A Systemic Account of Learning Organizations: Defining the Learning Capabilities of Organizations.

D Vriens and E Philips
Department of Business Administration
Faculty of Policy Sciences
University of Nijmegen
P.O. Box 9108
6500 HK Nijmegen, The Netherlands
E-mail: D=Vriens%BW%kun@vines.urc.kin.nl

Abstract

In this paper we will develop a systemic framework for the description of organizations by which we will define 'organizational learning' and 'learning organization'. The framework will follow modern insights on systems-theory and will be used to define and operationalize these concepts. In order to do this, first, a general framework for observing/defining systems will be introduced. This will follow the distinction between 'organization' and 'structure' of systems. Secondly, the general framework for defining systems will be used to define organizations. To this aim, the 'organization/structure' dichotomy will be further conceptualized according to social systems-theory. Here, the autopoietic, communication-oriented notion of organization (Luhmann, 1988) will be used. A communicative definition of organizations, however, does not suffice: a rationale for defining a 'communicative whole' as an 'organization' should be given. These rationales are to be found in the perceived network of 'outputs and transformation' of the organization to-be-defined. Finally, to an organization, defined as a 'communicative' system, a number of properties might be attributed. Among these are learning ('organizational learning' and the 'learning organization'), flexibility and anticipation. These concepts can be defined adequately within the developed framework. To conclude, it will be argued that the defined concepts of flexibility and anticipation contribute to the understanding of the learning capabilities of organizations. Therefore, these concepts may offer an increased understanding of learning, and of how learning can be influenced. Consequently, this leads to an increased understanding of how organizations may gain viability.

A Systemic Account of Learning Organizations: Defining the Learning Capabilities of Organizations.

1. Introduction

Recently, much attention has been paid to `learning organizations' and `organizational learning' (eg. Senge, 1992; Weick 1990). Due to the complexity and turbulence of environments new demands are made on organizations to maintain viability. Rapidly changing technological and market conditions force organizations to adjust their competences. In these circumstances learning becomes increasingly important. The organizational capability to learn reduces eg. educational costs for production, development and environmental scanning. Therefore, stimulating organizational learning is of primary interest. For steering reasons a clear conceptualization of the learning organization is needed. Such a concept seems to be missing until now.

In this paper we will contribute to the discussion on how `learning organizations' should be conceptualized by developing a systemic framework for the description of organizations. By means of this framework it will be possible to define learning at the organizational level. To be able to define a learning organization, first a general framework for describing systems will be introduced according to modern system theoretical principles (section two). The distinction between `organization' and `structure' has a prominent place in here. Further, this framework will be used to define organizations. To this aim, the `organization-structure' dichotomy will be conceptualized further according to social systems theory. Here, the autopoietic, communication oriented notion of organization (Luhmann, 1991) will be used. A communicative definition of organizations, however, does not suffice; a rationale for defining a `communicative whole' as an `organisation' should be given. In section three we explore the possibility to use perceived networks of `outputs and transformations' as such a demarcation-criterion. By then, we have a tool by which it becomes possible to attribute properties to the organization as a whole. Among these are learning (learning, organization and organizational learning), flexibility and anticipation. In section four these concepts will be defined adequately within the developed framework.

To conclude, we will notice that the developed framework offers us insights in how the learning capabilities of organizations can be influenced. It may be clear that organizations will be better suited to adapt to environmental changes if they, first, recognize changed situations earlier and secondly, react quicker to these changes. These competences can be actualized by developing a learning organization. As aspects of learning, anticipation and flexibility, contribute to the viability of the organization.

2. Organization and Structure

In this paragraph we will develop a general framework for the description of systems. In order to develop this framework we will start with an exploration of the systems concept. The first section it will become clear what is meant by a system and why it is used.
Secondly we will point out why the distinction between `organization' and `structure' is useful. In section three we will describe the main characteristics or the systems approach as used by us. Finally, in section four, a presentation of the framework for describing systems will be followed by an explanation of how it can be used.

