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***Modes of Organizational Learning:  
Indications from an Empirical Study***

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## **Modes of Organizational Learning: Indications from an Empirical Study**

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### **Abstract**

The paper presents design and results of an empirical study on organizational learning (OL). OL is conceptualized as a communication based process, changing organizationally shared reality constructions. A model is developed, which allows the description of organizations as learning systems. It serves as a frame for collecting and structuring data on reality constructions and communication relations. Gathered by interviews in two municipal administrations, data is further processed into cognitive maps (reality constructions) and networks (communication relations). Their analysis leads to propositions about the nature of OL processes. It is demonstrated that changes of organizationally shared reality constructions (OL) originate in self-organizing communication networks. Furthermore, a structural and a strategic organizational learning mode are distinguished. They differ with respect to the information which is processed in the networks, the outcome they produce and the logic they follow.

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## INTRODUCTION

It is certainly not incidental, that the call for the "learning organization" coincides with the occurrence of fundamental transformations in our economies and societies. Whether we think of economic change (automatization or globalization), technological change (information highways or cyberspace), political change (dissolution of communist regimes or ethnic wars) or demographic change (overpopulation or senilization of western societies), one thing is for sure: We are currently facing changes in the environments of organizations which are of - so far - unknown dimension, frequency and speed (Handy 1989). Looking at organizations, this implies that previously proven and successful strategies may become outdated over night, or in other words that "old ways are no longer working and that an improvement effort is required for organizational success" (Kilmann and Covin 1990:525).

The ability to cope with changing environments has almost at all times been regarded as a key element of organizational success (Lawrence and Lorsch 1967). Successful organizations encounter changes in their environments by changing themselves (Hedberg, Nystrom and Starbuck 1976, Nadler and Tushman 1986). As a consequence, today's changed and continuously changing world requires changed and continuously changing organizations (Kilmann and Covin 1990). At the same time, experience shows that well-intended strategies often fail (Mintzberg 1994), unintended and confusing effects emerge (Forrester 1972) and small interventions prompt revolutionary and unforeseeable changes (Freedman 1992), leading to a loss of trust in the efficiency of planned organizational change.

Combined, these two trends provide a fertile soil for the idea of the learning organization to flourish. Learning is conceived as a possibility to cope with constantly changing environments (Dodgson 1993), thereby ensuring success and survival.

Like various other concepts of modern management theory, "organizational learning" (OL) is rooted in a metaphor (Pedler, Boydell and Burgoyne 1989). We are familiar with learning on an individual level. We know that by learning, individuals can overcome previous boundaries of knowledge or ability and learn how to cope with more and different situations. The metaphor of OL takes individual learning as a model for whole organizations. By doing so, it inspires creativity, as it is illustrative, implies analogue relations and fosters associations.

Because of the variety of associations, there is room for partially overlapping and partially contrasting conceptions of OL (Argyris and Schön 1978, Daft and Huber 1987, Duncan and Weiss 1979, Hedberg 1981, March 1991, March and Olsen 1976, Senge

1990, Shrivastava 1983, Simon 1991, Weick 1991). These conceptions converge in a cognitive comprehension of OL as "changes of organizational knowledge". They lack however, a definite, convincing and commonly accepted understanding of how these changes come about. In our opinion, this situation requires empirical research to improve the knowledge about the processes contributing to the learning of an organization. This was the intent of the study presented in this paper.

The absence of a paradigmatic theory of OL (Dodgson 1993, Fiol and Lyles 1985, Garvin 1993) recommends an inductive, theory building research approach. Hence, our study is exploratory in nature, moving from the description of the empirical phenomena to the formulation of general hypotheses (Schwartz and Jacobs 1979). Notwithstanding, exploratory research of this kind requires a frame of reference - "a lens" - that limits the phenomena to be observed and described. We have to define "*what*" we understand by OL, this is to say, to be able to look for "*how*" it works.

For this reason, we built a model for the description of organizations as learning systems. The model served us as a frame for collecting and structuring data, and reflects our basic understanding of OL. The latter draws upon basic assumptions from theories about organizations and change, and learning and cognition, which will be specified next. As we will indicate, many of the assumptions are included in existing OL theories. However, it is not our purpose to combine these theories, nor is it our intention to establish yet another theoretical concept. We just elaborate a basic understanding, that makes the notion of OL empirically seizable, i.e. which is able to be observed and described.

## **THEORETICAL ASSUMPTIONS**

### **(1) Assumptions about Organizations and Change.**

The necessity for organizations to change results from transformations in their environments. From a systems perspective (Beer 1980, Nadler and Tushman 1980), organizations interact with their environment by producing goods or services - or generally spoken - problem solutions. In order to succeed and survive, a "system-environment fit" must be accomplished and maintained, i.e. the produced solutions must meet environmental demands. As environments of organizations are increasingly instable and turbulent, there is a permanent risk that once approved solutions become inadequate. This, in turn, leads to a continuous need (Argyris and Schön 1978) for renewal and improvement, i.e. change.

Concepts of self-organization (Ulrich and Probst 1984), self-design (Hedberg, Nystrom and Starbuck 1976, Weick 1977) or self-management (Manz 1992) indicate that change in complex social systems is not so much the result of conscious design, but rather emerges out of the actions and interactions of the organization members. In accordance with these considerations, we understand organizational change as an evolutionary process of self-transformation. In order to navigate organizational self-transformation towards an "organization-environment fit", one can think of at least two different reference points (Kilmann and Covin 1990, Nadler 1990). A "reactive" orientation stands for adaptation and refers to already given environmental constellations. The organization waits to see what happens in the environment, then identifies "mismatches" or "gaps" (Argyris and Schön 1978, Duncan and Weiss 1979) and adjusts itself. Unfortunately, "the world does not sit still long enough" (Kilmann and Covin 1990:525). Therefore, this strategy contains the risk that the organization is always late. A "proactive" orientation in contrast, is based upon anticipations of future needs. The organization tries to encounter environmental changes by developing strategies for self-transformation "before the pain of a crisis" (De Geus 1988:71). Unfortunately again, turbulence and complexity make future environmental constellations nearly unpredictable. Exact forecasts of the necessary problem solutions are practically impossible. Therefore, in our opinion, organizational self-transformation must aim at increasing the organization's problem solving capability (Klimecki, Probst and Eberl 1994), by building up "organizational resilience" (Wildavsky 1988) and "expanding its capacity to create" (Senge 1990:14), thereby widening the range of possible situations the organization will be able to cope with.

## **(2) Assumptions about Learning and Cognition.**

"Psychology of learning has seen the emergence and demise of many theories" (Shrivastava 1983:11), which can be condensed into two main streams: "Behavioral-Associationist Theories" and "Cognitive-Organizational Theories" (Bower and Hilgard 1981) or likewise, "Stimulus-Response Explanations" and "Cognitive Explanations" (Lefrancois 1982). From a behaviorist or stimulus-response point of view, learning is considered a change of behavior due to experience in a given situation (Bower and Hilgard 1981). The learning process is understood as one of trial-and-error, leading to a better adaptation to the environment. Its outcome is new or improved behavior.

Within the logic of cognitive learning theories (Bower and Hilgard 1981, Lefrancois 1982), learning is viewed as a change in states of knowledge - understood as the cognitive basis of behavior - and is due to the processing of information. The learning

process stands for the transformation of a given cognitive structure through the integration of new information. Consequently, it is new or improved knowledge, which is the immediate outcome of learning and not any particular action or behavior (Duncan and Weiss 1979). By that means, the focus of learning shifts from reactive trial-and-error experimentation, to include anticipatory problem-solving.

