedural norms), instructing people and motivating them to achieve the final objective (action norms), and describing people's responsibilities in the change process (responsibility norms) (Chew et al, 1991). Some evidence for this statement has been presented in section 4.4.3.

S10: *Reorganization risks increase organizational complexity and dynamics.*

Complexity increases when new methods, rules, tools, and knowledge must be applied in addition to the existing ones. Dynamics increase as a result of reorganization until new practices have settled in. Change reduces certainty about how to work and collaborate. Evidence for these statements has been treated in sections 5.4.1 and 5.4.3.
An *organizational learning paradox* can be formulated as follows: learning is required for survival, but learning may reduce survival chances as well. This paradox must be solved by the development of learning norms that match learning needs and are effectively implemented in learning activities to improve learning abilities.

S11: *The more environmental complexity and dynamics, the lower the survival chance of an organization which is unable to learn and adapt.*
S12: *The lower the survival chance of an organization, the greater its need for organizational*

learning.

Evidence for both statements was presented in sections 1.1, 1.2 and 1.3. Because of S11 and S12, organizations must be careful not to embark too quickly on double-loop learning strategies, because these could reinforce the trend to lower survival chances. At the same time the choice for SLL or DLL or deutero learning must be taken rationally, as far as the environment can be analyzed rationally. This requires the creation and explanation of management theories. If not done so, only political forces determine what will happen in the organization.

Con 2: *A combination of complexity and dynamics determines the amount of learning need.*

This conclusion results from S11 and S12, and has also been discussed in sections 4.8.3 and 5.4.1. The following two statements can be derived from this conclusion:

S12.1: *Lowest learning needs exist in cases where low complexity and low dynamics exist simultaneously.*
S12.2: *Highest learning needs exist when high complexity and high dynamics exist simultaneously.*

In these statements the situations of high complexity with low dynamics and low complexity with high dynamics are not explained. Therefore we need a statement about the relation between dynamics, complexity and learning needs.

S13: *Dynamics contributes more to learning needs than complexity.*

Complexity generates learning needs, because it requires knowledge to solve problems which must be mastered. An effective knowledge storage medium could lower the learning needs in complex situations. However, learning need will continu to be high in dynamic environments, even if the environment is simple. Section 5.4.3 specifically gives further evidence for this argument by stating that in dynamic environments especially the value of knowledge depreciates quickly. This means that the organization must increase its learning effort to stay in pace with environmental changes.
Now two conclusions can be drawn.

Con 3: *Lowest learning needs exist in cases of low complexity and low dynamics.*
Moderately low learning needs exist in cases of low dynamics and high complexity.
Moderately high learning needs exist in cases of high dynamics and low complexity.
High learning needs exist in cases of high dynamics and high complexity.

This conclusion is based on S12.1, S12.2 and S13.

Con 4: *Learning needs determine the learning norms required for survival.*

This conclusion is based on statements S3, S10, S11 and S12.

In previous sections and chapters, MICS was regarded as a part of the organizational learning norms, more specifically the procedural norms (section 5.4.2). This leads to some clarity problems when the impact of MICS is studied for single-loop and double-loop learning. It is then specifically problematic to separate the impact of MICS from the impact of other learning norms. As finding the specific impact of MICS is essential for the research problem stated previously, in the following MICS is treated separately from the learning norms.

SLL and DLL are significantly different ways of organizational learning. Studying MICS' impact on organizational learning therefore requires distinct statements about SLL and DLL. The impact of MICS on organizational learning was described in section 6.4 in terms of MICS' role and MICS' values in relation to learning activities and learning fields. In order to observe MICS' role we will only look at the problem anticipation and critical evaluation roles of MICS, because they are indications of SLL and DLL roles (setion 6.4.3 table 6.8) and are also indicative of lean and classic norms. These considerations lead to the following statements about MICS' roles and values:

S14: *Lean learning norms emphasize the critical evaluation and problem anticipation roles of MICS, whereas classic learning norms emphasize the problem anticipation and accounting roles of MICS.*

S15: *MICS contributes considerably to SLL-effort.*

S16: *MICS inhibits DLL-effort.*

Evidence for the validity of S15 was given by Argyris (1980) and De Raadt (1992), who both state that MICS is a useful tool for detecting errors and for error correction. S16 is based on the research and findings of Argyris (1980), Hannan and Freeman's inertia theory, Markus (1983), and classic theory about the impact of control systems on motivation in organizations (Merton et al. as described in Lawler and Rhode, 1976), described in sections 6.1, 6.3.2 and 6.4.5. The argument essentially is that MICS includes a management theory that emphasizes uni-lateral control in organizations, meaning the increase of power of certain people at the expense of other people's power. This reduces the chance that new ideas will be supported when they come bottom-up in the organization.

In order to score these contributions, we follow chapter 4, which proposes a score for single-loop and double-loop learning effort in section 4.8.3, and section 6.4.5, which states that the value of MICS should be assessed by looking at the intersections of the learning field and learning activities dimension of organizational learning. Thus the following assumption is made:

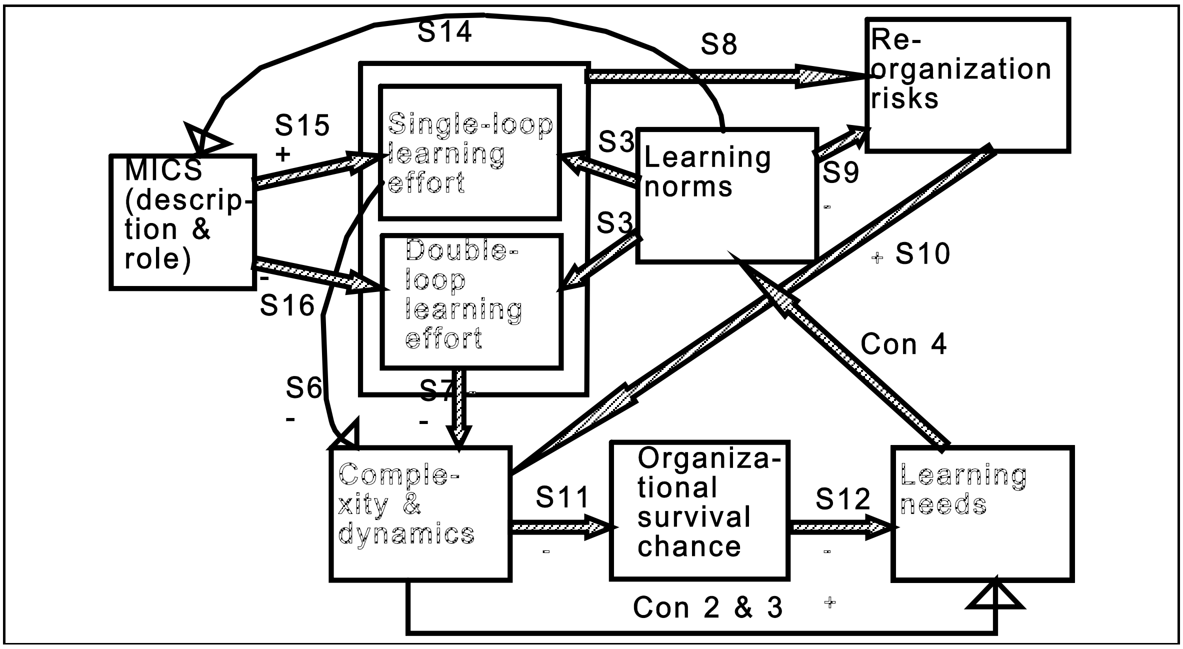
A score for the contribution of MICS to organizational learning consists of points gained on the intersections of the dimensions of learning: learning fields and learning activities (see table 7.2). A MICS can score -1, 0, or +1 when it contributes negatively, indifferently, or positively respectively on that cell. The total of MICS contributions is then obtained by adding the scores. The scores range from -16 to +16 for single-loop learning, and from -8 to +8 for double-loop learning.

Learning fields: Learning activities:↓	Human Resources	Product	Transformation	Markets
Double-loop learning				
Theory development				
Unlearning				
Single-loop learning				
Adaptation				
Storage				
Dissemination				
(re-)use				
Values can be -1, 0, or +1. Scores for DLL and SLL are obtained by adding the scores of the cells, and thus can range between -8 and +8, and -16 and +16 for DLL and SLL respectively.				

Table 7.2: Table Describing Cells on Which to Score MICS's value.

7.3 *Construction of the Research Model*

The previous considerations identified many possible variables and hypotheses (Statements and Conclusions). These are further connected in a causal diagram to make the coherence between them clearer (see fig. 7.3).



The variables 'Reorganization Risks' and 'Organizational Survival Chance' are excluded from the empirical research. The others will be operationalized in section 7.4. We decided earlier on only to study the direct relation between complexity/dynamics and learning needs, and between learning processes and complexity. Because of conclusion 2 (a combination of complexity and dynamics determines the amount of learning need), removing the organization survival chance variable does not lead to any complications. This is not true for the reorganization risks variable. Removing this last variable would make the theory logically inconsistent, because then organizational learning processes (SLL and DLL) would reduce complexity and dynamics (S6 and S7) and increase them at the same time (the indirect effect of SLL and DLL via reorganization risks stated in S10). The solution to this consistency problem is to connect learning norms directly with complexity and dynamics via a new conclusion (5) based on S9 and S10 that is formulated as follows:

Con 5: *Learning norms decrease dynamics and complexity.*

Because this study is about the impact of MICS on organizational learning and, more specifically, MICS' role and value for effective organizational learning, we will not further elaborate the direct causal line between learning norms, complexity and dynamics. Therefore, conclusion 5 is excluded as part of this investigation.
Two additional conclusions (con 6 and 7) can now be stated as well.

Con 6: *MICS contributes to single-loop learning effort and inhibits double-loop learning effort.*

.
This conclusion is a conjunction of statements S15 en S16.

Con 7: *Depending on the Learning Norms, MICS contributes to or decreases complexity and dynamics.*

This last conclusion is based on S6, S7, S10, S15 and S16.

As a summary to this section, first all major statements and conclusions are listed, and figure 7.4 shows their connections with the conclusions. The figure also shows which of these hypotheses are the subject of empirical research.

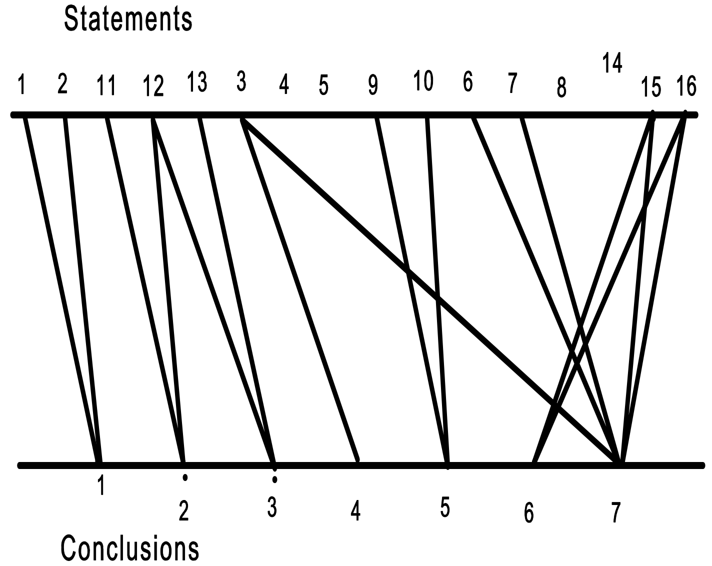
The major statements are:

S1: *Machine Bureaucracies have strong controls.*
S2: *Controls inhibit innovation.*
S3: *Organizations have learning norms that determine the effort an organization puts into single-loop and double-loop learning.*
S4: *MBs face increased environmental dynamics.*
S5: *MBs face increased environmental complexity.*
S6: *Single-loop learning efforts counteract low environmental complexity and dynamics.*
S7: *Double-loop learning efforts counteract high environmental complexity and dynamics.*
S8: *Double-loop learning involves reorganization and so entails higher risks than single-loop learning.*
S9: *Organizations create learning policies to reduce the risks of reorganization.*
S10: *Reorganization risks increase organizational complexity and dynamics.*
S11: *The more environmental complexity and dynamics, the lower the survival chance of an organization which is unable to learn and adapt.*
S12: *The lower the survival chance of an organization, the greater its need for organizational learning.*
S13: *Dynamics contributes more to learning needs than complexity.*
S14: *Lean learning norms emphasize the critical evaluation and problem anticipation roles of MICS, whereas classic learning norms emphasize the problem anticipation and accounting roles of MICS.*
S15: *MICS contributes considerably to SLL-effort.*
S16: *MICS inhibits DLL-effort.*

The Conclusions are:

Con 1: *Machine Bureaucracies are poor in innovation.*
Con 2: *A combination of complexity and dynamics determines the amount of learning need.*
Con 3: *Lowest learning needs exist in cases of low complexity and low dynamics.*
Moderately low learning needs exist in cases of low dynamics and high complexity.
Moderately high learning needs exist in cases of high dynamics and low complexity.
High learning needs exist in cases of high dynamics and high complexity.
Con 4: *Learning needs determine the learning norms required for survival.*
Con 5: *Learning norms decrease dynamics and complexity.*
Con 6: *MICS contributes to single-loop learning effort and inhibits double-loop learning effort.*
Con 7: *Depending on the Learning Norms, MICS contributes to or decreases complexity and dynamics.*

Figure 7.4 summarizes the links between the Statements and the Conclusions.

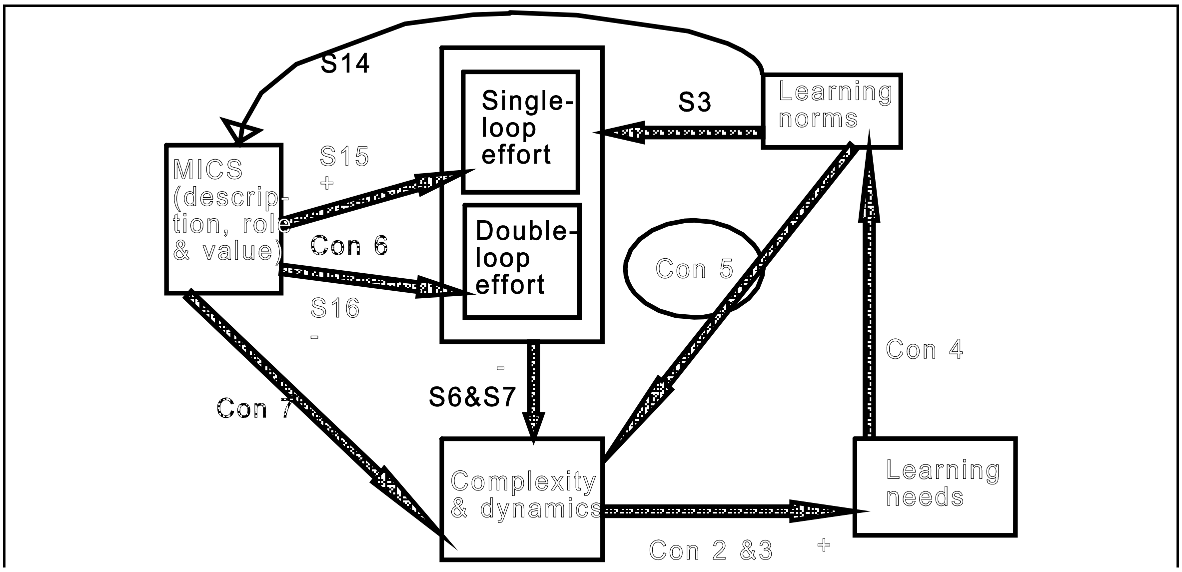


Tabel 7.3 now lists the concepts of the statements and conclusions that are the subject of empirical investigation. These concepts are operationalized in the following sections.

Concept	Variable	Location
Organizational Learning Need	Var. 1: Organizational Learning Needs Index	Table 7.4
Machine Bureaucracy	Var. 2: Machine Bureaucracy Type	Table 7.5
	Var. 2, factor 1: Lean-classic nature of MB	Table 7.6
	Var. 2, factor 2: Transformation nature of MB	Table 7.7
Learning Norms	Var. 3.1: Learning policy and identity norms	Table 7.8
	Var. 3.2: Learning responsibility norms	Table 7.9
	Var. 3.3: Learning action norms	Table 7.10
	Var. 3.4: Learning procedural norms	Table 7.11
MICS	Var. 4: MICS-description	Table 7.12
Single-loop learning effort	Var. 5: SLL-effort index	Table 7.2
Double-loop learning effort	Var. 6: DLL-effort index	Table 7.2
MICS'-role	Var. 7: MICS'-role	No table
MICS'-value	Var. 8.1: MICS'-value on SLL	Table 7.13
	Var. 8.2: MICS'-value on DLL	Table 7.13

Table 7.3: List of Concepts, Variables, and Location of Operationalization.

On the basis of these reflections, the previously described model can now be reformulated and simplified to the following research model (see figure 7.5).



7.4 *From Theory to Observations: Explanation of the Variables*

7.4.1 Methodological Problems for Empirical Investigations

When going from theory to observations the following problems appear according to the research methodology literature (Lee, 1989; Yin, 1984):

1. The theory must be described clearly and unambiguously in operational terms.
2. Measurement instruments must be correct operationalizations of the constructs to be observed.
3. Often multiple items form one index to find a score for a case on a theoretical construct. This requires a sound theory that combines the observations in one score.
4. Observations among cases must be comparable.

The operationalization of the theory is partially realized. This is because of the elicitation of the statements and conclusions. We must now add a correct operationalization of basic theoretical constructs. The statements and conclusions contain variables that must be observed, and by which empirical testing and further exploration of theoretical notions are made possible. Some parts of the theoretical model can be tested whereas others can only be described (e.g. Conclusion 4). In this section some proposals are given for scaling variables that require observations of multiple items. The validity of these scales will only be tested via reasoning about observations made. Statistical testing of the reliability and validity is not possible, because we lack the data to do so (for further insights into these methodological problems see Kerlinger, 1986). Also, a test on the uni-dimensionality of the scales is not possible here because the factor analysis technique that is required for this purpose requires a large amount of statistical data. The reader must be well aware of

these limitations. The most important issue for empirical research, its meaning in practical settings, is however closely guided. This is done via the application of case studies and a research design that takes the two basic explaining variables as main factors (lean-classic and service-manufacturing distinction).
Comparability of the cases is in principle difficult, because each case is in some sense unique (even a statistical research approach cannot avoid this fact). Comparability is achieved by constructing precise and standarized instruments by which we want to observe the cases. Hence, much effort has been put into constructing the scores that are described in the following subsections.

7.4.2 Description of Variables

This subsection provides a further operationalization of the variables described in the theoretical framework.

Variable 1: *Organizational Learning Needs Index.*

Conclusion 2 stated: "*A combination of complexity and dynamics determines the amount of learning need*". What is required therefore are scores of environmental dynamics and complexity with which a learning needs score can be assigned. The measures for complexity and dynamics are based on a classic study of Duncan (1972) and Duncan and Weiss (1978). Complexity was defined as the number of factors of relevance for decision-making, and the number of components to which these factors refer. The factors and components are issues that define an organization's internal and external environment (cf. chapter 5, table 5.7). Dynamics was defined as the degree to which relevant factors for decision-making remain the same over time or are changing, and the frequency with which new factors are relevant (cf. section 5.4.1).
Duncan and Weiss' measures were developed for analyzing decision-making, and were not applied to organizational learning. This study therefore applies the list of factors and components to understand complexity and dynamics in the case studies we will conduct. The observations will however not be made at the individual's decision-making level, because this will make the data-acquisition and analysis too laborious for our purposes. In the case studies we will ask interviewees for data sources about the factors and components of the environment, and will try to qualitatively assess the dynamics and complexity on the basis of these data. It will be difficult to obtain data on some components and factors, which also means that not all factors and components will be treated in detail. Only the most significant ones, from our theoretical perspective, will be considered.
Conclusion 3 provides a starting point for constructing an index of learning needs. Con 3 states: "*Lowest learning needs exist in cases of low complexity and low dynamics. Moderately low learning needs exist in cases of low dynamics and high complexity. Moderately high learning needs exist in cases of high dynamics and low complexity. High learning needs*

exist in cases of high dynamics and high complexity". Thus four scores of the organizational learning needs index are defined. See table 7.4.

<u>Variable 1:</u> *Organizational Learning Needs Index*	Simple	Complex
Static	Low learning needs Score 1	Moderately low learning needs Score 2
Dynamic	Moderately high learning needs Score 3	High learning needs Score 4
Based on Duncan, 1972, p. 320, and Duncan and Weiss, 1979.		

Table 7.4: A Four-Point Index of Organizational Learning Needs.

Because this study does not make learning need scores independent from complexity and dynamics, Con 2 and Con3 are assumptions for measurement.
<u>Variable 2:</u> *MB-types.*

Four types of Machine Bureaucracies were distinguished from the beginning of the book, by two main dimensions: classic-lean and manufacturing-service. The classic-lean distinction concerns the organizational norms (policy, structure, culture, motivations) that govern the organization. The service-manufacturing distinction is about transformation. Variable 2 thus has four values described in table 7.5.

<u>Variable 2:</u> *MB-types*		Norms	
		Classic	Lean
Transfor-mation	Manufacturing	Classic-Manufacturing	Lean-Manufacturing
	Service	Classic-Service	Lean-Service

Table 7.5: MB-types

Rating an organization on its lean-classic (Norms) dimension is based on a score using items found in Womack et al.'s study on lean production. These items were also considered to be relevant for lean organizational learning according to many other researchers in this area (Nonaka, 1988; Walker, 1991; Leonard-Barton, 1992; Adler and Cole, 1993). Table 7.6 lists items for this first factor of MB-types.

Variable 2, Factor 1: Indicators for Lean-Classic	Lean	Classic
Quality attitude	Yes=1	No=0
Decentralization	Yes=1	No=0

Lateral structures	Yes=1	No=0
Emphasis on relation with supplier	Yes=1	No=0
Emphasis on relation with client	Yes=1	No=0
Emphasis on positive management-employee relationship	Yes=1	No=0
Financial decision-making structure	Within consortium with low interest rate=1	Outside consortium with banks=0
Human resource management	Career paths and emphasis on mobility=1	No career path and local position=0
Motivation	Intrinsic=1	Extrinsic=0
Source of new ideas	Internal and external=1	Internal or external=0
Scale minimum of leanness = 0; Maximum of leanness = 10; Lean organization = 6....10; Classic organization = 0.....5.		

Table 7.6: Criteria for Scoring Organizational Leanness.

Items for the process factor are found in the previously discussed paper of Mills and Moberg (1982). The distinction we draw here is of course a simplification of reality as for instance Schmenner has shown (1986). In fact many types of services and manufacturing organizations will score on both values at the same time. Schmenner, and also other writers on services like Grönroos (1991), however do not dispute the relevance of the eight items listed in table 7.7.

Var. 2, factor 2, Indicators for transformation	Service	Manufacturing
Materials and Equipment	Knowledge	Machines, physical materials and labor
Involvement of client in production	Client is ego-involved because he must participate in the service process	Client has contact after production (sales) and sometimes before production (design and contracting)
Information processing	High, accurate and timely information from client is needed	Planned work
Responsibility for success	Client shares responsibility of success	Responsibility of success lies with the producer
Description of process phases	Input, conversion and output are hard to distinguish	Clear distinctions between input, conversion and output (logistic stream)
Stocks and buffers	Stocks are impossible. Buffers are made by selection of clients, routinization of service and rationing (delays and interrupts)	Stocks are possible (under certain conditions) and buffers are created by planning of the production stream
Systems boundaries	Operating core is open system	Operation and administration are

	(involvement of client), administration is closed system.	both closed systems.
Professionalism	Can be high or low.	Low (except in engineering)
An organization scores 1 when the left column value is assigned and 0 when a right column value applies. Minimum score = 0, maximum score = 8. Service organizations have score of 5...8. Manufacturing organizations score 0...4.		

Table 7.7: Scoring Organizations on Transformation.

Variable 3: *Learning Norms*

Learning norms are operationalized in four dimensions: policy and identity norms, responsibility norms, action norms and procedural norms (cf. chapter 4 section 9). The scores on the four related variables (3.1, 3.2, 3.3 and 3.4) can have two extremes that are related to the lean and classic nature of organizations. MICS is treated separately from procedural norms, because it is the independent variable in this study.

Var 3, factor 1: Policy and Identity Norms

Policy and identity norms can be typically lean or classic (cf. chapter 5). Therefore, the score of the index of variable 3.1 can be either 'work smarter' (typical of lean organizations), and 'work harder' (typical of classic organizations). Table 7.8 lists the items for describing learning policy and identity norms, and describes indicative values for both extremes of the index.

Var 3: Learning norms; factor 1: Policy and identity norms	Extremes Work Smarter	Work Harder
Policy and mission	Learning is mentioned in the mission, especially in terms of continual improvement (Kaizen).	Stressing of volumes sold and produced, Return on Investment, market share, profits
Learning infra-structure	Lateral relations are encouraged. When cost-effective, data highways (computers and networks)	No lateral relations, top-down communication. Use of mainframes and information access and maintaining control. Non-transparent organization.
Development and management of core competencies	Top priority for high innovation potential	People are mainly providers of labor. Competencies are what one can do now. Human Resource Management and R&D have lower priority than marketing, manufacturing and logistics.
Organizing principles	Production teams, with high responsibility and availability of	Strong departmental and functional differentiation, with

	management information. Strong project teams. Organization is open systems, with close relation with suppliers, banks and clients	strong line management. Large technostructures, with unclear influence on middle lines. Closed systems (to internal and external environments)
Motivation for business re-engineering	Emphasis on excellent processes, to maximize client satisfaction (ultimate boss). Organization culture and structure must adjust to process requirements.	Optimize processes from efficiency perspective. Technostructure and middle line have expertise for optimization and dictate what happens on the shop floor.
Maximum score of leanness is five when all left alternatives apply. Minimum score is zero when none of the alternatives apply.		

Table 7.8: Scoring the Organization on its Leanness Using Policy and Identity Learning Norms.

Var 3, factor 2: Responsibility norms

Responsibility norms can be typically lean or classic. The first is competence-based, and the second is power-based. The related index is given in table 7.9.

Var 3, factor 2: Learning Responsibilities	Extremes Competence-based	Power-based
Functional	No, because the functional division is regarded as too slow, and has limited information-processing opportunities.	Yes, because the functional division in an organization is a means for hierarchical control
Divisional	No, because it is almost as bureaucratic as the functional organization.	Yes, because now the work division concerns the products or the markets, but the same hierarchical control dominates.
Matrix	Yes, and the organization has the skills to handle this complex organizational arrangement, which supports specialization as well as market/client orientation	No, because it leads to a power struggle in which the functional or divisional branch dominates.
Network with joint (expertise) centra	Yes, because expertise is treated as a strategic asset that should be available to all in the organization.	No, because expertise is regarded as owned by a department or person.
Volvo teams	Yes, because it is important to have smart laborers.	No, because laborers are under-valued in their cognitive abilities.
Task groups with much authority	Yes, so that double-loop learning can be effective and quick when required.	No, because improvements can be done individually, in a department, and should not upset the existing organization.
Maximum score is nine, when the left column values apply. Minimum score is one, when none of the left		

values apply.

Table 7.9: Scoring the Organization's Leanness Using Responsibility Norms.

Chapter 5 also mentions three other organization structures that were considered as part of this index, namely: Network with independent companies, Parallel learning structures, and Project groups. We have however no arguments why these three structures would behave differently in the lean or the classic cases. Therefore they would make no contribution to the index.

Var 3, factor 3: Action norms

The main items describing action norms are given in table 7.10. This table gives an index of action norms, with extremes related to lean and classic organizations. The lean extreme emphasizes the team, the client, self-realization and fast reactions as the main motivators for organizational learning. The classic extreme emphasizes money, pain avoidance, and slow reactions as motivators for learning.

Var. 3, factor 3: Action norms:	Extremes Team and fast	Money and slow
Incentives	Intrinsic	Extrinsic
Interpersonal trust	Openness	Defensiveness
Attitude knowledge removal	Positive	Negative
Learning priority	Relative amount of money (budget), time and authority in relation to operational tasks.	Idem, low.
Source of knowledge	External & internal sources Self development	Internal or external sources Buying knowledge
When left score 1, when right score 0. Sum scores. Lean = sum of scores 3...5; Classic = sum of scores 0...2		

Table 7.10: Scoring the Organization for Leanness Using Action Norms.

Var 3, factor 4: Procedural norms

Table 7.11 describes the procedural norms index. The lean extreme emphasizes free and continuous flow of data and information. The classic extreme emphasizes discrete and constrained flows of data and information.

Variable 3, factor 4: Procedural norms	Extremes Free-continuous	Discrete-constrained

Temporality of data flows	Continuous	Discrete
Data access	Free	Constraints by authority limits
Number of Parameters measured	Everything potentially important for overall performance	Specific targets
Management style	Participation and selling	Telling
Feedback time	Fast	Slow
Distribution of expertise	Technostructure and workgroup	Technostructure and management
Maximum score of leanness is six, when all left column values apply. Minimum score is zero when none of the values apply.		

Table 7.11: Scoring the Organization for Leanness Using Procedural Norms.

Variable 4: *MICS-description*

This is a study of the impact of MICS on organizational learning in four types of organizations. MICS might however be very different in each case. Before assessing its role and value, a description of the technical and social aspects of MICS is valuable for a first orientation. This is done via Stamper's list of semiotic layers. This list is given in table 7.12 for the lean and classic extremes.

Var 4: MICS	Extremes Lean MICS	Classic MICS
Technical		
Physics	Coupling of systems, via network and databases.	Functional systems. Islands of automation.
Empirics	On-line systems.	Off-line systems, with period reports.
Syntactics	High quality user interfaces (easily understandable structure of software). Flexibility of databases. High quality administrative organization. Compatible data structures.	Hard copy reports. Change of database on request and when feasible. Inconsistent data. Incompatible data structures.
Organization		
Semantics	Consistency with possible control type. Shared mental models.	Inconsistency with control type. Mental models are diverse and incompatible and reflect stake holders' positions.
Pragmatics	Decisions are implemented at high speed and trust. Action based on theoretical understanding of practical problems.	Many complications in translating decisions to actions. Action based on past experience (routine) or command.
Social	Social networks of problem anticipation and critical evaluation are closely	Separation of problem anticipation and critical evaluation networks.

	connected. MICS serves problem anticipation and critical evaluation.	MICS service problem anticipation, or punish-reward.

Table 7.11: Describing Leanness of MICS.

Variable 5: *Single-Loop Learning Effort*

Single-Loop Learning is rated in terms of efforts that organizations allocate to any of the four learning activities (adaptation, storage, dissemination and (re)-use) and learning fields. The researcher must document his observations and conclusions when assigning a value (0 or 1) to each field and activity per case. The minimum value for SLL efforts is 0 and the maximum is 16. This scoring principle thus is the same as the one proposed for MICS' value on SLL-effort, with the exception that SLL-effort cannot be negative. For a description of SLL-effort the reader therefore is referred to table 7.2.

Variable 6: *Double-Loop Learning Effort*

The double-loop learning process concerns the creation of goals for the learning fields and the removal of goal definitions that are out of date. This process of double-loop learning is therefore often called 'innovation'. Double-loop learning can be rated via the application of the following questions:

- Human resources. How much money is spent on training? Is this training only for developing skills to accomplish routine tasks, or is it also for learning to develop new insights? Are newly acquired insights implemented in new practices? Are people encouraged to think and create innovations?
- Tranformations. Much innovation is about changing the way products and services are made, so that the organization is able to adjust more easily to specific demands. For instance shorter delivery periods, more flexibility in colors and product features. Much innovation is also about redesigning processes to meet competition by decreasing costs of transactions and coordination. This is not just marginal change but a revolution in thinking and working to accomplish the same job.
- Markets. How many markets and market segments are served? It is important to mention that markets for a company do not merely exist, but must be created by improving communications to potential clients, developing a strategy and plan to create a new profitable market, and adjusting products and services to the specific needs and demands of these new markets or market segments.
- Products. How many new products and product series have been launched within a period of time? Especially the series is an important observational unit, because many organizations only produce a small number of products. For

instance car manufactures produce cars, and maybe also lorries, fork-lift trucks and motor bikes.

A score for double-loop learning effort is obtained by finding evidence of learning within the four fields of learning. A score of 0 is assigned when no learning and no unlearning happens in the four fields. A score of 8 is attached when the organization learns and unlearns on all four fields. The scoring principle is thus exactly the same as the score that was defined for MICS' DLL-value in table 7.2, with the exception that DLL-effort cannot be negative.

Variable 7: *MICS' role*

Section 6.4.3 detected two roles of MICS, namely: Problem Anticipation and Critical Evaluation. MICS' role in one case can vary depending on the learning field and learning activity it supports. Thus MICS can have the critical evaluation role at the human resources field, and the problems anticipation role in the process development field. The researcher can easily detect the role, when asking about the purpose of MICS-usage.

Variable 6: *MICS' value*

Measuring MICS' value is important for investigating the most basic conclusions of this study: "*MICS contributes to single-loop learning effort and inhibits double-loop learning effort*" (Con 6). MICS' value is assessed by assigning a value (-1 for negative influence, inhibit, 0 for no influence and +1 for positive influence of MICS) to the cells that intersect learning fields and learning activities in table 7.2. This is done seperately for single-loop and double-loop learning (var 6.1 and 6.2 respectively), because they were regarded as specifically different. The minimum score for single-loop learning is then -16 and the maximum score is +16. The minimum score for double-loop learning is -8 and the maximum is +8. The researcher can apply table 7.13, which gives indicators for DLL- and SLL-values. This table is not intented to be complete. The learning activities for DLL-values are omitted, because these activities are binary (development versus removal). The researcher can easily ask himslef the question if the activity was development or removal (or both). The learning fields for SLL-values are omitted in the table, because they are easy to detect by asking about the application field.