2.1 System

As we speak of flexible, learning organizations we usually mean by this that the organization as a unity (firm) has certain characteristics. Attributing these properties to an organization presupposes a consistent frame of knowledge by which these properties can be defined adequately. The question is what this frame consists of?

Intuitively, this frame somehow contains an idea of a `unity' which consists of different `elements' and the `relations' between these elements. By means of this frame it will be possible to describe certain phenomena at the unity-level with reference to the elements of the unity and their relations. As we speak of `an organization which adapts quickly and flexible to a changing environment', we make a statement at the organization level. In order to understand these system level properties, it will be useful to relate them to internal configurations of elements. This understanding might then eg. enable a designer to actually design `flexible' organizations. The systems concept, consequently, make it possible to attribute properties to unities. `System' refers to `the whole'. Thus, systems theory can be characterized by `thinking in wholes'. A system is conceived as a set of element and the relations between them. The properties of a system as a whole are not characteristic for the individual elements of the system. Checkland and Scholes (1992, 18-19) indicate that the emergence of system properties implies a hierarchical order. Systems at one level can be conceived as elements of a system at a higher level. Conversely, the system parts again may be seen as complex unities with their own emergent properties. Systems theory, therefore, is non-reductionistic; unities as a whole (systems) posses emergent properties which can not be carried back to the individual elements.

Furthermore, systems theory is an analytical approach. A system is conceived as a frame which can be used by an observer for ordering observations. By defining a system an observer points out that certain elements should be considered in connection. This should be done so that emergent properties can be described. What elements an observer wants to perceive and what relations he considers between them is an act of ordering. Such an act is done with respect to a certain goal. According to Spencer Brown (1969) making distinctions is fundamental for observing. The boundary that arises because of a distinction is observer dependent; different distinctions result in different observations. Consequently, every complex unity which is identified is a construction of an observer. From a constructivistic, epistemological position, therefore, systems cannot be seen as descriptions of ontic unities, but as a (subjective) hypothesis about relations in a perceived `reality'. Though several authors plead for an observer dependent systems definition (cf. Checkland and Scholes, 1992, Beer; 1979), it is not yet commonly accepted that these subjective system-definitions are just an ordering which makes observation possible. The starting-point of Maturana and Varela (Maturana & Varela; 1980, 1988) is that `anything said, is said by an observer'.
Otherwise, not only is every system definition observer dependent, but the object of `systematization' is a construction of the observer as well. If there should be an observer independent `reality' there is no way to check the correspondence between the object and the defined system. For correspondence can only be established by observation (von Glaserfeld, 1992).

2.2. System, Organization and Structure

An important concept in systems theory is adaptability. Due to changing, environmental circumstances, it is important for systems to adapt in order to maintain viability. Therefore the ability to change should be investigated. How this ability has been accounted for can be used to mark a difference between two kinds of systems theory; `modern systems theory' (MS) and `classical systems theory' (CS). Schwegler (1992) assumes that the dynamics of CS concerns the change in elements, which themselves are stable. He considers `substantialism' to be fundamental for CS; Systems consist of `stable elements' in which `All change is due to changing properties of these elements' (p29). The change of the elements (that constitute the system) themselves has not been in consideration. Systems in which this occurs are systems wherein elements disappear and new ones come into bear. This (dis)appearance is regulated by internal system processes. MS approaches do not only accept change at the level of (the properties of the individual) elements, but the change of (the amount of) elements as well. Changes can occur because of the limited life-span of elements (disappearance of elements) and because of the production of new elements. Consequently, stability should not be considered at the elemental system level.

In spite of this elemental instability, it is possible to attribute stability to a unity as a whole; different constellations of elements realize the same system. However, to judge a constellation as a realization of one system, one needs criteria for `sameness'. The question is, therefore, what remains stable in systems, wherein elements continuously degenerate and new elements are added?

What remains stable in systems that reproduce itself continuously (as in autopoietic systems)? To clarify this question it is useful to distinguish between the `organization' and the `structure' of a system.