Within OL theories, the behaviorist view (March and Olsen 1976) has been of minor influence. The majority of OL theories refers to the cognitive perspective (Argyris and Schön 1978, Daft and Huber 1987, Duncan and Weiss 1979). Regardless of whether it is called "organizational theory-of-action" (Argyris and Schön 1978) or "organizational knowledge" (Duncan and Weiss 1979, Lyles and Schwenk 1992), it is in any case, the cognitive structure of an organization which is supposed to be changed by OL. And, it is precisely this change in the underlying cognitive structure, which is assumed to "give birth" (Friedlander 1983:194) to a new behavior, that ought to fit changed environments (Duncan and Weiss 1979).

There has been a variety of attempts within management publications to grasp the cognitive basis of organizational actions (Blackler 1993, Simon 1991, Walsh and Ungson 1991). It has been conceptualized as the sum of all knowledge about action-outcome relations within an organization (Duncan and Weiss 1979), as the organizational theory-of-action (Argyris and Schön 1978) or as its dominant logic (Prahalad and Bettis 1986). In general, these approaches have two features in common (Krogh, Roos and Slocum 1994): 1. They refer to a traditional notion of knowledge, and 2. They refer to organizational knowledge as to knowledge which is shared by organization members.

Point one, the traditional notion of knowledge assumes that cognitive structures are representations of some "truly" given outside world. They may be erroneous, but can obtain accuracy through learning, i.e. through the assimilation of information. In contrast to this notion, radical constructivism (Foerster 1984, Glasersfeld 1984, Watzlawick 1984) suggests "that the world is not a pre-given state to be represented, but that cognition is a creative act of bringing forth a world" (Krogh, Roos and Slocum 1994:58). In this view, knowledge is not a copy of reality but a construction of it (Watzlawick 1984). Nevertheless, these constructions guide action, define rationality and determine the evaluation of chances and risks. They are the cognitive basis of action. It is obvious that in this view, learning - by means of information processing - cannot be expected to lead to "true" knowledge. The more as information is not regarded as an objective entity, either. From a constructivist viewpoint, information is not a commodity or a substance that can be absorbed, but is the result of observing differences (Bateson 1971, Luhmann 1986). The only requirement that can be imposed on knowledge as the outcome of

learning then, is the requirement of "viability" (Ford and Backoff 1988, Glasersfeld 1984, Glasersfeld and Cobb 1983): It must be knowledge that enables its owner to survive.

The second point, the idea that organizational knowledge is knowledge, which is in some way shared by organization members, is based upon social constructivism (Berger and Luckmann 1966). It says that within social systems, such as organizations, individuals produce and reproduce shared understandings through social interactions (Ford and Backoff 1988). Social interactions, in turn, constitute and are constituted by communication (Ford and Ford 1995, Luhmann 1986, 1990). Through communication organization members mutually influence each others' views and create and change organizationally shared reality constructions.

### **(3) Organizational Learning.**

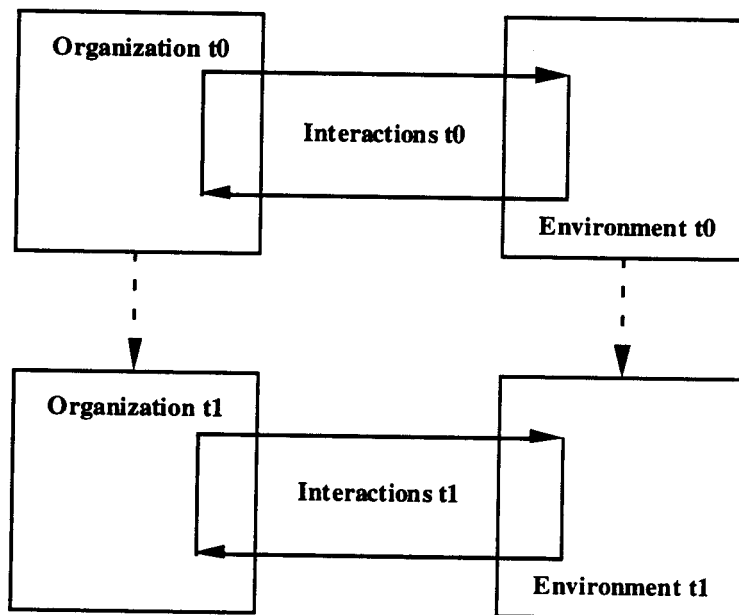
Together, our preliminary understanding of OL reads as follows: Speaking of OL, we refer to changes of organizational knowledge, that are induced by information processing, and enable an organization to find new ways in order to survive and succeed in new situations. We further assume that:

- Organizational knowledge stands for reality constructions, that are shared among organization members and guide and instruct organizational actions.
- Information processing, relevant for the learning of an organization, means communicating observed differences. In particular these are perceived deviations from an organization-environment fit.
- Organizational learning, enabling an organization to survive in turbulent environments, must aim at a general increase of the organization's problem solving capability. In our understanding, this is equivalent to a differentiation of the shared reality constructions.

## **DESCRIBING ORGANIZATIONS AS LEARNING SYSTEMS**

Building upon this basic understanding, we constructed a model that allows the description of organizations as learning systems. It serves as an assortment of "boxes" for collecting data, appropriate to describe organizations as learning systems. Essentially, it consists of 1. The reality constructions of the organization members, and 2. The communication relations between them.

Since in our view, OL refers to changes of organizational knowledge, it is not sufficient to analyze organizational actions. Instead it is necessary to look at the reality constructions that underlie these actions. Presuming that OL is aiming at an organization-environment fit, the relevant reality constructions are those about the organization itself, its environment and the interactions between the two. We know that change is a time-consuming process. It is a process in which "something" turns into "something else" (Ford and Ford 1994, Kanter, Stein and Jick 1992). In order to observe OL, one therefore has to compare the status of organizational knowledge during at least two different points in time. The difference then, can be said to be the result of an OL process. Our model transposes this difference into the learning system itself. Organization members are expected to depict their reality constructions with regard to the present ( $t_0$ ) situation and to the future ( $t_1$ ) situation. In between lies a hypothetical time gap ( $t_1-t_0$ ), which in our opinion allows the attribution of the differences between the two states of knowledge to learning. Accordingly, the model contains six "boxes" (Figure 1) to be filled with the knowledge, i.e. the reality constructions of the organization members.



*Figure 1: OL-relevant reality constructions*

The second core element in describing organizations as learning systems are the communication relations between the organization members. Presuming again, that OL is



aiming at an organization-environment fit, the relevant communications are concerned with deviations from this fit. We further assume that these communications can either deal with current or anticipated deviations from an organization-environment fit. It is our understanding that, unless there is a perceived need for change within an organization, resulting from observing and communicating "errors" (Argyris and Schön 1978) or "performance gaps" (Duncan and Weiss 1979), i.e. current misfits, respectively "tensions" (Senge 1990) between future requirements and the current state of affairs, i.e. anticipated misfits, there is no chance that OL will happen. Accordingly, we have to track down and follow up these two specific communication relations between organization members. In a graphic representation, the complete model then looks as follows (Figure 2).