Examples of Single-Loop Value Indicators	
Learning activity	MICS' single-loop learning value
Adaptation	Decrease of error costs Increase of theory applicability Increase of learning costs Accumulation of knowledge

Storage	Increased administration costs; Reduction of theory development costs; Reduction of quality costs; Steeper learning curve
Dissemination	Reduced coodination costs Reduced development costs
(Re-)use	Reduced development costs Reduced costs of buying expertise externally Faster and improved problem solving
Examples of Double-Loop Value Indicators.	
Learning field	MICS' double-loop learning value
Human resource development	Insights into knowledge for developing HR-policies. Insights into cost-benefit relations of HR-investments.
Market development	Strategic insights and forecasts.
Product development	Informed decisions about product lines and series. Parameters for investments. R & D policies and investments
Process development	Bench-marks. Production norms. Insights in causes and effects of inefficiencies. Insights in process limitations and capabilities.
MICS double-loop value score (var 6.1) is determined by scores (-1, 0, +1) on the intersections of learning fields and learning activities that are touched by MICS. The index score is created by adding these cell scores, and can reach a maximum of +8 and a minimum of -8 for DLL, and +16 and a minimum of -16 for SLL (confer tabel 7.2).	

Table 7.13: Example of Indicators for MICS' Learning Values.

These scores are of course tentative and experiences with them in the separate case studies must be documented. The final chapter must conclude about possible adjustments and consequences for the information audit instrument.

Con 6 also requires the rating of Single-Loop Learning and Double-Loop Learning effort.

7.5 *Summary and Conclusions*

This chapter has summarized the main statements about organizational learning, machine bureaucracies, and information systems. These statements are related to each other to show the coherence (a theory), to reduce the amount of redundancy, and to identify the main variables of this study. In total 8 variables are defined (learning needs, machine bureaucracy type, learning norms, description of MICS, role of MICS, value of MICS, single-loop learning effort, and double-loop learning effort) and operationalized. The case studies provide observations on these variables in order to draw conclusions about the hypotheses (five conclusions and one statement) listed in table 7.15. The comparative analysis of data from the cases must result in conclusions about the validity of the Conclusions, and about possibilities to further develop our understanding of organizational learning and information systems (for instance by constructing a normative theory).

The following steps are undertaken in the separate case studies.

1. *General description* of the case in terms of contextual variables such as size, age, organization chart, and learning fields.
2. *Description of the organization in terms of learning needs*, by scoring its internal and external dynamics and complexity.
3. *Description of the organization in terms of its lean-classic and service-manufacturing nature.* This for the classification of the case according to the main independent variable machine bureaucracy type. Note that we do not assign a value in terms of better or worse to the MB-type found.
4. *Description of the organization in terms of learning norms.* The description of organizational learning starts with learning norms because this is similar to the description made earlier of organization configurations, and sets the norms for the two learning processes to be described additionally. At the same moment the match between the machine bureaucracy type mentioned earlier and the values on the learning dimensions is tested. Deviations between the theory and the observations are of particular interest.
5. *Description of MICS*
6. *Description of learning* (single-loop and double-loop learning processes and learning fields). Description of each learning step (development, storage, (re-)use, dissemination, adaptation, removal/double loop trigger) *and the role and value of* MICS therein.
7. *Explanation of possible problems in learning steps from the role and value of MICS and recommendations.*
8. *Conclusion regarding the validity of the main hypotheses.*

Score sheets are used to summarize the findings. See tables 7.14 and 7.15.

Var 2: M.B.-type: Org. Learning variables:↓	1: Classic-Machine	2: Classic-Service	3: Lean-Manufacturing	4: Lean-Service
Var 1: Learning need	1 or 2	2 or 3	2 or 3	3 or 4
Var 3.1: learning polcy & identity	Work harder	Work harder	Work smarter	Work smarter
Var 3.2: Res-ponsibil-ity norms	Power-based and functional	Power-based and functional	Competence-based	Competence-based
Var 3.3: Action norms	Money and slow	Money and slow	Team and fast	Team and fast
Var 3.4: Procedural	Discrete and	Discrete and	Continuous and	Continuous and

norms	constraint	constraint	free	free
Var 4: Description of MICS	Classic	Classic	Lean	Lean
Var 5: SLL- effort (score 0..16)	4	8	12	16
Var 6: DLL-effort (score 0..8) Var 7: MICS' role	0 or 1 Problem Anticipation	2 or 3 Problem Anticipation	4, 5 or 6 Poblem anticipation and Critical evaluation	6, 7 or 8 Poblem anticipation and Critical evaluation
Var 8.1: MICS' value on SLL-effort (score 16..+16)	0..4	4..8	8..12	12..16
Var 8.2: MICS' value on DLL-effort (score 8..+8)	-8..-4	-4..0	0..4	4..8

Table 7.14: Score Card for Each Case Based on the Descriptions of the Organizational Learning Variables and MB-type Classification.

Hypothesis	case 1	case 2	case 3	case 4	case 5
Con 4: Learning needs determine the learning norms required for survival.					
S14: Lean norms emphasize critical evaluation and problem anticipation roles of MICS, whereas classic norms emphasize problem anticipation and accounting roles of MICS					
Con 6: MICS contributes to single-loop learning effort and inhibits double-loop learning effort.					
Con 7 Depending on the Learning Norms, MICS contributes to or reduces complexity and dynamics.					

Table 7.15: Evaluation Table for Cross-Comparative Assessment

Score sheet 7.14 contains a summary of expected values. Each case is related with these values, so that a test of the predictive quality of the theory per case is made. Because the purpose is to make a comparison between MB-types, the cases are presented in order of their expected leanness. Thus first a classic manufacturer is described, second a classic service company, third a manufacturer that is on the move towards leanness, but, as was noted later, not lean yet, fourth a service company that is at about the same stage of leanness, and finally a fully lean producer that also places a high emphasis on service. The results of all the cases are compared, specifically to find any patterns among MB-types and the organizational learning variables. In the most optimistic sense, the discovered patterns will be interpreted normatively, so that something can be said about the values the learning variables should have, given a certain context. Score sheet 7.15 brings together the results about the validity, or invalidity of certain Conclusions and Statements. This is input for a further elaboration of the theory. The results from sheets 7.14 and 7.15 are used to further elaborate on a theory on the role and value of information systems in organizational learning.

Chapter 8 : Case Studies

8.1 *Case 1: Cardboard Co.*[27]

8.1.1 Introduction to this Case

This case is about Cardboard Co., which previously consisted of three independent small manufacturers. At the end of the 1980s they merged under the heading of a packaging and paper division of a multinational operating in the office supplies business. Since 1989 these three companies still have separate production locations, but they share one management team that takes responsibility for commercial and strategic policies and planning. The management team is located at a separate town from the three production locations. The production locations are in Western Europe and in towns, approximately 40 miles from each other. As suggested by the management, two of these locations have significantly different organization cultures. This would explain differences in success of an information system dedicated to the management of adhesive paper, which is a relatively precious production component for finishing cardboard products. This fitted well in our research objective of detecting learning norms and the interaction of these norms with the learning process and MICS' use and value.

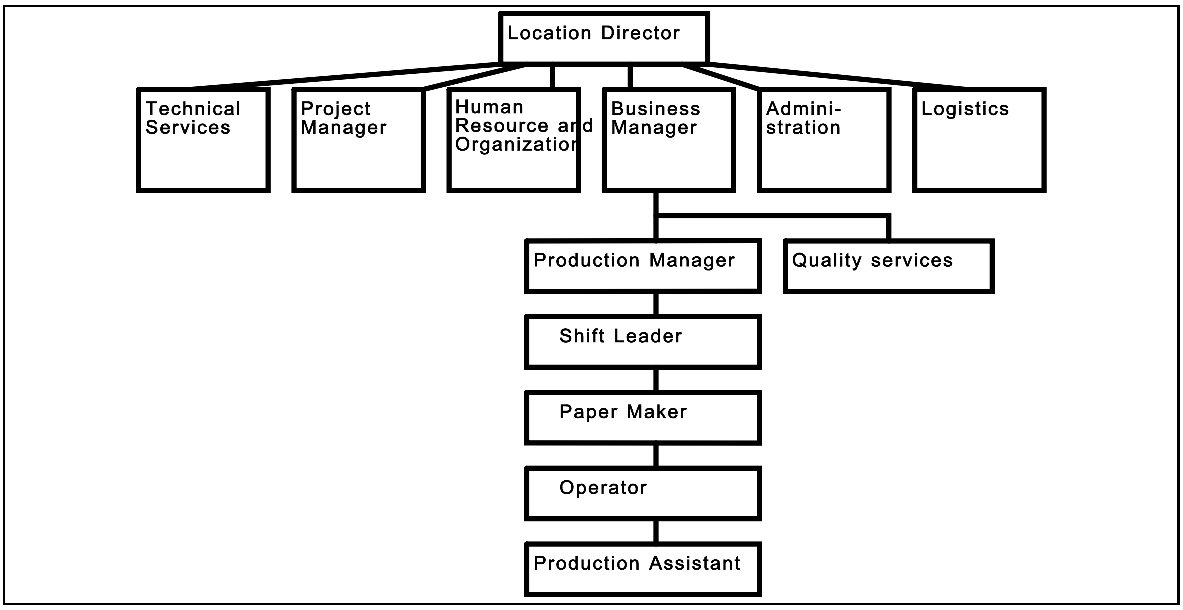
8.1.2 General Description of Cardboard Co.

Cardboard Co. is established as part of the paper and cardboard division of the multinational mentioned above and officially exists since 1989. One location of this company was already established in the 1920s. The merger of the companies was intended to create more benefits from large-scale economies. The three companies were acquired to reduce the company's dependence on suppliers, to reduce oscillation of prices in the industry and to optimize mutual deliveries.
The organization has three production plants, of which two are studied in detail. These are numbered 1 and 2 in table 8.1. The main differences between the plants are the product volumes, products and processes, organization culture, and effectiveness of their MICS. MICS consists of an adhesive paper management system (APMS) and a logistics management system (LMS). This case study mainly concerns the APMS part of MICS, which provides information to the management and employees about adhesive paper management in the (recent) past.

[27] I am grateful to Mr St. Kordelaar, who contributed substantially in the data collection for this case.

Location	Product	Transformation	Employees
1	Packaging cardboard	Large volume series	150
2	Packaging cardboard	Short series	193
3	Luxurious and fine cardboard	Small volume	Not known

Table 8.1: Differences between Locations



A production location has an organization chart that looks like fig. 8.1.
The organization produces about 250.000 tons of solid cardboard a year. This cardboard is a semi-manufactured product for the packaging industry. The Plant mainly makes use of recycled paper, and applies several types of adhesive paper on the cardboard. By changing the type of adhesive paper the cardboard acquires different characteristics that are important for the particular packaging purpose. For instance, the demands of the fruit industry with respect to waterproofing differ from those of the toy industry. Adhesive paper is the main factor influencing the potential variations Cardboard Co. can manufacture. The product variation is currently about 350 types. Adhesive paper is also the most costly raw material applied. For an average type of cardboard, the adhesive paper makes up about 30% of the manufacturing costs. The additional costs are: paper (10%), glue (1%) and fixed costs (personnel, machinery, buildings etc.) (60%). Included in these cost estimations are maintenance costs, technical support and overhead. Cardboard for tomato packaging, however, requires a better quality of adhesive paper, leading to 64% of production costs. Managing adhesive paper carefully is therefore a critical success factor.
Cardboard Co. delivers about 80 % of its products to other plants of the Cardboard and Paper Division. Additionally it has about 250 external clients. Production is

mainly based on order processing principles, although plans have been made to produce more on stock in the near future. As cardboard is a typical commodity, it is difficult to follow a differentiation or focus strategy in this industry. The strategy is therefore 'cost leadership' with some constraints on quality demands, depending on the specific processing demands of the clients. The clients and their quality demands are well known to Cardboard Co.

Obviously the efficiency of the production process is a major learning field. The cardboard market is typically led by cost leaders. Human resource issues are becoming increasingly important learning fields and training has been emphasized as important for the company's success in several interviews. There is not much innovation in products and most of the customers are known.

8.1.3 Cardboard Co.'s Learning Need

The Static-Dynamic Dimension

The internal environment of both locations is very stable because no major innovations in transformation occur. The company seals the production locations off from possible disturbing influences from the environment by placing marketing and planning functions at the central office of Cardboard Co. In the last four years authorities for logistics and commerce also moved to the central office.

The external environment is stable as well. Some cyclic events might influence stocks and orders. For instance, during our investigation, the poor summer led to a poor fruit harvest resulting in a small demand for fruit packaging. The division and top executives strategically try to minimize turbulence. The acquisitions of the three locations were explicitly intended to lower turbulence and dependence on unpredictable market forces. Yearly delivery contracts with its customers led to further stabilization. Only very infrequently are high urgency orders processed. During our study, the divisional Headquarters negotiated with a major competitor to create a merger. This was realized in the second half of the year. The delivery of raw material, used paper and adhesive paper are very stable because there is an oversupply on the market. Used paper can be obtained for very low prices. On the other hand, adhesive paper is very expensive, difficult to obtain on time, and frequently quality problems occur because the paper is vulnerable to mistreatment during transportation. It is important for the company therefore to have firm negotiating power against the suppliers of adhesive paper.

The Simple-Complex Dimension

Locations 1 and 2 differ slightly on complexity. The internal complexity of location 1 (high volume, long batches) is very low. The production process is almost continuous, in which used paper is preprocessed to a basis material, and then processed to cardboard. Finally, the adhesive paper is glued to the cardboard. Depending on the features of the product, different types of adhesive paper are used. During the production process, visual inspection and sensors are used to monitor product quality. The manufacturing at location 1 is carried out by 72 persons. Additionally, Technical Services (25 employees) maintains the machinery and electronics involved. Human Resource Management regularly organizes training to improve operators' abilities of machine handling and trouble-shooting. More recently, courses have been developed to increase knowledge about production control, automation, administrative procedures and quality awareness. The Logistics and Procurement department manages the stocks, and develops detailed production schedules on the basis of the orders that are received from the Central Logistics and Planning department.

The external complexity of location 2 is slightly greater because the production runs are smaller

and quality demands are higher than in location 1. This leads to a greater complexity in scheduling, logistics and materials handling. The result is a much higher spoilage of adhesive paper. Besides the quality of monitoring adhesive paper usage, cultural differences also explain part of the higher spoilage at location 2. When MICS was introduced, spoilage of adhesive paper at location 1 was 16% and at location 2 this was 30%!
Conclusion: the complexity and dynamics of CBM are very low. This means that the learning needs score is the lowest possible (score 1), which confirms insights into classic manufacturing machine bureaucracies.

8.1.4 Cardboard Co.'s Leanness and Service-Manufacturing Nature

Leanness of Cardboard Co.

Cardboard Co. does not have a detailed and dominant quality attitude, because its strategy is based on cost leadership and differentiation on possible use for clients. The division has developed a plan called 'Cost Reductions', which is the dominant action plan at the moment. It aims at reducing the costs of adhesive paper, production disturbances, machine stand-still, and use of personnel. Ideas about differentiation are restricted to making variants in size, thickness and strength.
Vertical decentralization is reduced to a minimum. Since the merger of the three Plants, the director of Cardboard Co. attracts his own staff who take care of many managerial responsibilities that in the past were the responsibility of separate locations. The commercial function is completely centralized and the location director is confronted with a large list of authority limits. The logistics manager at Headquarters plans procurement and Plant loading among the locations. The locations are only responsible for the detailed scheduling of the runs and the internal storage and distribution of the supplies. Only the human resource function is decentralized. The task of this function is restricted to training, mainly technical training and on-the-job courses. For the adhesive paper management problem the local administration, logistics, human resource and production functions are important. The tasks of these groups are listed in table 8.2.

Function	Adhesive Paper Management Task
Logistics	Check quality of delivery Analyze source of spoilage and propose action Negotiate with suppliers about quality of delivery
Production	Key-in (in MICS) problems with adhesive paper in production process Aim at minimal spoilage
Administration	Check data of MICS (control data from production for reliability) Make statistics about adhesive paper spoilage
Human Resource	Provide training to minimize costs of spoilage (e.g. by use of simulations) Detect needs for new courses Detect needs for external training

Table 8.2: Localized Authorities Related to Adhesive Paper Management

The lateral structures are not strong because of the geographical distance and local cultural differences. Additionally, the production processes are not easily comparable because of some important differences in the processes. Despite these differences, the large difference in spoilage of adhesive paper (16% at location 1 and 30 % at location 2) became apparent by MICS-data and led to an active search at location 2 for causes and opportunities for improvement.
Because poor deliveries increased production costs, one location started to systematically evaluate deliveries using MICS. Systematic problems were

communicated to suppliers leading to a joint search for improvement. The relations with the clients are particularly strong, mainly because this is part of the larger consortium policy of decreasing instabilities in the supply market for their packaging manufacturers. The importance of clients is not as strongly felt at the locations. There is no systematic client feedback system. Relations with clients are bureaucratic and based on yearly plans created by the divisional top management.

The local Plants were purchased by a huge consortium for strategic reasons. Low internal interest rates to encourage innovation and competitiveness (as in Japanese lean production) are less important than direct financial success. Cardboard Co. also differs in its career patterns from a typical lean organization. A production assistant, for instance, can become a paper maker or maybe shift leader. Because of their limited education and the decrease of management numbers as a result of several mergers, no further career progression is likely for the employees. Relations between the local management and the employees are informal and friendly. At the same time however, management does not explicitly allow employees to participate in managerial affairs. The work motivation is extrinsic. MICS introduced a new element in motivation, namely the opportunity to measure a shift's performance in adhesive paper management. This does not always lead to positive behavior. Shifts sometimes try to pass on problems to the subsequent shift. This behavior obstructs the effective use of MICS for improving intrinsic motivation.

New ideas on logistics frequently originate at the local logistics department. Most other innovations are thought out at the divisional level and implemented via local training.

Conclusion: the company only scores lean on its emphasis for positive management-employee relations, and to a lesser extent on its seeking mutually beneficial relations with clients and suppliers. As part of a larger division it deviates from the pure classic type through its more secure financial situation.

<u>Service-Manufacturing</u>

Cardboard Co. is obviously not a service company. Its output is tangible and discrete, thus easily measured in tons of each type of cardboard. Profits and (gross) costs are detected easily as well. Only a few objective reference points are needed to determine the performance of the Plant. This means that there are relatively many unambiguous reference points.

The organization's output goals are defined in yearly plans, in terms of tons and profits. Although this company is a clear case of a manufacturing machine bureaucracy, its position in a consortium with no internal market feedback mechanisms complicates learning from its output.

Cardboard Co.'s clients are only involved at the contracting stage and for the definition of requirements. This is done at the general and divisional management level. Work is a planned process, disturbed by only a few urgent orders. The final success of the cardboard is partly dependent on what the clients (of the packaging

Plants) do with it. Phases in production can be clearly demarcated. Stock production is avoided because stand-still costs less than stocking this relatively cheap but voluminous product, and because stocks are risky as clients require specific types of cardboard. The operation and administration systems are closed to the clients. The informal communication in the Plant seems to be effective. Professionalism, also at the managerial level at locations, is rather low. The merger introduced a trend for more advanced management.
Conclusion: Cardboard Co. is a typical example of a Classic-Manufacturing machine bureaucracy.

8.1.5 Cardboard Co.'s Learning Norms

Learning policy
Cardboard Co.'s management aims at reducing costs, increasing volumes produced and sold, and increasing returns-on-investments. Learning is not specifically an objective in this company. One director for instance stated that Cardboard Co. is a company of do-ers rather than of theorists. Cardboard Co. has no policy to explictly encourage communication and has no infrastructure for organizational learning. Nevertheless, it places much emphasis on improving skills via training. The training manager communicates with the quality manager about systematic errors, and sometimes develops a course to improve the situation. Most production assistants also learn the job of paper and cardboard making by a combination of working on the shop floor and studying at school. Cardboard Co., because of its small size, has many possibilities for informal lateral contacts. In this, Cardboard Co. clearly differs from the 'work harder' extreme. Nevertheless, self-management of production groups is very limited. The planning department, logistics and production management clearly decide about what has to be done on the shop floor. Business re-engineering is a non-existing word at Cardboard Co. The management is however very keen on opportunities to reduce costs. Motivation for business re-engineering therefore exist, at least in principle.
Conclusion: this organization in most senses has 'work harder' learning policy norms. It has a limited informality because of its small size.

Responsibility norms
Two learning processes can be detected in Cardboard Co. which I call project learning and adhesive paper management learning.
Project learning concerns engineering, developing and discussing investment projects to improve cardboard production. The initiative comes mostly from the project manager, who uses people from Technical Services and Mechanics to find out the best solutions. No market orientation is carried out, and responsibilities are clearly associated with the project manager and one or a few additional support departments. The frequency of projects is quite limited (no process innovations were mentioned during our visits).
Adhesive paper management learning can occur when shifts receive data about their performance and receive possible instructions to improve. Particularly important here are:

- The Administration who makes statistical analyses via MICS and feeds these insights back to the shifts in concrete suggestions. The difference between locations 1 and 2 in adhesive paper management is frequently explained by location 2's lessor experience with MICS and the fact that the administration there lacks understanding of the shop floor because none of the administrators have ever worked there.
- The logistics manager, who analyses delivery data from APMS, and feeds these insights back to the suppliers.

The second learning process has been especially successful in the past three years. Location 1 has reduced its spoilage from 16 to 8%. Location 2 has just started to improve, now that reliable data are available. They reduced spoilage in the last two years from 25 to 17%. One percent decrease of adhesive spoilage leads to a cost reduction of about $175,000 a year!
Because the organization is in a stable and simple environment no type of active search via networks exists. The volvos (shop floor groups, shifts) have some responsibilities to lower the adhesive paper costs. They are supported in this by the management and the technostructure (logistics manager and administration in particular and human resources for specific training). Project groups do exist sometimes, but are restricted to solving technical problems. Task forces with clear strategic intent are absent.
Conclusion: this case verifies the opinion that learning in classic machine bureaucracies is basically power-based and functionally organized. The learning process is organized around the technical production process. No divisional and matrix structures exist.

<u>Action norms</u>
Although we did not have the opportunity to interview workers, motivation is probably extrinsic because the routine and often dirty nature of the work does not give much instrinsic satisfaction. Extrinsic work motivations reduce the chance for creative learning and kaizen to null. People on the shop floor have a defensive attitude to innovations because they do not have the training or ability to get another job. Knowledge removal, when linked to the loss of jobs or requiring additional training to keep a job are not favored. Our informants (project manager MICS, trainer, location director) could not give exact data about training budgets, because these data were not seperately registered in the organization. The locations do have their own full-time training consultant. Some younger people worked in the organization as well, engaged in external training to become professional 'paper makers'.
Conclusion: Cardboard Co. has 'money and slow' action norms. Its small size however enables quick implementation of new operational insights.

<u>Procedural norms</u>
Feedback frequencies for a location as a whole (from divisional headquarters) are mostly once a year, when the yearly plans are reconsidered and budgets are allocated to the locations. This is slow, even for a classic manufacturer.
Data flows are discrete. For APMS, data are keyed in at the shop floor. Next day the Administration checks the data and corrects errors. Additionally, Administration analyses the data. Finally the shift can have its feedback and the logistics manager can take action if required. A big problem in this long procedure is that the shifts are not present when the data become available. Sometimes they stay away for the weekend, and sometimes even for a week. This makes communication about what happened and what the sources of the spoilage are quite difficult.
Data access is not free. There are precise authority limits and defined information needs. It is not clear how this hurts the company, but it certainly does not contribute to business awareness.
The number of issues measured is very limited. The main system, APMS, only measures adhesive paper spoilage. Additionally a logistics information system includes data about materials, people and machine hours. At Cardboard Co.-Headquarters, commercial data are also available. These data sources are not connected in an integrated system that could give people at all levels access to information. No-one seems to think that the dissemination of data could be valuable and people are not interested in data other than those of direct relevance to their task.
The management style is a uni-directional communication from Cardboard Co.-Headquarters to the location directors. The operators and paper makers only receive instructions to produce cardboard in certain volumes and with certain characteristics.
Feedback is slow, because the information supply is slow. The environment does not require this to be speeded up, although technically it would not be difficult to arrange. The impact of this on a further reduction of adhesive paper spoilage would probably be less at location 1. This learning

cycle has already reduced spoilage to 8%; further reduction depends on production planning and the commercial process (order acquisition), because the major spoilage source is 'loss caused by width' (LCW). LCW is caused by the fact that each location has machines of different width. In the commercial process, orders are made concerning the delivery of cardboard with a certain volume, features and width. For instance, a client asks for a width of e.g. 2.00m. This order may be planned on a machine of width 2.34m. The loss is .34m of production. The solution for this problem could be:

- Install more machines of different or varying widths.
- Increase the price to compensate for losses, or refuse the order.

Because Cardboard Co. has a very stable environment the first option is realistic. The second option is commercially unattractive and not considered by Cardboard Co.

Expertise is concentrated in departments. There are no interdisciplinary groups. Only occasionally an 'interdisciplinary' project group is created, mostly consisting of the project manager and some people from Technical Services.

Conclusion: the procedural norms are 'discrete and constrained', though more discrete than constrained, because shifts have access to data about other shifts' performance.

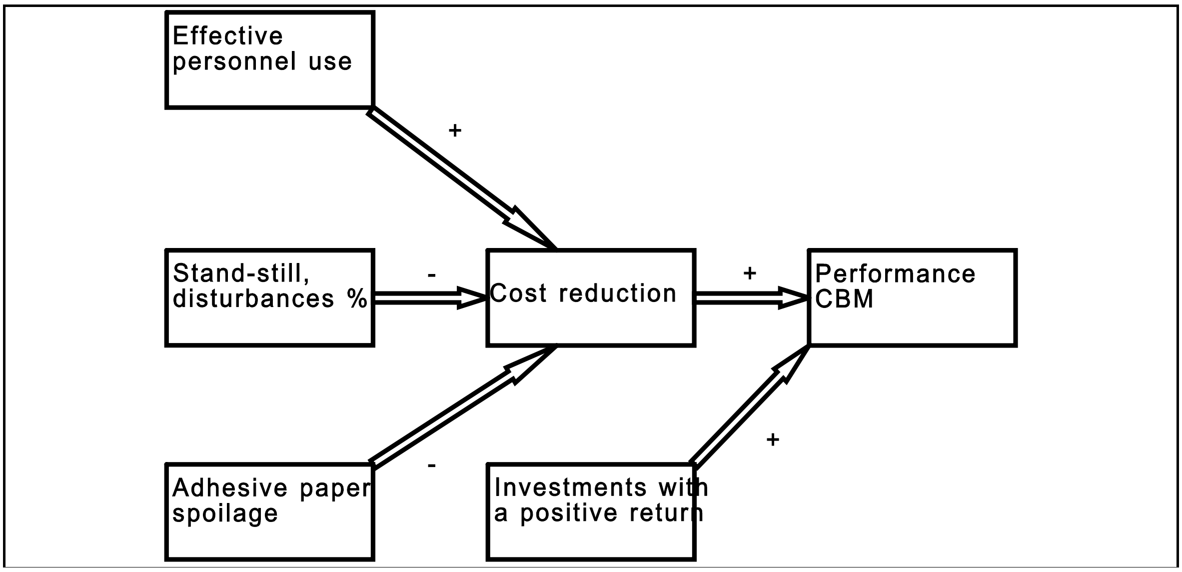
8.1.6 Description of MICS

MICS is a functional system. Data from the APMS branch can be transferred to its LMS-branch (logistics management system), so that the quality of the data can be compared with registrations from logistics and purchasing. It is however not yet completely integrated in the Logistics Management System.

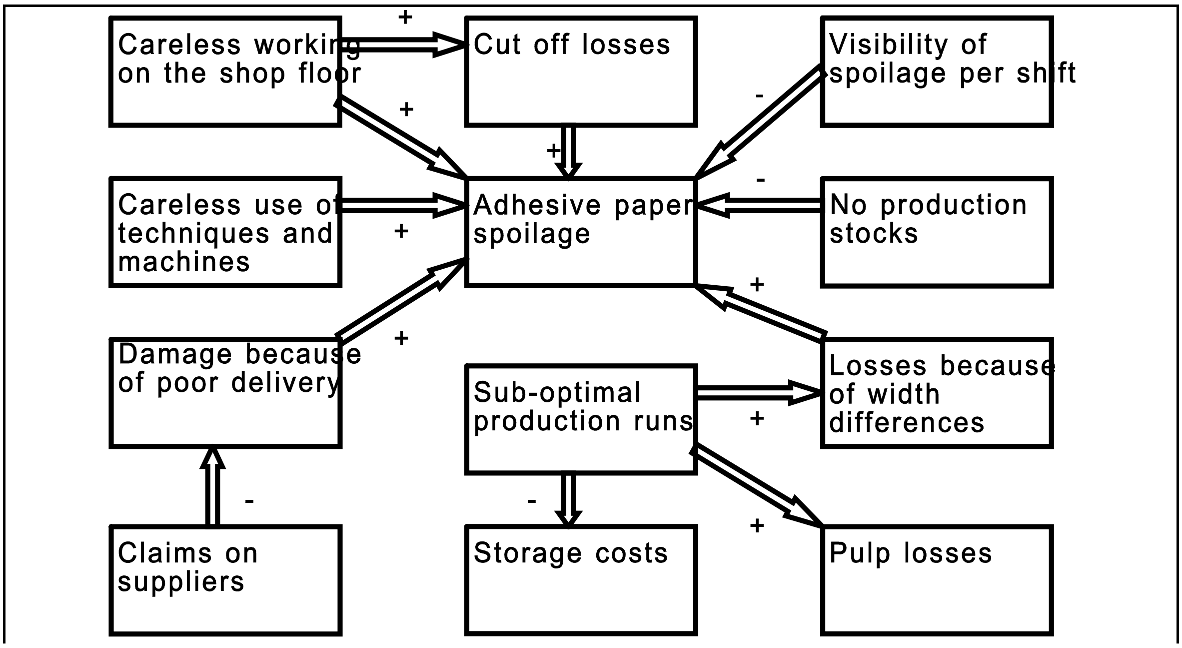
At the moment MICS is off-line. When it becomes part of a Manufacturing Resource Planning system, which completely integrates APMS and LMS, it could become on-line as well, and the learning process could speed up considerably. This is especially the case at location 2, where the administrative process is much more complex because of the shorter product orders, larger variety, and availability of two machines (instead of one at location 1). The use of an on-line system for performance evaluation at the end of each day, could enable much learning in both locations.

Until now, however, data are often inconsistent between APMS and LMS, and interpretation is done via hard copy reports. Changes in data supply must go through a bureaucratic request for proposal, thus constraining flexibility in use.

There is some inconsistency with the control type that is possible in this situation. For instance shifts could be set spoilage targets, and MICS could give data about performance. It is important that a correct interpretation is made of the data, based on a concrete management theory. This theory is not described explicitly, but easy to describe in a causal diagram (see fig. 8.2).



The theory visualized in diagram 8.2 is made concrete on the subject of adhesive paper



management in the causal diagram of figure 8.3.

A conflict of aims is apparent in the logistics choice between higher order processing targets and decreased spoilage. The larger the batch, the lower the spoilage. Predictability of processes could decrease width spoilage, but possibly decrease flexibility. This problem must be carefully considered by Headquarters when making the yearly plans with the other Plants in the division.

Because decisions are about operational issues they can be implemented easily. This is the advantage of being a rather small company. The typical examples of ineffective implementation of decisions in bureaucracies are mostly based on large, government bureaucracies, which require many translations before a policy is put into practice (Van Gunsteren, 1976). This mostly results in many communication and agency problems (Douma and Schreuder, 1991) and people losing a critical attitude to their work.

The problem anticipation network is centralized at Headquarters. Some further detailed scheduling of activities is carried out at the locations. The performance control network consists of administrators. At location 1 there was also a close connection between the local logistics manager and the administrators. This was because the head of Administration at location 1 had a strong affinity with production, and the administration and logistics people also work in the same room. At location 2 this was both not the case, which hindered the understanding of APMS data!
MICS is thus used for logistics problem anticipation (LMS) *or* critical evaluation of performance (APMS). These are however not yet integrated.
Conclusion: procedural norms are 'discrete and constrained', which is typical of classic machine bureaucracies. Some deviations are important to note:

- Location 1 is clearly less bureaucratic than location 2 at the social level. This might explain its better performance in adhesive paper management, because more complexity is involved there.
- Absence of conflicts in management theories.
- Absence of problems of inconsistent data structures. The small size management information system makes the problem of data-structure inconsistency easily manageable.
- High speed of decision-making.

8.1.7 Role and Value of MICS

Single-loop learning

<u>Adapation of management theory</u>
Supply and actual use of adhesive paper is administered and evaluated precisely. The adapation process is carried out by the Administration Department and local logistics managers. The results were substantial (from 30 to 16% spoilage at location 2 and from 16 to 8% at location 1 in a few years). This impact is so great because for the first time APMS enabled the availability of accurate and timely data for generating knowledge about adhesive paper management. Previously, adhesive paper management was simply not an issue because its consequences were not known. At the moment location 2 seems to be improving considerably more than location 1. Only more fundamental solutions could improve location 1. The management theory is particularly well developed for the following variables:

- Amount of spoilage per shift. This introduced a competition element among the shifts.
- Reduction of damage. The impact of poor deliveries became evident, and suppliers were threatened by claims if they did not improve their delivery quality. Internal damage was also measured, but it seems difficult to influence poor quality in this respect.
- Improving care of working and techniques applied. This was done via various suggestions from the logistics manager, and by the creation and execution of training schemes.

The basic question of introducing new, more flexible production techniques and machinery, and improving the fit between market demand and production capabilities is a difficult double-loop learning issue which we will discuss later on.
The role of MICS is in performance measurement and evaluation via APMS, and problem anticipation via the logistics planning and scheduling system LMS. MICS aids the adaptation of knowledge, although learning is restricted to the transformation field and human resource issues (performance measurement of shifts and feedback).

<u>Storage</u>
Storage of knowledge is realized via:

- Training and handbooks that are used for that purpose.
- The management of delivery is carried out by Administration and the creation of delivery performance files. The logistics manager has a precise historic overview per supplier which is used for improving deliveries.

- MICS historical data about performance, and LMS models.

This means that knowledge is aquired, retained and retrieved via information systems and some additional organizational memories. APMS and LMS parts of MICS both contribute to this activity, though learning is restricted to the fields of transformation an human resources.

Dissemination

Dissemination of knowledge occurs by supplying data from MICS to the locations 1 and 2. The locations therefore have bench-marks, that act as de facto standards against which to assess improvements. MICS' role in this learning activity is obvious, and also has a positive value on it. Dissemination is thus restricted to the transformation field and the field of human resources (providing shifts with performance data).