The `organization' of a system abstracts from existing material properties; it only considers the network of relations that constitutes the system as a unity. Maturana and Varela (1988) emphasize that the organization of a system concerns `all relations that have to exist among the components of a system to remain a member of a certain class' (p 37). The `structure' consists of the actual components plus the actual relations that take place between them while realizing the system as a particular composite unity characterized by a particular organization. Thus, structure refers to the actual components and relations which constitute a certain unity and realize it organization (p 37). Different structures can be realizations of the same organizations. Besides, every spatial realization (structure) can vary in time. Therefore, it is possible to identify a structure which can deviate from a structure at an other point in time. In other words, a system can be described as an succession of structures which realize the organizations. As soon as a certain structure ceases to realize the organization, the system disintegrates.

The conceptual couple `organization-structure' can be used to make the distinctions between CS and MS more clear. If from one system, characterized by an organization, at different points in time `pictures' of the structure would be taken, in CS at each picture the same elements would appear. However, the features of the elements might be changed. In MS, on the contrary, some elements might be disappeared while others might be added. The fact that it is possible for more than one structure to realize one and the same organization can be called `structural equivalence'. At the same time, if a structure is defined by an observer as a realization of an organization, as an effect, this realization restricts future structure possibilities. This restriction is called `structural determinism'.

2.3. The Used System Concept

Defining a system is drawing a boundary; the observer presupposes a certain invariance in organization and structure. As a result the boundary can be seen as a marking of the hypothesis of the observer with respect to the invariance of the defined system. The distinguished boundary is conditioned by:

1. The hypothesized relations among the elements (organizational aspects).
2. The current spatial realization (structural aspects).

Maturana and Varela (1980) elaborate this idea by defining a `unity' as an observer dependent ordering in an environment. Next, the observer ascribes a certain organization to the unity. Within this organization, it is possible for the unity to vary; the structure can vary with conservation of the organization and is conditioned by previous structures (arisen by the definition of the unity). Consequently, the four central notions observer, system, organization and structure can be related in the following sense:

1. An observer makes a distinction between a unity and a medium (background).
2. This unity is called a system. A system is the result of different hypotheses of an observer with respect to the invariance in related observations.
3. By means of invariance-hypotheses, an organization is attributed to a system. These hypotheses concern the relations between the components of the system.
4. This organization can be realized by a structure; this is the observed spatial realization of the organization of the system.
5. Several distinct structures can realize the same organization.
6. The invariance-hypotheses that dominate the definition of a certain system condition the `structural freedom' of the system. When a system is defined, not every structure can realize its organization. Certain criteria, which follow from the invariance-hypotheses that the observer made earlier, eliminate a range of structure. If an observer considers two spatial realizations consistent with respect to these hypotheses, they both can account for the realization of the same organization.
7. Attributing a certain structure to a system at one point of time limits the range of possible structures at later points of time. This is dependent on the observer who defined the system.

The fact that these possible structures depend on earlier realizations of the organization is called `structural determinism'. It is important to note that this structural determinism is observer dependent.

2.4. The General Framework

The framework presented in this section is a general tool for the description of systems. It will be formulated according to the above mentioned principles of MS. Accordingly, A system definition should be observer-dependent and account for the possibility of changing elements. A description of systems requires three elements. First there is an observer who defines a certain organization. This definition consists of a presupposed set of hypothesized relation among elements. The organization is realized by a certain structure. Consequently, both organization and structure are observer-dependent. The description of the structure, however, can not be made arbitrarily. The hypothesized invariance concerning the organization of the system condition the possible realization i.c. structures of the same system. Given a certain organization of the system a set of distinct structures can be defined. From this set one unique structure may be observed to realize the organization of the system at a given point of time.

As noted, our system-concept should account for the possibility of changing elements. Since we have seen that the organization of a system can be realized by different structures, the structure of a system may change under the condition of realizing its organisation. The set of possible structures that realize the organization, however, is restricted by the current structure. The defined organization and the current structure condition the generation of a class of equivalent structures by hypothesizing certain transformations of the current structure. From this class of equivalent structure one element is selected to become the next structure. This selection has the form of a filter comprising hypotheses concerning eg. priorities. This structure constitutes again the realization of the organization of the system. As depicted in figure 1 a system is constituted by an observer who defines an organization which is realized by some structure from which other structure can be generated (the equivalence class).