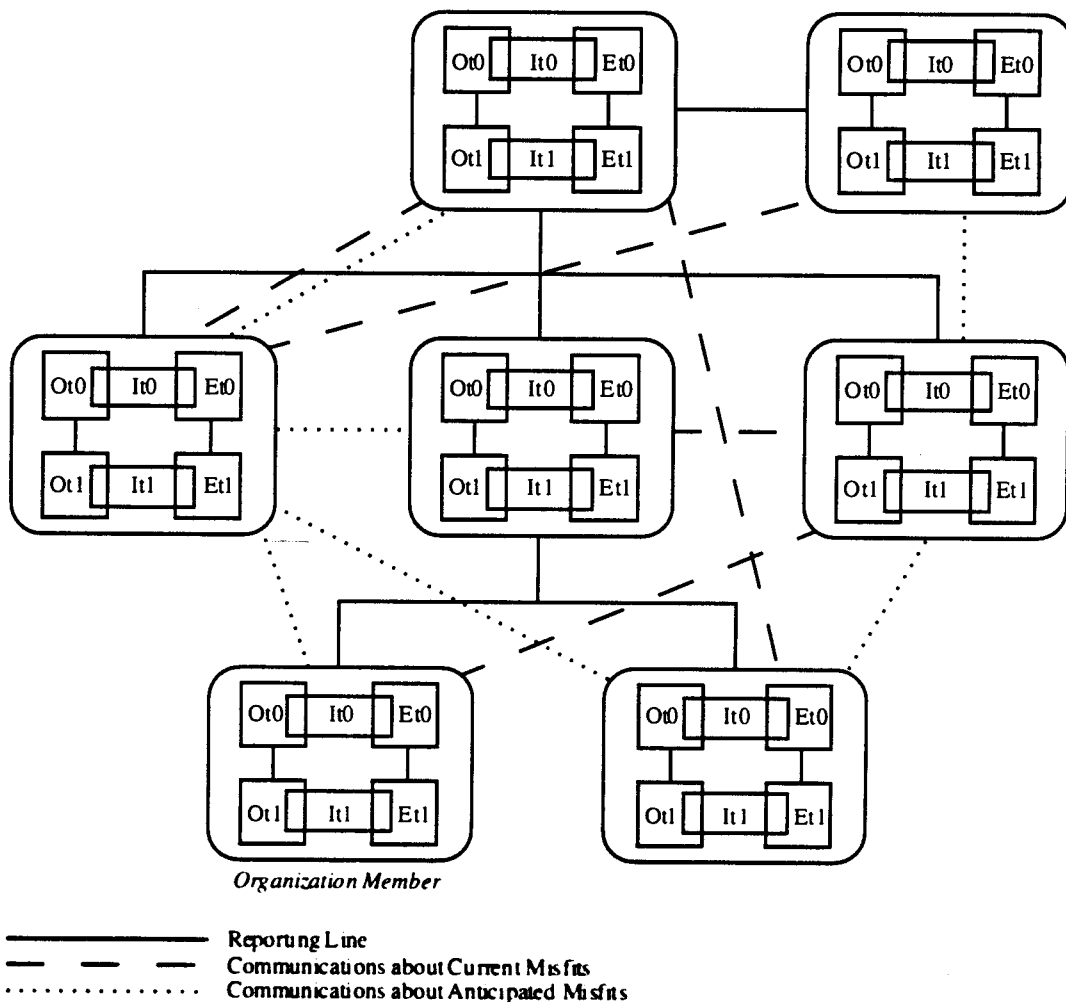


Figure 2: Model for the description of organizations as learning systems

It should be clear however, that we are not primarily interested in specific results of OL processes, but in the conditions they presume, the courses they follow and in the formative mechanisms they depend on. Looking at organizations through the glasses of our model, we receive information about the reality constructions of the organization members and about their communication relations. Comparing and aggregating individual constructions, we can identify different and shared bits of knowledge and infer interrelations of knowledge sharing with communication structures, or features of the organization or its members. Describing organizations by means of the model should thus allow us to draw conclusions on the conditions under which shared reality constructions build up and change.

The empirical research project was conducted in the municipal administrations of two German cities. These are referred to as southern city and northern city in this paper. We concentrated on the departments concerned with public services for senior citizens. We chose this policy field because 1. Legal regulation regarding the development of public services for the senior citizens is not extensive, thus providing room for autonomous decision making, and 2. Enormous changes (especially demographic ones) are taking place in the relevant environments of these organizations, putting them under pressure to find new solutions. In other words, we believe that there is the possibility - as well as the necessity - for OL to occur.

## **METHODS AND ANALYSIS**

### **(1) Interviews.**

The data to fill the "boxes" was gathered in interviews. For that purpose, an interview guide (Table 1) was developed that translates the components of the model into open questions, adapted in content to the organizations under study. In accordance with the model, questions 1-6 are supposed to catch hold of the reality constructions, while questions 7 and 8 track down the communication relations. Twenty-two interviews were conducted in northern, and twenty-one in southern city, lasting about one hour each. Interviews were recorded and later transcribed. For consecutive representation and analysis of the interviews, cognitive mapping and network analysis was applied. By cognitive mapping we depicted the reality constructions, by network analysis we represented the communication relations between organization members. Both techniques allow to build formal measures and make different OL systems comparable despite heterogeneous contents.

1	How would you describe the situation of senior citizens in your community?	Environment t <sub>0</sub>
2	What developments do you expect in this area?	Environment t <sub>1</sub>
3	What are the administration's most important programs for senior citizens and what are their effects?	Interactions t <sub>0</sub>
4	What is your function and what are your main tasks at the moment?	Organization t <sub>0</sub>
5	What should the administration look like to meet the requirements of tomorrow?	Organization t <sub>1</sub>
6	Which programs should this administration deliver?	Interactions t <sub>1</sub>
7	If you have problems on your job, whom do you ask for support?	Communication about current fit-deviations
8	To whom do you talk, if you want to realize innovative ideas?	Communication about anticipated fit-deviations

*Table 1: Interview guide*

## (2) Cognitive Mapping.

In principal, knowledge, whether of individuals or of organizations, is not directly observable. Representation tools are needed to model cognitive structures upon the basis of assertions (Laukkanen 1994). Cognitive mapping is such a tool to represent and analyze knowledge (Axelrod 1976, Bougon, Weick and Binkhorst 1977, Eden, Jones, Sims and Smithin 1983, Huff 1990). It depicts a person's belief system as a map. Dependent upon the chosen mapping procedure, different kinds of maps result.

Cause maps capture a person's world view as a cognitive structure consisting of causally interconnected sets of concepts (Lee, Courtney and O'Keefe 1992). Cause maps consist of two types of elements: concepts and causal beliefs. Concepts are treated as variables and have to take on more than one value. Causal beliefs relate variables to each other. Positive causal relations point out that changes occur in the same direction, negative causal relations stand for changes in opposite directions. Graphic documentation of cause maps uses nodes for concepts and directed, signed arcs for causal beliefs

(Axelrod 1976). Tabular documentation (Eden, Jones and Sims 1979) places cause variables in rows, effect variables in columns and the causal relations in the linking cells.

Maps of attention (Huff 1990), in contrast, omit causal relations and confine to a registration of the concepts used by a person, when referring to a certain domain (Laukkanen 1994). Maps of attention are documented as lists of concepts, including the frequency of their usage.

Individual maps can then be subject to a comparative analysis. It can be determined, how much and which concepts and causal beliefs are shared among how many and which persons. And, through aggregation of identical concepts and relations (Langfield-Smith 1992, Laukkanen 1994, Weick and Bougon 1986), collective maps, i.e. shared reality constructions can be configured.

Within the setting of our research project, we used cognitive mapping to depict the reality constructions of the organization members along the components of the model. For that purpose, the primary resource texts (interview transcripts) had to be coded (Wrightson 1976). As the raw data is usually full of redundancies caused by synonyms, the natural language terms of the interviewees had to be first grouped together and replaced by standardized terms referring to the same phenomena (for a more detailed description of the standardization procedure see Laukkanen 1994:327). On the basis of this first consolidation, omitting expletives and making use of software<sup>1</sup> support, individual maps of attention were derived, separately for each interviewee and for each of his or her answers (questions 1-6). They consist of the used concepts and the frequency of their occurrence. With regard to questions 2 (environment  $t_1$ ), 5 (organization  $t_1$ ) and 6 (interactions  $t_1$ ), containing the "new" ( $t_1$ ) knowledge as perceived by the organization members, we, in addition, worked out cause maps. For that purpose, we went through the interviews again and encoded the included causal assertions connecting the concepts, as positive or negative causal relations. The resulting cause maps for each interviewee and answer were documented as tables<sup>2</sup>.