(Re)-use

Planning algorithms have been developed to distribute orders to locations. This knowledge is part of LMS and adapted and (re-)used by Cardboard Co.'s Headquarter logistics manager. APMS generates historic overviews that are reused for performance control and motivation of personnel. Here APMS' role is performance control. APMS' value is not restricted to process (efficiency) improvement, but also for developing the human resource. APMS motivates people and also clarifies some problems, which could be tackled by training.
Conclusion: MICS' role in Cardboard Co. is in the critical evaluation and problem anticipation restricted to the learning fields of transformation and human resources. Cardboard Co. seems to be learning in all the four areas of SLL. It scores on all cells intersecting SLL-effort activities and the fields of transformation and human resources, leading to an SLL-effort score of 8. During our visit no systematic SLL learning procedures about the other learning fields were detected. The reason for this are the so-called 'authority limits', responsibility norms that restrict the opportunity for learning in other fields. No negative impacts of APMS were found in the organization. In fact, MICS contributes to all cells of SLL-learning in which Cardboard Co. is active. MICS' SLL-value is thus +8. The only reason why it did not work in location 2 was because the administrative procedures and evaluation experiences were absent.

Double-loop learning

Double-loop learning is completely absent at the locations but is a specific task for Headquarters. The tomato project is one example in which some product development happened to capture a larger share of the fruit packaging industry. This project was a joint project of Cardboard Co. together with some other parts of the division. Cardboard is a mature product making market development difficult. New markets are created by taking over competitors or by fundamental process innovations that could strongly decrease production costs. The main production factors are: adhesive paper, used paper, personnel and (inflexible) machines. Personnel costs could be lowered by further production automation. The costs of these innovations are however also substantial. Automation of production could however be combined with flexibility improvement (introducing Flexible Manufacturing Systems). Cardboard Co. is not seriously considering this.
Conclusion: Cardboard Co. has a DLL learning effort score of 0. Information systems are therefore not used for double-loop learning. MICS reinforces the single-loop attention focus. This could predict negative impact of MICS on DLL-value. The cause for this restriction to DLL learning is however not MICS itself, but the existing learning norms (specifically the learning responsibilities). Hence, the impact of these systems on the DLL-value is scored zero and not negative.

8.1.8 Learning Problems Related to MICS and Recommendations

Many learning problems were detected, namely:

- Location 2 has a decision-making network that seperates problem anticipation from critical evaluation.
- Cardboard Co. locations (the Plants) are physically and mentally separated from their Headquarters.
- Cardboard Co. has no systematic insight into other single-loop learning issues than the adhesive paper management.
- Cardboard Co. has a strong functional separation of responsibilities, decreasing the capacity for interdisciplinary thinking.
- Double-loop learning is not supported in Cardboard Co. (even not at Headquarters).

My advice is to develop a new MICS, and some new management structures, as follows.
MICS:

- The new APMS could easily be made part of an integarted MICS. It should not only prompt suggestions for improved planning, but also systematic reviews of performance indicators. The organization should develop a set of performance indicators and implement these as part of the new LMS.
- The new LMS should be developed on the basis of an explicit management theory, which is recognizable and understandable by all organization members.
- Organization members should be invited to participate in thinking about Cardboard Co.'s success by combining data from LMS with the managerial theory.

Management structures:

- Authority limits should be less detailed and used more informally. To decrease the communication problems, Cardboard Co. Headquarters should be closer to the locations.
- Cardboard Co.'s commercial department should consider innovations in product, markets and transformations. The existing transformational technology is getting out of date, and causes spoilage of expensive materials. It is quite certain that some competitor will introduce solutions for the spoilage problem within a few years.
- Possibilities for reducing spoilage of adhesive paper with the existing machinery are now exhausted. It is now time to consider new flexible manufacturing technology. Cardboard Co's 'width loss' is substantially larger than its 'cut loss' (3.1 versus .4 in location 1). Width loss can only be reduced by: not accepting non-standard orders, improving planning processes by using an advanced planning module of LMS, or introducing flexibility in machine width.

8.1.9 Conclusions Regarding the Main Hypotheses

For Cardboard Co. the score sheet is as follows.

Org. Learning Variables:	Var 2 (MB-type) is 1: Classic-Machine
Var 1: Learning needs	1 (low complexity and low dynamics)
Var 3.1: Policy and Identity norms	work harder
Var 3.2: Responsibilities	Power-based, functional
Var 3.3: Action norms	Money and slow, but *quick implementation of operational insights*. The small size of the organization for an MB-type might explain this deviation from the theory.
Var 3.4: Procedural	More discrete than constraint, because *shifts have access to data from other shifts for motivational purposes.*
Var 4: Description of MICS	Classic (functional, some parts off-line, no intergated database)
Var 5: SLL effort (rate 0..16)	8, *four points higher than expected maximum*
Var 6: DLL effort (rate 0..8)	0

Var 7: MICS' role	Problem anticipation and *Critical evaluation.*
Var 8.1: MICS' value on SLL (rate -16..+16)	+8, *two points higher than expected maximum*
Var 8.2: MICS' value on DLL (rate -8..+8)	0, *not negative*
Unexpected values are italicized in the table.	

Table 8.3: Score Card for Cardboard Co.

Some deviations from the expectations about learning norms and MICS are commented on here:

- Cardboard Co. also uses project groups, though not frequently, to solve problems. This improves the single-loop learning process. MICS contributes sometimes as a system that signals problems.
- Cardboard Co. also learns by disseminating the experiences of volvos and disseminating experience among the locations. Improvement projects often involve the collaboration of logistics, volvos and training and human resource specialists.
- New operational insights are quickly implemented. Because of Cardboard Co.'s small size, management can easily check the effectiveness of the implementation by just walking into the factory.
- The MICS provides data for budgeting and problem anticipation, but also for critical evaluation.
- The most important reason for the high SLL-score is that MICS contributes to two fields of learning, and does this on all SLL-activities.

The differerences on the learning efforts score are not very significant. It is more significant that the negative impact (inhibiting) of MICS on double-loop learning seems not to exist in this case. As far as DLL is constrained in Cardboard Co., the causes are based on (responsibility) learning norms (called authority limits).

Con 4 states that learning needs determine the learning norms required. This statement is a truism, but leaves open the important question of how learning needs influence learning norms. The learning needs score for this case is 1 and this correlates with the following learning norms:

- Absence of a learning identity and policy definition. Learning is not a major issue, and therefore has not led management to define a learning policy.
- Because learning needs are low and the problems are simple, it is mostly not necessary to make responsibility norms involving an interdisciplinary group.
- Action norms concern the implementation of concrete instructions and suggestions for improvement (mostly found out as a result of an improvement project, or as an idea of a manager or expert of the technostructure). The organization likes concrete action suggestions, and disapproves of complex theorizing.
- Procedural norms exist to disseminate information about performance between locations 1 and 2, and between shifts.

Statement 14 says that classic learning norms only lead to problem anticipation

MICS roles, whereas lean learning norms lead to MICS that also supports critical evaluation roles. This classic case however shows that statement 14 is not true because APMS and LMS support both roles.
The validity of Con 6 in case 1 is not yet clear. MICS indeed increases SLL-effort. It has however no impact on DLL-efforts. This means that Con 6 is invalid. The suggestion therefore is to confirm Statement 15, and to modify Statement 16 to: MICS has a negative or no influence on DLL-efforts.
Con 7 proves to be right in this case. The learning norms support SLL-effort that can only reduce complexity and dynamics when they are already low. MICS contributes to this SLL process by providing data useful for this process (Statement 6). In this case, the critical evaluation role of MICS does not lead to theory development and unlearning (DLL-efforts), but only leads to theory adaptation, because the organization perceives neither high complexity nor high dynamics.

8.2 *Case 2: The Bank*[28]

8.2.1 Introduction to this Case

This case is about a major European Commercial Bank located in most European countries and other continents. The case studied was its Branch in one European country. It has been particularly successful in the business market segment, and now is entering into the less cyclically sensitive private sector (especially the richer subsegment). The Bank aims at delivering full financial services in both market segments. We stressed the functioning of the Branches in this case, because these are the sites at which the 'moments of truth' occur when interaction with clients take place (cf. chapter 5). A bank was chosen as a typical example of a classic machine bureaucracy. The organization in this case is however larger than in the others (about 3000 employees). The Bank is also interesting because of attempts by its senior management to improve organizational learning and reduce its bureaucratic nature.

8.2.2 General Description of The Bank

The bank originated from mergers among small banks under the leadership of a huge European bank. In the country studied it has about 3000 employees. There is pressure to cut staff as the payoff of information technology, and to meet price competition among banks in Europe. Data about employment in this bank are given in table 8.4.

[28] I am grateful to Mr M. Hafkamp, who contributed substantially in the data gathering for this case.

Year	Number of Employees	Full time equivalents**
1990	3637	3450
1991	3417	3261
1992	3235	3070
1996*	2800	2650

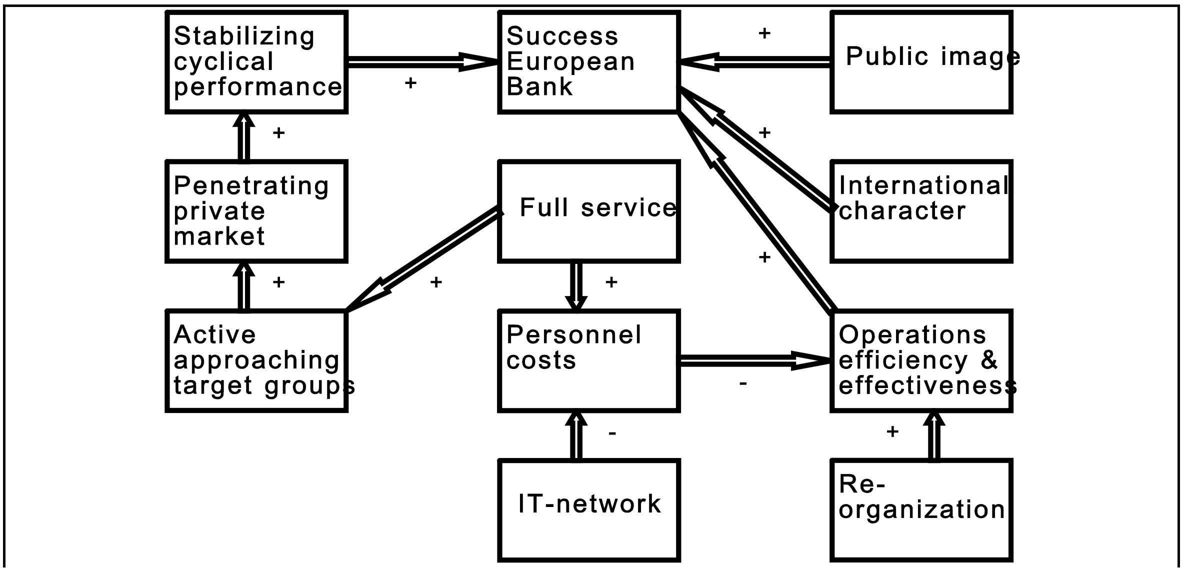
* According to business plan 1992-1996
** FTE data are estimated by multiplication of number with a factor .95

Table 8.4: The Bank's Employment Figures

The Bank has a business plan for 1992-1996 listing these critical success factors:

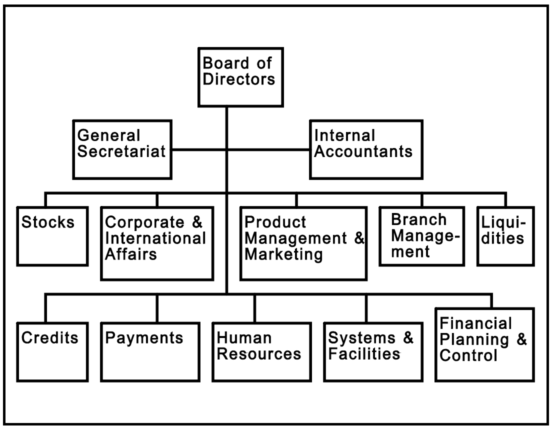
- Actively approaching the target groups (upper 40% of the private market and business companies).
- Stabilizing its market size in the state of operation.
- Full service to optimize relationships with clients.
- Reduction of costs (mainly personnel) by means of business process redesign and information technology.
- Improving internal communication for improving core activities for the business market, private market, and support and facilitation of these markets. The influence of Headquarters should consequently decrease and some structural organization changes are planned.
- Improvement of its image via new products and communication programmes.
- Improvement of the international character of the bank, mainly through the development of an international educational center for its personnel and managers.
- Improving performance stability by penetrating the less cyclical private market.

The bank has an explicit management theory stating that its success depends directly on its public image, operational effectiveness and efficiency, and the stabilization of cyclical performance. Figure 8.4 gives a causal diagram of this theory and some indirectly related factors.

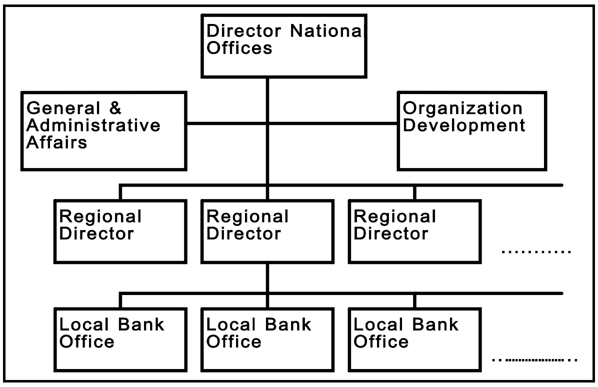


Striving for full service and the elite target group are not consistent with a cost leadership strategy. The Bank is well aware of this fact and does not have a cost leader but client satisfaction strategy.

The Bank is divided into two types of Directorates: Commercial Directorates (Stocks, Corporate & International Affairs, Product Management & Marketing, Branch Management and Liquidities) and Support Directorates (Credits, Payments, Human Resources, Information & Organization, and Management & Planning). Most employees work in the Commercial Directorates (about 2000). About 1600 of these people work for the Branch Management Department, which consists of the Branches that directly serve The Bank's clients. In the Branch Management Department about 200 people have non-managerial jobs. Figure 8.5 gives a general organization chart of The Bank.



A further detailed study was made of the Branches. One reason for this choice was that the Branches are the main locations where The Bank can learn about its performance. The other reason is that The Bank is explicitly trying to make the Branches more self-managerial. The Department of Branch Management is divided geographically into six regions, managed by Regional Directors. In total the Department consists of 78 Branches, with 4 big Branches (containing more than 50 employees), 38 small Branches (7 employees) and 36 middle-sized Branches (between 7 and 50 employees). Coordination between the Branches is hierarchical via the Regional Directors and the Departments at Headquarters. Headquarters prescribes the main rules in the organization by: setting return-on-investments, making the strategic market plan, choosing the service type (full service in The Bank's case), setting acceptable risk limits, developing new products, stating human resource policies, setting rules and norms for the administrative organization, developing information technological plans and related investments and projects, and developing financial control systems for cost accounting and cost allocation.



The Department of Branch Management has an organization chart as illustrated in fig. 8.6. MICS-use and organizational learning were studied in ten Branches. Two Branches were studied in detail, one medium-sized and one small Branch. We found, in a first interview round, that the way of management, learning and MICS use, does not differ much among these Branches, although they all had very different client groups. To obtain a correct and complete picture of organizational learning and MICS, we received information from the Regional Directorate and Headquarters as well. This means that this study is a typical embedded case study, with multiple units of analysis (Yin, 1984, pp. 44-46). The emphasis is however on the functioning of the Branches.

The following functions are most important in each Branch: commercial functions, administrative functions and managerial functions. Commercial functions include: market orientation, action planning, acquisition planning, acquisition, credit loan, credit consulting, additional banking services, management of credit relations, general account management and documentation. Administrative functions include: counter-activities, cash management, payments, book-keeping, deposits handling, database management, administration and sending of cheques, handling of PBX, telexing and faxing, postage, mail and archives, input of data in The Bank's total management reporting system, and some additional administration activities.

The management tasks are listed below.

- To lead the commercial activities of the Branch, by developing commercial policies.
- To make budget proposals for the Branches and discuss these with the regional director.
- To report periodically to the regional director about goal attainment and reasons for ineffectiveness.
- To select and acquire a qualitatively and quantitatively excellent work force. To make proposals for changes to the required work force.
- Responsibility for several management reports.
- To lead coordination and discussions between chiefs of administration and

account management.
- To control and inspect the ways administrative procedures are performed.
- To assign tasks to Administration for performing internal controls according to rules set by the regional director and the Internal Accounting & Control Group.
- To authorize contracts and transactions within a certain authorization limit.
- Outside representation of the Branch.
- To contact important outside stakeholders such as solicitors and local government.

These management tasks are to some extent shared with other sections of The Bank (such as departments of Headquarters).
If we look at the organization charts, the four learning fields all are clearly allocated to departments, as is shown in table 8.5.

Learning field	Department
Process	Systems and Facilities, Administration, Financial Planning and Control
Human resource	Organization Development, Human Resources
Market	Product Management and Marketing, Regional Director and Branches
Product	Product Management and Marketing

Table 8.5: Learning Fields and Departments Responsible

8.2.3 The Bank's Learning Need

The Static-Dynamic Dimension

The banking business is extremely vulnerable to macro-economic trends. This is particularly so with banks that have their roots mainly in business services, like The Bank. At the time of our investigation (1992-1993) a world-wide recession was leading to increased problems. At the same time interest rates, currencies and stock exchange indexes were strongly fluctuating, making business unpredictable. Additionally, a trend of further deregulation and liberalization of the economy (Common Market and GATT discussions) influenced the European banking business. National market boundaries were being removed and national banks were confronted with increased competition from abroad. Banks were also looking for new markets to enter (e.g. insurance, travel, real estate). To survive in this environment, banks chose one or more of the following options:
- Strong emphasis on cost reduction, by use of information technology.
- Active and even aggressive marketing of services and products.
- Many new products and services.
- Mergers between banks to stabilize their position and increase power over a market.

All these issues are relevant for The Bank. The first three have been shortly touched on in our model of the management theory. The latter issue is relevant for The Bank as well, because The Bank resulted from mergers of small banks under the leadership of a multinational. A fifth option was also chosen by The Bank: optimization of client-bank relationships as a strategy to enter a mature bank market.
Uncertainty is a dominant factor and The Bank was trying to decrease it by putting more emphasis

on the private market (which up to that time had been contributing about 20% to The Bank's revenues).
After the mergers that led to the existence of The Bank, the CEOs centralized authority and introduced bureaucratic mechanisms to reduce internal instability. This period is now over and The Bank is following a philosophy of decentralization and encourages self-management. However, this increases internal instability. The instability differs with respect to administration and commercial functions.
Because administrative tasks are clearly defined and easily measured, performance and planning data for this part of Branch work are easily determined. The commercial functions however are much harder to measure in terms of amounts and predictability of work-loads. As a consequence only data about commercial performance are available with indirect relations to work-loads.
The bank is well aware of the risks involved in the commercial activities. Therefore it has developed a specific approach to treat prospects, to estimate a relation and to develop a cost-effective sales strategy. Nevertheless, work-load as well as changes in profitability are extremely difficult to determine in advance, and risk is an inherent issue of the commercial services.

The Simple-Complex Dimension
In the sixties, banks offered just a few standardized products. Since then, many new services have been developed to differentiate from competitors. Since the 1980s, this differentiation trend has been reversed, in the sense that banks merged to provide clients with a total service. The Bank is an example of such a 'full service' bank. This means that complexity has increased considerably. Clients also demand more added value by a better customer fit, which requires more expertise and specialization. Simultaneously, banks have been offering services that were recently not considered as bank services (insurance and travel services). Information technology enables new products such as electronic banking, salary processing, and management information for its clients. These trends are all applicable to the situation of The Bank now.
The external complexity is clearly reflected in the specialization which is an indicator of internal complexity. Additionally, banks are also supposed to act according to some general rules and laws that garantee their trustworthiness and credibility. These are implemented in many rules for internal control and inspection. In studying the functions, tasks and handlings in a Branch, we found some interesting indicators of The Banks internal complexity (see table 8.6).

Function	Management	Administration	Commerce
Tasks	24	12	10
Activities (including control)	76	94	12
Control activities	24	30	3

The cells show the number of tasks, activities and control activities that are prescribed in The Bank's handbook for performing managerial, administratitive and commercial functions.

Table 8.6: The Bank's Branch Tasks and Activities Indicating Internal Complexity

What is remarkable is not only the amount of specialization but also of control to check for possible mistakes, fraud and performance (the latter was only performed by the management). Of the 24 managerial control activities only 2 were for performance control. The managerial (76) activities were the task of the location director (13), Chief of Administration (25) and several other managers at local, regional and Headquarters levels.
Many procedures are described in administrative handbooks, overview lists for

authorizations, circulars, internal instructions from the Chief of Administration and Headquarters, waivers, warning lists in case of calamities, etc.
Conclusion: The Bank has a dynamic and complex environment, and therefore has the maximum learning needs score of 4, a much higher score than expected.

8.2.4 The Bank's Leanness and Service-Manufacturing Nature

Leanness of The Bank
The Bank has not developed a particular quality policy. The required control procedures and checks are compulsory by law and market demands. High quality of service is a minimal requirement for staying in this service business. Important mistakes lead to a low image. The bank tries to augment its image by an explicit public relations campaign and through creation of new products. Some of these products are particularly interesting for the new (private) market it wants to enter.
After some years of centralization, Branches are being given more autonomy and responsibilities. They have to develop their own business plans and are held increasingly responsible for their own performance. The task and activity descriptions are explicitly not written in terms of how people should execute the job, but explicitly in terms of what they should have achieved.
Lateral structures, i.e. interactions among Branches, are not found in this case. In general the Branches work independently, and the regional director coordinates when necessary. Meetings at the regional office are sometimes organized to have interactions at the lower management level. This is not an explicit policy. Mostly the problems and policies of the Branches all go up to the regional office and from there to Headquarters. The added value of the regional director seems to be as a post-box.
A main supplier is the Central Bank which prescribes credits and loan policies. The Central Bank is a superior authority, and has legal means to enforce its policy. The Bank is part of a huge financial consortium that can provide cheap money to help The Bank survive in case of threatening situations. The Bank is also used by its multinational parent to have a foot-in-the-door in the national market.
Because of the strong competition in the banking business, the client has a very strong position and The Bank does everything to optimize the client-bank relationship. Additionally The Bank has a relatively expensive workforce, because the general age, experience and knowledge level in its workforce is higher than those of its competitors. This makes a cost leadership strategy not yet feasible. Only high IT-investments could make cost leadership achievable. The Bank's strategy is primarily to show clients its added value despite its higher price.
Management-employee relationships are hierarchical. The small Branches (7 or less employees) have very friendly and constructive interpersonal relationships. Nevertheless the tasks and responsibilities are clearly demarcated. There are now specific programmes to raise worker participation in management, however, human resource management is ambiguous because the management and the lower level personnel are treated very differently. Management positions are mobile and have an international orientation. Lower level management and clerks have a clearly local position and mobility is unlikely. Motivation is extrinsic. No specific programmes exist to create a more professional work attitude (possibly leading to lower incomes, but more interesting jobs).
New ideas are taken from where possible. The Headquarter departments develop new products, do assessments of performance, think over information systems and facilities, and consult on possible improvements. They have highly educated personnel (mostly university Master's Degrees) and apply the new insights where possible.
Conclusion: the human resource management, quality attitude and financial decision-making structure looks lean, but also classic at the same time. Decentralization is low, although, The Bank

has recently started moving to a more decentralized structure. The Bank could therefore better be qualified as moving towards lean, but it is still fundamentally a classic machine bureaucracy. The score on the 10 point leanness scale is 3.

Service-Manufacturing Nature of the The Bank

Although the services The Bank provides are intangible, they are not difficult to measure when an output has been delivered. The amount and volume of loans are easy to measure. This is also true for stocks delivered and traded, and liabilities paid. The output is less easily measurable when it is professional advice. In fact the bank is not paid for advice only, but gains its revenues from transactions that result from advice. Even more important than the transaction volume is the client's perception of the output. Objective reference points could be constructed by counting the payoff of a service for a client. The Bank, however, prefers to monitor its contact with clients closely and frequently. Administrative services are much more easily quantifiable in this respect than commercial services. The output goal of the bank is defined in terms of client-service relationship. This is monitored in terms of profit per client/relation and the associated costs.

Commercial services are difficult to measure, but a further problem is that the time lag between activities and success can be quite long. For instance it may take a client more than two years of communication and negotiations with account managers before he decides on some huge and (for The Bank) very profitable transactions. For administrative services the relation between activities and success is almost direct, because the costs and prices of the administrative activities are known in advance.

The main resource for the commercial function is knowledge about products that support the services, and knowledge about clients and the local market. The Bank has explicitly chosen a decentralized Branch policy in recent years because of the specific characteristics of local markets. One Branch might for instance earn a substantial amount with one 'big' client, whereas others earn their money from many small (private) clients. The Branches sources of income vary so much that The Bank's CEOs have removed centrally established performance targets. Planning and budgetting is therefore a top-down and bottom-up communication process. As well as a good understanding of The Bank's products, 'close touch' between account managers and clients/prospects is a critical success factor for the commercial function. The administrative function is very different. Although the establishment of effective and efficient procedures is a knowledge-intensive activity, administrative processes are increasingly carried out by programmed machines possibly in a network environment.

Clients are ego-involved in the transformation process, because it is otherwise difficult to deliver the right services to a client. This is however less so for the machine-like transaction processing of administrative services. The Bank's focus on business and the top 40% of the private market makes most of The Bank's activities less mechanistic and they clearly require specific attention to the clients' needs.

Some routine information processing is carried out (e.g. salary accounts and salary services). This makes the information processing a planned process. The same applies for much of the administrative function. Our inventory of administrative activities showed that there were few deviations from the plans in this area.

The administration function distinguishes clearly between input, transformation and output. The commercial function is also more procedurally organized. The Bank developed an information system that supports commercial functions by means of a process view of commercial activities. Buffers are only available in the administrative process, but in general this is quite limited and clients demand timely service. Some buffering in the commercial function is possible via selection of clients and making agreements about the delivery of the services that are acceptable to the client. A well-functioning agenda/calendering system is required to ensure that a complete service is delivered on time.

The commercial function is open for prospects (potential clients) and clients. This is true also of some parts of the administration (front office). Electronic banking and cash dispensers make the administrative function more directly accessible to clients. *Dual cores* (see chapter 5) are however still available. This can also be seen in the organization structure of the support and commercial departments and the split between the Branches and the Headquarter departments. The Bank is now in a process of reorganization and wants to reduce the barriers between the cores, and aims at complete integration.

Professionalism is high in the commercial and management positions. Also at Headquarters, professionals are organizing administrative functions. Professionalism is low in most administrative positions.

Conclusion: The Bank is a service company, but there are still many manufacturing features, particularly within the administrative function. The Bank is also a classic MB. Hence, The Bank belongs to the classic-service MB type.

8.2.5 The Bank's Learning Norms

Learning policy norms

The Bank does not have an explicit learning philosophy. At the Branches there is no process of continual improvement. They regularly receive feedback and instructions from Headquarters, but it is not clear how they should improve on the basis of experiences in the market. There are regular learning meetings to update and adapt management knowledge at Headquarters. The Branch Management department communicates the findings to the Branches.

Communication is via the hierarchical command and reporting structures. The organization is non-transparent as it is sometimes difficult to find out who should be contacted to solve certain problems. This is of course closely related to the size and geographical separation of the company's parts, but certainly a problem when wanting to create learning processes.

The development of new products and training people to improve The Bank's performance are recognized as basic for The Bank's survival. In 1992 an average of about US$950 and 1% of the total working time was spent per employee on training. This amount represents a strong increase in relation to previous years. Recently, a special training center has been established. There is also a trend to shift the emphasis of courses from internal knowledge and product skills to skills for effective management. This training is also closely related to the internal change processes.

Headquarters has a large technostructure, thinking about processes and products. The decisions are implemented via the Branch Management Department. Because of the integration of back and front offices, branches can gain a better overview of the performance of all their activities.

Business re-engineering is an important issue. Many ways of improving performance and efficiency are being considered. A major project now underway is the network project, which is trying to implement data highways to improve internal communication in the bank, and to smooth interactions between the front and (virtual) back offices. These data highways could enable very lean communication processes. The network project has however not yet been realized.

The commercial function is pure people's business and demands the development of human resources and core competences. At the same time it makes administrative and back office services more industrialized. This requires new skills and expertise. The account managers function more and more in teams, so that they can support each other and have access to information about clients. The Branches however only have some ad hoc collaborations initiated by the Regional Director.

Motivation for business re-engineering is high. People are professional and aware of the need for modernization. Also, employees think that The Bank is still able to grow in the market.

Conclusion: The Bank has many initiatives for improving learning via changing the existing learning policy norms. These policies in many ways preceed behavioral and organizational changes. The Bank therefore is in an organizational turnaround. Also, the relation between the Branch Management Department and the other commercial and support departments is being reconsidered. The 'work harder' extreme is dominant. The 'work smarter' extreme is exemplified by the implementation of networks, the way account managers work, and the motivation for business re-engineering. This is possibly also the result of the service transformation, which e.g. requires less additional investments to create a network (cf. chapter 5).

Responsibility norms

The Bank is a prototype of a classic machine bureaucracy with a classic distribution of learning responsibilities. Learning occurs along hierarchical lines with support from the technostructure at Headquarters.
The Bank has a functional learning structure, thus dominated by the hierarchy (management and technostructure). No use is made of organizational networks. The volvo principle is to some extent available in the Branches to adjust work processes and communicate specific issues of interest. Task groups have not been formed despite the fact that The Bank is starting a major organizational change process. The change process is strongly supported by the organizational apex, but the changes are implemented top-down with a major role played by the Branch Management Department's Organizational Development group. Project groups are frequently started up to accomplish technical and product changes. These are mostly initiated by Headquarter departments.
Conclusion: the competence-based structure in The Bank is restricted to operational working in the Branches. The learning structure follows the principle of the command chain, and thus is of the type 'power-based and functional'.

Action norms

Work motivation in the bank is primarily *extrinsic* and oriented towards personal success and income. There is however no policy to pay people for success. This is also almost impossible in the commercial function, because of the time lag between action and result, and the ambiguity about this relation. The success of the administrative group is easier to measure, but again it is difficult to assign efficiency gains solely to the efforts of the administrative group alone. The Department of Information & Organization, regional director, account managers etc. all contribute in some sense to the success of the administration. Despite this motivation, no indications of defensiveness were found that would obstruct learning processes.
Learning priority is very high in the bank, although learning was not a basic part of its identity definition. The reason for this conclusion is the large number of employees (443, making 15,6% of the total work-force) in technostructure positions, which includes those responsible for the standardization of work processes, personnel analysis, recruitment and training, analysts for planning and control, budget analysts and accounting.
Knowledge sources for learning are internal as well as external. Many insights are gained from professional education, and many are gained from experience and analysis of the business The Bank is in.
Conclusion: despite The Bank's action norms falling mainly in the 'money & slow' extreme, it invests substantially in learning (high learning priority).

Procedural norms

The operational feedback, client-relation interaction, must be very quick. A poor response of the Branches to complaints could seriously harm The Bank. However, it is bureaucratic and reacts slowly when problems about products are discovered. The problems are then communicated from the bottom (account managers) to the Branch Director, who in turn communicates with the regional director. The latter then communicates them to the director of Branch Management, who in turn communicates with the Department of Product Management and Marketing. Recently, however, the Branch Management Department and Product Management and Marketing moved into the same building. Because both departments are rather small, communication at this level is quick and effective. In our interviews with Branch employees and Headquarters nobody complained about the existing communication procedures, which might indicate that feedback frequencies are in line with demands. Larger banks would probably suffer more from this problem. The future information network could be used as a lateral structure to support quick communication about

products.
In most cases the procedural norms can be qualified as 'discrete and constrained', which is typical of classic machine bureaucracies. The information flow is discrete and not on-line. Many reports are produced and disseminated on a periodic basis, e.g. once a week, once a month, once a year etc. Data access is clearly connected to authorities and responsibilities. The management style is telling and the technostructure and management are important knowledge creators in the organization. Deviations from the classic case are the feedback time and the number of issues measured. The feedback time differs strongly between operational and tactical-strategic feedback. Operational feedback is sometimes rapid for administrative services, which have a very precise and limited period. A service failure provokes quick feedback requiring direct action, because competing banks can supply most administrative services as well. For commercial services the feedback period can be long, because the impact of these services manifest themselves no sooner than after a few years. The tactical and strategic feedbacks take a long time as well. Many communication nodes in the hierarchy must be passed before problems from the Branches finally reach the attention of Headquarters.

8.2.6 Description of MICS

A most remarkable feature of The Bank's MICS is the large number of indicators measured. For instance a Branch director receives the following reports, generated from several information systems, all called MICS here:

- Monthly Overviews showing the profits of the bank related to several products, the costs involved and the costs and profits per employee. Also, a comparison with the budgets is made.
- Monthly Budget Comparison. About 193 items of cost and profit data are generated by comparing the results to the budget, cumulative budget data from the beginning of the year are given, and data about budget target realization are given.
- Status Interests Analysis, providing data on six interest products with respect to the capital available, the interest margins and the interest margins related to the amount of capital involved. It also compares these data with data from the last two years.
- Balance and Profit/Loss Accounts per product, generated monthly, quarterly and yearly.
- Human Resource Costs, on the implications of personnel changes on personnel costs.
- Absentee Overviews, on absenteeism through illness at all Branches in one region, for commercial and administrative personnel.
- Acquisition Plan, which presents data about the money gained by account managers in relation to periods in the past. The data only concern the six interest-generating products of the bank. Data about acquired provisions (e.g. insurances sold) are registered elsewhere.
- Transaction Monitor, showing the average number of transactions (monthly, quarterly, yearly), the work-force allocated to the Branch and the number of people required (according to a general norm) to process these transactions. In total 196 transaction types are identified in the reports!
- Overview of Transaction Bills. For each account manager and for each account and relation a monthly report is made of the amount of money billed to a client.
- Total Overview of Added Value of an Account Manager. This is a report about the interest margins, provisions received, amount billed, and costs of transactions per account manager, quarterly and cumulative per year. This report is also made per relation per account manager. As The Bank now has 6 interest-generating products and 8 provision-generating products, and account managers have an average of 250 relations, reports can have a length of about 3584 items!
- Number of Relations (accounts) in Relation to Commercial Work-Force. Per region and Branch an overview is generated of the number of private and business relations, split up into debit and credit relations, the size of the commercial work-force and number of

relations per commercial employee.