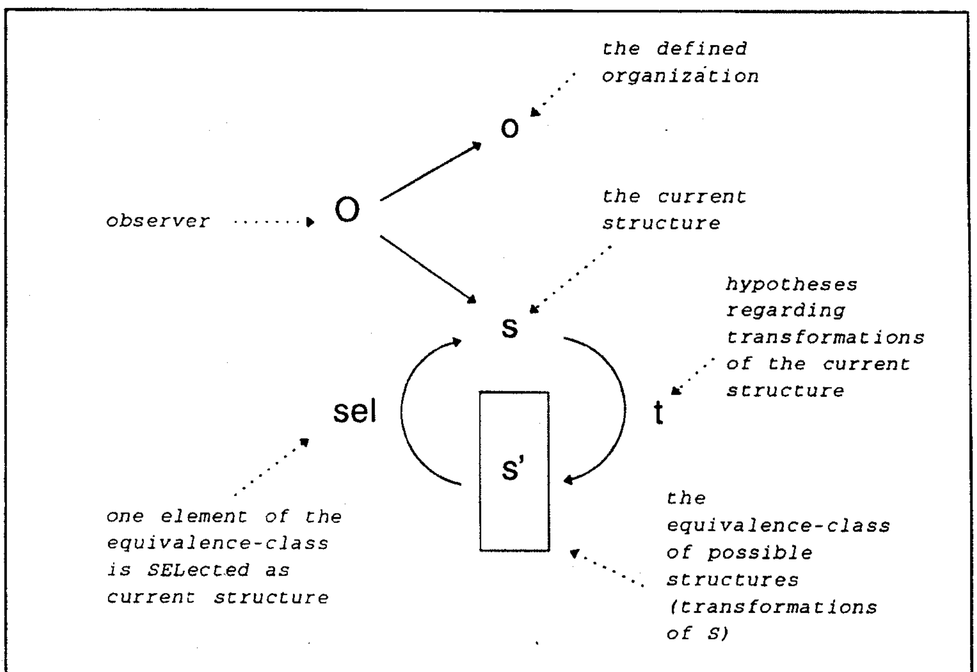

Figure 1 A general framework for defining systems: The 'OOS-triple'.

As a descriptive tool it seems possible to use the triple (observer, organization and structure) in two different ways. It can be used by an observer to describe a unity as a system with some organization and spatial realization. Applicating the triple can be understood as a way of bringing order into the observer's descriptions. The position of this observer can be inside or outside the described unity.

3. Defining the Firm

In this section the general framework for defining systems, as introduced above, will be used to define a firm. This means making clear what the `organization' and what `the structure' of a firm might consist of. In order to do this, the theory of `social systems' (Luhmann, 1984) will be followed. Luhmann presents a view of social systems as `autopoietic systems of communications'. Firms, in turn, are special cases of social systems (Luhmann, 1988) in which the communications have the form of `decisions'. By defining a firm in this way an explicit choice has been made concerning the organization of a firm (`autopoiesis') and the possible structures (`coherences of communication').

In this definition, the elements of a firm are thought to be communications. These should not be seen in the context of the traditional transmission-metaphor. Instead, following Luhmann (1984), `a communication' should be conceived as a synthesis of three `selections': the selection of information (performed by the `sender' in choosing what is to be transmitted), the selection of a `message', which concerns the choice of how to transmit the information, and the selection of `understanding', which is performed by the receiver and consists of `making sense' of the message. Understanding takes place when a sender is able to extract information from a message. Whenever these three selections occur, a communication occurs. The product of these selections, the communication, is attributed to a firm by an observer. These communications are thought to interact in such a way, that the system as a whole could be described as autopoietic. A system is said to be an autopoietic system if it consists of elements (distinguished by an observer at a suitable level), that interact in such a way that leads to the production of (the same type of) elements that, in turn, are integrated in the system. Autopoiesis is a continuing process of "bringing forth" (cf Maturana and Varela, 1988). Turning to firms, this implicates that communications (being the elements of the system) engage in a process of interaction leading to the production of yet other communications: in firms one can only distinguish communications and these communications can only lead to other communications. Because of the self-productive nature of autopoietic systems (at the level of the elements), they are said to be closed, ie. they do not exchange elements with the environment.