Individual maps of attention, respectively cause maps, were then grouped together, in order to derive organizational maps for the six components of the model. There is a long-standing discussion in the cognitive mapping community, regarding the question of "how much shared is shared" (Hall 1984, Langfield-Smith 1992, Laukkanen 1994). As our interviewees came from different angles of the organizations and our questions were fairly open, individual maps were quite varied. To demand that organizational maps should consist only of items shared among all members would have resulted in empty maps. We therefore followed Laukkanen's (1994) advice to decide this question "in casu"

and included all concepts and relations that were stated by the interviewees, simultaneously recording the degree of their sharedness.

Organizational maps of attention were configured by compiling individual concept lists, aggregating identical concepts, summing up their frequencies and writing down the quantity and the acronyms of interviewees contributing to the total amount. The documentation structure is exemplified by the following passage (Table 2), taken from the organizational map of attention of southern city's administration regarding environment  $t_0$ .

Concept	TF	DoS	CI
Family	46	12	EL, HE, RA, KI, DO, HA, PO, SP, SR, SI, SO, MI
Poverty	37	11	HO, KI, ZM, DO, HU, PO, SP, SR, SI, SO, MI
Isolation	24	7	RA, SR, LÖ, MI, DO, SO, HU
(...)	(...)	(...)	(...)

TF: Total Frequency, DoS: Degree of Sharedness (N=22), CI: Contributing Interviewees (Acronyms)

*Table 2: Documentation structure of the organizational maps of attention (example)*

Organizational cause maps were configured by compiling individual cause map tables, summing up identical concepts and arranging identical relations, including the interviewees' acronyms, in the linking cells. The documentation structure is exemplified by the following passage (Table 3) taken from the organizational cause map of northern city's administration regarding organization  $t_1$ .

	Effect	1	2	3	4	5	6	7	(...)
	<b>Cause</b>								
1	Expertise						(+) NI		
2	Short Official Channels								
3	Teamwork		(+) NI		(+) JO (+) EP (+) FR				
4	Cooperation							(-) KE (-) KR	
5	Front Work	(+) HU (+) FÖ							
6	Decentralization		(+) PE			(+) SR			
(...)									

*Table 3: Documentation structure of the organizational cause maps (example)*

Proceeding this way, we compiled three organizational maps of attention (organization  $t_0$ , interactions  $t_0$  and environment  $t_0$ ) and three organizational cause maps (organization  $t_1$  and interactions  $t_1$  and environment  $t_1$ ) for both administrations, consisting of several hundreds of concepts, each. It is obvious that they cannot completely be enclosed in this paper<sup>3</sup>. Instead, we will highlight fractions - where appropriate and necessary - to demonstrate results.

### **(3) Network Analysis.**

Network analysis is a technique to represent and analyze social structures or communication structures which connect a set of persons (Ibarra and Andrews 1993, Knoke and Kuklinski 1982, Rogers and Kincaid 1981). Generally, networks are traced by means of name-generating questions of the type: "With whom have you most

frequently...?" (Krackhardt and Hanson 1993, Rogers and Kincaid 1981), which specify the content of the relations under examination. Graphic representations of networks use nodes for actors and directed arcs for relations. In tabular representations, rows represent the initiators, and columns the addressees of relations. Presence of a relation is coded [1], absence [0] in the linking cells (Knoke and Kuklinski 1982). In general, networks are quadratic or closed, due to "snowball sampling" (Knoke and Kuklinski 1982) or the analysis of complete populations. However, it is also possible to construct non-quadratic or open networks, with different arrays of actors in rows and columns.

Within the realm of our research project, we used network analysis to depict the communication relations generated by questions 7 and 8. Derived from the name generators, we called the resulting networks "problem oriented network" (communications about current fit-deviations) and "innovation oriented network" (communications about anticipated fit-deviations). To delineate the networks, the relations, as quoted in the interviews, were coded in the above mentioned way and documented as tables. Since we used "snowball sampling" for the selection of interviewees, beginning with top-management and ending at the administrations' borders, we received closed networks, i.e. networks with identical arrays of initiators and addressees, representing the relations of the interviewed organization members amongst each other. However, interviewees, in their answers, also pointed at persons and positions outside the organization (e.g. politicians, other administrations, charitable institutions or scientific institutions). As these persons were not consulted, we obtained a second - open - version of each network, when including them on the addressees' side.

Proceeding this way, we received two networks (a problem oriented and an innovation oriented) in two versions (closed and open) for both administrations. Table 4 contains, as an example, the closed version of the problem oriented network of northern city's administration.

	KR	MI	KW	HÜ	HU	BA	FE	KE	FR	SZ	EP	FÖ	PE	JO	KI	NI	SA	SE	SU	SL	Σ
KR		1	1	1	1					1	1	1			1			1	1	1	11
MI	1		1	1	1	1	1	1		1	1									1	10
KW				1	1	1	1	1	1		1		1								8
HÜ	1	1																			2
HU			1	1						1	1	1									5
BA			1		1					1											3
FE			1		1	1			1												4
KE																					0
FR					1	1															2
SZ	1	1			1						1									1	5
EP	1	1	1	1	1					1		1	1	1	1	1	1	1		1	14
FÖ			1	1	1					1	1		1	1	1	1	1	1		1	12
PE	1	1	1	1	1					1	1	1		1	1	1	1	1	1		14
JO						1	1		1						1	1	1	1	1	1	9
KI			1		1	1	1														4
NI	1						1			1	1	1	1								6
SA					1					1		1	1								4
SE					1		1		1	1	1	1	1	1	1	1	1		1		12
SU														1	1	1	1	1			5
SL	1	1	1	1	1					1											6
Σ	7	6	10	8	14	6	6	2	4	8	11	7	7	5	7	6	6	6	4	6	136

*Table 4: Problem oriented network of the northern city's administration (closed version)*

**(4) Data Analysis.**

The standard operating rules of qualitative data analysis suggest that the phenomena under examination are to be observed, described, classified and scanned for interconnections (Dey 1993). Instructed by the model of OL systems, we observed the reality constructions of the organization members and the communication relations between them. We described the cognitive contents by funneling interview data into cognitive maps, and the communication relations by casting them into networks. Upon this basis, further descriptive measures, referring to contents as well as to structures, and facilitating the analysis and comparison of the two OL systems, were derived:

- Regarding the contents of the organizational maps, we identified the dominating concepts. As to the organizational maps of attention, this was done by ranking concepts according to degree of sharedness and total frequency. For the organizational cause maps the same procedure was applied, separately for cause concepts, effect concepts and causal relations, thus detecting main causes, main effects and main relations.



- Regarding the contents of the networks, we looked for central initiators, depicted by outdegrees (row sums), and central addressees, shown by indegrees (column sums), within each network.
- With regard to the structures of the organizational cause maps, we derived measures for their size (number of concepts and relations) and integration (relations per possible relations), and scored accordances between every pair of interviewees (1 point for every shared cause or effect or relation), for all maps.
- With regard to the structures of the networks, we measured their size (number of participants and relations), and ranked proximity between every pair of interviewees: (2) mutual, (1) unilateral, and (0) no mentioning of contact, for each network.

The heart of qualitative data analysis, i.e. the subsequent steps of classifying and scanning the data for interconnections, is the part of qualitative research, "least well described in research methodology" (Hartley 1994:220). How to come from the recording of the data to its interpretation and the conclusions is scarcely codified, since it is highly subjective, interpretive and case-dependent (Eisenhardt 1989). It resembles an iterative, evolutionary process (Strauss and Corbin 1990), for which a detailed action plan can hardly be formulated in advance. Generally speaking, classifying refers to the development of categories, in which the the original data is placed (Dey 1993, Hartley 1994). Classification's main aids are practical reasoning and discrimination. The classifications we imposed, predominantly relate to characteristics in contents and structures of the organizational maps and networks. They are presented and substantiated in the following chapter.