- Audit Reports of the Internal Accountants Office, about the quality and reliability of procedures and how these are applied.
- Overview Prospecting, describing per account manager the prospects and some main data on prospects, such as Branch involved, size, status of the prospecting process, and dates for further activities.
- Credit Overview, describing per account manager the accounts' credit limits and terms of payback.
- Conversation Notes. Many notes about the communications between account managers and prospects and clients are made that are used for further communication and for other account managers to take over the conversations when required.
- Calendering System. This system combines data from Credit Overview, Conversation Notes and Overview Prospecting, so that in weekly meetings between account managers and the Branch directors operational actions can be planned.
- Overview of Relations and Accounts, containing an overview of relations (private, business and its legal shape) to their account status (positive, negative, no account).

Conclusion: this MICS is not lean because no explict connections are made with the mental models of its users. The system will change from hard copy to interactive output. The problems of accomplishing this are however huge. At the moment therefore, almost all organization members receive the same package of paper output, with many irrelevant details and difficult to analyze!

8.2.7 Role and Value of MICS

Single-loop Learning

<u>Adaptation</u>

When initiated by Branches, adaptation is sometimes a slow process. Problems with products are first communicated to regional directors and the director of Branch Management. Secondly, they are communicated to Product Management. Product Management also initiates adaptation itself. This is done by asking account managers about previous experiences.

The Department of Management and Planning also initiates adaptation. Depending on past performance and The Bank's policy and aims, this department develops new ways for internal budgeting, tariffs and pricing. It develops new products, processes and markets, which identifies this activity as adaptation.

Adaptation is also an activity of the Branch Management Department, mainly by suggesting new parameters for budgeting. This statement explicitly uses the term 'suggesting' because The Bank has changed its internal policy from a command (top-down) structure to a more participatory approach that gives the Branches more freedom. The reason for this policy change was not only the maturing of the organization (the initial years after the merger were completed and the internal situation has become more stable), but also in order to widen the information processing capabilities at the local levels, which was required because of the large variety of locations.

Finally, the Department of Information & Organization also has a task, in evaluating and suggesting changes for administrative procedures and internal control, but also through changing information supply and systems.

The role of MICS in adaptation is problem anticipation (scheduling and longer term) and critical evaluation (of products, operations, costs etc). MICS' value is limited to the fields of processes, products and markets. No specific human resource planning and performance measurement system exists.

<u>Storage</u>

Administrative procedures are well stored in handbooks, courses and people's experience and education. The Bank also has experience with storing the knowledge of the account managers. The following systems were specifically developed for this purpose: Overview Prospecting, which supports the account managers via expert knowledge about the prospecting process, Conversation Notes, which document conversations and make them accessible to other account managers, and the Calendering System that combines information from the two previously mentioned systems, for making and archiving schedules of activities. The many other management reporting systems mostly provide data in relation to past periods. This enables interesting learning from the past, but it is not clear how it could be used for more than extrapolating the past. MICS' roles are thus scheduling and monitoring progress. Its value in these activities is restricted to the process field.

<u>Dissemination</u>
The coordination between Headquarters and the Branches could be improved considerably via the IT-network. The Bank has a project to develop this. At the moment the periodic reports are a basic mechanism of dissemination. The Branch Management Department also organizes regular meetings at one Branch, or region, in which interpretations are given of the data and the conclusions are discussed. The Branch Management Department then serves as a facilitator in the discussions. More operationally, the systems for the account managers also have an important role in disseminating experience and knowledge.
MICS' roles are on the process, market and product fields here. MICS' value is positively related to these three learning fields.

<u>(Re-)use</u>
The systems do not specifically lead to improved skills. It is also not clear how they contribute to augmented knowledge. Nevertheless, the dissemination of data when accompanied by a discussion facilitator seems a good way to update knowledge and improve behavior.
MICS' roles are problem anticipation and the critical evaluation of the fields of process, products and markets. MICS' values are positively related to these three learning fields.
Conclusion: The Bank is actively engaged in single-loop learning in all four learning fields, and scores 1 for all cells. Its single-loop learning effort score is therefore 16. MICS contributes to most cells. It helps to adapt, store and disseminate knowledge in all fields, but it does not contribute much to using this knowledge, because of the complexity in interpreting, combining and searching through the many reports. No inhibitors in SLL were found because of MICS. This means that its SLL-value is +12. Statement 15 (MICS' positive impact on SLL-efforts) is confirmed. The human factor is however essential (Con 7). MICS' role is in problem anticipation as well as critical evaluation.

Double-loop learning

There is a lot of training and indoctrination at The Bank. Training amounts to about 1% of its total budget. It is, however, not explicitly aimed at innovation. Double-loop learning efforts in the human resource field is therefore zero, and MICS has no specific role here.
The network project is an important issue for technological innovation, but it is not clear how the change of technical infrastructure is related to new ways of providing The Bank's services. The network project has already been going on for some years and implementation of this new philosophy is slow. At the Branch no systematic re-engineering is taking place, despite the feedback data available. Only the Department of Information & Organization seems to initiate some process innovation. There is however no systematic business re-engineering process and philosophy. DLL thus seems not to occur in the transformation field, and MICS neither contributes towards, nor inhibits double-loop learning in this field.
The Bank is in a typical growth situation. Its percentage of the mature national market is still quite low and they are working to get more. At Headquarters much energy is spent on how to achieve it. This is why The Bank entered the private market, a segment in which they were not very experienced. They approach the private market with the idea that customer relationships are more

important than short-term profit, so that longer term success can be achieved. This means that The Bank displays double-loop learning on the market development field. MICS contributes to this field by providing precise market information. It is however not clear how it unlearns. The director for Organization Development mentioned this also as a typical problem in The Bank.
New products are being developed especially for the private market. At the same time, The Bank wants to provide a full financial service. This requires the development of relationships with suppliers (e.g. insurance) to sell their products. The Bank is very active in this product development double-loop learning field. MICS contributes by providing accurate data about the performance of products. Unlearning was not found.
Conclusion: double-loop learning occurs at the Headquarters level, where the experts are. Effective double-loop learning however also requires bottom-up participation, involving the later producers of services. The Bank seems to have no systematic process innovation. The Department of Information & Organization, in collaboration with the Branch Management Department, should consider developing a process innovation philosophy, policy and methodology. Most remarkable in this case is the positive impact of MICS on The Bank's double-loop learning processes. Headquarters seems to be particularly keen on MICS data for designing new products, and initiating marketing strategies and process innovations. This is contrary to Statement 15!
In total, DLL-learning efforts are counted for one activity and two fields leading to a score of 2. MICS contributes positively to both fields and the activity, and does not inhibit DLL learning. MICS' DLL-value is therefore +2. MICS' role is in critical evaluation and problem anticipation.

8.2.8 Learning Problems Related to MICS and Recommendations

As a conclusion we would state that The Bank must improve its procedural norms considerably. This can be done more concretely at the technical and organizational levels as follows.

- The Bank measures its operations, but under-utilizes this potential, because not everyone has direct access to the data. The system is batch and information dissemination is selective. An electronic and on-line management information system seems most needed.
- The Bank could profit considerably from a clear managerial theory, so that the most important issues to measure are identified. Specifically, management theories for Branch Management are under-developed, leading to reactive behavior.
- Try to improve learning capabilities at the Branches, so that action and theory are more closely connected. The coordination problem that this could generate should be solved by quick network communications between the Branches and Headquarters. The long and slow communication lines increase the chance of mutual misunderstanding. Solution: flatten the organization. Develop organizational procedures that increase the learning speed in the organization according to network principles that can be easily realized in The Bank (the technical infrastructure is already available). The value of the regional director is also obscure, and possibly superfluous.
- Knowledge creation is a centralized activity in The Bank. This leads to under-utilization of intellectual capabilities at the Branches and increases the tension between theory and action. Solution: empower Branches to think and make lateral structures that can act as electronically supported project groups and task forces.

8.2.9 Conclusions Regarding the Main Hypotheses

<u>The Bank's score card</u>

Org. Learning Variables:	Var 2: M.B.-type: Classic-Service
Var 1: Learning needs	*4*
Var 3.1: Identity and Policy norms	Work harder

Var 3.2: Responsibilities norms	Power-based and functional.
Var 3.3: Action norms	Money and slow (implementation of new theories). *Quick implementation of operational insights.*
Var 3.4: Procedural norms	Discrete and constraint (hierarchical chains), but *free within group in the Branches*
Var 4: Description of MICS	Classic (functional, most parts off-line and hard copy, no integrated database)
Var 5: SLL effort (rate 0..16)	*16, extremely high for classic service, but corresponds with learning needs*
Var 6: DLL effort (rate 0..8)	2
Var 7: MICS' role	Problem anticipation, accounting and *critical evaluation*
Var 8.1: MICS' value on SLL (rate -16..+16)	*+12, expectation was between 4 and 8!*
Var 8.2: MICS' value on DLL (rate -8..+8)	+2
Unexpected values are italiced in the table.	

Table 8.7: Score Card for The Bank.

Some interesting deviations from the theory must be mentioned here:

- The Bank has a high learning need, whereas its structure is still classic. The organization is clearly moving in a lean direction. Headquarters take the lead in this, and use an incremental change philosophy. Therefore its score for DLL is higher than would be expected in a classic MB.
- Some activities in the commercial part are difficult to measure and control precisely, because they have more professional features and therefore are not precise examples of MB-types.
- Task forces do not exist in The Bank. The change process is steered from the top.
- Action norms are according to the expectations for classic machine bureaucracies. Implementation of new theories requires many discussions in many management layers. Operational improvements are discovered on a day-by-day or week-by-week basis in the Branches. Because the implications of operational measures can be easily understood, implementation goes quickly.
- MICS helps to produce critical evaluation information, however in a batch-like way and in standard reports.
- Most remarkable are the very high scores for single-loop learning effort and SLL-value of MICS. This can be explained by the decentralization and professionalism in the Branches. MICS is detailed and well developed, combining many systems. MICS scores high on its SLL-value, despite the fact that it is user-unfriendly (mostly periodic hard copies) and not well integrated.

Conclusions and evaluation

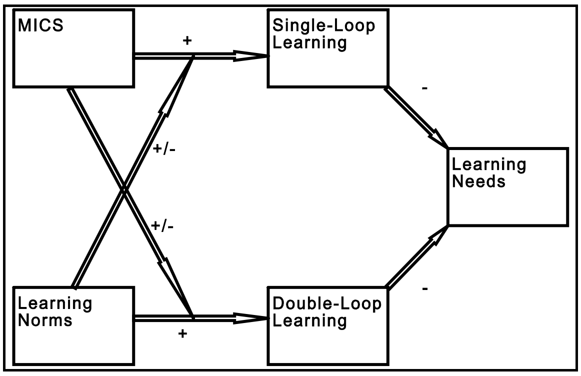
Con 4 states that learning needs determine the learning norms required for survival. As in the previous case, Con 4 bothers us again. The high learning needs of The Bank corresponds with high SLL-effort, but not with the corresponding extent of DLL-effort. The Bank is improving this DLL-process by the construction of new learning norms. The senior management for instance is experimenting with self-management and empowerment (delivering data to the shop floor so that they can carry out their own analysis, facilitated by some central expertise). After case 1, I stated that Con 4 is a truism and requires defining learning norm profiles in order to become informative. The following learning profile is found for The Bank.

Learning Need	Learning norms The Bank	Ideal situation
4	No identity or learning policy norms	Learning policy and identity
4	Learning in functional groups and management	Everybody learning with good ideas and time
4	Dissemination of performance data for detecting problems by management and business analysts	Quick and on-line dissemination of data and knowledge. Electronic learning highways
4	Quick implementation of concrete action suggestions, instructions, and many initiatives by management for new theories.	Close connection between theory and action. Motivating people to act and think.

Table 8.8: Linking Learn Need Score 4 with Learning Norms for Case 2

The point we detected was that management indeed recognized the importance of single-loop and double-loop learning, but that its learning norms are such that they prevent employees, other than managers and business analysts at Headquarters, to be involved. The bureaucratic hierarchical structure thus is imposed on the organization of the learning processes. The 'determination' of these organization norms therefore is a clearly political process of distributing learning responsibilities. Information technology can enable a flatter organization structure with many lateral structures, a high learning environment, to be efficient.

Statement 14 tells us that lean norms lead to MICS with critical evaluation and problem anticipation roles, whereas classic norms lead to MICS with problem anticipation and accounting roles. This classic MB however has a MICS with both critical evaluation and problem anticipation roles. This means that statement 14 is not true. It is interesting to note that the critical evaluation role of MICS in this case is often ineffective, because MICS is too complex to handle and the learning norms (especially procedural norms) limit the effectiveness of critical evaluation.



Con 6: "*MICS contributes to single-loop effort and inhibits double-loop learning effort*". MICS indeed influences SLL in a positive way, as in case 1. However, it also has a positive impact on DLL. This means that Con 6 is invalid. The suggestion therefore is to confirm Statement 15. Statement 16 not only should include opportunities of negative or no influence on DLL (case 1) but also positive impact. This makes Statement 16 completely uninformative. The conclusion to be drawn is that DLL is probably more influenced by learning norms than by information technology. MICS only has a mediating (reinforcing when well organized and inhibiting when bad) impact on organizational learning norms and double-loop learning relationships. This would also explain the usefulness of the cybernetic paradigm for SLL and the usefulness of the group dynamics paradigm for DLL. A possible revised model is given in figure 8.7. The mediating relations are still undetermined. We will wait until the other cases have been analyzed for a further consideration of these relations. Meanwhile it suffices to state that the value of these relations depends on the effectiveness of the MICS and Learning Norms variables. This effectiveness can be described in terms of technical quality for MICS (in lean terms) and organizational quality of Learning Norms (also in lean terms).

Con 7 states: *Depending on the Learning Norms, MICS can increase or decrease complexity and dynamics*. Con 7 is proved to be correct, but its formulation is such that it would be difficult to prove the contrary. The following cases will be analyzed to come to more insights and better formulations of the subject at stake here. The learning norms are in this case supportive for SLL and DLL. MICS contributes to both processes by providing data.

8.3 *Case 3: Chemical Plant*[29]

8.3.1 Introduction to this Case

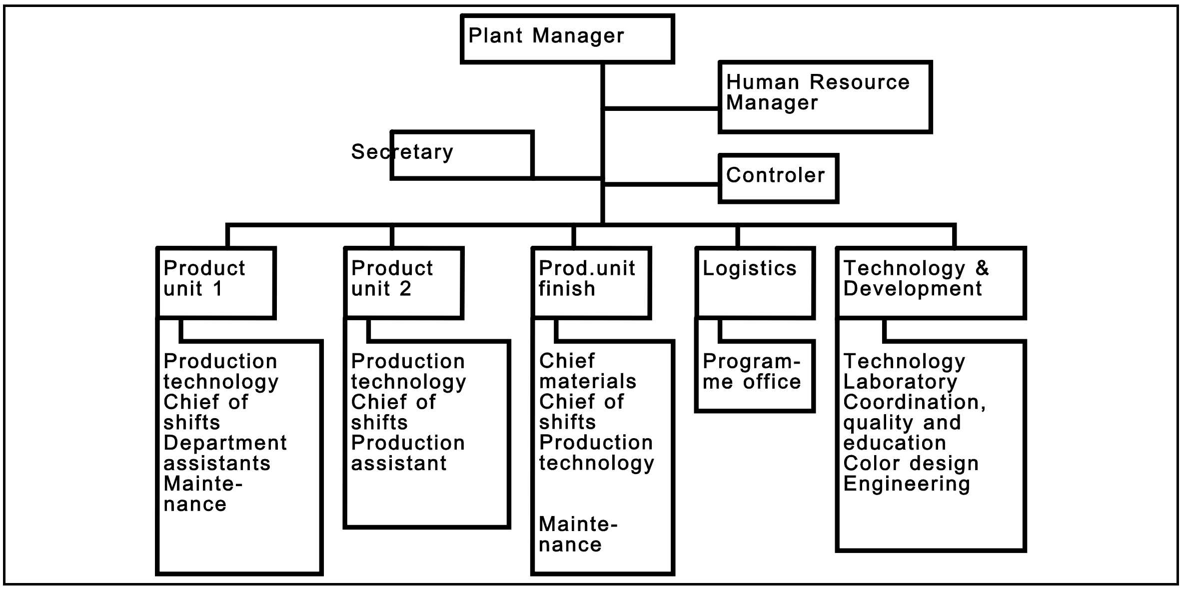
In 1991, one of my M.Sc. students integrated the information systems that were available at that time in this Chemical Plant. These systems contained data for logistics, production planning, and performance control. We investigated whether the organizational conditions were available to use this management information system effectively. We concluded that many organizational changes would be required. For instance, the existing cultural differentiation between the management and the employees was regarded as a huge obstacle to effective communications and management. After one year, we were invited to observe the changes. Meanwhile, the fibers industry was going

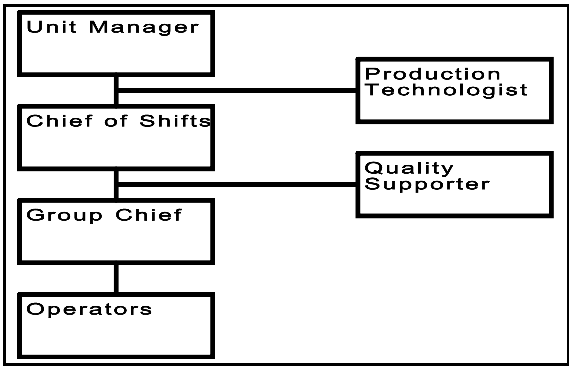
[29] I am grateful to Mr St. Kordelaar, for contributing substantially to the data collection for this case.

through a crisis on the world scale and Western European producers suffered from fierce competition from low wage countries. During our stay (November-February 1992-1993), over 100 employees out of the initial 240 were dismissed. Just after the completion of our data collection we heard that the company had been sold to a competitor, and is now in a turnaround phase. All the information we present here refers of course to the situation before the take-over.

8.3.2 General Description of the Chemical Plant

The Chemical Plant is part of an international chemical concern and has over 200 employees. The Plant produces chemical fibers used mainly in the carpet industry. It is particularly good at producing a large variety of fibers, also for small orders and in a short time span. By a combination of input materials and sequences of transformations about 40 different production streams exist. At the top of the Plant's organization structure is the Plant manager. Organization charts are given in figures 8.8 and 8.9.





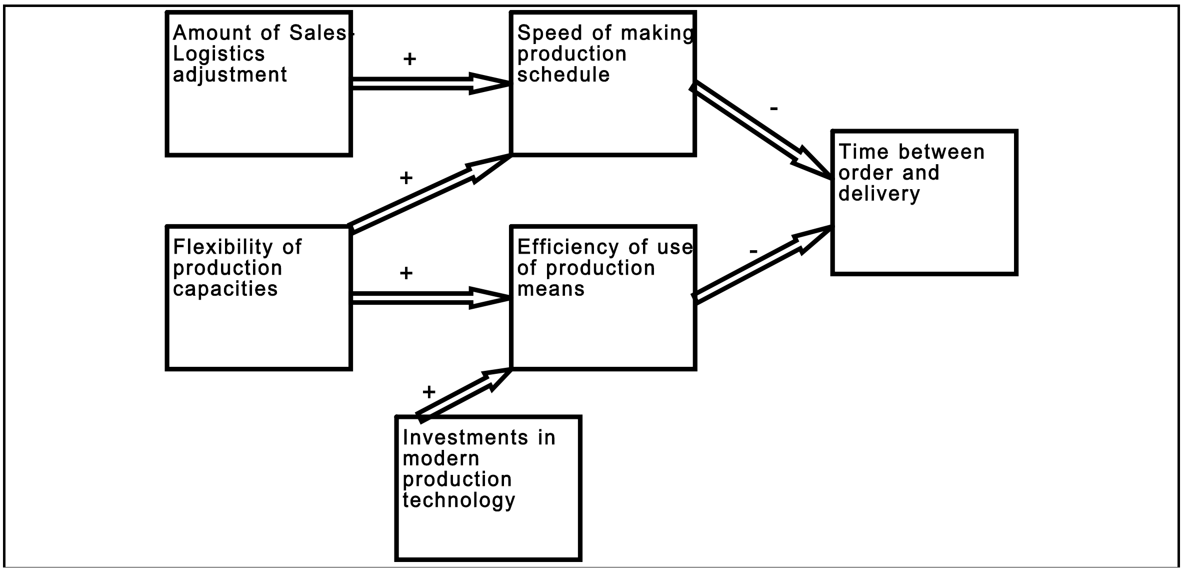
The production is based on orders that are received from carpet manufacturers. Production planning is a difficult task because it is difficult to predict when orders will be received. The fibers produced are of an extremely high quality (specific for the so-called industrial project market) and client specific (e.g. strength, color, width).
The Plant produces finished fibers for the carpet industry in a sequential process of flushing, winding of fibers onto a cone, and twining. The production is scheduled so that clients can receive their products at an agreed date. Several problems can occur when orders are changed (for instance because of changes in delivery time or volume), when disturbances in production occur (because of machine break-down or personnel illness), and when there is a high amount of disapproved quality. In principle there is a planned schedule, but important clients have special priorities.

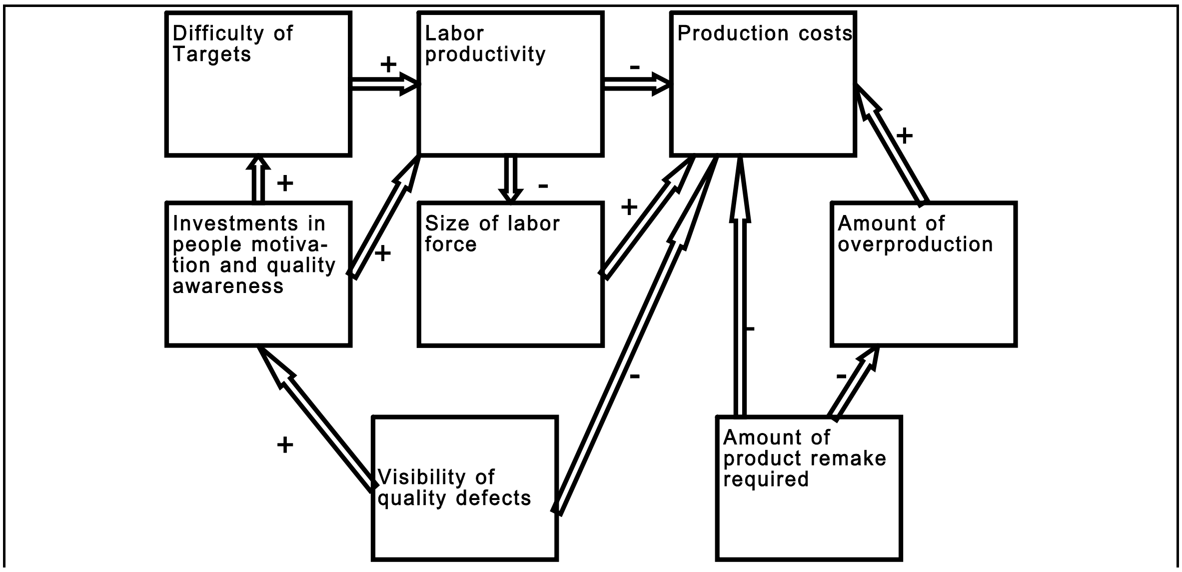
Three types of policy problems exist, closely connected to specific organizational functions, summarized in table 8.10.

Stakeholder	Problem
Sales	Satisfying important clients
Logistics	Achieving planned delivery time
Production	Achieving cost minimization

Table 8.10: Problems and Stakeholders at The Chemical Plant

The reasons for these separate and sometimes conflicting issues, is the existing performance measurement system, which evaluates these departments on their handling of these problems. This results in very different management theories, elicited on the basis of our interviews (see figures 8.10 and 8.11). We will restrict the discussion to production and logistics, because sales is not actually part of the case studied, but an external actor.





The so-called pre-stream (controlling, planning, and unit management) at this moment boosts the production norms. Production finds this dangerous for the Plant, because it will lead to less intensive machinery maintenance and workplace cleaning, at the end lead to declined productivity.
The delivery and costs problems found are further described in table 8.10, which also shows the relation of these problems with departments and responsibilities.

Delivery Problems	Cost Problems
• Adjustments between Logistics and Sales are problematic. The groups communicate ineffectively because of the spatial distance between both. • Time between planning and order production start can lead to serious problems. • Duration of through-put must be well controlled (according to expectations).	Personnel Cost • Too many employees in relation to orders. • Low productivity per employee. • Sequential production process (some competitors already work in parallel). Production Means • High out-turn and disapprobation. • Some overproduction to avoid re-start.

Table 8.10: Analysis of Main Problems at the Chemical Plant

The Chemical Plant is only learning in a single field: production process (transformation).

8.3.3 Chemical Plant's Learning Need

<u>The Static-Dynamic Dimension</u>
Although the orders are unpredictable, the company masters the technological aspects of the production very well. However, no new technologies are tried and no systematic research for product and process innovation are carried out. The company has a particular advantage in being

able to make a large variety of fibers in about one million color combinations. At the same time it uses relatively obsolete transformational technology, because it makes the products in sequences, whereas some competitors use parallel production modes. Because of the fierce price competition in the market these process innovations are absolutely necessary. Substantial organizational learning is therefore needed in order to stay in the market.

The Simple-Complex Dimension

Because of the many production routs and assembling combinations, the process looks complex. Nevertheless, much experience has been gained in this area, thus leading to perceived low complexity. More complex is the need to combine demands from sales, production and logistics. These are competing and difficult to manage.

The innovations required and the integration abilities give rise to new learning needs. These are especially important because of the strong competition from low wage countries, which require the company to decrease its costs, or to further differentiate in quality. Quality improvement means process innovation (decreasing waste, increasing client satisfaction by improving delivery performance).

Conclusion: The Chemical Plant has a simple but dynamic environment. This means that its learning needs are 3 on our scale with a maximum of 4.

8.3.4 Chemical Plant's Leanness and Service-Manufacturing Nature

Lean-Classic

The company is seriously involved in quality programmes and has had an ISO 9000 certificate for some years. Effective quality control demands decentralization of responsibilities. This has been tried by the management, but is very ineffective because people at lower levels lack the skills and authority to make independent decisions.

The Plant is organized via its sequential production process, and only aims at producing certain amounts of fibers of certain types. For this no direct communication with clients is needed. The sales people therefore disconnect the Plant from its clients. On the shop floor shifts divide jobs, and some vague evaluation of the performance is made. At the Plant level, the managers form a management team, which meets every three months. It is not clear what kind of communication occurs in this way. Lateral structures will therefore be mainly informal.

The Plant is part of a larger division that in turn is part of a large multinational chemical concern. Decisions about investments in the Plant are basically motivated by strategic concerns (product portfolio and possible synergies), rather than the actual costs of investments compared to financial interest rates or revenues. New ideas are to be gained from the consortium's research and development organization. A small lab only supports quality control and inspection. The sources of innovative ideas from inside the Plant are limited.

Career paths for lower level management (chiefs) and workers are very restricted. Unit and Plant managers, however, are academically trained and have taken (or are taking) part in a management trainee programme and have an international career path. As a consequence the relation between the management and the employees is problematic because of the cultural segregation of both groups (high versus low education, cosmopolitan versus local). The Plant manager emphasizes improving these relations but this is still wishful thinking. The motivation of the workers and the management is mainly extrinsic: keep the job, keep the salary or even increase it if possible, with a minimum of effort.

The organization is a *classic* MB. Only its emphasis on quality and its being part of a larger consortium could give it lean features. These observations lead to some discrepancies, because the rather high learning needs require a more lean organization.

Service-Manufacturing

As the company produces fibers, the output is tangible and measurable in tons. Because of the lack

of direct contact with the clients it does not receive a clear and useful market feedback. The fibers produced are high quality and custom made (order production). Clients only participate in the design and planning of the production, which is Sales' final responsibility. The Plant's production process is frequently affected by the specific demands of big and important clients, who require delivery in a short period. This obstructs the scheduling of production. As a compensation, the Plant hopes to acquire rebuy from these major clients.
The following points describe the production process:

- Machines, material, labor, and know-how (chemical knowledge, production organization knowledge and experience) are the main production factors.
- Clients are not ego-involved and the sales group shut the Chemical Plant off from the market.
- Production scheduling determines much of the Plant's efficiency and must be done very accurately. This requires a high amount of information processing.
- If the Plant makes a poor product this is clearly visible and is the Plant's own responsibility.
- The production process has three clearly distinguished phases.
- Stocks are possible, but small because the production process is order oriented.
- Operation and administration (including management) are spatially and mentally separated, but the production personnel is responsible for part of the data input to the MICS.
- Professionalism is low, except in engineering and management.

Conclusion: except for information processing, this case fits perfectly in the manufacturing class. The Chemical Plant therefore scores *classic-manufacturing* on the MB-type variable.

8.3.5 Chemical Plant's Learning Norms

Learning policy norms

Quality improvement has been stated as a high priority by the divisional senior management, and formally announced as such. In fact however this is not much more than a letter of intent. The ISO 9000 certificate has been awarded, but volumes, costs and return-on-investment are the main drivers. This makes the learning norms variable ambiguous. Therefore we could consider adding one more activity to the previous two (theory development and unlearning), namely: implementation.
The organization is a classic functional organized system, and computers are not used to support lateral communications (for instance E-mail is not used). Nevertheless, performance data about the shifts and groups are openly available. The production teams are well equipped with data about performance. Project teams clearly have a minor position in relation to the standing organization. The technostructure is very small, and since a few years ago is integrated in the line. The Chemical Plant is trying to move to these lean principles, but the culture lags behind.
As well as data, also skills and theoretical knowledge are important. For this purpose, some recognition of core competences exists that must be managed and is part of the manager's responsibilities. The basic learning driver is achieving cost cuts and business re-engineering is motivated as such. At the same time there are some trends to change the culture to achieve a stronger internal commitment. The Plant manager talks in this respect about the creation of a 'we-feeling' that enables an open and supportive attitude for the detection of problems and creation of solutions.
Conclusion: The management is interested in achieving the 'work-smarter' learning norms but cannot yet implement them. It also has short term (survival) priorities that dominate all other activities. In crises this is a typical management attitude that could bring the organization into a negative vicious circle.

Responsibility norms

The following responsbilities distribution exists:

1. Two unit managers are responsible for evaluating the materials used and the personnel.

2. Chiefs-of-shifts evaluate personnel and material, mainly on a daily basis. This does not however lead to an evaluation of methods and techniques.
3. The Department of Control checks the targets. When it finds structural deviations, it first tries to investigate possibilities for improving work methods. When this is not possible it changes the target (single-loop and double-loop learning).

The chiefs-of-shifts and shift chiefs are responsible for implementing structural changes that are designed by logistics, production management and unit management. They however lack the time and the skills to implement incompatible 'solutions'. They are in a difficult position, because they have several bosses and must maintain good contacts with the management as well as with the workers. Line management is the most important coordination instrument. The shifts are volvo teams and have a large autonomy of task allocation. The shifts however do not explicitly document what they are doing to improve processes. They restrict themselves to ad hoc problem solving. Projects do not fill in this gap, because after an initial enthusiasm, implementation problems are usually experienced, leading to the termination of a project. The organization thus fits into the 'power-based and functional' extreme of learning responsibilities.

Action norms

The Chemical Plant has the following action norms:

1. Management is not directly involved in the production process, and expects workers to solve problems themselves, whereas they in their turn lack the skills and motivation to do so.
2. The shop floor regards problems as incidents and applies only ad hoc solutions.
3. The shop floor feels that problems that recur frequently originate elsewhere (such as production planning, logistics and sales).

It is important to note that the possible sale of the Chemical Plant is being prepared by a managerial task group at divisional headquarters. This may possibly result in some further work displacement at the Chemical Plant. Hence employees on the shop floor are more defensive and less cooperative with the management. The Chemical Plant's action norms are thus according to the 'money and slow' extreme.

Procedural norms

The PLATO system contains all basic data to support the learning processes:

- Performance indicators and defined targets.
- Operational planning (scheduling) data.
- On-line access to data about the production process.

The system provides excellent capabilities for the on-line adjustment of processes, and gives access to management as well as to operators. However, it lacks aggregated data, trends and overviews for management (according to the Plant manager).

To generate management information via PLATO, the following additional responsibility norms exist:

- A production assistant makes aggregated overviews.
- Input of weekly schedules and monitoring of realizations is carried out by the programme office of Logistics.
- Input of raw data is the task of production personnel.

The frequency of the feedback is not a problem, but rather the organization that must connect the data for effective use in the right culture and structure. At this moment, nobody takes the responsibility for anything done with the data, and the production assistant is too junior to influence what happens.

Except for data access and the number of issues measured, the procedural norms are according to the 'continuous and free' extreme. The restriction of the number of issues measured to specific targets is not always an indicator of a classic MB. It could be that these specific targets are the result of an excellent understanding of the business, and that these are well monitored for their relevance. At The Chemical Plant this is not the case, because mental models are incomplete and

conflicting.
Two reasons might explain this unexpected data pattern:

- Management is forced to create a participatory management style, because the shifts are well-organized groups and form a counter-force against the management.
- The existing MICS is technically very sound, so data flows continuously and freely. There are no technical restrictions to fast data flows.
- Learning is strongly horizontally decentralized. The procedural norms variable does not measure the vertical decentralization of learning activities (this is done by the responsibility variable). Looking at vertical decentralization of learning, the volvos are not well equipped to participate.

8.3.6 Description of MICS

MICS consists of PLATO and several additional computer-based and non-computer-based information sources. These additional sources are:

- Target/performance indicators that are very explicitly defined and used in performance control and evaluation.
- Action plans are described for departments and specific agents.
- Internal audits and quality audits.
- Structurally planned meetings and conferences, such as unit-management team meetings every three months. These meetings seem to use the three previously mentioned data sources extensively.

The MICS is from a technological point of view quite modern and lean, because of its couplings and integration of data and on-line access. Nevertheless, from an organizational point of view it is poorly connected with the learning processes in the organization (Most important are the problems with the management theory that is essential for making sense out of MICS' data (the so-called semantic issue). Another complication is how to start action from well-defined insights).

8.3.7 Role and Value of MICS

Single-loop Learning

Sales at the divisional Headquarters emphasizes the importance of meeting delivery demands. The CEOs at the business unit stress the importance of reducing costs because of increased competition from low wage countries. Both are issues for single-loop and double-loop learning in the Plant.

<u>Adaptation</u>
The adaptation activities are dominated by cost reduction and quality improvement needs. The logistics system and a performance control system have been established to support adaptation. The logistics system is used for the problem anticipation role, by supplying a tool for scheduling and rescheduling. The critical evaluation system consists of a set of standards for departments and shifts. This critical evaluation system was only recently introduced and was regarded as a major innovation. The intention is to monitor performance indicators and to adjust them on the basis of evaluations of output in management employee communications.
Despite these learning needs and information systems, the organization has some important problems with learning:

- Complexity of understanding the impact of actions that are interdependent and taken at the same time. A solution could be the formulation of a coherent management theory, upon which actions can be based that will be tested later for their impact.
- Urgency of orders (external dynamics) that disturbs the discovery of regularities and theories.

The role of MICS here is therefore in critical evaluation and problem anticipation. MICS' value is positive, as it contributes to learning processes of this kind. Nevertheless the *effectiveness* of the learning processes is questionable. The effectiveness seems to depend on the availability of a closed learning loop (c.f. our discussion of Hofstede in section 6.3.2).

Storage
The Chemical Plant stores knowledge as follows:

- Weekly predicted costs and output figures are stored and compared with results, based on PLATO data.
- Frequently reports are made about garbage and out-turn.
- Monthly reports are made about aggregated data of weekly reports.
- Each year the Plant makes extensive reports about its activities, performance and plans.
- Audit checklists are made and are ready for re-use in case new audits are required.

MICS' role and value here is considerable.

Dissemination
Two main and incompatible management theories (the logistics management theory with its emphasis on delivery times, and the production cost management theory emphasizing phased production and the ability to produce buffers and stocks) exist that have been 'sold' by their creators to the chiefs-of-shifts for implementation. This has resulted in a rather ineffective use of both theories, because the chiefs-of-shifts are unable to connect them. Because of this conflict over theories, MICS (PLATO) data cannot be interpreted unambiguously, and MICS data were not used to test the validity of either of these theories.

Re-use
The logistics system has a logistics model that is re-used in scheduling processes. The performance control system has standards and measures that are re-used in performance appraisal.
Conclusion: single-loop learning occurs for all four activities, but only in the process field. The single-loop learning effort score is therefore 4. The role of MICS is substantial: problem anticipation and critical evaluation. MICS contributes to all activities, and has no negative impact on single-loop learning. Its value is therefore +4. The question about the effectiveness of the learning process is related to responsibility, action and procedural norms. Given the existing situation the norms negatively influence single-loop learning effectiveness. This is also strongly influenced by the external instability (possible sale of the Plant, work displacement, world market competition and production over-capacity)! A model about organizational learning should therefore distinguish between learning effort and learning effectiveness.

Double-loop Learning

At the moment the management is vaguely considering investing in modern parallel transformation technology. The chance that this will really happen is nil, because the implementation of a new management theory is a slow and resistance-evoking process (according to several lower and higher managers). At the same time all large investments have been frozen because of a possible take-over of the company by a US-multinational. The double-loop learning score for The Chemical Plant therefore is 0.
MICS has no positive or negative influence on this double-loop learning score, thus also leading to a MICS' value of 0. It has only a critical evaluation control role in this area, for detecting the major cost factors and providing internal data on which investments can be based.

8.3.8 Learning Problems Related to MICS and Recommendations

The PLATO system seems to be technically and theoretically very sound. Also some responsibilities have been created to extract knowledge out of the PLATO data. The major problems in learning with MICS are caused by the unsuccessful integration and connection of the existing management theories. In principle there is nothing against theoretical pluralism in a company, but now the chiefs-of-shifts have the task to combine the theories, while they lack the skills and authority to do so.

The following solutions are suggested:

- Raise the educational level of the chiefs-of-shifts so that they can carry out the theoretical combinations, and give them the required authority (decentralization).
- Get unit management closer to the shop floor, so that they make decisions that are based on concrete observations and experience of the shop floor. This suggestion could be combined with the first one, and result in another type of unit manager and a career path from shift chief to unit manager.
- Additionally, a much stronger integration of sales, logistics and production is required. The geographical distance between Sales and the two other parts of the Plant inhibits this. Discussions between logistics and production should also be based on the development of a common management theory, and joint responsibilities for the whole.
- Regular meetings in a management team (sales, logistics and production) should be held with the production assistant and logistics office to discuss the evaluation figures in order to learn systematically from the Plant's performance. Of course the Plant's policy should also be evaluated and adjusted on the basis of these figures.

8.3.9 Conclusions Regarding the Main Hypotheses

The Chemical Plant's score card

Org. Learning Variables:	Var 2: M.B-type: Classic-Manufacturing: Chemical Plant
Var 1: Learning needs	*3*
Var 3.1: Identity and policy norms	Work harder
Var 3.2: Responsibility norms	Power-based and functional, however *divisional, R & D department, some ineffective project groups*
Var 3.3: Action norms	Money and slow
Var 3.4: Procedural norms	*Continuous and free*
Var 4: Description of MICS	*Technically lean*, but critical evaluation and problem anticipation are not well connected
Var 5: SLL effort (rate 0..16)	4
Var 6: DLL effort (rate 0..8)	0
Var 7: MICS' role	Problem anticipation and *Critical evaluation*
Var 8.1: MICS' value for SLL (score range -16..+16)	+4
Var 8.2: MICS' value for DLL (score range -8..+8)	0, *not negative*
Unexpected values are italicized in the table.	

Table 8.12: Score Card for The Chemical Plant.

Some interesting deviations from predictions should be mentioned here:

- Although this case concerns a classic manufacturer, it is in great need of learning (costs must be reduced, delivery quality improved and the way management works must also be reconsidered). The organization structure, and the fact that it is part of a larger consortium might negatively influence opportunities to increase learning speed and depth.

- The learning need is high, but not enough effort is made for effective single-loop learning because the work-load prevents people from reflecting on their work and developing and testing new ways of working.
- Double-loop learning is not done at all at the Plant locations. Some learning identity definition is made by the senior management at the top of the division. This definition is something like 'we are a quality company'. Concrete suggestions, except the procedures required to obtain the ISO 9000 certificate, are not found anywhere in the Plant.
- Learning responsibilities are only allocated to some junior staff members of logistics and production. Task forces and project groups were not found at the moment of this investigation (or they are more-or-less secret). They seem to be very ineffective in implementation.
- Information is distributed within and between groups. MICS is in principle a critical evaluation and problem anticipation mechanism. Both these remarks indicate that the Plant is very lean with regard to its information handling. It is however very classic with respect to its learning norms and processes. Theoretically this is significant because an effective MICS cannot be forced on an organization.

Conclusions evaluation

Hypothesis	Case 3
Con 4: Learning needs determine the learning norms required for survival.	True
Statement 14: Lean norms emphasize the critical evaluation and problem anticipation roles of MICS, whereas classic norms emphasize the problem anticipation and accounting roles of MICS	False
Con 6: MICS contributes to single-loop learning effort and inhibits double-loop learning effort.	False
Con 7 Depending on the Learning Norms, MICS contributes to or decreases complexity and dynamics.	True

Table 8.12: Evaluation Table for Cross-Comparative Assessment.

Comments

This case showed that this chemical manufacturing Plant, able to manufacture a large variety of products, can handle its complexity very well. The big problem is handling situations that require change, which are often induced from 'outside' (market changes and divisional policies). This supports conclusion 3, that dynamics contributes more to learning needs than complexity.

Concerning Con 4: after case 1, I stated that Con 4 is a truism and requires the definition of learning norm profiles in order to become informative. The Plant's profile is described in table 8.13.

Learning needs	Learning norms The Chemical Plant	Ideal situation
3	Identity or learning policy norms described	Learning policy and identity
3	Learning in many groups, horizontally decentralized	Committed learning: decentralized learning where possible
3	Dissemination of performance data for discussing performance with shifts	Dissemination of data and improvement of communication between management and shifts, and training of shifts in management skills
3	Slow implementation of concrete instructions, and initiatives by senior management for new theories.	Quick implementation required through effective communication and understanding. Motivate workers to be creative and to think.

Table 8.13: Linking Learning Need Score 3 with Learning Norms after Case 3.

Concerning Statement 14: MICS has problem anticipation and critical evaluation roles in this case, and is very advanced in lean terms. The other learning norms are however very classic, which means that the potentials of MICS are under-utilized from a learning perspective.

Concerning Con 6: MICS does not have much impact when the learning norms are not appropriate. MICS only contributes to facilitate learning by providing data. These data can only be interpreted via mental models. When mental models clash, the learning situation can become political and disruptive. These insights considerably influence our understanding of the relation between MICS and Single-loop and Double-Loop Learning. Let us write this in a set of additional statements.

S17: *MICS is a provider of data. The better MICS is, the more relevant are the data at any time and place.*

S18: *The type of data that are available from a MICS depend on a mental model. This model has semantic implications which are incorporated into the structure of the information system.*

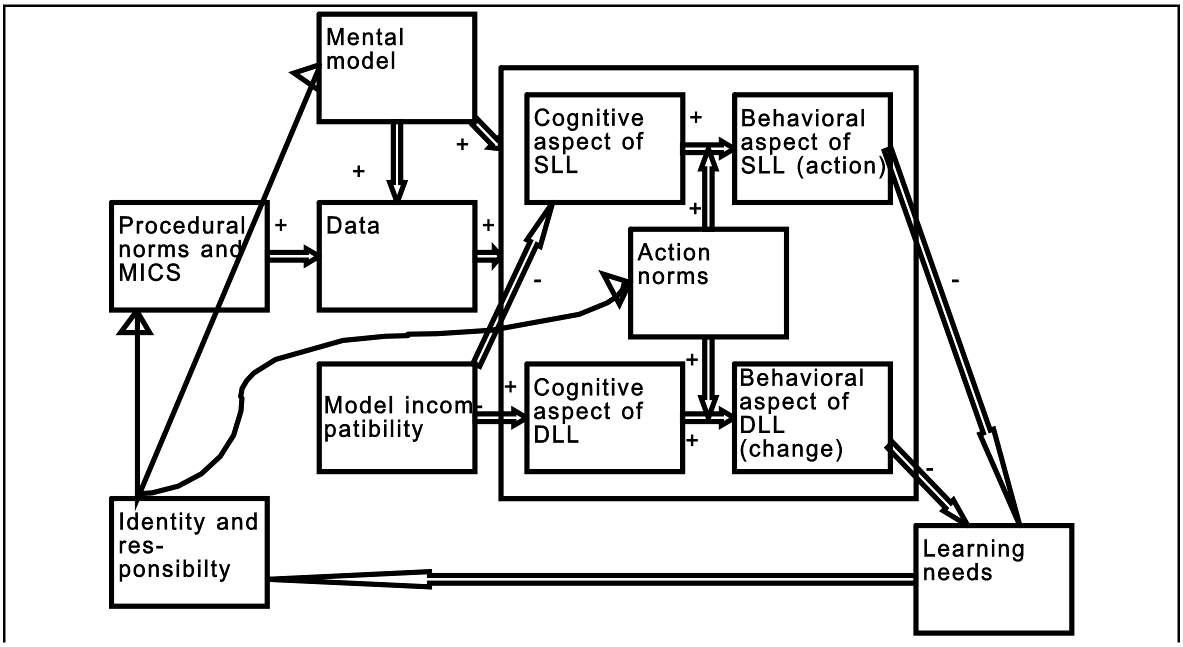
S19: *The availability of data and a mental model are prerequisites for an interpretation of reality.*

S20: *In organizations, people or groups of people can share models, but also can have unconnected and even incompatible mental models.*

S21: *When, in interpretation processes (the cognitive part of the learning processes), incompatible mental models are applied (as in the Chemical Plant case), the result is an increased double-loop learning effort if people are not deliberateley avoiding the problem.*

S22: *When, in interpretation processes, shared (non-conflicting) mental models are applied, the* *interpretation process will be followed by actions (the behavioral part of organizational learning) if people are motivated (action norms) to take these actions.*

This leads to a considerable revision of our insights about MICS, SLL and DLL. This



insights are summarized in figure 8.12.

Concerning Con 7: Although the Chemical Plant's learning needs are high (3), its learning norms only enable it to handle low complexity and low dynamics. Dynamics in particular are totally beyond the Plant's control. In the longer term this will require reorganizations (the Plant was sold to a competitor just after the completion of our study).

8.4 *Case 4: Health Insurance Company: Health Co.*[30]

8.4.1 Introduction to this Case

[30] I am grateful to Mr M. Hafkamp, who contributed substantially in the data collection for this case.

As a result of a students visit, the author received a lot of information about the innovation efforts of this company, which was supposed to be lean in many respects. We contacted the company for further information, which they were very willing to provide. The information showed that the company had a large and complex MICS, but it was not clear how it was used. After an initial discussion it became clear that the company was still heavily engaged in moving towards a more innovative organization. It was clear that the MICS was not functioning properly and that the organization was still not lean in all respects. The purpose of our study therefore was to find out how lean this service organization was and what the problems were with using MICS for organizational learning.

8.4.2 General Description of Health Co.

Health Co. is a health insurance company, founded in the 1930s, and recently confronted with major problems because of its old-fashioned management style. As a result the management was replaced and fundamental organizational restructuring took place, with innovative information technology as one of its basic changes. The company could easily cope with the changes, because most of its initial employees had retired and young employees had been appointed. In 1990 Health Co. had about 324 employees. This number was 240 at the time we obtained our data (February 1993). In terms of its market share in the health insurance business, it belongs to the biggest in Western Europe. It acts in the private sector as well as the business market.
The senior management had discovered two basic problems for the company:

1. The management had not enough control over business processes, which led to many inefficiencies (cost problem) and long lead times (quality problem). Measuring quality and operationalizing it was regarded to be of strategic importance.
2. Some tension between cost and quality problems also existed.

At the beginning of 1991, the senior management (assisted by an external consultancy firm) developed a management theory consisting of five basic concepts, namely:

1. Planning and management on the basis of explicit targets in terms of volumes handled and time required for handling the activities.
2. Development of an organization structure that supports high speed and quality: the so-called volvo teams.
3. The development of an Incentive Bonus Scheme to motivate departments and units to improve and find improvements, by rewarding them with a percentage of the profits the solution provides.
4. Developing a training programme to improve individual and group performance. Organization members should be rated on several indicators to find out what their training needs are.
5. Use of information technology to boost individual productivity (like E-mail and image processing).

The major learning fields therefore are process (efficiency, quality and IT) and human resources. Also, some activities for market development exist in the construction of specific products for specific market groups.

8.4.3 Health Co.'s Learning Needs

<u>The Static-Dynamic Dimension</u>
Internal dynamics are in all senses high. This is not what one would expect of an insurance company, because stability was a typical feature of this business just a few years ago.
Educational and technological backgrounds and skills had changed recently, mainly as a result of the introduction of new information technologies in the company. The introduction of electronic networking, E(lectronic)mail, CD-ROM and WORM memory technology, changed the

organization and its way of handling documents dramatically. Additionally, many new products and product innovations are required to keep pace with competitors all working in a business with declining profit margins. As a result the organization also puts a systematic effort into education and training. In 1992 it spent an average of about 470 US dollars on personnel training per employee. In general this led to an *optimization at the individual task level*. Interdepartmental coordination is not well managed. The impact of the target setting explains this situation. Interpersonal behavior style is informal but there is also a keen control on meeting standards.

The technological characteristics of the organizational units are very bureaucratic, meaning that work is regulated by many formally written rules. The organization consists of six business units that carry out the direct administrative interaction with a client and 12 service departments that support the business units with specific knowledge and activities. The business units are:

- Corporate Business Division: responsible for the collective insurances of the employees of a company.
- Individual Business Unit: services individual subscribers, professionals, and small business entrepreneurs.
- Special Business Unit: responsible for special client groups for which specific rules apply.
- Personal Health Division: service the market of more wealthy client groups, not insured according to minimal legal requirements.
- Health Saver Scheme: insurance for special medical treatments and supplies.
- International: to promote the company abroad, for traveling and world wide-coverages.

The twelve service departments support the business units with medical-technical knowledge, information technology, finance (payments, accounting etc), marketing, information services for dissemination of internal messages, human resources management, quality improvement, support for brokers, telemarketing, client service teams for sales to large companies, contract storage and maintenance, and a company secretariat for mainly legal issues. This organization structure is not very stable because market developments and government policies (which influence the business severely) often demand changes.

There is a considerable exchange of information between the service departments and the business units, but not much between the business units and between the service departments themselves. The Business Management Group (consisting of the general managers of the business units and the managers of the service departments) meets only once a month with a standard agenda. This discussion platform was started recently and is not yet well established. Problems are solved informally when they occur. There is much more integration within the business units, where the general manager, supervisors and volvo members (lowest shop floor level) meet each week for 1½ hour to discuss issues. The low frequency of interactions and the rather stable organization structure indicate low internal dynamics.

Intra- and inter-unit conflict is low. When it arises, senior management interferes. The competitiveness of the environment seems to strengthen the senior management's control over the organization.

The objective and goal of the company is mainly to survive. There is no clear formal description of the goals, but by employee training and the supervision of new managers, basic values (quality and efficiency) are taught. New managers have an experienced manager as supervisor and mentor during the first period. When the new manager is regarded as competent enough he is allowed to 'fly solo', i.e. act without supervison. With the training schemes the employees learn a lot about activities that are carried out elsewhere in the company. This is done to achieve high personnel flexibility (data about flexibility are documented on the flexibility chart that is part of MICS) and mutual understanding.

The service is increasingly differentiated to meet specific client needs and to gain a larger market share. The business units described earlier demonstrate the importance of trying to attract special market segments.

Many new distribution channels are being actively developed, such as tele-selling and direct marketing. In general, however, the networks that are made with brokers and existing client groups are still very essential, making the business less dynamic.

New material for health insurance could be reinterpreted in terms of suppliers of health care. Developments in medical science are important here, making the business more dynamic. The suppliers of information technology, by which the effective and efficient handling of the huge amount of documents is improved, are important. Labor supply changes all the time mainly because younger and higher educated people are applying for jobs. High unemployment makes it possible to recruit bright young people for administrative jobs. These people apply their greater abilities to work that was previously thought to be merely routine. This means that many improvements are made in these jobs.

Government policy has a huge influence on the insurance industry in Western Europe. It decides about what treatments should be provided. Government also sets production capacities for health care, and in some countries the governments have nationalized or nearly nationalized health care. This makes the industry dynamically dependent on medical science developments that lead to increasing health service costs and declining financial possibilities of governments. The public attitude is that a minimum of health care should be accessible for all citizens. This puts a lot of pressure on prices.

Conclusion: the dynamics is increasing in the business. Health Co.'s management is actively engaged in making the situation more stable.

<u>The simple-complex dimension</u>

Higher educated people are required for handling the complexities of modern transformation technology and understanding the increasing complexity in services. Training therefore is not only a matter of learning to master routine tasks, but also to increase business awareness (knowledge about the branch and understanding of working of other departments).

The technological characteristics of organizational units are very bureaucratic, meaning that the work is regulated by many formally written rules. To demonstrate the amount of regulation we found that the Corporate Business Division had 13 main tasks, consisting of 89 activities, which in their turn consisted of 468 detailed handlings. These handlings are not precisely described in a handbook, but are learned via training.

The company has not developed strong lateral structures, and the hierarchical command structure dominates. MICS measures the performance of individual organization members and in great detail. It has no measures to rate the effectiveness of inter-business unit collaboration.

Complexity increases because insurance products are becoming more complex and client groups are less homogeneous. This means that different ways of treating clients must be developed, and hence an increased variety in distribution channels created. Information technology enables efficient management of this increased complexity.

Competitors can make business more complex, because many try to create new services to attract clients. The management keeps a keen eye on these developments and is forced to increase the quality and variety of service. The government demands a decrease in health care costs, without reducing coverages.

Information technology creates a new complexity that is treated by sophisticated specialists in the IT-field. Keeping pace with innovative technology is a strategic asset in the insurance industry. Advances in R & D and in product and process development are required. Product and market development go hand-in-hand with commercial activities. The technology applied at this moment is well known and easy to learn by practice and training courses. The complexity in this company is thus not high, though it is increasing especially in the area of the application of information technology.

Conclusion: the score for learning need is 3 (dynamic but simple).

8.4.4 Health Co.'s Leanness and Service-Manufacturing Nature

<u>Leanness of Health Co.</u>

The company is in some senses typically lean, but in others typically classic. This ambiguity can be explained from the fact that:

1. Its learning needs are not extremely high, because its complexity is moderate.
2. Survival seems to dominate what happens in the organization. The company is not part of a huge financial consortium that could give it security. This has resulted in a type of crisis in which the management has a strong and dominating position (therefore low decentralization). Lateral structures exist at the lowest work-groups, but between the Business Units these structures are just at the first stage of development and many of the discussions of the Business Management Group seem to have the character of window dressing.
3. Motivation in the company is primarily extrinsic, people want to keep their jobs and are strongly valued by means of their output (measured via MICS). Output is measured on 'reasonable expectancies'. For each business unit a Major Volume Indicator is established that describes a unit's activities in a measurable form. For the Corporate Business Division this indicator was related to the number of subscribers to insurances that are managed by this unit.

Health Co. scores 6 on our 10 point scale of leanness and thus is slightly lean.

<u>Service-Manufacturing Nature of Health Co.</u>

Although the case is about an insurance company, obviously servicing in nature, many deviations from the theory are signalled.

1. Outputs of employees, business units and departments are carefully measured for their separate contributions.
2. Because of the many measures, it is possible to compare performances between units and over time.
3. Because of these output features, it is likely that performance control systems can be effectively used. It is however important to know what issues must be measured, because they have large impact on behavior and outcomes (Ansari, 1977; Lawler and Rhode, 1976).
4. The insurance business not only uses knowledge but makes especially use of information technology as equipment.
5. The organization is in a competitive environment, and thus must take a large amount of responsibility for the success of the service measured in client satisfaction terms.
6. Many objective (intersubjective) reference points are created, to systematically evaluate performance and give feedback.

All these issues are different from most ideas about service companies, because professionalism in this case is low. Professional services (e.g. legal, educational and medical) demand high responsibility from the client because the professional applies knowledge and skills, but does not have a routine process. When services are routine, the organization can analyze how to improve them. It is obvious that professional and machine bureaucracies are very different (compare the The Bank that has a routine, administrative, and a professional, commercial, service branch). Health Co. scores on three service items of our service scale, but also on four manufacturing items of this five point scale. According to the definition it is therefore service, but also could be called industrialized service to express its manufacturing-like transformation process.

Conclusion: Health Co. is a service and slightly lean machine bureaucracy on transition to increased leanness.

8.4.5 Health Co.'s Learning Norms

<u>Learning policy norms</u>

Although the organization borders on leanness, it does not behave in this way according to its identity and policy norms. There are several reasons for this:

1. The organization has changed dramatically since 1988 and is still in a process of further development of its lateral structures. This is done via the previously mentioned Business Management Group, which was established just three months before our study started. The Quality Improvement Team is best comparable to a technostructure and therefore supports management in decision-making. The RTA processes (for MICS-maintenance) hardly work. In general the learning in the company is carried out via traditional line management structures. At the same time, informal communication (e.g. via E-mail) is well developed for operational problems. Electronic data highways however are not implemented to support information logistics. They are only used for operational processes and not for managerial and learning purposes yet.
2. Health Co. lacks a learning policy and identity formulation. This could also be explained because of its low administration/production ratio, by which management has not enough time to formulate policy-identity goals. Health Co.'s management does not see the use of a policy formulation because it wants to keep the management as flexible as possible. Systematic investments in people are made, and performance control information systems are used explicitly to detect training needs, which is important for increasing the operational effectiveness of the organization.
3. The organization is not very decentralized. The influence of the hierarchical lines is strong, which can be explained by the fact that the company is still busy redesigning itself and by the strong competitiveness in the industry. Business re-engineering is an important issue in the organization now, to improve service quality and decrease costs simultaneously. Information technology applications are considered to realize these demands.

Because of these data, Health Co.'s learning identity and policy norms therefore fall in the 'work harder' extreme.

<u>Responsibility norms</u>

The company combines the traditional classic functional and divisional coordination mechanisms in a matrix structure. There is a weakly developed technostructure (Quality Improvement Team) and small work-groups on the shop floor manage client problems at an operational level, but do not have authority for self-management. Project groups are sometimes created (for instance for MICS maintenance) but their authority is weak in relation to the authorities in the standing organization.

Service companies were expected to work with loosely coupled groups (chapter 5). This is not so within the business units, although coordination among the business units is weak. The routine-like nature of this service work bears a strong resemblance to manufacturing organizations.

Although Health Co. is seriously trying to change, its responsibility norms are still according to the 'power-based' extreme.

<u>Action norms</u>

The organization members' involvement and commitment to attaining the set goals were high. Management tries to motivate people by means of the clear definition of targets. People are measured daily for their time performance, and managers can thus carefully control the output. Senior management holds the management accountable for performance and is very keen on monitoring them. Managers who underperform are dismissed. Management explicitly tries to create intrinsic motivation and openness. This is done via:

1. The strong emphasis on training that would make employees more connected with the fate of the business and triggers interests in developing the whole.
2. Openness via the business unit is exercised in weekly meetings of 1½ hours with all levels in the business unit together.
3. People are willing to remove knowledge when it improves practice. This is contrary to our

previous statement that MICS would make unlearning more difficult. The deutero norms (specifically the action norms) make it otherwise. For the future, the organization can achieve an important competitive advantage when MICS can have the same role for innovation support, and simultaneously be used for efficiency control.

4. Learning priorities are high in the organization, which is indicated by a high emphasis on training, and the institutionalization of improvement and innovation procedures. For instance the procedures for MICS maintenance (called RTA procedures) are well documented. Also other innovation projects are well guided by project support (so called Situation Review Procedure).
5. Sources of knowledge are internal and external. An organization consultancy firm provided the basic knowledge and insights for transforming the 1988 organization to what it is now. Contacts with universities have been established leading to frequent joint projects.

This evidence places Health Co.'s action norms in the 'team and fast' extreme, which is typical of lean organizations.

<u>Procedural norms</u>

Nevertheless, competition is fierce and clients feel no obligation to stay with the company. Thus client dissatisfaction must be reacted to at once. This also counts for reacting to changes in government policies and new medical services that are covered by competitors. Health Co.'s management follows these trends intensively.

The existing MICS is still a periodic standard report. This makes the flexible use of data difficult, and thus inhibits opportunities to learn from the large amount of data gathered. Improving people's awareness of the organization's performance can be very motivating and increases people's willingness to participate in creating improvements and innovation. This is excluded when the management style remains of the telling form. This also explains the deviations from 'off-line systems', 'standard reports', 'inflexible databases' and the fact that actions are based more on tradition and command than business understanding, described in the following description of MICS.

8.4.6 Description of MICS

Health Co. has many features of a lean learner, but is not yet complete. This is clearly seen in the following:

- Learning processes are not connected with the development of theoretical knowledge. The so-called Situation Review Procedures are seldom effective and the RTA procedures are not applied.
- Performance control is ineffective, because people lack the time to review and analyze the huge amount of data that is created. Computer support for MICS could solve this problem, but does not exist.

We had the impression that no explicit connection between problem anticipation and critical evaluation was made for developing business understanding. This also indicates that Health Co.'s MICS is according to the 'classic' extreme. To test this opinion we made a more detailed study of single-loop and double-loop learning and MICS' role, as described in the following section.

8.4.7 Role and Value of MICS

Single-loop learning

We made some quantification of the role of MICS in developing, disseminating, and storing efficiency knowledge consisting of production standard concepts. We compared these concepts with alternative media like memos, vision statements (regular letters of management to its personnel) and output measurements. Some of the following conclusions are based on this investigation.

<u>Adaptation</u>
MICS use has led to an improvement in insights into the business for the management, particularly on how to match work volumes and work capacities. According to the financial director this resulted in a system's payback period of only 9 months, and has resulted in a total performance improvement of 30%. There are however no indications that MICS increases people's feeling of responsibility. Also no attempts were observed for increased self-management, except the use of the term volvo and a not yet successfully working Business Management Group. The system therefore has the role of a support of top-down management communications. The theories about these types of systems (Lawler and Rhode, 1976) suggest that it can easily lead to dysfunctional behavior. We have no evidence for this, but at this moment it is also unlikely to happen because the standards are not too difficult to achieve and the company has the opportunity of dismissing less motivated people under the influence of its survival crisis. No double-loop triggers were observed.

<u>Storage</u>
MICS is primarily used for reporting about operational tasks. It does not develop a major management theory in the form of planning models that later on are tested for validity. This is because this service industry has much difficulty with planning its processes, as the work-volumes depend on unpredictable moments when clients approach the company with a request for service. Particularly its quality policy, which demands speedy handling of claims and other services, inhibits a longer term planning and the use of buffers and stocks. Additionally the activities consist of many small handlings, whereas manufacturing environments have often large orders and project, with detailed planning, pre-budgeting and post-evaluations. This will make the development of a management theory much more complicated, but not impossible and very rewarding.

<u>Dissemination</u>
Data are quite easily accessible, and when used in connection with business awareness programmes, might motivate doing things better than before. The business management group is not yet working properly. The business units hold weekly meetings that could lead to important dissemination of knowledge. How these meetings precisely work is not clear (possibly very top-down again). E-mail and informal gatherings are often used to solve problems and disseminate suggestions.

<u>(Re-)use</u>
Understanding of cost and quality sources seems to have increased and the developed knowledge was explicitly used in departmental budgetting, which leads to a further reduction of the required labor force (as mentioned under adaptation). Strong management and positive attitudes to the company's survival, linked with the young age of the employees, enable the quick implementation of progressive ideas.
Health Co.'s single-loop learning efforts are in all the four activities, but restricted to the transformation and human resource fields. This means that Health Co. has a SLL effort score of 8. MICS' role is in problem anticipation and critical evaluation. MICS contributes to (re-)use, storage and dissemination of knowledge gained about transformations and human resources. It does not contribute to adaptation, because the adaptation of norms that are used is a very underdeveloped process by now. MICS has no negative consequences as far as can be mentioned. Its contribution is thus +6.

Double-loop learning

Double-loop learning is typically an activity carried out by senior management, that does not use much MICS data at the moment. MICS' value could increase at this level if:

1. Excellent user interfaces and interactive systems are made.
2. It is used to provide data about markets and products.
3. Decision proposals are well grounded on correct data and well discussed before they lead to decesions. The E-mail system could have an important function here, because it can work as a lateral structure when the people can react in an anonymous way to concept proposals.

At this moment the company seems strongly internally focused. This can be explained from the fact that it is hard to become a market leader in this business and that much of the health insurance business is regulated by government policies. Therefore the learning fields are transformation and human resources, and not much product and market innovation is carried out. The double-loop learning effort is development as well as unlearning. It is not clear how systematic and theory-based these DLL-activities are. Implementation is quick in this organization, although DLL is a centralized activity. This results in a DLL-effort score of 4 (2 activity and 2 fields). MICS role and value in DLL is however not present yet, but also not negative, leading to a MICS value of 0.

8.4.8 Learning Poblems Related to MICS and Recommendations

MICS does not seem to lead to learning problems, however:

1. At this moment it is rather expensive, because data gathering is done via filling in many forms. It is recommended that data be collected as by-products of the activities of the company.
2. MICS is not yet very actively used in adaptation processes, because these organizational processes are not yet well established in this case company.
3. MICS does not yet contribute anything to market and product development, but is restricted to process improvement. This attitude can be explained from the restrictions that are set on market and product development. At the same time it is not clear what additional market and product information is needed for learning.
4. There are no unlearning problems connected with MICS, because of the progressive attitude of employees and management. However, this should be followed carefully to ensure that these problems will not happen in the future.

The following concrete list of recommendations were given to Health Co.:

1. Develop an on-line MICS.
2. Collect data as by-product.
3. Develop norms such that people consistently check MICS data for possible issues of management and policy. This can be done by dissemination of MICS data or broad access to an on-line MICS system, and/or making this activity part of an internal intelligence office.
4. Specific issues detected should be followed by the creation of a task force or parallel learning structure (Bushe and Shani, 1991), which can advise on improvements and test solutions.

8.4.9 Conclusions Regarding the Main Hypotheses

<u>Health Co.'s score card</u>

Learning Variables	Var 2: MB-type is a moving service (value 4)
Var 1: Learning needs	*3*
Var 3.1: Policy norms	Work harder
Var 3.2: Responsibilities	Power-based in transition

Var 3.3: Action norms	Team and fast
Var 3.4: Procedural norms	Discrete and constraint
Var 4: Description of MICS	Classic and not computer-based.
Var 5: SLL effort (0..16)	8
Var 6: DLL effort (0..8) Var 7: MICS' role	4 Problem anticipation and Critical evaluation
Var 8.1: MICS' SLL value (16..+16)	+6
Var 8.2: MICS' DLL value (8..+8)	0, not negative
Unexpected values are italiced in the table.	

Table 8.13: Score Card for Health Co.

<u>Comments:</u>

- Because the learning needs score is 3 (low complexity, high dynamics), it is understandable that management tries to centralize the learning process. Essential in this situation are action norms that realize quick implementations. This was indeed the case at Health Co.
- Double-loop learning efforts are however lower than would be expected for a lean service company. This is caused by Health Co.'s internal focus on quality and efficiency and its lack of opportunities for product and market development. The small size of Health Co. (about 250 employees) contributes to the fact that Health Co. cannot create enough managerial knowledge and skills for improving the double-loop learning process. This 'small-size' fact also contributes to a management style that is strongly telling and centralized, and without a clearly defined management policy.

<u>Conclusions evaluation</u>

Hypothesis	Case 4
Con 4: Learning needs determine the learning norms required for survival.	True and false
Statement 14: Lean learning norms emphasize problem anticipation and the critical evaluation roles of MICS, whereas classic norms emphasize the problem anticipation and accounting role of MICS	True
Con 6: MICS contributes to single-loop learning effort and inhibits double-loop learning effort.	False
Con 7 Depending on the Learning Norms, MICS contributes to or decreases Learning Needs.	True

Table 8.15: Evaluation Table for Cross-Comparative Assessment

<u>Comments</u>

Concerning Con 4: learning needs are important, but the way an organization reacts to learning needs also depends on issues such as internal power relations (compare The Bank), being part of larger consortia (to have shared learning resources in e.g. divisional R&D departments) and, for this case specifically, its size that prescribes the effectiveness of centralized learning. After case 1, I stated that Con 4 is a truism and requires the definition of learning norm profiles in order to become informative. Table 8.16 presents the learning profile for Health Co.