Scanning for interconnections refers to the within-case and cross-case search for patterns (Eisenhardt 1989) and co-dependencies between categories and features. Most of our interrelations were inferred by "hands-on" comparison. With regard to the sharing of knowledge, however, i.e. explaining the development of organizationally shared reality constructions, a correlation analysis could be computed<sup>4</sup> using "Spearman Rho" rank correlation coefficients. It systematically assesses the correlations between accordance on knowledge and proximity in networks, across all pairs of organization members. As control variables, we included department, hierarchy level, client distance and qualification of the interviewees to characterize the organizational context. It is clear though, that within qualitative analysis, the computation of correlation coefficients can only be a tool for detecting co-dependencies, not for testing them. Follow-up research is necessary to prove the hypotheses we offer in testing designs.

## RESULTS AND PROPOSITIONS

Analysis and comparison of the two OL systems led us to three interdependent sets of hypotheses about OL processes. Unfolding them, we proceed by displaying empirical evidence and supporting literature first, then presenting our propositions.

### **(1) Organizational Learning Networks.**

We have argued, that OL can be understood as the transformation of reality constructions that are shared among organization members. We have supposed that these changes arise from communications about perceived deviations from an organization-environment fit. With our collective cause maps, we obtained information about the changed ( $t_1$ ) reality constructions and about the extent to which they are shared among pairs of interviewees. The latter were measured by scores of accordances [ACCPOI5 for accordances in the organization  $t_1$ -map, and ACCPOI6 for accordances in the interactions  $t_1$ -map].

Upon this basis, we were able to compute a correlation analysis to identify factors, correlating significantly with the sharing of changed reality constructions. Variables, included in the correlation analysis, were proximity (coding 2/1/0 for mutual, unilateral or no relation) in the problem oriented network [PNETCON] and in the innovation oriented network [INETCON], affiliation to the same department (coding 1/0 for identical/non-identical) [DEPIDENT], affiliation to the same hierarchy level (coding 1/0; three levels distinguished: top management, middle management and operational) [HIEIDENT], affiliation to the same qualification background (coding 1/0; two categories distinguished: administrative and functional qualification) [QUAIDENT] and affiliation to the same category regarding client distance (coding 1/0) [DCCIDENT], for every pair of interviewees. Correlations and intercorrelations for these variables with accordances scores in the cause maps on organization  $t_1$  and interactions  $t_1$  were computed, separately for each organization. The results are included in tables 5 to 8.

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MATRIX OF SPEARMAN RHO CORRELATION COEFFICIENTS

	1	2	3	4	5	6
1 ACCPOIS						
2 PNETCON	<b>*0.17</b>					
3 INETCON	-0.03	<b>**0.61</b>				
4 DEPIDENT	0.07	<b>**0.34</b>	<b>**0.45</b>			
5 HIEIDENT	0.08	<b>*0.19</b>	-0.01	0.02		
6 QUAIDENT	-0.08	0.09	0.16	0.18	<b>**0.23</b>	
7 DCCIDENT	0.04	<b>**0.39</b>	0.12	<b>*-0.04</b>	<b>**0.66</b>	<b>**0.28</b>

NUMBER OF OBSERVATIONS: 153

\* significant at  $p < 0.05$

\*\* significant at  $p < 0.01$

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Table 5: Correlations and Intercorrelations "Organization t1 - Northern City"

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MATRIX OF SPEARMAN RHO CORRELATION COEFFICIENTS

	1	2	3	4	5	6
1 ACCPOIS						
2 PNETCON	<b>**0.20</b>					
3 INETCON	-0.12	<b>**0.20</b>				
4 DEPIDENT	0.17	<b>**0.38</b>	<b>**0.23</b>			
5 HIEIDENT	0.01	0.07	<b>*-0.17</b>	-0.04		
6 QUAIDENT	-0.08	-0.10	-0.10	-0.05	0.14	
7 DCCIDENT	-0.04	0.12	-0.04	-0.06	<b>**0.43</b>	<b>**0.21</b>

NUMBER OF OBSERVATIONS: 190

\* significant at  $p < 0.05$

\*\* significant at  $p < 0.01$

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Table 6: Correlations and Intercorrelations "Organization t1 - Southern City"

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MATRIX OF SPEARMAN RHO CORRELATION COEFFICIENTS

	1	2	3	4	5	6
1 ACCPOI6						
2 INETCON	<b>**0.20</b>					
3 PNETCON	-0.02	<b>**0.61</b>				
4 DEPIDENT	-0.08	<b>**0.45</b>	<b>**0.34</b>			
5 HIEIDENT	0.03	-0.01	*0.19	0.02		
6 QUAIDENT	-0.04	0.16	0.09	*0.18	<b>**0.23</b>	
7 DCCIDENT	0.16	0.12	<b>**0.34</b>	-0.04	<b>**0.66</b>	<b>**0.28</b>

NUMBER OF OBSERVATIONS: 153

\* significant at  $p < 0.05$

\*\* significant at  $p < 0.01$

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Table 7: Correlations and Intercorrelations "Interactions t1 - Northern City"

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MATRIX OF SPEARMAN RHO CORRELATION COEFFICIENTS

	1	2	3	4	5	6
1 ACCPOI6						
2 INETCON	<b>**0.20</b>					
3 PNETCON	<b>**0.18</b>	<b>**</b> -0.08				
4 DEPIDENT	0.06	*0.15	<b>**0.32</b>			
5 HIEIDENT	0.04	-0.08	0.15	-0.03		
6 QUAIDENT	0.09	-0.06	-0.05	-0.03	<b>**0.22</b>	
7 DCCIDENT	0.06	0.04	0.15	-0.01	<b>**0.58</b>	<b>**0.44</b>

NUMBER OF OBSERVATIONS: 171

\* significant at  $p < 0.05$

\*\* significant at  $p < 0.01$

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Table 8: Correlations and Intercorrelations "Interactions t1 - Southern City"

In our understanding, the most obvious result, applying to both OL systems, is that accordance scores correlate significantly with network contacts. This indicates that the sharing of changed reality constructions between organization members corresponds with the presence of communication relations between them.

Within the OL literature, communication has ever since been attributed an important role. According to Duncan and Weiss (1979), individual knowledge changes "must be made public, communicated to and be accepted or legitimated by others" (Duncan and Weiss 1979:237) in order to result in changes of the organizational knowledge base. Argyris and Schön believe that the "collaborative inquiry of individual members" (Argyris and Schön 1978:20) - a process necessarily grounded in communication - mediates OL processes. Today, particularly Peter Senge and his colleagues give prominence to practices of dialogue with respect to mastering the disciplines of the learning organization (Isaacs 1993, Schein 1993, Senge 1990).

The question then is, however, whether the function of communication is predominantly distributive, i.e. spreading individual new insights throughout the organization, or, whether it is generative, i.e. that it is communication itself, which brings forth changes of organizational knowledge. The generative role of communication in organizational change and learning processes is stressed by Ford and Ford (1995). With reference to social constructivism, they argue that change is a phenomenon occurring within communication. They consider communication not as a tool for announcing and explaining change, but as "the very medium within which change occurs" (Ford and Ford 1995:542). Similarly, Krogh, Roos and Slocum (1994), with reference to autopoiesis theory (Maturana and Varela 1987), propose that the key concept for understanding the development of organizational knowledge is "languaging" (Krogh, Roos and Slocum 1994:63).

If it were mainly for the distribution, announcement and explanation of individual learning results, one should suppose that official communication channels were used, that news first spread among colleagues or peers, and that people doing similar jobs or having similar education, tend to gain similar individual insights. Actually, with regard to the two OL systems, neither is the case. Descriptive statistics could not detect significant interconnections between same department (colleagues), same hierarchy level (peers), same qualification (education), same client distance (job) and shared reality constructions in neither organization, and for neither map. We therefore conclude that:

**P1:** *Organizational learning - the transformation of organizationally shared reality constructions - is generated by communication.*

The very fact that they do not comply with reporting lines, obey department borders or remain within hierarchical layers, legitimates in our opinion the assumption that the relevant communications, bringing forth shared knowledge in organizations, actually take place within the structure of networks. Obviously, shared reality constructions build up and change, as it were naturally, whenever organization members jointly engage in solving problems or meeting challenges.