Learning needs	Learning norms Health Co	Ideal situation
3	No identity or learning policy norms described	Learning policy and identity
3	Centralized learning by management	Committed learning: decentralized learning where possible
3	Dissemination of performance data for punishment and reward	Dissemination of data and improving communication between management and shifts, and training shifts in management skills
3	Quick implementation of concrete instructions, and initiatives by senior management for new theories. Motivate employees to obey.	Quick implementation required through effective communication and understanding. Motivate workers to be creative and think.

Table 8.16: Linking Learning Needs Score 3 with Learning Norms after Case 4.

About Statement 14. In this moving-to-lean case MICS has critical evaluation and problem anticipation roles. The effectiveness of the critical evaluation role is however still low, because the organization lacks the appropriate technical tools to make the use of MICS cost-effective. Additionally, the reponsibility norms are not yet clearly enough defined so that all data can be usefully exploited to improve SLL and DLL. Critical evaluation and problem anticipation groups are not integrated.

Concerning Con 6: MICS has little impact when the learning norms and technology are not appropriate. When mental models are shared, as in this case, the following observations are important:

- Action norms are no limitation to implementation. Theories are quickly transformed to action because their non-execution is clearly visible to the powerful people who constructed the theory.
- Model incompatibility therefore has a strong impact on action norms as supporters or inhibitors of theory implementation.

An additional statement therefore is required:

S23: *The greater the model incompatibility, the more action norms exist inhibiting behavioral learning (SLL and DLL). The more compatible the mental models, the more action norms lead to quick implementation of new theories and insights.*

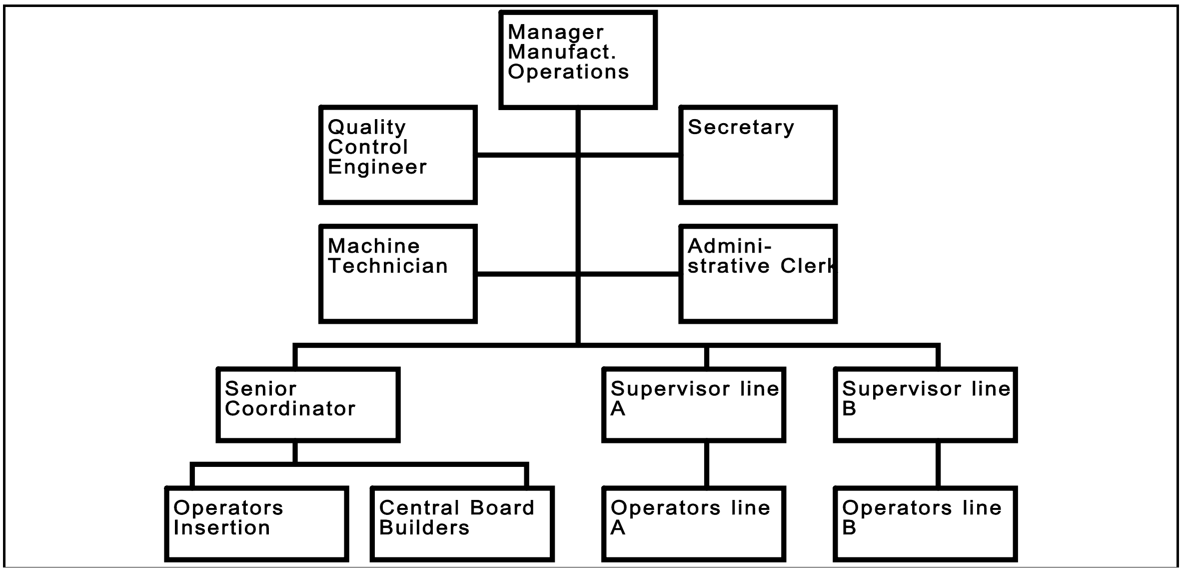
1.5 *Case 5: Hitec*

8.5.1 Introduction to this Case

This case concerns a high tech manufacturing Plant, named Hitec, located in Western Europe and part of a division of a US multinational. It produces electronic apparatus for industry and the military. In the beginning of the 1980s it had about 700 employees, gradually reduced to 200 in 1993 with a constant output of 75 million US dollars and the introduction of some new products. In the mid 1980's the company faced possible closure. A new management team (consisting of Europeans) was formed with a survival strategy, based on increasing worker commitment to the organization's success, aiming at top quality products, just-in-time (JIT) delivery and excellent internal communication. This resulted in an ISO certificate (1986), many other quality awards, an MRPA+ certificate and increased labor productivity. It is now one of the best performing Plants of the company. The Plant has one product line of its own and others manufactured under license from Headquarters in the USA. Their main markets are: USA (21.4%), Germany (16.1%), France (15.3%), Britain (10.8%), Italy (9.4%), Scandinavia (5.8%), and Japan (1.7%). Despite the large budget cuts in the military in the recent years, sales have been constant and there is a large order volume at the time of this study (second half of 1993).

8.5.2 General Description of Hitec

The parent multinational was founded in the first half of this century. The Hitec Plant was started in 1961. Because of personnel reductions some hierarchical lines (middle management) have been removed. The local Plant is headed by an the operations manager who is directly supported by a Human Resources Department, a Public Relations Department, a Controller, a Quality Assurance Department and the manufacturing operations manager. The manufacturing operations manager is responsible for the work done in seven departments, named: Value Engineering, Manufacturing Technical Support, Instrument Manufacturing, Order Processing, Purchasing, Manufacturing Planning, and Warehouse, Customs and Shipping. This study will focus on the Instrument Manufacturing Department, of which an organization chart is given in fig. 8.13.



The span of control of supervisors in the production organization is large: 8 for the 'Insertion and

Board Build' group (responsible for the final assembly and th production of electronic boards) and 30 to 40 for the two other groups. This is realized by the creation of semi-autonomous groups (called work cells), which have many joint responsibilities with respect to:

- quality
- output (delivery time and volume)
- work coordination and distribution
- detailed planning and materials supply
- administration of issues directly related to production (such as failures of delivery and quality problems)
- coordination with support staff (e.g. with quality and planning)

The work cells have a very mature way of collaborating, not requiring much supervision. The 'Insert and Board Build' cell has regular meetings on Monday mornings chaired by each of its members in rotation. The supervisor is only present when special problems occur. Work cells and the existing organization charts were introduced in the second half of the 1980s, after the introduction of a new management philosophy called 'Manufacturing Excellence' based on four main issues: Total Quality Commitment, People Involvement, Manufacturing Resource Planning and Just-In-Time production. The major learning fields therefore are 'process' and 'human resources'.

8.5.3 Hitec's Learning Need

<u>The Static-Dynamic Dimension</u>

The internal environment was stable because of low personnel turnover and product lines that have not changed much. Since 1985 the Total Quality philosophy, however, changed the way of working considerably, finally leading to a completely new way of thinking. The organization became more democratic, open communications have developed, procedures have been precisely measured and evaluated, and a new organizational culture was introduced. Things have begun changing rapidly. New product lines and transformations were introduced. For instance material supply is changing from traditional kits to Kanban systems. Automation will have a large impact on the production process in the near future. Labor productivity for some product lines (instruments) increased by more than 250% in the past three years.

The external environment is only indirectly perceived by the Plant, via the marketing department (located at headquarters in the USA) and the sales and service offices. These offices report on delivery problems and problems of clients that could be related with the production process. At the same time, countries in the Far East are severe competitors for European manufacturers, not only because of the low price they offer, but especially because of their superior quality. According to the manufacturing manager however, wages are a decreasing part of production costs. Material handling and lead times are important, because of the high material costs and costs of work-in-process. Supplier instability is decreasing gradually because of the Plant's programme to define supplier requirements precisely. Process innovations are particularly important in this saturated and slightly declining market (military budget cuts and the world economic recession).

<u>The Simple-Complex Dimension</u>

The internal environment is increasing in complexity, mainly because of the demands for higher quality, shorter lead times (high work-in-process (WIP) costs), cost reduction, and improved client delivery services. The Plant has reacted by developing an organization that is extremely flexible by:

- reducing 31 specializations to three skills levels, so that employees have become more flexible;
- removing departmental barriers. Work cells are flexible task groups that take responsibility for specific client orders. Because of this responsibility they have the authority to deal with

specialists, staff members etc. when required in order to carry out their tasks. Supervisors can assist in this process, but in general are only facilitators and intervene when problems in coordination are structural and absolutely require senior involvement;

- JIT philosophy. In planning and production the emphasis is on delivery targets, and not a just-in-time approach to all parts of the logistic stream. The production system is certainly not push, but pull and then some push when possible (cf. Aggerwal, 1985).

The external environment is increasing in complexity because customers demand more product innovation. From 10 years the product life cycle was reduced to just a few years. At the same time innovating the manufacturing process is important for producing the new products and keeping pace with the cost reductions that are demanded by the industry. This means that management is still faced with many uncertainties. Many projects are underway to develop new knowledge about how quality can be improved and how innovations can be carried out.

Conclusion: complexity and dynamics are high and still increasing. The *learning needs score therefore is 4.*

8.5.4 Hitec's Leanness and Service-Manufacturing Nature

<u>The Lean-Classic dimension</u>

The quality attitude is accepted, especially in the production function. The support departments are also finding out what the Total Quality Management philosophy implies for them. Many quality awards have been gained. The company audits its quality systematically according to ISO 9001, 9002 and 9003 standards, but also follows a continuous improvement philosophy (ISO 9004). For this last purpose it applies the European Malcolm Baldridge Award criteria[31]. The quality assurance manager is a leading member of a European national quality managers society.

The work cells have the responsibilities and authority for self-management. This autonomy allows them to engage in (lateral) relations with other departments, without asking permission from supervisors. Another aspect is the availability of data about their performance. This, according to my informants (a cell member, a cell coordinator, and the director of manufacturing) increases a cell's motivation to achieve targets and initiate actions to find causes of problems and opportunities for improvement.

[31] See Evans and James, 1993 for further information about ISO norms and Malcolm Baldridge Awards.

The relation with suppliers is regarded as one of mutual benefit. Hitec helps suppliers to improve their quality by its Supplier Performance programme. Suppliers are precisely monitored on their performance (delivery time, defects etc.) via a special information system. Problems are fed back and suggestions for improvements are given.
Although the client-plant relation is indirect (mediated via sales, marketing and services), the Plant appreciates systematic feedback from clients via service and sales reports which are analyzed by the quality assurance department for possible structural sources of problems (in procedures, equipment used, and skills of personnel).
Because the Plant is part of a larger division, essential financial decisions are made in the USA. Hitec's management team does not have much influence on this decision-making process. The idea of low interest rates in large consortia therefore is not true, but depends on top management's perception of the Plant's profits in relation to investments. Therefore the Plant has an uncertain future. The managerial skills and the quality of the organization however are unique in the larger organization, possibly safeguarding it from tough decisions.
One of the main pillars of the new management philosophy is to increase the involvement and skills of the employees. The Plant therefore has invested considerably in human resources by technical training for job enlargement, and interpersonal and management training for realizing autonomous work cells and establishing a new culture. The total training effort is about 5% of annual wage costs. As a consequence, job rotation is now easy though with a negative reaction from the more highly educated employees who feel they are given tasks not matching their qualifications. However, this job mobility is confined to this Plant. The Hitec managers have not been invited to become members of the American or international management team. But as a benificial side-effect, Hitec's management gets on extremely well with local employees.
Major new ideas are not infused via labor force composition, but via the process of learning in the quality programme and some external training and consultants.
Motivation is intrinsic and extrinsic. The intrinsic part is institutionalized via the quality audits and diverse other learning norms (work cells, performance data monitoring by managers and employees etc.). The US management has also instituted awards for extremely good performance which some managers think are appreciated although interviews on the shop floor suggest these awards and quarterly management 'appreciation' meetings are typically American and do not belong to their culture. They prefer monetary awards.
New ideas are consistently searched for via the quality improvement processes. At the same time management is very open for new ideas that emerge from academic research. This was one of their motivations for offering me the opportunity to interview many people and study their organization. In general they appreciated discussions about their management theory to preserve them from possible business blindness.
Conclusion: the company is *lean* for all criteria of our scale of leanness.

The Service-Manufacturing Nature
The output is tangible: instruments produced. Units can be distinguished and measured in terms of quantities of specific types and variants.
The value of the output is precisely known in monetary terms, because the production is almost 100% order production with a preset price. After completion of production one therefore already knows the profit contribution (if the client pays, no large currency fluctuations happen and no unexpected shipment and disbursement costs occur).
The organization is keen to satisfy clients, and communicates precisely what problems clients have with the products. This is of course increases its quality reputation and enhances its image and maintains client loyality.
Output control is important. As a total quality Plant Hitec tries to increase process quality. Therefore, errors are detected as soon as possible by inspectors. Measurements of 'first part yield' have been developed to find out how frequently one product is made in one go without expensive and time-consuming reiterations. Much effort is put in finding the causes of quality problems.

Regular audits are carried out on each department.
As opposed to the situation of many manufacturing bureaucracies, machine costs are only a small part of the total production costs. The materials and components are the most costly. Employees are extensively trained, and their technical as well as managerial skills are regarded as an essential production resource. The knowledge about processes and quality are regarded as major issues for achieving the quality ambitions of Hitec. Work is done on basis of weekly schedules, that are in principle flexible. Of great importance is accurate information about what must be produced (which product, what variants, what bill of materials applies, which cell can do the job, what quantities are demanded and what delivery date has been agreed). This is typical of unit order production.
A clear distinction between input, semi-finished and finished products can be made. The work cell structure makes handling these subprocesses more flexible, because tasks are often rotated and task integration is implemented.
Stocks are technically possible, but economically unfeasible. This is because the costs of WIP and materials are high and the order volumes for specific types are unpredictable.
The service, sales and purchase departments seal the production system off from the market environment. Clients are not ego-involved. Responsibility for product success lies mainly with the Plant, and to some extent with services. Services and the Plant have regular meetings to exchange information. The Total Quality philosophy is now also being implemented with the services. Within the Plant however there is much openness between production, quality and planning. The administration (including data processing) however has very poor relations with other departments, and is called a 'factory within a factory'.
Professionalism is high among managers, who are continuously trying to improve. The shop floor has a mature (Hersey and Blanchard, 1982) work force, capable of self-management and committed to quality for the longer term survival of the company. Most members of the cells have a lower level technical education plus some additional on-the-job training. They have extensive experience on the job (most are over 40 years of age and joined Hitec for their first job). Payment is good in relation to other companies. These facts explain a strong commitment to the company.
Conclusion: Hitec has both characteristics of a manufacturing and of a service machine bureaucracy. This combination of characteristics is typical of lean manufacturers.

8.5.5 Hitec's Learning Norms

Learning policy norms

Hitec emphasizes its TQM policy. At the same time however, divisional management sets the targets about output volumes and costs. Plant management does not have much influence on this target-setting process.
Lateral relations are strongly encouraged. Initiatives to start lateral contacts can be prompted by signals from the MRP or other information systems. The organization is however not equipped with electronic communications. When problems occur, face-to-face or telephone communications are used.
Much effort is put into skill development. The organization invests about 5% of its wage costs in training. Simultaneously much effort is placed in improvement projects and quality assurance activities under the support of a full-time project manager. Of the 200 people employed, 10 work within the quality assurance department, and much operational quality assurance work is done on the shop floor, mainly in the weekly (sometimes twice weekly) work meetings of a work cell.
Production teams are responsible for their performance, and have access to relevant management information systems. Project teams are strong, because senior department members participate in them. This is likely to happen in this rather small organization and makes problems about project team responsibility and authority less difficult to solve than for instance in the car industry. Hitec is seperated from its environment via the purchase and sales departments. The supplier improvement programme tries to solve the problems that could occur as a consequence. The Quality Assurance

department is now busy with a quality assurance programme for services, and makes systematic assessment of field failures.

Business re-engineering is an enduring activity and motivated from quality improvement and possible technological changes (in products and processes).

Conclusion: Hitec has 'work smarter' learning policy norms. Policy and mission norms are indeed oriented towards the 'work smarter' extreme, but the 'work harder' norms (expressed in production volumes) are also applicable to Hitec. Remarkably, Hitec has a large administration/production ratio (123/77[32]). This could indicate a non-lean organization. The interpretation of the a/p-ratio is however very complex. In situations where production automation is increasing (as at Hitec), it is likely that the a/p-ratio will rise. Furthermore, a head count is not a good indicator of leanness when personnel costs are only a minor part of production costs.

Responsibility norms

At Hitec, learning is an organizational responsibility, in which departments, management and work cells participate. Work cells, responsible for and committed to quality, search for information to support continual improvement. When the problems are interdepartmental, contacts with these departments are made. A quality engineer may also be involved.

At Hitec the subdivision between a functionally and divisionally (market) oriented work force is becoming irrelevant. Only the Insert and Board Build group is a functional 'work cell'. The other two work cells are related to product and market lines. The work cells produce as a group from the beginning to the end. Volvo teams are the basic organization principle in the production department. Further automation in production and technical developments will decrease the number of people involved and require closer connections between production and support groups. This could lead to the development of one large work cell.

Project groups are created frequently to research possible errors, improve quality and search for renewal. Professional project management exists here. The error detection and improvement projects often have the same collection of participants and a routine-like procedure. The renewal projects (that introduce a basically new way of working, e.g. Kanban), often use a completely different way of working and other participants.

The Plant constructs partnerships with suppliers and service/sales companies, also to learn from each other. The Plant also has a leading position in a national quality association, and via this distributes ideas and picks up new interesting ideas as well. At this moment the Plant is regarded as a production unit within the division. Divisional Headquarters centralizes design and engineering, however some decentralization would be feasible because the expertise and technology is available.

[32]Only 77 of the 200 people employed are working in the manufacturing department (Instrument Manufacturing Department).

Hitec combines functional specialism and market orientation in a matrix-like learning structure. Learning is embedded to some extent in the volvos (work cells) that have substantially large responsibilities and discretion in analyzing and solving problems. This resulted in a large span of control for two production cells (about 30 to 40 employees per supervisor) and a very passive management attitude of the senior coordinator of the Insert and Board Build cell. The importance of task groups in this company is also interesting and indicative of its greater appreciation of learning. The task groups also indicate interest in double-loop learning (major changes that fundamentally influence the way of working and thinking. (Some examples were the task force SMD[33] and Kanban). These double-loop learning activities are restricted to transformational innovations. The Plant is not allowed by headquarters to think strategically about product and market development! The Plant's management team and divisional CEO's only discuss targets and output performance (typically the divisional control type as described by Mintzberg). Double-loop learning about products and markets therefore is a top-down activity.

Conclusion: distribution of learning responsibilities is competence-based, however restricted to single-loop learning and the process field of double-loop learning! Major double-loop learning for this Plant is done by divisional Headquarters, and results are communicated top-down, leaving only implementation activities at the Plant level. Some double-loop learning occurs as a result of the quality monitoring.

Action norms

The Plant and company emphasize the importance of work satisfaction created through a 'we-feeling' and the use of internal awards to individuals and groups. In this West European case this system is possibly not effective. Employees stated that they were very committed to the company's success because this is essential for maintaining the relatively well-paid jobs. The intrinsic motivation to help the company succeed and excel is therefore closely related to extrinsic motivations. People prefer financial rewards.

No indications of defensiveness were found. According to a tester interviewed, people on the shop floor were eager to improve their work when they received comments about failures. Additionally, the quality assurance group communicates clearly about what they will audit and when they will do so. Findings lead to improvements, some through simple changes of work, sometimes through training, sometimes through projects.

New findings and technologies are easily introduced and adopted. At the same time it is likely that people on the shop floor will resist these changes, because many involve labor-displacing automation. For some workers several years of training effort also can become worthless because the new technologies do not require the new skills.

Conclusion: Hitec has action norms that are according to the 'team-fast' extreme. At Hitec we also see the close relation between theory (the managerial philosophy of excellence) and action. Implementation of insights is carried out persistently and carefully during the course of many years.

[33]SMD is a new soldering technique, completely automated and extremely quick.

Procedural norms

The feedback frequencies are much higher than expected from a classic manufacturer but still are not on-line (most are weekly or monthly reports). The high frequencies result from the Plant's desire for excellence, through detecting errors and the source of the mistake as soon as possible, so that people will connect it more easily with what they have done. For these purposes testers give feedback to the shop floor, and the quality assurance group analyzes outgoing quality data, and communicates problems when found.

In all cases the existing information norms seem to fit with the lean type. The only deviation is the fact that data from the main MRP system cannot be analyzed and accessed on-line. The MRP system now is being replaced by one that has this on-line ability.

Conclusion: Hitec's procedural norms belong to the 'free and continuous' extreme, that was regarded as typical of lean organizations.

8.5.6 Description of MICS

It is particularly interesting to mention the main issues and systems with which the organization assesses its performance, because this gives an operational description of the management theory used and the procedure for communicating about it. The official management theory emphasizes: Total quality commitment, People involvement, Manufacturing resource planning and logistics, and Just-in-time production[34].

From these major issues a number of indicators are derived:

- Total quality commitment indicators: customer service level, outgoing quality, reliability of deliveries, error registration in delivery and production, vendor analysis and performance rating, and the Malcom Baldridge assessments[35].
- People involvement with absenteeism indicators.
- Manufacturing resource planning and logistics indicators: inventory as percentage of net sales, work-in-progress volume costs also specified by components and parts and, manufacturing costs of sales.
- Just-in-time production, or OPT indicators are: manufacturing velocity, inventory turns, and manufacturing service level.

Some additional reports are present as well:

- Efficiency measures: net sales per employee (NOE); administration expenses as percentage of net sales (these measures are extracted from the accounting system).
- Several financial performance indicators.

[34] In fact, Hitec has not yet achieved JIT in all its processes, but it has OPT which means just-in-time delivery and adjusting processes to accomplish this with the least effort (cf. Aggerwal, 1985).

[35] See Evans and Lindsay (1993) for a detailed treatment of the Malcom Baldridge assessment.

- First part yield.

At this moment various systems are being developed by separate departments (e.g. error registration system is developed and maintained by the Quality Assurance department). These systems can in all cases be coupled to the MRP (corporate) information system. This situation can still easily lead to data islands, lack of data compatibility and applications that do not communicate easily. Therefore the situation is not optimal for creating flexible reports and leading to incomplete (suboptimal) pictures of reality. The high quality of the data administration therefore refers only to the MRP system.

The solution to these problems must be found in applying a consistent, shared mental model, from which the information needs are derived, and secondly by solving possible problems of duplication (redundancy) and inconsistency. A first attempt to make this shared model explicit is found in the manufacturing excellence policy description. The organization is very willing to monitor performance and analyze the data for prescribing new actions. Therefore, the data-action gap is small. The existing data are also closely related to what is required for manufacturing excellence. Because the organization has an open culture and is increasingly small, problem anticipation (done by production planning and logistics) and critical evaluation (done by quality assurance and controlling) are closer together. In the production meetings and quality meetings (each week, in a group consisting of the supervisors, senior coordinator, quality assurance, production planning manager and some additional managers), the social networks of problem anticipation and critical evaluation are integrated.

Conclusion: at the social level the MICS is lean. The technical level however does not yet fully correspond to the leanness demands:

- The main (MRP) information systems is still off-line and requires hard copy reports that are less user-friendly for analysis and learning. The new MRP system will solve part of this problem.
- There are many information systems that provide information for learning, but they are not integrated within the management information system. Links are made with the MRP system.
- Because systems are more or less separate, the chance for incompatible data and data-structures is huge.
- The Plant has no internal electronic mail.

8.5.7 Role and Value of MICS

Single-loop Learning

<u>Adaptation</u>

Adaptation of knowledge at the Hitec Plant consists of testing the quality of the way people are working, and thus could lead to adjustments of theories by critical evaluation and training. MICS has several functions here in detecting problems. Several people are involved in analyzing these data and suggesting improvements. Data about outgoing quality and delivery are available. Adaptation of knowledge about planning, ways of budgeting, ways of organizing (work cell construction etc.) is done on a permanent basis through open communications. According to some managers the distance between management and employees is rather small, therefore leading to effective feedback. It is not clear if this is just wishful thinking. The distance between the management team and employees seems to be too large. The quarterly meetings are ineffective for bottom-up communication (they are clearly top-down).

<u>Storage</u>

Storage of knowledge is done whenever new procedures are discovered that could improve effectiveness. Knowledge is written down in handbooks and the modular construction of the product concepts, makes it easy to build some variants on a product line. New product lines lead to more severe changes. This recently happened. Training then can become obsolete, which is quite frustrating for people who have passed difficult exams. The stored knowledge is also to a large extent available by electronic means. It was quite easy to obtain data about performance in recent years, so that improvements could be related to managerial practices.

Dissemination

Much of the conceptual dissemination occurs through training in the basic issues of manufacturing excellence. These trainings are followed by all members (top and shop floor). This training is about social communicative aspects of successful team membership, management and motivation, and quality concepts. The role of MICS in the dissemination of concepts is implicit. The information systems supply data that are interpreted via the concepts. At the same time, concepts used for data gathering and understanding were disseminated during the information systems user training and systems development processes. Because concepts and information are mentally and organizationally closely connected, interpretation problems are not problems about the syntactics of the data, but problems about the structure of reality. The data can support alternative points of view (Hegelian principles according to Kirsch and Klein, 1978). Nevertheless there is one clear organizational philosophy, which decreases the chance of conflict about interpretations.

(Re-)use

(Re-)use is not problematic, because knowledge and data are closely connected and knowledge and action are closely connected via training and the fact that learning processes are an inherent part of everyday life in the Plant (work cell meeting, Tuesday's quality meetings, and Thursday's production meetings).

Conclusion: MICS is absolutely crucial for the adaptation process. It only has a limited role in storage. Of course set targets are part of the monitoring process, but even more essential is how people understand these targets and norms. For this purpose extensive training and many meetings and handbooks are essential. The dissemination process is supported by the quick way reports can be generated and distributed by hard copy and by data on the terminal. Dissemination of concepts (targets, norms and theory) goes through trainings and meetings. (Re-)use happens through the interpretation of data that are the output of the various information systems. The MRP-system seems to be particularly effective here because no additional informal information circuit exits in the organization that could lead to conflicting interpretations. This means that the system must be always right.

Hitec's SLL-learning effort therefore concerns all four activities and two fields (transformation and human resources). All the SLL-activities for the two fields are performed, thus its SLL-effort score is 8. MICS contributes to all these values and no negative impacts were found, so MICS' value for SLL-effort is +8. MICS' role is in problem anticipation and critical evaluation.

Double-loop Learning

At Hitec, a production Plant, the opportunities for market and product developed are almost restricted to zero. This type of double-loop learning is the task of the marketing department located at Headquarters in the USA. The Plant has no opportunities to seriously influence what happens there. One could describe the larger division best as a classic divisionalized form, with a command and report relation between Headquarters and divisional units (Plants). This could seriously threaten the Plant's longer term survival despite its excellence in quality.

Much effort however is placed in improvements of transformation. Some of the major innovations in this area were not developed and chosen by the Plant itself. Again divisional Headquarters decides what investments are made in transformations. Project management is an important organizational information system to support the introduction of these innovations. MICS is often used to discover required innovations.

Conclusion: Hitec has a very restricted double-loop learning process. Most double-loop learning occurs in the USA with no participation of Hitec. Hitec is a successful implementor of ideas developed by Headquarters. Here we touch the delicate question of the effectiveness of excellence for longer term survival (cf. replications of Peters and Waterman, as described in Lammers, 1986). Because Hitec is a successful implementor, its unlearning capacity is high. It has done this in the past through innovation in transformation and products, which were externally developed. This means a learning score of 2 (1 activity and 2 fields). MICS' value is very limited for double-loop learning. Market data and strategic product data are not processed at Hitec. This means that MICS' value for DLL is 0.

8.5.8 Learning Problems Related to MICS and Recommendations

MICS could accelerate the single-loop learning process when technical features are improved (compatible data structures, integration of systems, on-line high quality user interface). The social system is ready to profit from these investments. The double-loop learning process is inhibited by responsibility norms that cannot be changed by information technology. When changes occur, MICS could be an important support instrument when market and commercial data are made accessible to Hitec's management, and when the design and product engineering group of Hitec is given more responsibilities.

8.5.9 Conclusions Regadring the Main Hypotheses

<u>Hitec's score card</u>

Org. Learning variables	Var 2: MB-type, score for Hitec is Lean Manufacturing
Var 1: Learning needs	*4*
Var 3.1: Policy norms	Work smarter and work harder
Var 3.2: Responsibility norms	Competence-based
Var 3.3: Action norms	Team and fast
Var 3.4: Procedural norms	Free and continuous
Var 4: Description of MICS	Lean. Integration via MRP, *no common model*
Var5: SLL effort (0..16)	*8*
Var 6: DLL effort (0..8) Var 7: MICS' role	*2* Problem anticipation and Critical evaluation
Var 8.1: MICS' SLL-value (16..+16)	*+8*
Var 8.2: MICS' DLL- value (8..+8)	*0*

Unexpected values are italicized in the table.

Table 8.17: Score Card for Hitec.

Some deviations from the stated hypotheses are interesting to mention:

- The Hitec situation is complex (complex product and process) and dynamic (many competitors and changes in markets and technologies). Especially the complexity makes it deviate from the predictions. The complexity is high because of its high-tech production. It is however not a professional bureaucracy. The highest entrance knowledge is a bachelors degree and these positions are rare. Most education is on-the-job training provided by Hitec itself, so that the external knowledge gained by Hitec employees is low.

- Double-loop learning effort is much lower than expected. Hitec only double-loop learns about the 'transformation' field (score of 2 on DLL efforts). This is because the larger organization does not permit the Plant to engage in more than production and some service (learning responsibilities are inhibitors here). Most remarkably MICS does not contribute to DLL at all.
- Single-loop learning effort is also below what is expected. MICS does contribute to all the items for SLL.
- Generally one could say that the lean structure developed does not lead to the expected learning abilities, because of the existing internal power relationships and authority limits.

Conclusion evaluation

Hypothesis	Case 5
Con 4: Learning needs determine the learning norms required for survival.	True and false
Statement 14: Lean norms emphasize problem anticipation and the critical evaluation roles of MICS, whereas classic norms emphasize the problem anticipation and accounting role of MICS.	True
Con 6: MICS improves single-loop learning effort and inhibits double-loop learning effort.	False
Con 7 Depending on the Learning Norms, MICS contributes to or decreases complexity and dynamics.	True

Table 8.18: Evaluation Table for Cross-Comparative Assessment.

Comments

Concerning Con 4: learning needs are important, but the way an organization reacts to learning needs also depends on issues like internal power relations (compare The Bank), and its being part of a larger consortium (to have shared learning resources in a centralized divisional R&D department). After case 1, I stated that Con 4 is a truism and requires the definition of learning norm profiles in order to become informative. Table 8.19 presents the learning profile for Hitec.

Learning score	Learning norms Hitec	Ideal situation
4	Identity and learning policy norms	Learning policy and identity

	described (mainly in TQM terms)	
4	Decentralized quality and operational learning, and divisional strategic learning	Committed learning: decentralized learning where possible
4	Dissemination of performance data for improving and some rewarding	Dissemination of data and improving communication between management and volvos, and training volvos in management skills
4	Quick implementation of concrete instructions, initiatives for DLL by senior management, and quick implementation of new theories.	Quick implementation required through effective communication and understanding. Motivate workers to be creative and think.

Table 8.19: Linking Learning Needs Score 4 with Learning Norms for Hitec.

Concerning statement 14: Hitec is a lean organization that indeed emphasizes problem anticipation and critical evaluation roles of MICS. It also has a philosophy that integrates the problem anticipation and critical evaluation groups in the organization.

Concerning Con 6: MICS does not have much impact on double-loop learning because the responsibility norms do not require Hitec to participate in this process. This statement is typically true for the cognitive part of the learning process because in the implementation part (behavioral aspect of learning) the action norms determine whether the uninvolved people are motivated to participate in the implementation of the theory (this is of course essential). Hitec seems to be an effective implementor of management theories. This is typical of lean organizations. Classic organizations are (mentally) less integrated wholes and therefore organization departments and units can resist implementation. Responsibility norms therefore largely determine the extent to which mental models will be shared or are incompatible. In the case of Hitec improved participation of Hitec management and design group in divisional decision-making could decrease the chance of resistance. Lean organizations have however a stronger sense of commitment to the whole of the organization. The lower integration in classic MB-s improve their chance of resistance. These ideas can be formulated in the following additional statements:

S24: *Lean machine bureaucracies have a stronger consensus on management theories than classic machine bureaucracies.*

S25: *Effective implementation of management theories is improved by having the implementors involved in the development and adaptation processes of those theories.*

S26: *Lean machine bureaucracies create commitment to management theories via the development of consensual mental models. Classic machine bureaucracies do so by bargaining.*

S27: *Effective MICS for single-loop and double-loop learning depends heavily on effective responsibility norms.*

Conclusion 8 (based on S24, S25, S26 and S27):

Lean machine bureaucracies have very effective theory implementation processes without *having implementors involved in the theory development and adaptation. Classic MBs require responsibility norms that have implementors involved in the development and adaptation process.*

Chapter 9 : Conclusions and Discussion

8.6 *Aims and Objectives of the Research*

The objective of this study was to understand and explain *under what conditions computer-based MICS contribute to organizational learning in lean and classic machine bureaucracies*. Management information systems were studied because of their pretention of creating smarter organizations. Because of their particular problems with organizational learning, the study focussed on machine bureaucracies (MBs) and monitoring information and control systems (MICS). In seeking to answer this question, we were first faced with the lack of clear concepts and theory in the joint area of organizational learning and information systems. Here we set ourselves the following tasks:

1. Review the theory of organizational learning. This resulted in definitions and operationalizations of organizational learning, and a basic assumption that states that learning effort should be based on the learning need, and that learning can be facilitated by learning norms and information systems.
2. Study the specific *organizational and technical features of monitoring information and control systems*, and especially the way these features are combined with socio-technical learning systems in machine bureaucracies.
3. Generate a theory to explain MICS' impact on organizational learning.

Tasks 1 and 2 should result in concrete hypotheses and variables for the construction of a theory.
On the basis of these tasks the following questions were formulated:

1. What are the basic dimensions of organizational learning?
2. How do lean and classic machine bureaucratic organizations learn?
3. Do lean and classic machine bureaucracies differ significantly in their way of using MICS for organizational learning?
4. What is the influence of MICS on organizational learning in machine bureaucratic contexts?
5. How can one observe the impacts of MICS in machine bureaucratic environments?

These five questions are evaluated in this chapter, some comments are made about the results, and issues for further research are mentioned.

8.7 *What are the Basic Dimensions of Organizational Learning?*

Organizational learning consists of three *processes*, each with several activities (see table 9.1), which are governed by organizational learning norms. This preliminary answer was based on insights from four approaches to organizational analysis: cybernetics, organization development, scientific management, and soft systems analysis.

Learning Process	Learning Activity
Single-Loop Learning (SLL) (getting better at handling the theory)	Knowledge Adaptation
	Dissemination
	Storage
	(Re-)use
Double-Loop Learning (DLL)	Theory development (incl. implementation)

	Unlearning
Deutero Learning (learning about learning)	Learning identity and policy norms creation
	Learning responsibility norms creation
	Learning action norms creation
	Creation of procedural learning norms (included MICS)

Table 9.1: Process Dimensions of Organizational Learning

Learning may take place in several relatively independent *fields* (transformation, human resources, products and markets), which are relatively easy to observe. The *learning needs* are the responses to the *complexity* and *dynamics* of the business environment. The *learning norms*, which determine the manner of learning, relate to four main areas: corporate identity and policy, responsibilities, procedures and actions. To observe learning in action we can see how new *management theories* are adopted, these theories being models of how domain variables influence one another (e.g. fig. 9.1). In the hierarchy of learning processes, deutero learning is learning about learning and its norms govern changes to the single-loop and double-loop learning norms.

8.8 *How Do Machine Bureaucratic Organizations Learn?*

MBs, simple structures, professional bureaucracies, divisionalized forms and adhocracies have different learning needs and learning norms. As the complexity and dynamics of the business environment give rise to the learning needs, complexity is higher in MBs than in simple structures but lower than in the other types (Mintzberg, 1983). Machine bureaucracies have a less dynamics environment than all other types of organizations (Mintzberg, 1983). Nevertheless, environmental pressures show that in all MB-cases studied, the learning needs score was increasing. As a result, four *profiles of effective (ideal) MB-learning combinations of norms and needs* are described. These profiles are summarized in table 9.2.

Learning needs score: Ideal learning norms↓	1: low complexity and low dynamics	2 high complexity and low dynamics	3: High dynamics and low complexity	4: High dynamics and high complexity
Identity & policy norms	None, or 'work harder'	Emphasizing core competencies and managing them to 'work harder'	Learning policy and identity norms described as 'work smarter'	Learning policy and identity norms described as 'work smarter'. Learning infra-structures are designed and core competencies are developed.
Responsi-bility norms	Learning in functional groups, and power-based	Learning in specialist groups (mostly technostructure), which have power	Committed learning: decentralized learning where possible, and competence-based.	
Action norms	Money and pain	Money and pain	Quick implementation of insights is required, and	

	avoidance motivation. Quick implementation of commands	avoidance. Quick implementation because of expert power and hierarchy.	enabled via effective and fast teamwork. Workers are creative members of the team.	
Procedural norms	Discrete and constrained dissemination of performance data.	Discrete and constrained dissemination of performance data (among specialists and managers only).	Dissemination of data is free and continuous, improves communication between management and shifts, and supports shifts' self-management	Dissemination of data and knowledge is free and continuous, improves communication between management, experts and employees
Example	Low tech manufacturers, like Cardboard Co.	The Roman Catholic Church. No case like this was found in our study.	Classic MBs that are moving to lean, like Health Co. and Chemical Plant	High tech companies, like Hitec

Table 9.2: Learning Profiles in Machine Bureaucracies.

The differences between the 4 profiles are:

- Profiles 1 and 2 differ because profile 2 requires more internal expertise, which means that competencies are treated as an asset in the second profile. The first profile pays no specific attention to competencies.
- Profiles 2 and 3 differ because profile 3 has a much higher dynamics score, which makes the precise prescription of work and required knowledge less effective. More emphasis is then given to developing knowledge in Learning Policies and Identity norms. Profile 2 (like 1) does not need such an explicit policy statement.
- Profile 4 differs from profile 3 in that it has a higher complexity to treat. This calls attention to core competencies (as in profile 2), but now higher dynamics requires all other organization members besides the specialists to participate in knowledge development and adaptation. It is important to develop a learning infrastructure to speed up the learning process and to store and adapt the knowledge gained. Procedural and responsibility norms must enable this decentralized learning.

Because learning needs are obviously increasing today, it is important to correctly rate learning needs and design learning norms.

8.9 *Do Lean and Classic Machine Bureaucracies Differ in How They Learn?*

This research question was valuable for detecting major insights into MICS' roles in organizational learning. We compared several cases, some clearly classic and some clearly lean, and some that were moderately lean or moving from classic to lean (table 9.3).

M.B.-type	1: Classic-Manufacturer	2: Classic-Service: The Bank	3: Classic-manufact. Chemical Plant	4: Moving to lean service	5: Lean Manufacturer Hitec

(var.2)	Cardboard Co.			Health Co.	
Learning need (var. 1)	1	*4*	*3*	*3*	4
Policy norms (var. 3.1)	work harder	work harder	work harder	work harder	work harder and work smarter
Responsibility norms (var. 3.2)	Power-based and functional		Power-based and functional, but also *R & D department and (ineffective) project groups*	Power-based and functional but moving to competence-based	Competence-based
Action norms (var. 3.3)	Money (financially motivated) and slow to adopt new theories, but *quick implementation of operational insights*.		Money and slow	*Team and fast.*	Team and fast.
Procedural norms (var. 3.4)	Discrete but less constrained because *shifts have access to mutual performance data.*	Discrete and constrained. *Free within branch,* constrained via hierarchical lines	*Continuous and free*	Discrete and constrained via hierarchy	Free and continuous
Description of MICS (var. 4)	Classic	Classic, but *very large*	*Technically lean*, but socially separated problem anticipation and critical evaluation	Classic (however large) but not computer-based.	Lean. Integration via MRP, *no common model*
SLL-effort (0..16) (var. 5)	8, *four points higher than expected*	*16, extremely high for classic service*	4	8	*8*
DLL-effort (0..8) (var. 6)	0	2	0	4	*2*
MICS' role (var. 7)	Problem anticipation and *Critical evaluation*	Accounting, problem anticipation and *critical evaluation*	Problem anticipation and *Critical evaluation*	Problem anticipation and Critical evaluation	Problem anticipation and critical evaluation
MICS' SLL-value (16..+16) (var. 8.1)	+8, four points higher than expected	*+12, expectation was between 4 and 8!*	+4	+6	*+8*
MICS' DLL-value (8..+8) (var. 8.2)	0, *not negative*	+2	0, *not negative*	0, not negative	*0*

Unexpected values are italicized in the table.

Table 9.3: Score Card for all Cases.

The Lean-Classic distinction and MICS Use

Lean and Classic MB-organizations differ significantly in their *Action Norms*. Lean organizations are effective and quick implementors of new management theories, also when these theories have not been developed by the implementors themselves. In the classic cases the implementation of new theories was problematic (slow, incomplete, provoking resistance).

For all the other organizational learning variables, no systematic patterns along the lean-classic line were found. This was probably not the result of research artefacts, because the rating of lean and classic characteristics was done with care.

We expected *MICS* in classic cases to only be an appendix to accounting, problem anticipation or critical evaluation systems. This was not true, because in our observations no differences existed about MICS' roles. More interesting was the question whether critical evaluation and problem anticipation communications were done by separate groups or among groups that formed a closely knit network. The lean case (Hitec) indeed showed that planners (performing problem anticipation) and performance evaluators (performing critical evaluation) exchanged insights and this demonstrated a closed learning loop at the organizational level. This type of loop was absent in all other (classic) MB-cases, where problem anticipation and critical evaluation were performed by strongly separated groups.

<u>The Manufacturing-Service distinction</u>

An alternative hypothesis was introduced in chapter 1, and explained in chapters 5 and 7, stating that the differences between machine bureaucracies were not only the result of learning norms, but also of transformations (Manufacturing-Service). The following were observed:

- *Double-loop learning* was stronger in the service cases (scores 2 and 4) than in the manufacturing cases (scores 0 and 2). A possible explanation (Adler and Cole, 1993) is the cycle time of the work done: very short cycle times restrict attention to *detailed* process improvements because there is not enough time to experience and learn about the *wider* process involved. This also restricts double-loop learning. In service industries detailed monitoring is more difficult as people are assigned a budget and a longer time period (week or longer) to accomplish the task without detailed control. This encourages double-loop learning, thinking about the interconnections of the task with the broader process involved.
- *Responsibility norms* differ: manufacturing cases used project groups whereas the service cases learned via functional and managerial lines.
- *Procedural norms*: the role of management in learning was significant in the service cases and less so in manufacturing.
- The expected differences in *MICS-use* (MICS used for problem anticipation in manufacturing and for critical evaluation in service cases) seem not to hold. In all cases MICS was used for problem anticipation and critical evaluation. Nevertheless MICS differed in social as well as technical features.

Many of these results are possibly a consequence of the idiosyncracies of the small sample of cases. Only a survey could test this. The result on Double-loop learning is however also theoretically significant and unexpected. It could be that product and market development are more important issues for service than for manufacturing organizations. Manufacturing may also be more technically constrained with respect to introducing new product markets (manufacturing organizations must invest heavily in machinery, whereas service organizations only have to invest in people's skills and knowledge). This last statement was however not investigated here.

Most interesting were the differences between two organizations with respect to the role of MICS (Cardboard Co. and Hitec, the former is classic and the latter is lean). In both cases MICS contributed considerably to single-loop organizational learning activities. In the classic case MICS' contributions were achieved by the fact that someone took responsibility for creating knowledge with MICS (responsibility norms) and also had the power to implement their insights (action norms). In the Hitec case responsibilities were clear in the organization, but what was more important was that MICS was considered an essential element in the company's TQM philosophy. This is a verification of our statements that learning norms should be linked with learning needs. The Cardboard Co. case had very low learning needs, thus no explicit policy norms were defined, and MICS existed to perform administrative routines. In the Hitec-case the high learning needs demanded an explicit learning policy and procudural norms of which MICS was an essential ingredient. This means that the design of effective MICS requires, in analogy to the principles of socio-technical design (Mumford, 1983), the assessment of learning needs and the corresponding learning norms, and also the assessment of learning processes and the procedural learning norms (included MICS) to support them.

8.10 *What is the Influence of MICS on Organizational Learning?*

Organizational learning includes three very different processes with different impacts of MICS: single-loop, double-loop and deutero learning, the third not the subject of this but of a new study[36]. To assess the value of MICS for organizational learning, we need to understand these two learning processes (Con 2, 3 and 4). Finally, we assumed that the effectiveness of learning can be not only the result of MICS, but also of the learning norms (Con 7).

[36]This study is titled 'Information Systems to Enable Organizational Learning' and is being conducted by Marc C.P. Hafkamp.

Hypothesis	Case 1: Cardboard	Case 2: Bank	Case 3: Chemical	Case 4: Health Co	Case 5: Hitec
1. Learning needs determine the learning norms required for survival (Con 4).	True but what learning needs require what learning norms?	True, but requiring learning profile		True. Reactions to needs are dependent on power relations, sharing learning resources, and organizational size	
2. Lean norms emphasize the critical evaluation and problem anticipation roles of MICS, whereas classic norms emphasize the problem anticipation and accounting roles of MICS (S 14)	False, MICS supports both roles in this classic case. Chemical also has a technically lean MICS.			True, but no social integration of both roles.	True, and social integration of both roles.
3. MICS improves single-loop and inhibits double loop learning efforts (Con 6).	True for SLL, false for DLL (no impact on DLL)	True for SLL, false for DLL (MICS has positive impact on DLL)	False, MICS' impact is mediated via mental model (S17-S22)	False, incompatible mental models inhibit DLL actions (S23)	False, responsibility norms can inhibit DLL (S24-27; Con 8)
4. Depending on the Learning Norms, MICS increases or decreases complexity and dynamics (Con 7).	True	True	True	True	True

Table 9.4: Table for Cross-Comparative Evaluation of Conclusions.

Our opinion about Con 4 evolved during the project. After case 1, we felt that the conclusion was not concrete enough, because no answer could be given about the question which learning norms are required given a certain extent of learning needs. Therefore we started by describing learning profiles for each case. This resulted in table 9.2, which prescribes certain learning norms for each learning need level. Table 9.2 only offers hypotheses. We were however not able to test the quality of these ideas yet, because no scores for 'survival chance' were defined. As a next step in this subject, the researcher should also check the influence of interpersonal relations, abilities of sharing learning resources, and the size of the organization on the required learning norms profile.

Statement 14 is correct in the two lean cases, but in the classic cases MICS also had critical evaluation and problem anticipation roles. The most important difference between lean and classic MICS is therefore not so much in their roles, but in how the MICS (as formalized procedural norms) are linked with the other organizational learning norms. Especially important here are the policy norms (that state the importance of MICS explicitly and create an infrastructure), the action norms (how is behavior changed as a consequence of conclusions drawn from data-analysis), the responsibility norms (who takes responsibility for the quality of data and its analysis) and other procedural norms (the way the insights are communicated and discussed). More specifically we found that lean organizations have a more developed social aspect of MICS. In particular we found that these organizations have an intergrated network of problem anticipation and critical evaluation, which is not available in the classic organizations.

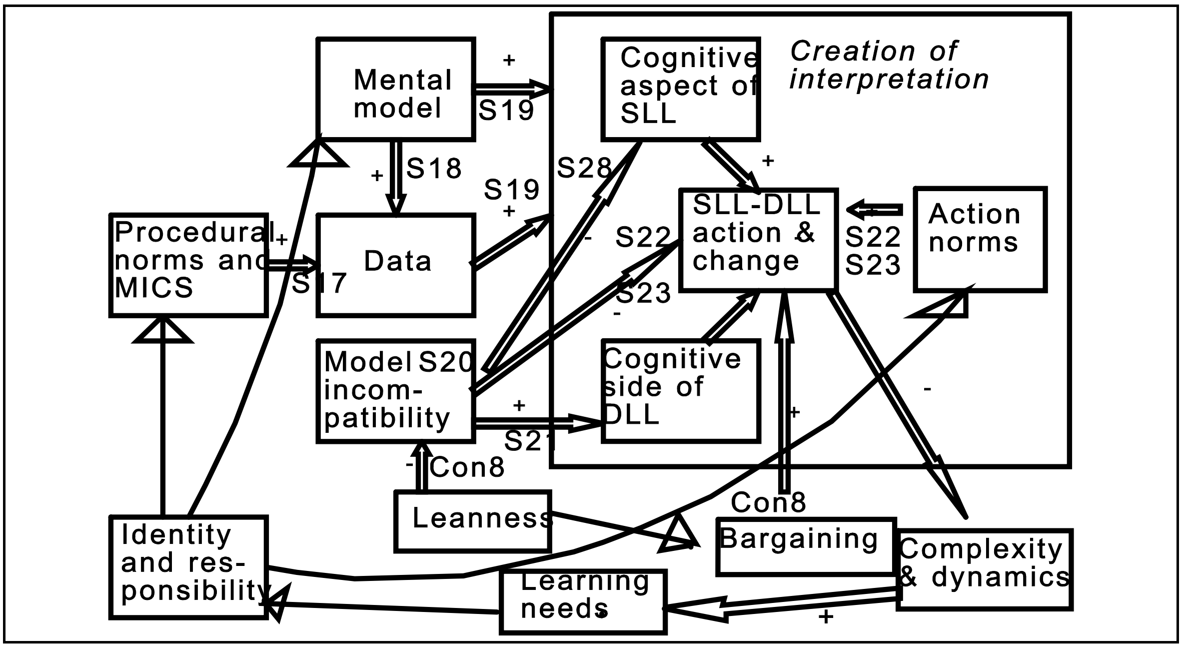
In the first two cases we found that Con 6 was correct with respect to SLL. The impact of MICS on DLL was not clear (in one case positive, and in another no impact was found at all). I concluded that MICS does not have much impact when the learning norms are not appropriate (cf. Markus' interaction paradigm, 1983). MICS facilitates learning by providing data, but these can only be interpreted via mental models. When organization members have *incompatible mental models*, the learning situation *can* become political and disruptive. Information systems can then only be supportive when they aid in discussion and negotiation. This type of system is called *semi-confusing* (Hedberg and Jönsson, 1978). These insights considerably influence our understanding of the relation between MICS and single-loop and double-loop learning, and are summarized in the following paragraph.

MICS is a provider of data. The better MICS is, the more relevant are data at any time and place (S17). The type of data that are available from a MICS depend on a mental model. This model has semantic implications which are incorporated into the structure of the information system (S18). The availability of data and (a) mental model(s) are a prerequisite for an interpretation of reality (S19). In organizations people or groups of people can share models, but also can have unconnected and even incompatible mental models (S20). When, in interpretation processes (the cognitive part of the learning processes), incompatible mental models are applied (as in the Cardboard case), the result is an increased double-loop learning effort, if people are not trying to avoid the problems involved (S21). This leads to the folowing new statement: *When shared mental models are used, this leads to more effective single-loop learning processes (even with the same amount of SLL-effort)* (S28). When, in interpretation processes, shared (compatible) mental models are applied, the interpretation process will be followed by actions (the behavioral part of organizational learning), if people are motivated (action norms) to take these actions (S22). The greater the model incompatibility, the more action norms exist inhibiting behavioral learning. The more compatible the mental models, the better the action norms lead to quick implementation of new theories and insights (S23).

Conclusion 8 now can be drawn, based on S24, S25, S26 and S27,:

Lean organizations have very effective theory implementation processes without having implementors involved in the theory development and adaptation. Classic MBs require responsibility norms that have implementors involved in the development and adaptation process.

This results in model 9.1.



The insights of model 9.1 enable us to predict MICS-impact in different settings, and use this knowledge to design an effective MICS as a socio-technical accomplishment. The model is formed on the basis of insights gained in MBs, but is applicable to all organizations, because the variables involved can be observed in all other organizations. This means, in Glaser and Strauss' terms, that the 'substantive' theory has become 'formal' (cf. chapter 3.2.2 and 3.5). Subsequent research should find out the validity of this formal theory, by testing it with evidence from other organization types. The theory is however limited to MICS systems.

8.11 *How Can One Observe the Impact of MICS?*

The diagnosticum in the cases, if effective, may in the future be applied to practical business problems. The scales used thus far could be improved by evaluating the construct validity and reliability. The ratings as used thusfar are briefly evaluated here.

The learning needs score (var 1):

- This score was originally based on Duncan and Weiss' measures. These were however too elaborate to use here. Mostly, the cases were subjectively rated. Duncan's factors and dimensions are useful, but scoring via this scale was found to be very laborious and complex. It is therefore important to develop a shorter checklist for learning needs and to decide about how the observations can be combined into a single score.
- The statement that dynamics contributes more to learning needs than complexity (an essential assumption for the learning needs scale) seems to be true.

MB-type (var. 2)

The score of this variable was based on an index of leanness and a transformation. The ratings of leanness and transformation were in some cases ambiguous, because most cases did not score neatly along the extremes of the scales, and in some cases the organizations scored on both extremes for the same item. For instance Health Co., although scoring high on the service extremes of the transformation scale, also scored high on the manufacturing extremes of this same scale, because it was an industrialized service company. A solution to this 'problem' might be to regard these scales as multi-dimensional. It would be useful to find out if a factor analysis also finds evidence for correlations among the dimensions. This is however useless without a rather large statistical sample. If these correlations are strong, the items could also be reformulated.

Learning Norms (var. 3)
Factor 1: Identity and Policy norms.
The items mentioned gave a quite complete picture of the identity and policy norms. This factor however has some ambiguity because it is sometimes not clear whether the items refer to ideas and wishes or whether the items must refer to about actual organizational behavior. This problem is typically relevant for the 'policy and mission' item. For instance the Chemical Plant has an explicit statement of its learning intentions, formulated in its charter. In practice however not much learning was going on there. On the other hand, Health Co.'s management stated that it did not like to make statements about organizational learning, though in practice it did quite a lot to improve the organization's learning. When improving the ratings this problem should be sorted out.
Factor 2: Learning responsibilities.
The distinction between standing and change organization is important. Some problems are:

- If an organization scores on functional *and* divisional responsibilities it does not score automatically on matrix. To score on 'matrix', it is also required to assess the organizations abilities in handling the complexities of the matrix structure.
- We found that task groups were difficult to observe in classic organizations, where they were more or less secret groups formed by a few top members. In lean organizations they are better known and overt, making them more easily observable. This was very clearly the case in The Bank and Cardboard Co. where much strategic thinking was done at the top, without people at the Branch and Plant knowing what kind of strategic projects were under way. In Hitec however, people on the shop floor were knowledgeable about strategic plans. For instance they knew that the top management was considering whether to close the Plant, sell it, or invest in new technology.

Factor 3: Action norms.
To observe this factor, people should be interviewed using a quite long questionnaire that unfortunately is also quite complex. Therefore our ratings were reduced and based on some indications of incentives, interpersonal trust, attitude about knowledge removal, and source of knowledge.
Factor 4: Procedural norms.
No specific comments.

MICS (var. 4).
The semiotic approach in describing MICS was extremely useful. In many cases the technical and organizational issues could be traced as causes of problems in the learning process. This approach is also consistent with our view of MICS as a socio-technical system. This information audit method also requires contributions from the area of other information systems, which are important from an organizational learning perspective. Of special interest are Executive Information Systems because of the role of vertical communications in learning (Adelman, 1992; McAuliffe and Shamlin, 1992; Boone, 1991), Computer Support for Collaborative Work because of the role of lateral communications (and possibly inter-organizational communications as well) (Greiff et al., 1988; Kraemer and Kling, 1988; Stamper et al., 1991) and knowledge-based systems because of elicitation of tacit knowledge, storage and re-use of knowledge (Coats, 1991; Venugopal and Baets, 1994). Most interesting are non-computer-based information systems (i.e. informal communications, defined in procedural and other learning norms) because these contribute at least as much to organizational learning than computer-based information systems do. This was clearly seen in the Cardboard Co. case, where a specific computer system, successful in one location, failed in another location because of these learning norms. The very broad systems of The Bank

were only of limited learning value because of the lack of well-designed procedural and action norms. Learning in that case was almost completely based on the informal system. The Hitec case showed that the advanced information systems for quality control were successful because this system was well connected to the company's philosophy (identity and policy norms). The analysis of informal systems is however still at an early stage. Some consultancy companies are now trying to develop this as a service under the headings of communication audit. This is a valuable approach. Stamper's MEASUR methods might be particularly interesting to apply here (Stamper et al., 1994).

Single-loop learning effort (var. 5).
SLL-effort was rated by counting the scores (1 or 0) on the intersections of learning activities and learning fields. This means that no scoring was made of the amount on SLL-effort in more precise terms terms such as the amount of money invested, hours that are spent, or the number of people involved in learning. The reason for not doing this was that it would have taken an enormous amount of research effort, and that the resulting data would not have been clearly interpretable. For instance what would it mean if an organizations states that it spends 1 million dollars and 1000 hours a year on learning? The only way to make these data interpretable is to relate them to other data, via the definition of ratios, that can be compared to the ratios of other companies or to what is theoretically a maximum score. This will be explored in a further study.

Double-loop learning effort. (var. 6)
The reflections about SLL-effort scoring also are applicable to the DLL-scale. Some additional problems with the DLL-scale are further discussed here. In the theory, only two activities of DLL were mentioned (development and unlearning). But the cases revealed more activities. In some, for instance, we found that well-formulated learning norms existed, but that in practice no concrete activities resulted. This theory-action problem (or cognition-behavior problem) was very clear in The Bank case, were management was trying hard to develop a leaner and learning organization, but were still in a turnaround situation. The same was true in the Health Co., where management preached leanness and total quality management, but where, according to our observations, still a lot had to be done to make Health Co. comparable to the ideal lean situation. Both cases indicate that theory development and unlearning are not the only activities of DLL. The implementation of new insights is also most important. One could argue that implementation is part of unlearning (removing resistance to change), but it is also a separate activity (training people in new ways of thinking, advocating and boadcasting new ideas etc.).

MICS' role (var. 7)
In this study, the scoring of MICS' role in the learning activities of the learning fields concerned only knowledge adaptation in the related learning fields. This led to a simple variable with two values: problem anticipation role versus critical evaluation role. All the cases showed MICS in both roles. Additionally we observed whether the problem anticipation and critical evaluation activities were explicitly connected (for instance, by invoking the same people, or by explicit procedural or action norms), because these links create closed learning loops which are important for single-loop learning and double-loop learning. MICS' role can be summarized as follows:

- MICS has no explicit roles in DLL besides providing data, which can be operationalized by asking if MICS' data provide incentives to DLL.
- When MICS has problem anticipation and critical evaluation roles, it automatically supports the (re-)use activities. This is because problem anticipation requires the application of existing models and data, and critical evaluation is only effective when reference data and standards (developed in the past) can be used.
- In order to realize its problem anticipation, accounting, and critical evaluation roles, MICS must store data and parts of a management theory, because critical evaluation and probem anticipation are based on these.

- Data dissemination must be solved less as a technical problem (but see Health Co.), and more as a problem of procedural and responsibility norms.

For these arguments, the two-value variable we applied is an invalid operationalization of MICS' roles. MICS' roles are better operationalized in three values: problem anticipation, critical evaluation and procedural links between problem anticipation and critical evaluation. In MICS design processes, it might be more useful to look at all SLL- and DLL-activities separately, because MICS then is expected to support different learning activities.

MICS' Value (var. 8)
MICS' value was scored by counting the scores on the intersections of the learning activities and learning fields with SLL and DLL. The only values that were allowed on the intersecting cells were +1 (supporting learning), 0 (no impact) and -1 (inhibiting learning). This is because as yet we lack more detailed measures. Another limitation of the variable is the operationalization of the DLL-value. We have not scored 'implementation' separately, because DLL was not operationalized on this activity. The MICS' value for SLL seems to be useful and practical and does not need additional comments.

8.12 *Proposal for a Learning Audit*

A learning audit requires a frame of reference for selecting issues to investigate and instruments for observation. Additionally, the auditor might adopt a prescribed method. This study's theory can be used as a frame of reference with the operationalized variables. This section deals with a possible audit method.

8.12.1 Frame of Reference

Learning audits should reveal significant problems and make recommendations about improvements. The theory is important as a guide to observation. It also gives criteria for what is going right or wrong.
This study emphasized contingency factors (called learning needs) for explaining effective organizational learning and information systems' effectiveness. Deutero learning is the process by which the information about these contingencies is used in developing skills, structures, policies and instruments for SLL and DLL. So by defining the organizational learning needs we can detect a mismatch between needs and learning abilities (norms, efforts and MICS) and suggest improvements. If this discrepancy is very large, an organization must go through several stages to evolve the required abilities. Additionally, if stages of learning can be defined, organizations can also be prescribed how to develop learning abilities.
In this study we have found four learning profiles, consisting of sets of learning norms that match with certain levels of learning needs (defined as an index of complexity and dynamics). In this section we will describe these profiles, and add the learning efforts to enable a complete evaluation of SLL, DLL and their learning norms. This leads to four stages of organizational learning. Consistent with organizational growth theories (e.g. Greiner, 1972; Quinn and Cameron, 1983) an additional stage is added in which learning is still at a beginning (birth) stage.
Stage 1: Fighting the moras. This first stage as yet has no procedures or policy concern for organization learning, and we find no allocation of organizational resources to learning. This can happen in at least two types of organizations:

- Organizations in their infancy, when it is too early to have developed procedures for organizational learning. They are preoccupied mainly with survival. If this period lasts too long, they will be beaten by organizations that are learning to acquire more efficiency and competitiveness.
- Organizations in a hyper-dynamic and complex environment. In this case anything learned

will be obsolete before it can be applied (Hedberg, 1981). At this stage an organization cannot even define the knowledge needed, and when it is acquired, applying it would endanger service and products. This is typically the case in organizations which must deliver unique services rapidly (e.g. police and hospitals).

Stage 2: Bureaucratic learning. At this stage learning needs are recognized and met by learning norms consisting of procedures and rules. This may be done provided that the environment is analyzable and not too dynamic, the typical environment of the classic machine bureaucracy. This situation can lead to efficient learning, but not without danger:

- The shop floor can easily feel alienated from a formal and centralized learning process (organized in Research & Development, Management, Technostructure etc.) as they are trained uncritically to obey commands.
- This easily leads to an under-utilization of human potential, which after a while is not able to do more than obey.
- Although a lot of learning can best be done on the shop floor, where a close connection between thinking and doing can be established, it will however not happen because these organizations have no learning responsibility for shop floor people.
- Creating major changes is extremely difficult because of a lack of understanding on the shop floor. At the same time, problems are incompletely comprehended at the top because no knowledge goes bottom-up. A lot of senior management courage and effort are required to achieve changes, a process which may take many years.

The organization in this stage corresponds with the profile mentioned in the simple-stable situation and is typical of the classic MB. It only learns in the transformation field. When looking at the priorities among learning activities, most priority will be given to knowledge storage (archiving). The second priority is the adaptation of existing rules and the dissemination of these adaptations via formal letters. Hopefully this knowledge is also (re-)used. The lowest priorities are given to theory development and unlearning, thus resulting in very inert organizations.

Stage 3: Expert learning. At this stage management regards knowledge as a strategic asset. It allocates budgets to specialist groups to develop the very complex new knowledge required. Organizational learning therefore is institutionalized learning. Research & Development departments and project groups are created. After the development activities most emphasis is placed on storing and adapting the findings, considered to be of strategic value and kept secret or patented. This is appropriate in environments of high complexity and low dynamics, but also can lead to serious problems. The dissemination of the findings is often a neglected topic, leading to under-utilizations of knowledge (Hamel and Prahalad, 1990). A critical success factor in these cases is not only the creation of knowledge and skills, but especially the communication of findings and the speed at which these findings can be implemented as new products, production processes and services. Almost no emphasis is placed on the implementation of the new ideas in the area of human resources and marketing, which is the major reason for the failures of the great new ideas (Hamel and Prahalad, 1990).

Stage 4: Dispersed learning. To solve the many communication problems in organizational learning typical of stage 3, some organizations allow strong decentralization (vertical and horizontal) to encourage learning in all corners of the organization. The guiding principles for learning are in this case:

- Support creativity and critical thinking.
- Allow experimentation.
- Encourage democratic relations among organization members.
- Create strong commitments to the organization via indoctrination and reward systems.
- Give priority to innovation in relation to costs.

An excellent example of such an organization is documented by Leonard-Barton (1992) in her study of Chaparral Steel. The strong point of this learning configuration is the enormous amount of energy that is freed from organization members, encouraging learning everywhere in the organization. The most detailed problems are taken up by someone for analysis, improvement, and/or innovation (people are allowed to create a group or project to think about possible new products, even when in the initial stage the ideas might seem stupid).

Dispersed organizational learning is very strong in the adaptation of existing work procedures, especially because the improvements are created by the people who must use them. The findings are disseminated well in the organization, and picked up by people who have the knowledge and skills to develop more profound innovations. A relatively weak point in this organization type is the way how improvements and insights are stored. The human factor (individuals' memories, culture, stories, myths and beliefs) are vital organizational memories here. On the other hand, however, unlearning is accepted more than sticking to old experiences and insights. This type of organization learns on the fields of transformation (especially quality), and human resources (by appealing to people's interest in growth and personal curiosity).

The organization corresponding to this stage has high dynamics and low complexity, and is sometimes called a 'learning lab' (Leonard-Barton, 1992). The basic problem with this type of organizational learning is the allocation of limited learning resources and stopping projects. The learning activities can become so popular that they could go out of control. Another problem is that the amount of communication required, though possibly less than in the case where learning is organized via hierarchical procedures, will generate problems of too much decentralization (high coordination costs and agency problems. (Galbraith, 1973; Douma and Schreuder 1991).

Stage 5: Middle-Up-Down Management. This is a stage in which dispersed learning is guided by business ideas, which are made more concrete by middle management functions that facilitate the learning process. The following statements are typical of this stage of learning:

- Management gives direction about learning priorities via its strategic view of core competencies.
- Management becomes receptive to ideas flowing upward, connecting them with their own priorities and insights.
- Middle management makes general ideas about learning concrete by formulating budgets, organizing work (especially the relation between on-going work and change work) and other resources such as learning infrastructures (computers, archives, communication networks etc.).
- Top management lays down a policy about the importance of learning and how learning should be supported.
- A major issue is that learning does not occur within the confines of a separate organizational unit, but is close to the everyday work process and includes awareness of its effects on other organizational departments and work groups.

In this organization type, top managers that have brilliant and appealing visions (theory development) are important, but even more important are the middle managers that can bring these visions to ground level (adaptation). This also requires strong communication and indoctrination processes as a coordination instrument (Mintzberg's 'missionary form'), so that learning is better organized than in the dispersed type. As a result of this communication process people must feel committed to using and re-using the gained insights, although more emphasis is given to the first than the second because of the high demands of innovation. This learning type (originating from Ikujiro Nonaka Honda Company experiences, 1988) serves an environment of high learning needs (high dynamics and high complexity).

The *stages* mentioned describe levels of learning norms, and *must themselves be learned*. It is not likely that an organization that has not yet reached stage 2 (the bureaucratic procedures that are minimally required to stay in business) could be ready for stage 3 (expert learning), because expert learning requires an administration that can be counted on. Stage 4 is mostly a reaction to the limitation of the expert learning experiences, when organizational dynamics increase. At stage 5, management realizes the essential importance of managing the learning process, not only for keeping the process within the confines of budgets, but also for linking the efforts with strategic demands.

The single-loop and double-loop learning efforts have costs involved that are valued differently in

the different learning stages. The first stage sees learning as not relevant yet and therefore evaluates learning efforts as costs that should be omitted. The second stage sees learning as an improvement of administration and operational management. At the third stage, learning is initiated by the management, and thus management costs. The fourth stage has learning implemented in its on-going operational processes. The costs thus are embedded in operations, and impossible to administer separately from these. The fifth stage regards learning as vital for the organization's mission, because it is initiated by top management and requires the involvement of all organization members.
When a limited budget exists for learning, priorities will be shared out differently at the different stages. These priorities are summarized in table 9.3.