Until now, research on networks in the field of organization and management theory has mainly focused on the collaboration among firms (Aldrich and Whetten 1981, Jarillo 1988, Powell 1990). Research on networks within organizations is comparatively scarce and concentrates on networks as hidden sources of power (Krackhardt and Hanson 1993) or enablers of innovations (Kanter 1983). Regarding the latter, the main thesis is, that "rich networks of contacts that cut across functional boundaries" (Mohrmann and Mohrmann 1993:94) promote innovations.

Although the literature on OL generally suggests that non-hierarchical structures support OL processes (Levinthal and March 1993, Senge 1990), the discussion concentrates on teams or work groups, which are viewed as the key learning units in organizations (Kofman and Senge 1993, Senge 1990). There is, however, a difference between teams and networks, which lies in the fact that teams are part of the formal organization while networks are not. As teams did not constitute significant building blocks in neither of the organizations under examination, we cannot predicate anything about their influence. We can just confirm that, according to our observations, networks, i.e. informal cross-functional communication relations between organization members, lead to changes of shared reality constructions, that is OL. In order to generate further research on this interrelation, we suggest the following proposition:

**P2:** *OL relevant communications occur as informal and self-organizing organizational learning networks.*

## **(2) Organizational Learning Modes.**

As a further result, correlation analysis brought to light that high accordance scores regarding the organization  $t_1$  maps (Tables 5 and 6) correlate significantly with proximity in the problem oriented networks, while high degrees of consensus regarding the interactions  $t_1$  maps (Tables 7 and 8) do so with proximity in the innovation oriented networks. This is true for both OL systems. Calling to mind the construction principles of the underlying model, this is to say that communications about current organization-

environment misfits (reactive orientation) correspond with the development of shared attitudes about necessary changes of the organization's form, while communications about anticipated organization-environment misfits (proactive orientation) coincide with the development of common persuasions about alternative future programs. There is, in other words, evidence for a connection between the information processed in the networks and the outcomes of OL. Because of the distinctness of these results, we labeled the particular constellations of OL networks and OL outcomes, modes of OL. Derived from the outcomes, we call the first a structural learning mode (leading to shared assumptions about changes of organizational structures) and the second a strategic learning mode (leading to shared assumptions about changes of organizational strategies).

There are quite a number of similar bipartitions within the literature on OL. The most prominent is certainly Argyris' and Schön's (1978) distinction of single- and double-loop learning, where double-loop learning stands for deeper changes of the "underlying norms, policies and objectives" (Argyris and Schön 1978:3). March (1991) separates exploitative from explorative learning, and Senge (1990) distinguishes generative from adaptive learning. However, none of these distinctions exactly matches with our observations. Our OL modes differ from each other neither by the dimension of change (single vs. double) nor by the novelty of the results (exploitative vs. explorative), but by the object (structure vs. strategy; in Chandler's [1962] sense of organizational form versus course of action) about which the assumptions change - in combination with the information (current vs. anticipated misfits) that brings forth these changes. For this reason, even Senge's distinction (adaptive vs. generative) only covers half - the information part - of what the two OL modes purport.

Because, as we have seen, our findings go beyond suppositions of current OL concepts, we set forth the following propositions to stimulate further research:

**P3:** *The outcomes of OL are dependent on the information which is processed in the OL networks. Combinations of information and outcome constitute fundamental learning modes, which occur in every organization:*

**P3a:** *In the structural learning mode, networks, processing information about current organization-environment misfits, produce shared assumptions about structural changes.*

**P3b:** *In the strategic learning mode, networks, processing information about anticipated organization-environment misfits, produce shared assumptions about strategic changes.*

Looking closer at the OL outcomes, i.e. the changed reality constructions, captured as organizational maps (organization  $t_1$  and interactions  $t_1$ ), we could identify the dominating (according to degree of sharedness) concepts for each administration and map, differentiated in regard to whether they are used as cause or effect variables. The results of this analysis are shown in table 9.

				DoS	TF
Organization $t_1$ Map	Northern City	Main Cause	Expertise	7	9
		Main Effect	Effectivity	6	9
	Southern City	Main Cause	Office for Senior Citizens	13	30
		Main Effect	Transparency	8	13
Interactions $t_1$ Map	Northern City	Main Cause	Costs	7	9
		Main Effect	Empowerment of Senior Citizens	11	20
	Southern City	Main Cause	Costs	7	10
		Main Effect	Costs	5	8

TF: Total Frequency, DoS: Degree of Sharedness

*Table 9: Dominating cause and effect concepts of organizational maps*

The most remarkable findings, indicated by this table, are the outstanding roles of the concepts "Office for Senior Citizens" in southern administration's map on organization  $t_1$ , and of the concept "Empowerment of Senior Citizens" in northern administration's map on interactions  $t_1$ :



In northern city's administration, the organizational map on interactions  $t_1$  focuses on the demand that future programs shall effect an encouragement and promotion of the self-help potential of senior citizens ("Empowerment"). Future policies shall enable these citizens to manage their lives on their own and become independent of external help, thus taking away pressure from public budgets. Compared with what is perceived as the organization's most important achievements at present (interactions  $t_0$ ), this new attitude constitutes a major strategic shift. Regarding the map on organization  $t_1$ , no such outstanding concept can be identified.

In southern city's administration, there is a common understanding that, with regard to organization  $t_1$ , a major reorganization has to take place, concentrating all jobs concerned with the development of public services for senior citizens in one department ("Office for Senior Citizens"). It is assumed, that this centralization will cause an improvement of organizational transparency, thus encountering the need of senior citizens to easily get hold of support. Regarding interactions  $t_1$ , this administration lacks a guiding principle. The main ideas relate to an expansion of already enforced (interactions  $t_0$ ) programs.

Summing up, the results exhibit that the OL outcomes in northern city's administration are predominantly strategic, manifested in the interactions  $t_1$  map and relating to the market behavior of the organization, while they are predominantly structural, manifested in the organization  $t_1$  map and relating to the design of the organization, in southern city's administration. The question now is, how these different OL results come about. Differences in the perception of the environment can largely be excluded from being explanatory as the respective maps (environment  $t_1$ ) of both OL systems are of a very same tenor, focusing on an increase in number and a differentiation of the needs of senior citizens. Beyond that, we have seen above that in principle both OL modes could be traced in both OL systems. Why then, are the OL results of one organization clearly structural, while those of the other strategic? Comparing the size of the OL networks of both administrations (Table 10) gives a hint.

	Northern City				Southern City			
	Participants		Relations		Participants		Relations	
	I-Net	P-Net	I-Net	P-Net	I-Net	P-Net	I-Net	P-Net
Absolute Number	39	75	128	242	28	74	89	177
Relative Number	2,2	4,2	7,1	13,4	1,3	3,4	4,1	8,1

I-Net: Innovation Oriented Network, P-Net: Problem Oriented Network  
 As there were different quantities of interviewees, the relative numbers are basic for comparison.

*Table 10: Size of the OL networks (open versions)*

It can be inferred from table 10, that both OL networks (problem oriented and innovation oriented) are larger in the northern organization, with respect to the number of participants as well as with respect to the number of relations. On average, they exceed their southern city counterparts by factor 1.7 (except the number of participants in the problem oriented network, where the factor is just 1.2). Comparing the size of the two networks (problem oriented and innovation oriented) within each OL system, it turns out that the problem oriented networks are generally twice as large as the innovation oriented networks, in both administrations (with the exception being the number of participants in the southern city, where the factor is almost 3).

Interpreting these divergences, we conclude that 1. The problem oriented network is relatively strong in the southern city's administration, if compared with the northern one, and that 2. The innovation oriented network is relatively strong in the northern city's administration, if compared with the problem oriented in the same organization. Recalling that northern city's administration is the organization where the learning outcomes concentrate on strategic renewal and southern city is the one where they are predominantly structural, we now suggest the following proposition:

**P4:** *Although organizations in principle dispose of both learning modes, the relative strength of the particular OL network, token by the number of participants, influences which mode of OL prevails.*

### (3) Organizational Learning Logics.

Searching for further aspects that promote a certain learning mode, we investigated how the particular OL outcomes (the restructuring in form of the "Office for Senior Citizens" in southern city's administration and the strategic shift towards "Empowerment" in northern city's administration) are embedded in their respective cause maps, or how they influence and are influenced by other concepts. To illustrate the findings, we include two fractions (Figures 4 and 5), taken from the respective organizational cause maps. We confine to a graphical representation of the two dominating concepts and their in- and outgoing causal relations, which were shared by organization members.

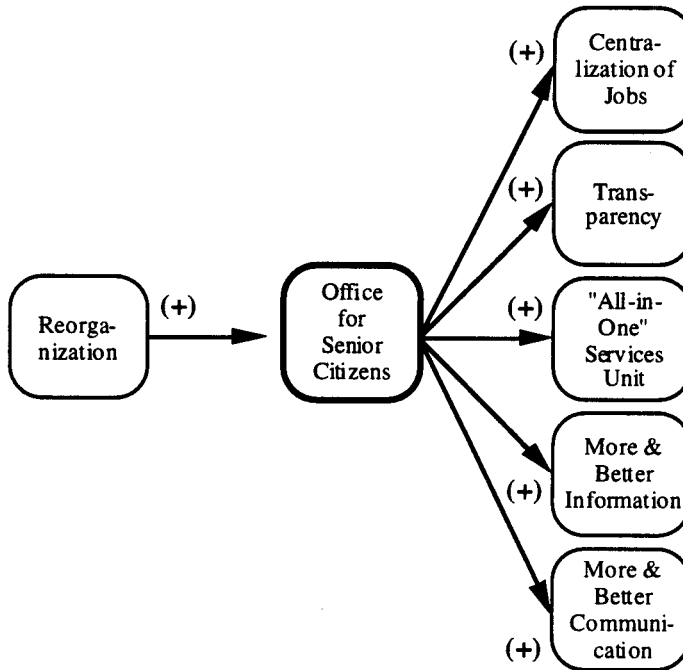


Figure 4: Fraction of organizational cause map (Southern City - Organization  $t_1$ )

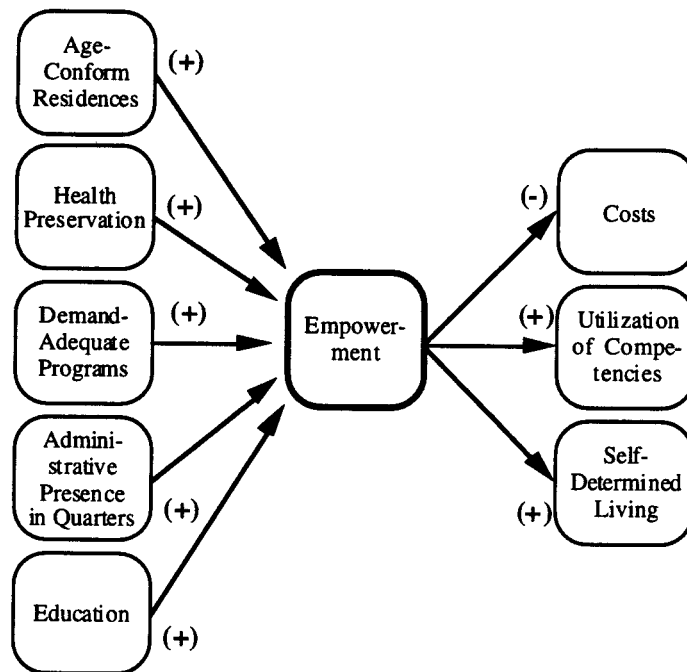


Figure 5: Fraction of organizational cause map (Northern City - Interactions  $t_1$ )

At first sight - disregarding the descriptive technical aspects "Reorganization" and "Centralization" - there is seemingly no reason, provided in the southern administration's organizational map, which "causes" the establishment of an "Office for Senior Citizens" (Figure 4). Knowing however, that there is no such "Office for Senior Citizens" in the organization today, it is legitimate to reverse the premises (presence to absence) of this and all connected concepts, in order to receive the relations that describe the current situation: "Absence of an Office for Senior Citizens" leads to "Intransparency", "Various Service Providers", "Poor Information" and "Poor Communication". Based upon this modulation, it is our interpretation that the causes for establishing an "Office for Senior Citizens" lie in its expected effects. We conclude that the "Office for Senior Citizens" is meant to be a remedy for problems, arising from a lack of organizational transparency. The trigger for the OL process thus is a problem.

It is clear that principally the same modulation could be applied onto the northern organization's map (Figure 5). However, we have to take into account that - in contrast to "Office for Senior Citizens" - it is not the role as a "cause" by which "Empowerment" surpasses the other concepts in its map, but its role as an "effect" (see also Table 9). It is thus particularly the left side of the figure - the ingoing causal relations - which deserves

consideration. On this side, one can observe that various programs ("Age-Conform Residences", "Health Preservation", "Demand-Adequate Programs", "Education" and "Administrative Presence in Quarters") are intended to contribute to the "Empowerment" of senior citizens. As they obviously do not represent actual problems, we conclude that it is the attractiveness of the vision: "empowering senior people to help themselves allows the administration to gradually withdraw from direct aid", which pulls them in a joint direction, thus triggering the OL process.

These interpretations are supplemented and confirmed when comparing structural measures of the respective organizational cause maps (Table 11).

	Organization t1		Interactions t1	
	Northern City	Southern City	Northern City	Southern City
Number of Concepts (cause*effect)	181*183	185*206	95*84	137*127
Number of Relations	417	527	219	289
Number of Shared Relations	10	32	12	7
Degree of Integration (relations per concepts)	1.26	1.38	2.74	1.66

*Table 11: Structural measures of organizational cause maps*

Two striking differences come into view: The degree of integration is by far highest in northern administration's map about interactions  $t_1$ . High integration indicates that the concepts contained in the map are highly interrelated with each other. In our viewpoint, this is due to the attractiveness of the concept "Empowerment". As seen above, this concept is able to align organizational change aspirations into a common direction, thus revealing the integrative power of a vision (Nanus 1992, Senge 1990). The absolute number of identical relations is by far highest in southern administration's map about organization  $t_1$ . Surprisingly, this does not impact the degree of integration. In our view,

this can be explained by high agreement on a few relations. As we have seen above, these relations are about a particular solution ("Office for Senior Citizens") to a particular problem ("Intransparency").

Summing up the results of the above analyses, it is important to stress that, obviously, the different learning modes correspond with different learning logics. While structural learning develops cures for problems, strategic learning seeks to realize visions. These findings are in line with assumptions of the literature on organizational change. Ford and Ford (1994), for example, confront the traditional logic of change - dialectics - with a new logic - trialectics - which is based on the writings of Ichazo (1982). They argue, that changes do not only result "from something being 'pushed', pressured or opposed, as in dialectics, but also from something being 'pulled', drawn toward, or attracted to different possibilities" (Ford and Ford 1994:775). In a more popular version, Hammer and Stanton (1995), with reference to the Bible, propose that it always needs a "wedge" which repels (Pharao's Army) and a "magnet" which attracts (Land of Milk and Honey), in order to change (Flee Egypt).