	Stage 1	Stage 2	Stage 3	Stage 4	Stage 5
Cost view	Must be omitted	Administrative & operational management costs	Management costs	Embedded in operations	Mission critical
Theory Development	6	2	6	3	5
Unlearning/ Removal	1	1	1	2	2
Adaptation	2	5	4	6	6
Dissemination	4	4	3	4	4
Storage	5	6	5	1	1
Re-use	3	3	2	5	3
Total spending points on activities	21	21	21	21	21
Learning fied	none	Transformation	Trans-formation Product Market	Transformation Product Human resource	Transformation Product Human resource Market

Table 9.5: Stages of Organizational Learning and Ranking of Priorities for Learning Activities and Learning Fields

8.12.2 Learning Audit

The audit could follow the steps used in the cases, starting with a general focus and then narrowing to SLL, DLL and finally MICS' role and value.
The aim however should not only be to gain quick and valid scores but also reliable insights to help the client understand his problems, and find a course of action. Well-designed presentation tools can help support discussions and the development of an opinion. Our empirical work suggests that the existing tables about the learning norms (table 9.2 and the tables in chapter 7) are well designed for presenting major distinctions. The tables about learning effort and the learning value of MICS could however better be split into a table for SLL and a table for DLL, to make clear that they are very different types of learning (see tables 9.6 and 7.7).

SLL-fields: SLL-activities↓	Human Resource	Process	Market	Product
Adaptation				
Storage				

Dissemination				
(Re-)use				

Table 9.6: SLL-Assessment Sheet

DLL-fields: DLL-activities↓	Human Resources	Process	Market	Product
Development				
Unlearning				

Table 9.7: DLL-Assessement Sheet

Each cell can be discussed separately to aid the systematic discovery of opportunities to improve organizational learning activities and to detect and solve problems with MICS, or other information systems. Finding which combinations of activities and fields appear in the organization can reveal learning limitations. The application of these tables however must be done in the broader context of the organization's learning needs and the related learning norms and learning efforts.

8.13 *Limitations of this Study*

This study has a number of limitations. As with every project with a deadline, choices had to be made. For instance I decided to operationalize single-loop and double-loop learning processes but not deutero learning processes. Statements were formulated about the link between learning needs and learning norms, but no description is made of how organizations can organize the deutero learning process themselves, and thus assess learning needs and norms.

Another limitation is related to the implicit rationalist approach to reality that is adopted here, which implies that people, by understanding organizations and their problems, will find better (transformation) technologies. The technology involved should imply a scientifically correct relation (management theory) between the goals and the most effective and efficient means. This optimistic view has been challenged by writers such as H.A. Simon (1976) emphasizing people's *bounded rationality*. Organizations have many ways of coping with these human limitations, and accomplish very complex tasks by such devices as division of labor, use of standard operating procedures, use of decision premisses (task goals and constraints), which can be effective when the organizational environment can be analyzed. When the environment is difficult to analyze, it is difficult to find an optimal organization or information systems design. In that case the rationalist paradigm reveals its limitations. Consequently, Cohen, March and Olsen (1972) developed a so-called 'garbage-can' model, that states that decisions are not made via a rational selection from several alternatives, but emerge from the interactions among more or less independent streams: a stream of problems (with dates of first appearance of the problems, energy required for finding solutions, and a list of decisions), a stream of choices (containing decision moments, agendas, and participants), a stream of decisions, and a stream of participation energy per participant. This model explains that solutions for problems in organizations depend on the moment the problems were recognized, the energy participants put into solving them, and group structure and task division. In this unanalyzable situation knowledge about the right solutions is not a critical issue. In principle, someone with the least knowledge about a subject could become the most important decision-maker, when he has the power gained via his position, or by putting more energy into the decision-making process than the others. Information systems could help to identify problems more quickly, after which the priority on the decision-making agenda becomes a problem and a part of the garbage-can. This model gives an insight into the limitations of organizational rationality and learning. It is however only valid in cases of unanalyzable environments. When the environments are analyzable, the best learning organization will be most effective. It seems as if lean production organizations have solved many limitations of learning. Competitors then have no other choice than to improve their learning ability as well.

A third limitation of this study is its restriction to the organizational level of analysis. Many improvements in organizational rationality imply the adoption of new production technologies, especially automation of manufacturing and services. This process of impovement is not limited to within the gates of the factory, but increasingly involves improvement along the external value chains as well. Some examples are the demands for better supplies of materials by applying ISO 9000 standards (cf. case of Cardboard Co. and its adhesive paper supply). Another example is the trend to outsource the activities of a company (e.g. its administration) that are considered not to belong to its core business. This *outsourcing* process is not limited to national borders, but often involves the search for optimal physical and socio-political environments for production and service anywhere in the world. Famous examples are the outsourcing of computer programming by European software houses to India, where many skillful programmers are available for low wages. Other examples are the establishment of West European manufacturing plants in developing countries. The problems of coordination that limited these opportunities in the past are nowadays solved via telecommunications means. The consequences of these trends are large, because (western) countries must now rethink their economic function in the world.

A fourth limitation concerns about the conceptualization of learning needs. It was decided to score learning needs in terms of organizational uncertainty (complexity and dynamics) following Duncan and Weiss (1979). This scale does not rate individual learning needs nor did it rate specific problems or problem classes and their urgency of solution. Individual learning needs were excluded because this study is about *organizational* learning. Organizational learning can also be approached by studying problem classes and how organizations could manage them (Etheredge, 1980 and Mason and Mitroff, 1973). The only reason why this was not done is that learning about problem classes, for an unknown reason, is not a main issue in the tradition of organizational learning and information systems.

This study also clarifies the need for further research in many areas. Some of these needs are listed below.

- Chapter 6 proposed that dynamics and complexity have a different impact on the value of knowledge. This proposition needs further empirical research, because it could shed light on the value of organizational knowledge and organizational memory stores. In such a study also criteria for investments in different organizational memories could be developed.
- The scales and indexes we developed are only a beginning for further research, which should be more codified, to support surveys on the issues of organizational learning. It would be particularly interesting to develop a measure for organizational learning effectiveness. This requires the development of a scale that measures learning effort and learning needs. The match between needs and effort could be an indicator of learning effectiveness. In a survey, measures could be tested for their validity and reliability, and it could clarify the quality of organizational learning in the research population.
- Deutero learning was not studied. Rather then describing learning processes (many researchers have done this already under the headings of quality research, organizational change, and innovation) one could study the effectiveness of techniques being marketed at this moment (such as computer-aided systems engineering, micro-worlds, executive information systems, knowledge-based systems, case-based reasoning, learning labs).
- Research also might be fruitful in the area of novel types of information systems such as group decision support systems, electronic highways, knowledge-based systems. What are

the opportunities and limitations of these systems for organizational learning? What kinds of changes in organizations and people are required to make them profitable from an organizational learning perspective?

- Research on the method of information systems development could profit from an organizational learning perspective in two ways. First, information systems development is a learning activity, which means that the knowledge created should be stored, removed, (re-)used, maintained and disseminated. How are these activities linked with the practice of systems development, and how should this be done? Secondly, system development has often suffered from a technological determinism, for example in business re-engineering which usually fails to consider how to make business re-engineering a social activity, involving intelligent people each with their own experience and knowledge. Business re-engineering practice could thus profit considerably from applying the organization development and soft systems perspectives, by which it creates a more complete and closed learning loop, rather than by limiting itself to the scientific management and cybernetic approach.
- A final research project could concern problem classes and the types of organizational norms that are most suited to cope with these problem classes (Etheredge, 1980). Strangely enough, as far as I know, it has not led to any larger research project until now.

Researchers interested in organizational learning are very much encouraged to participate in this fascinating field.

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Index

Samenvatting (Summary in Dutch)

Vooronderstellingen bij deze studie

De afgelopen jaren is een discussie gevoerd over het belang van informatiesystemen voor ondernemingen (Earl, 1989; Strassmann, 1990). Hierbij stond meestal de vraag centraal wat informatietechnologische investeringen financieel opleveren. Deze vraag veroorzaakt verwarring, ten eerste omdat informatie-technologie een zeer ruim begrip is en ten tweede omdat voor sommige toepassingen van informatietechnologie kosten-baten berekeningen bijna onuitvoerbaar zijn. Het tweede punt is in dit onderzoek nader bestudeerd voor de zogenaamde management-informatiesystemen, in het bijzonder het type management-rapportagesystemen. Dit soort systemen is reeds veelvuldig ingevoerd in bedrijven, met vaak teleurstellende resultaten. Zij laten zich moeilijk beoordelen op kosten en baten aangezien zij niet primair de verandering van kostbare productieprocessen dienen, maar ten dienste staan van de verandering van *intellectuele* vermogens van managers. Dit laatst is moeilijk direct te relateren aan verbetering van kosten-baten verhoudingen van informatiesystemen, maar is wel essentieel voor de effectiviteit van organisaties. Vanuit deze probleemformulering is gekozen om management-informatiesystemen vanuit een *organisatorisch leerperspectief* te evalueren.

Vervolgens is na gegaan hoe deze probleemstelling geconcretiseerd kan worden. Gekozen is voor een eerste beperking van het onderzoek tot het gebied van *Prestatie-Evaluerende en Controlerende Systemen* (een type management-rapportagesysteem dat in het Engels Monitoring Information and Control System heet, en hier verder MICS wordt genoemd). De reden hiervoor is dat met name deze systemen in het verleden veel kritiek hebben gekregen van organisatie-deskundigen op grond van mogelijk negatieve effecten van deze systemen op organisatie-leerprocessen. Deze argumenten zijn echter gebaseerd op slechts summier geformuleerde theorie en empirisch nauwelijks onderzocht. Voor zover studies op dit gebied bekend zijn (Jelinek, 1979 en Lee and Guinan, 1991) wijzen de resultaten juist op een positieve bijdrage van MICS op organisatorisch leren. Deze resultaten worden echter bestreden door enkele vooraanstaande organisatiedeskundigen (o.a. Mintzberg, 1989 en Argyris, 1971).

Volgens Markus (1983) en Markus en Robey (1988) spelen organisatiecondities een essentiële rol bij het totstandkomen van positieve of negatieve impact van informatietechnologie. Het *methodologische probleem* dat zich dan voordoet is dat de grens tussen informatiesysteem en organisatie diffuus wordt, waardoor geen uitspraken meer mogelijk worden over de impact van MICS op organisaties en vice versa. De gekozen oplossing is om het begrip MICS op te vatten als een set van *formele normen* volgens welke informatie zou moeten worden opgeslagen, verspreid en veredeld. Daarnaast kennen organisaties ook informele normen waarin het MICS is ingebed, en die behalve bepalend zijn voor de effectiviteit van het MICS, tevens de leerprocessen in een organisatie vormgeven en sturen.

De organisatieliteratuur levert door de onderkenning van organisatietypen, logische combinaties van organisatienormen. Door een vergelijking van organisatietypen kan per organisatietype de invloed van MICS op leren vastgesteld worden. Bij de definitie van deze organisatietypen is gebruik gemaakt van de *configuraties* zoals door Mintzberg beschreven op basis van zijn synopsis van de organisatie-literatuur tot eind jaren zeventig. Ter vereenvoudiging van het onderzoeksontwerp is alleen gekozen voor de bestudering van de *machine bureaucratie*, een configuratie met een simpele en stabiele omgeving. Hiermee is de tweede beperking van het onderzoeksdomein gegeven. De keuze voor deze configuratie is ingegeven op grond van de volgende redenen. Ten eerste wordt de machine bureaucratie door velen beschreven als het prototype van een slecht lerende organisatie (Argyris, 1971; Senge, 1990). Bestudering van dit organisatietype moet daarom veel informatie opleveren over leerproblemen in organisaties. Ten tweede is dit organisatie-type gekozen omdat de omgevingsdynamiek en -complexiteit van deze organisaties de laatste decennia aanzienlijk is toegenomen, wat vraagt om verbetering van het organisatorische leervermogen. Hierbij kon ook aangesluiting worden gevonden bij studies over 'lean'-productie, een machine bureaucratie-type dat onder toenemende dynamiek en complexiteit is getransformeerd tot een zeer efficiënte, flexibele en hoge kwaliteit genererende organisatie (Womack e.a., 1990). De derde reden om machine bureaucratieën te bestuderen, is gelegen in het feit dat deze organisaties te groot zijn om alleen een informeel MICS te hebben, waardoor duidelijker de invloed van MICS kan worden waargenomen.

Dit onderzoek concentreert zich aldus om drie *hoofdvariabelen*: Machine Bureaucratieën, MICS en Organisatorisch leren. De eerste twee variabelen zijn reeds duidelijk beschreven in de bestaande organisatiekundige en informatiekundige literatuur. De derde variabele is echter bijzonder onduidelijk. Het was daarom noodzakelijk een uitgebreide literatuurstudie uit te voeren naar het begrip organisatorisch leren, alvorens criteria voor evaluatie van MICS te formuleren. De literatuur over organisatorisch leren heeft de gedachte van Argyris en Schön dat organisatorisch leren uit drie hoofdprocessen aanvaard. Het eerste proces noemen Argyris en Schön 'single-loop'-leren: het creëren en evalueren van feedback-informatie, met als doel om bestaande transformatieprocessen te verbeteren. Hierbij worden de basisdoelen van dat proces niet ter discussie gesteld. Het tweede leerproces wordt 'double-loop'-leren genoemd: activiteiten met als doel om de basisdoelen of assumpties van organisatorische processen te evalueren, te vervangen en te vernieuwen. Het derde leerproces, 'deutero leren', heeft als doel om de organisatorie (cultuur, managementstijl, informatiesystemen etc.) dusdanig te verbeteren dat haar *leervermogen* wordt vergroot. In deze studie is deze terminologie geaccepteerd. De onderliggende cybernetische gedachte is hiermee tevens aangenomen, met de aantekening dat organisatorisch leren plaatsvindt in een politieke en sociale context die bepalend is voor het feitelijke leergedrag en de acceptatie van haar resultaten. Tot slot is een nadere operationalisering van de begrippen gemaakt, door concrete activiteiten te benoemen. Deze zijn weergegeven in de onderstaande tabel.

Leerproces	Leeractiviteit
Deutero Leren	Creatie van identiteits- en leerbeleidsnorm
	Bepaling van leerverantwoordelijkheden
	Bepaling van actienormen
	Bepaling van procedurele normen en MICS
Double-Loop Leren	Theorie-ontwikkeling (incl. implementatie)
	Afleren
Single-Loop Leren	Kennisaanpassing
	Kennisverspreiding
	Kennisopslag
	Gebruik en hergebruik van kennis
Dimensies van Organisatorisch Leren	

Overeenkomstig de gedachte dat leren niet alleen een proces is maar ook betrekking heeft op onderwerpen waarover geleerd moet worden (Kolb, 1984), zijn de volgende *leervelden* op basis van Quinn en Rohrbaugh (1983) geïndentificeerd: transformatieprocessen, mensen, producten en markten.
Het Deutero leerproces is niet bestudeerd in deze studie. Wel is het belang onderkend van de bepaling van *organisatorische leernormen*, die bepalend zijn voor de wijze waarop Single-loop en Double-loop leerprocessen plaatsvinden. Deze leernormen dienen afgestemd te zijn op organisatorische *leerbehoeften*, welke beschreven worden in termen van een combinatie van organisatorische complexiteit en dynamiek.

Doel en aanpak van het onderzoek

Het doel van het onderzoek is het leveren van een manier waarop MICS-systemen kunnen worden beoordeeld naar hun waarde voor organisatorisch leren. Hiervoor is het noodzakelijk te beschikken over een referentiekader waarmee bepaald kan worden welke variabelen geobserveerd moeten worden, en hoe uit observaties conclusies getrokken kunnen worden. Een gevalideerd referentiekader, bestaande uit een theorie over de relatie tussen MICS, organisatorisch leren, en machine bureaucratieën, ontbreekt echter in zijn geheel in de literatuur. De onderzoeker heeft daarom zelf zo'n theorie geconstrueerd in twee stappen, namelijk: (1) Een literatuurstudie, en (2) een empirisch onderzoek gericht op het testen en verder ontwikkelen van de bevindingen uit de literatuurstudie.

De *literatuurstudie* leidt ondermeer tot het inzicht dat organisatorische normen en organisatorische leerbehoeften bepalend zijn voor de wijze van organisatorisch leren en de rol en waarde die MICS hierin heeft. Machine bureaucratieën hebben tevens een grote diversiteit aan leerbehoeften en -normen. Met name is dit verschil groot tussen 'lean'- en 'klassieke' machine bureaucratieën. Daarnaast suggereert de literatuur over service-industrieën, dat de kosten-baten verhouding van MICS in leerprocessen bij service-industrieën positiever is dan in productie-organisaties. Aldus moeten hypothesen over de relaties tussen MICS, organisatorisch leren en machine bureaucratieën, worden genuanceerd naar de variabelen 'slankheid' (leanness) en voortbrengingsproces (organizational tranformation). De inzichten uit de literatuurstudie zijn vastgelegd in *Stellingen* en *Conclusies* die gebruikt zijn om het onderzoek richting te geven. Een meer uitvoerige beschrijving van de stellingen en conclusies is gegeven in hoofdstuk 7.

Vervolgens zijn de variabelen geïdentificeerd en geoperationaliseerd. Deze variabelen zijn: Leerbehoefte van een organisatie, Organisatietype, Leernormen (beleid, verantwoordelijkheden, actienormen en procedurele normen), Beschrijving van MICS, MICS' role, MICS' waarde (voor single-loop en double-loop leren afzonderlijk) en de Leerinspanningen van een organisatie (wederom voor single-loop en double-loop apart). Deze set van variabelen vormen het waarnemingsinstrument dat is toegepast in het veldonderzoek.

In het *veldonderzoek* is de eerder genoemde diversiteit aan machine-bureaucratieën bestudeerd. Deze vier ideal-typische machine bureaucratieën zijn met elkaar vergeleken. Door de variëteit in organisaties kan tevens het MICS-effect van het organisatie-effect op organisatorisch leren worden afgezonderd. Tevens is een beperking opgelegd. Overheidsorganisaties en 'not-for-profit' organisaties (Hofstede, 1981) zijn buiten de beschouwing gelaten. Het onderzoeksontwerp lijkt aldus het meeste op een *semi-experimentele veldstudie*, aangezien slankheid en transformatieproces worden gezien als determinanten voor leerbehoeften, leernormen en MICS-gebruik en -waarde (vgl. Glaser en Strauss, 1967, analytical induction).

Beschrijving van de gevalstudies

In het aanvankelijke onderzoeksontwerp werd gepleit voor een onderzoekspopulatie bestaande uit vier machine bureaucratieën: (1) een klassiek productiebedrijf, (2) een klassiek dienstverlenend bedrijf, (3) een slank productiebedrijf, en (4) een slank dienstverlenend bedrijf. Vier bedrijven zijn benaderd die op grond van een eerste inschatting leken te voldoen aan de gestelde eisen. Gedurende de studie bleek echter dat de vermeende slanke bedrijven niet aan de eisen van een slank bedrijf voldeden. In feite was de onderzoeker misleid door uitspraken van de eerste contactpersonen

(mensen van de bedrijfsleiding), die slankheid als een ideaal beschreven dat de onderneming al zou hebben bereikt. Deze verwarring tussen ideaal en actuele toestand werd helaas pas later ontdekt. Wel bleken beide gevallen achteraf toch zeer waardevol te zijn, aangezien hierdoor stellingen te formuleren zijn over de overgang van klassiek naar slank, een leerproces in zichzelf. De onderzoeker was aldus genoodzaakt een extra gevalstudie (5) uit te voeren naar een bedrijf waarvan met meer zekerheid gezegd kon worden dat het aan de eisen van slankheid voldeed.
De resultaten per geval worden hieronder kort gegeven.

Geval 1: Een kartonfabricant (Cardboard Co. genoemd) in een stabiele en simpele omgeving (met een lage leerbehoefte).

Een plakpapierregistratiesysteem (APMS) werd in deze organisatie gebruikt in twee van haar locaties. In de ene locatie was het succes groot en in de andere locatie gering. De oorzaak van dit feit lag niet in het systeem (dat was in beide gevallen identiek), maar in het vermogen van operationele managers om de gegevens uit het systeem te interpreteren, en op grond daarvan gerichte en cumulatieve verbeteringen voor te stellen en in te voeren. Essentieel voor het vormen van voorstellen voor verbetering was kennelijk een goed begrip van hoe in de practijk met het plakpapier wordt omgegaan. In locatie 1 (het succesgeval) was de operationele manager zelf jarenlang werkzaam geweest op de werkvloer en kende de (informele) managementtheorie daardoor van binnenuit. In locatie 2 was de operationele manager administratief geschoold, en had geen ervaring in het productieproces.
Het succes van het single-loop leerproces in locatie 1 is daardoor meer te verklaren uit de wijzen waarop gegevens en kennis in actie worden omgezet (actienormen) dan uit het informatiesysteem en andere leernormen. De bijdrage van het MICS (APMS) was zeer groot bij het single-loop leren. Locatie 1 bijvoorbeeld, verminderde in twee jaar tijd het plakpapierverlies van 16% naar 8%, wat een kosten besparing van 1,4 miljoen US dollars per jaar met zich mee heeft gebracht.

Geval 2: Een commerciële Europese bank (The Bank).

Deze bank begeeft zich in een complexere omgeving dan geval 1 (veel producten en veel verschillende klanten), en de dynamiek vertoont een stijgende lijn (met name door de toename van concurrentie en verdere liberalisering van de markt). Hierdoor heeft de bank, tegen onze aanvankelijke verwachting in, een hoge leerbehoefte (score 4 op een schaal van 1 tot en met 4). De bank heeft een zeer diverse en omvangrijke verzameling van MICS-systemen. Deze systemen zijn echter onsamenhangend, gebruiksonvriendelijk en hun gegevens krijgen een geringe aandacht bij het management. Het leerproces vindt daarom minder direct via de systemen plaats, en is sterk gecentraliseerd bij het hoofdkantoor. Leren vanuit de decentrale kantoren vindt zelden plaats, en is een moeizame aangelegenheid vanwege de ingewikkelde communicatiewegen die daarvoor afgelegd dienen te worden. De ineffectiviteit van deze situatie wordt door het management onderkend, en men is nu bezig met het veranderen van de procedurele en verantwoordelijksnormen. Tegelijkertijd is een herautomatiseringsproject gestart dat moet leiden tot een betere samenhang in systemen, grotere gebruiksvriendelijkheid en de ondersteuning van laterale communicatieprocessen. Een datanetwerk is ontwikkeld om hiervoor een deel van de infrastructuur te bieden.

Deze case toont dat de leerbeleids- en identiteitsnormen reeds in overeenstemming zijn met de toegenomen leerbehoefte van de organisatie. Het belangrijkste probleem is nu het implementeren van de noodzakelijke nieuwe normen en informatiesystemen.

Geval 3: Chemisch Productiebedrijf (Chemical Plant).

Dit bedrijf kent een chemisch productieproces dat in eerste instantie complex lijkt vanwege de grote hoeveelheid productvariaties. Er bestaat echter veel routinekennis over dit proces, waardoor zich weinig onverklaarbare problemen voordoen. De markt voor deze producten is wel sterk in beweging, m.n. door de verhoogde concurrentie uit lage-lonen-landen, die ook steeds betere kwaliteit leveren, en door diverse proces-innovaties. De hoge leerbehoefte (score 3 op de 4-puntschaal) die hieruit resulteert, wordt niet opgevangen met specifieke leervermogens. De divisie, waar dit bedrijf een onderdeel van is, blijft op hoger managementniveau bepalen wat en hoeveel er wordt geproduceerd. Het bedrijf voert geen eigen beleid en wordt van omgevingsturbulenties afgeschermd. Het bestaande MICS is integraal, maar levert weinig zinvolle informatie op. Voorzover problemen worden gesignaleerd heeft de organisatie weinig middelen om deze op te lossen vanwege de conflictueuse aard van de diverse managementtheorieën die door verschillende belanghebbenden (m.n. verkoop versus logistiek en productie) worden aangehangen (dit verschijnsel wordt *model-incompatibiliteit* genoemd). De ploegenchefs worden geconfronteerd met deze tegenstrijdigheden, maar hebben niet het vermogen om ze te overbruggen op het operationele niveau.

Concluderend kan men stellen dat het rendement van MICS nihil is, en alleen kan worden vergroot door de ontwikkeling van een nieuwe integrale managementtheorie die door alle betrokkenen kan worden gedeeld. Dit double-loop leerproces moet nog aanvangen.

Geval 4: Zorgverzekeraar Health Co.

De Europese zorgverzekeringsindustrie is sterk in ontwikkeling als gevolg van bezuinigingen in de gezondheidssector, vernieuwingen in de gezondheidszorgindustrie (nieuwe specialismen en nieuwe producten), vergroting van het internationale karakter van gezondheidszorg en verzekeringen, en procesvernieuwingen (o.a. door herontwerp van bedrijfsprocessen en door toepassingen van informatietechnologie). Health Co heeft een leerscore van 3. Het bedrijf bestaat sinds de dertiger jaren, en heeft eind jaren tachtig een grondige verjonging ondergaan. De managementtheorie is sinds die tijd veranderd door dat de focus is verschoven van routine-afhandeling naar differentiatie in diensten en kostenreductie. Een van de elementen in de nieuwe managementtheorie is het MICS dat bij Health Co de prestaties van medewerkers tot op detail meet. De hoeveelheid gegevens die zo verkregen wordt, is bijzonder groot en Health Co komt er niet aan toe om ze goed te analyseren. Essentieel is daarom een vergroting van de informatieverwerkingscapaciteit van het MICS. De huidige handmatige werkwijze is te kostbaar en biedt onvoldoende meerwaarde voor het leerproces.

Geval 5: Een slanke electronische apparaten-producent (Hitec).

Hitec is een electronische apparaten-producent, en een onderdeel van een divisie van een Amerikaanse multinational. De markt waarin dit bedrijf opereert wordt gekenmerkt door korte levenscycli van producten, en bijzonder belangrijke procesinnovaties (o.a. invoering van robots, nieuwe soldeertechnieken en flexibele productiesystemen). De leerbehoefte van dit bedrijf is reeds vanaf het begin van de jaren tachtig zeer groot. Midden jaren tachtig werd het bedrijf met sluiting bedreigd. Het topmanagement van de divisie heeft vervolgens het bedrijf de kans gegeven om in afgeslankte vorm verder te gaan, en een nieuwe managementtheorie in te voeren, gebaseerd op principes van Integrale Kwaliteitszorg en kenmerken van slanke organisaties. De nieuwe leernormen zijn met succes ingevoerd. Het MICS heeft een belangrijke rol in het overzien van de kwaliteit in het productieproces, en het genereren van kwantitatieve en kwalitatieve feedback aan werknemers. Eveneens wordt feedback van klanten systematisch verzameld en geanalyseerd. Ook hierin heeft MICS een belangrijke rol. Het single-loop leerproces kan daarom geschetst worden als tot-in-de-puntjes georganiseerd en uiterst perfect. Het double-loop leerpoces is echter sterk beperkt vanwege de geringe bevoegdheden die het locale management hierin heeft. Het divisionele management is ook niet van plan in deze verdeling van leer-verantwoordelijkheden verandering aan te brengen.

Onderzoeksvragen en antwoorden

1. Wat zijn de basisdimensies van organisatorisch leren? Deze vraag eist verheldering van het begrip organisatorisch leren. Hierbij is expliciet niet een psychologische invalshoek gekozen, maar is gekozen voor benaderingen uit de organisatie-analyse, namelijk: Cybernetica, Organisatie-Ontwikkeling, 'Soft Systems' Analyse, en Wetenschappelijk Management. Deze benaderingen vullen elkaar aan op epistemologisch en ontologisch vlak. Het resultaat bestaat uit zes leeractiviteiten voor Single-loop en Double-loop leren, en de beschrijving van vier leernormen die deze leerprocessen aansturen en het resultaat zijn van Deutero-leren.
2. Hoe leren machine bureaucratieën? De resultaten van de veldstudies tonen dat machine bureaucratieën zeer verschillend leren afhankelijk van hun leernormen.
3. Leren slanke en klassieke machine bureaucratieën significant verschillend? Deze vraag poogt te doorgronden of de organisatorische leernormen waarin beide organisatietypen verschillen, bepalend zijn voor de aard en wijze van gebruik van MICS in leerprocessen. Hoewel slechts één sterk slanke organisatie is

onderzocht, bleek dat deze toch heel anders leert dan de klassieke machine bureaucratie. De slanke organisatie heeft een totaal-leervermogen ontwikkeld (middle-up-down). De drijvende kracht achter het leren in zo'n organisatie zijn de policy en identity norms. In de klassieke organisaties wordt leren meestal gedelegeerd aan specialisten en staat vaak los van alledaagse werkprocessen. Enkele organisaties toonden een overgangstrend, waardoor een aantal *leerstadia* konden worden beschreven. De volgende leerstadia kan een organisatie ondergaan in het leersproces: Gevecht tegen de Chaos, Bureaucratisch Leren, Expert Leren, Verspreid Leren en tot slot Totaal Leren. Deze indeling wordt geschouwd als een aantal fasen in een deutero leerproces. Bij iedere fase behoren andere leernormen.

4. Wat is de invloed van MICS op organisatorisch leren in de machine bureaucratische context? De invloed van MICS op organisatorisch leren staat sterk onder invloed van de managementtheorie die wordt gebruikt en de bestaande leernomen. De managementtheorie vormt enerzijds een kader waaruit de objecten voor gegevensverzamelingen en -verwerkingen zijn afgeleid. Anderzijds zijn de managementtheorieën een referentiekader waardoor de gegevens betekenis kunnen krijgen. In de meeste gevallen vormen de objecten voor MICS slechts een beperkte afbeelding van de totale (impliciete) managementtheorie. De niet afgebeelde elementen (tacit knowledge genoemd) zijn evenwel net zo belangrijk voor de interpretatie van andere informatiebronnen (Hedlund, 1994). Belangrijker is echter de bevinding dat managementtheorieën niet altijd door iedereen gedeeld worden, en dat managementtheorieën een incompatibele relatie tot elkaar kunnen hebben. Dit doet zich met name voor in de klassieke machine bureaucratieën, waar verschillende afdelingen verschillende theorieën hanteren, en elkaar soms niet begrijpen en zodoende niet tot een synthese kunnen komen. MICS wordt dan alleen gebruikt voor single-loop leerprocessen binnen de normen en het kader van de afzonderlijke afdeling (suboptimalisatie), of als een wapen voor de politieke strijd met andere organisatie-onderdelen (dialectisch gebruik). Binnen slanke organisaties wordt minder nadruk gelegd op afdelingsverantwoordelijkheden, en bestaat er een duidelijke bedrijfsfilosofie, die door iedereen wordt geaccepteerd (shared mental model). Hierdoor heeft het MICS de mogelijkheid om fundamentele organisatieproblemen te detecteren en als communicatiemiddel te fungeren tussen afdelingen. Indien belangentegenstellingen zich voordoen, wordt binnen de filosofie naar een gezamenlijke oplossing gezocht. De resultaten van deze tweede benadering komen niet alleen op het cognitieve vlak tot uitdrukking, maar ook in een betere acceptatie en implementatie van nieuwe inzichten, waardoor de kloof tussen theorie en practijk aanzienlijk kleiner is.
5. Hoe kan men de impact van MICS in de machine bureaucratische omgeving bepalen? Hiervoor zijn twee meetinstrumenten ontwikkeld, één voor Single-

loop leren en één voor Double-loop leren, waarbij de scores worden bepaald door scores op de snijpunten van de dimensies leeractiviteiten en leervelden. Indien leren plaatsvindt op een cel wordt een 1 gescoord, anders 0. Voor het instrument voor meting Single-loop-leer-inspanningen zijn vier leeractiviteiten onderscheiden (aanpassing, opslag, verspreiding en (her-)gebruik) en vier leervelden gemeten (mensen, producten, processen en markten). De waarde van MICS op Single-loop leren wordt bepaald door per cel aan te geven of de bijdrage van MICS positief (+1), neutraal (0), of negatief (-1) (belemmering van leren) is. De maximumscore is aldus +16, en de minimumscore is -16. Voor Double-loop leren zijn slechts twee activiteiten gemeten (theorie-ontwikkeling en theorie-verwijdering). Aangezien dezelfde leervelden van toepassing zijn als bij Single-loop leren, kan hierdoor een maximale score van +8 en een minimale score van -8 worden gemeten. In dit onderzoek is nergens een geval van een negatieve score gevonden, waardoor de frekwent geuitte stelling dat MICS een belemmering is voor het Double-loop leren (stelling S16) moet worden verworpen. Opmerkelijk was ook dat in de lean case, de scores op Single-loop leren zeer hoog waren, maar de scores op Double-loop leren niet hoger waren dan bij de klassieke organisaties. De verklaring hiervoor moet worden gezocht in de beperkte leerverantwoordelijkheden die de bestudeerde 'lean' organisatie van het moederbedrijf had gekregen (stelling S27).

About the Author

A. (Fons) B.J.M. Wijnhoven is born in The Netherlands in 1957. He received a bachelors (candidatum) and a masters degree in *political science* (major political research methodology) from the Catholic University of Nijmegen in The Netherlands. He taught *government organization* at the School of Public Administration at the University of Twente. He followed several courses on information management and read extensively in business administration. He became assistant professor in *information management* at the School of Management Studies of the same university in 1987. He published several papers in English about information technology impact on organization and management, evaluation of information systems, organizational learning and knowledge management. He joined the IFIP 8.2 WG programme committee (Ann Harbor 1994), and reviewed papers for several international conferences and journals. Besides his work and study, Fons co-founded a specialized center for epileptic health care, is member of the board of a local primary school, and takes managerial responsibilities at the University of Twente. His current research subjects are *knowledge management, designing organizational memory*, and he participates in the *research management* of the Department. He teaches on information management (overview course) and impact of information technology. He has a study book about *Impact of information technology* in press. He is married to Carolyn Karthaus. Carolyn and Fons have three children, Kim, Jules and Armelle, of age 11, 6 and 2 respectively.