In the OL literature, the "magnetism" of a shared vision, inspiring people to work towards its accomplishment (Senge 1990), is as well to be found as "repellent" factors, such as errors, bringing people to search for corrections (Argyris and Schön 1978). They are, however, not discussed as antagonistic learning logics, nor are they related to different types or modes of OL. In the interest of stipulating such reflections, we offer these final propositions:

**P5:** *The different modes of OL correspond with different learning logics.*

**P5a:** *Strategic learning is more likely to occur, if there is a shared vision, which "pulls" OL activities.*

**P5b:** *Structural learning is more likely to occur, if there is a serious problem which "pushes" OL activities.*

## CONCLUSIONS

Drawing on insights of theories on organization, change, learning and cognition, we developed a screen to view organizations as learning systems. Collating the pictures, taken of two organizations, we pointed at the major correspondences and discrepancies between these two OL systems. As we have shown, the correspondences concern the generative role of communications - occurring as informal organizational learning networks - with respect to organizational knowledge changes. They further concern the relations between the information processed and the learning outcomes, which we called "learning modes". The pictures differed however, in that the OL results of one organization were clearly structural, while that of the other, strategic. We could show that the prevalence of an organizational learning mode depends on the relative strength of the respective learning network and that the different modes make use of different learning logics. While organizations, facing serious problems, are likely to fall in the structural learning mode, the strategic learning mode is favored by the existence of an attractive vision.

It may not surprise, that the pictures we took were even richer, containing more correspondences and discrepancies than the condensed results suggest. Within the frame of this paper, we concentrated on the most important findings and left out others, which were less central or less evident. Now, at the end of this paper, we want to sketch at least their outlines, as they extend the modes of OL to larger patterns.

Regarding the innovation oriented networks, we could observe differences in the attribution of, and access to power between the two organizations. While the structural learning organization predominantly allocates power in external domains, especially within the political arena, the organization in the strategic learning mode regards it to a great extent as being situated within the organization, and is aware of ways to approach external stakeholders. As the legal frame is equal for both administrations, these differences can at best be tackled as different levels of "organizational self-confidence". We assume that they affect the organizations' ability to initiate and realize OL processes.

Regarding the contents of the organizational maps on interactions  $t_0$ , i.e. current achievements of the organization, as assessed by the organization members, it turns out that the structural learning organization focuses strongly on production related concepts, while the organization in the strategic learning mode quotes to a larger extent customer related issues. For us, this indicates that a strategic learning mode profits from "customer orientation" as a guiding principle in the organization's culture, while "production

orientation" increases the probability that changes are restricted to structural improvements.

A further difference concerns the character of the concepts, as used by the interviewees. Members of the structural learning organization impress by detailed knowledge, often punctuating arguments with numerical specifications. Employees of the strategic learning organization, in contrast, use much more general terms. However, they sketch overall trends, outline interdependent issues and interpret complicated contexts. In our opinion, this indicates that specialized expert knowledge of organization members favors structural, while general strategic knowledge fosters strategic OL.

Finally, there is a last observation, equally to be found within both OL systems and concerning the role of management. It refers to the networking behavior of managers. Analysis shows that a high degree of networking activities at the managers' side corresponds with a high degree of networking activities on the side of the reporting organization members. In our view, this indicates that communicativeness and responsiveness of managers contribute to large and dense OL networks, thus catalyzing OL processes.

Bringing together the empirical findings, which we surfaced and elaborated into propositions, with the indications behind the scenes, which we pointed out in this last chapter, yields a pattern of characteristics (Figure 6), on which the the actual learning behavior of an organization depends. Further research should especially concentrate on investigating these dependencies as well as on examining the proposed distinctions and conclusions across larger samples of organizations.



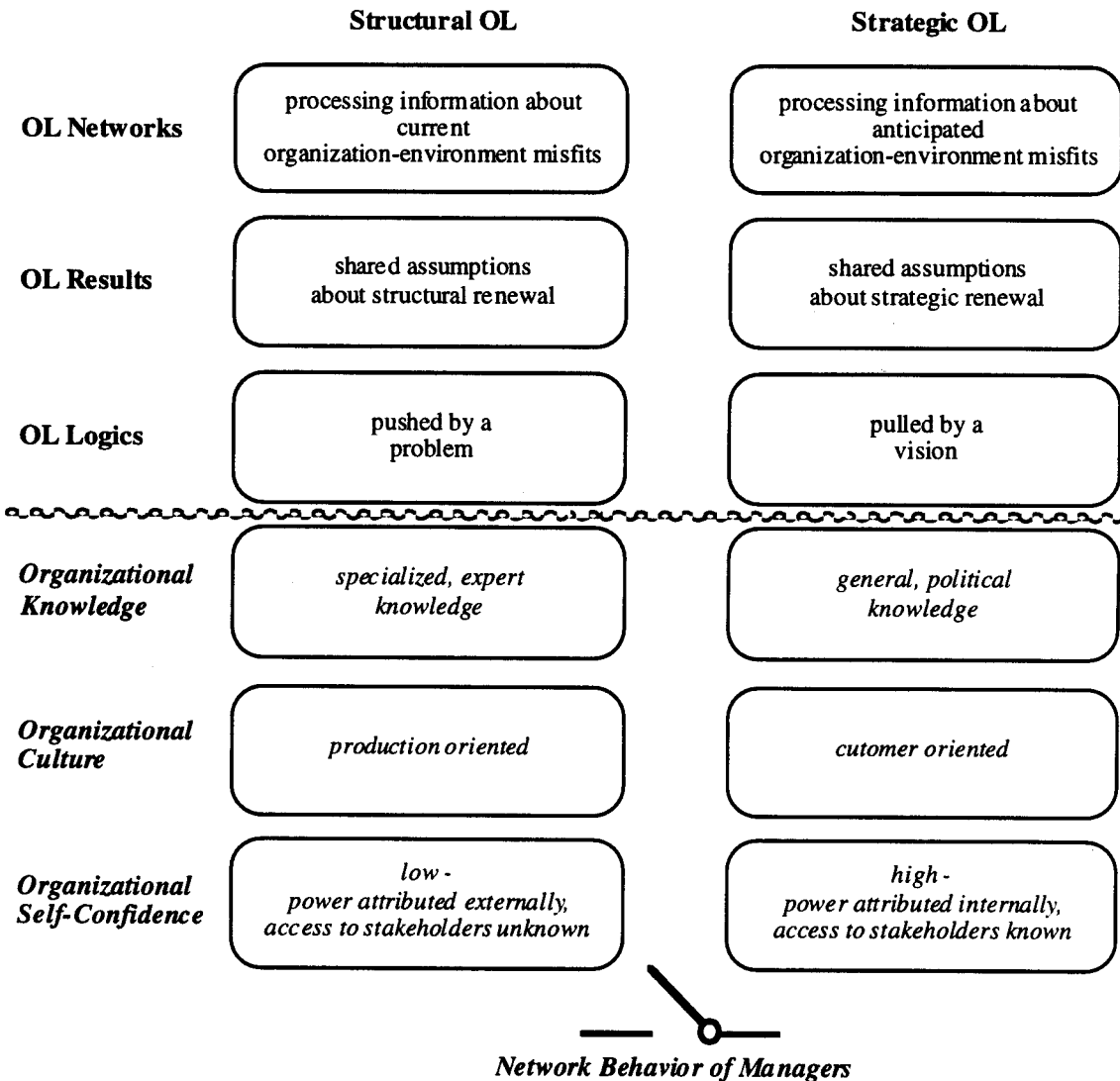


Figure 6: Patterns of OL

This paper has - on the basis of empirical observations - presented new constructions about the reality of OL processes. From a constructivist point of view, these constructions cannot claim to be accurate copies of the OL reality. Their purpose should rather be seen in stimulating further debate on OL. If this debate ends up with a transformation of the constructions on the participants' side, or even better, with a refinement of shared assumptions within the OL community, they were of use. Because then, learning had happened.

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## ENDNOTES

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- <sup>1</sup> TEXTPACK, Version V, Release 4.0 for PC, by ZUMA Mannheim, 1990.
- <sup>2</sup> On Microsoft Excel, Version 4.0.
- <sup>3</sup> A complete report of the study (in German), including all maps and networks, can be obtained from the authors upon request.
- <sup>4</sup> On SYSTAT for the Macintosh, Version 5.2, by SYSTAT, INC., Evanston, Illinois, 1992.