According to Luhmann (1988) the communications within `a firm', as a special kind of social systems, can be conceived as decisions. A decision is seen as a `contingency-transformation'. Both the state a decision transforms and the state into which it is transformed consist of a number of possible courses of action (both states may, however, differ in either number or nature of the courses of action, depending on the transformation).

One may wonder, however, whether all communications transform contingencies, and, hence, if decisions can serve as a defining element of firms as social systems. A firm is a coherence of communications (according to Luhmann: decisions). The organization of the firm is thought to be autopoietic. This means that the elements of the system (communications/decisions) exist in a network of relations in which they produce themselves as well as the system they are observed to be part of. The structure of the firm consist of an actual realization of the (coherent) network of communications.

In this section we will elaborate on the choice of a firm as an autopoietic communicative system. When the autopoietic nature of social systems is taken seriously it follows that once a social system of communications has been established, there should be a clear distinction between communications that are elements of the social system (ie. brought forth by it) and those, which are not. It should also follow that when communications cease to produce other communications, the social system should disintegrate. When the observer defines a firm as a social system the question is: what criteria are used to define a firm as a particular network of communications, ie: What is the observer's demarcation criterion for choosing a particular set of communications/decisions as a coherent one?

Without being able to specify such a criterion, the (perceived) autopoietic nature of firms is also hard to defend. Any autopoietic system should somehow produce a demarcation-criterion according to which it is possible to indicate what elements belong to it. Although Luhmann acknowledges this (eg. in saying that a firm should somehow establish its identity, 1988 p. 167), he does not give any clues on how this might be done. It is the aim of the rest of this section to illuminate the possible nature of such a criterion and how it could be used in defining firms. To set up such a demarcation-criterion, it will be useful to consider the concept of `change' or `difference' as described in cybernetics (Ashby, 1958). In section 2 we noted that MS accounts for both systems stability and dynamics. Several structures could realize one organization. These structures could consist of different elements. Consequently it is not appropriate to consider a demarcation criterion at the level of the elements, for then it is impossible to decide whether two different structures at different points of time are realizations of the same organization of the system. This is the reason why the demarcation criterion should be found in the relation between different structures. This relation consists of change. In describing change, the important point is that an observer defines an `initial stage' and an `end stage'. The difference between these states is called the (observed) `change' (transformation) of the initial state into the end state. The distinction of (initial and end) states and, hence, that of change, is taken to be constitutive for the criterion for identifying a coherence of communications. In fact it is asserted that, in order to distinct a set of communications as coherent, one needs a second distinction: that of change. So, describing the demarcation criterion will take the form of making clear what the distinction of `change' amounts to and how it can be used by an observer to distinct a particular social system, i.c. a firm.

The basic entity for building the demarcation-criterion for the distinction of social systems might be the following string:

(1) I ---> T ---> O

This is to be read as: "a transformation T transforms some (initial) state (input I) into a new state (the end state); the output O". The nature of the states, an observer identifies, is not a priori limited. Important to note, however, is that they are observer-dependent, and therefore limited by the distinctions the observer already made. Thus, an initial state may be `a pile of half-fabricates'. The end-state could be `assembled products'. In all cases the observer hypothesizes these states to be connected and terms this connection the `transformation' of one state into the other. Because both I(nput) and O(utput) are `states', and all input-states can be considered as the output of some transformation, the following string will be treated as equivalent to (1):

(2) ---> T ---> O

A transformation can be seen as some `sequence of actions'. Next, transformations can be decomposed. This means that one or more sub-states (residing between the initial and end state) may be distinguished. In doing so one also distinguishes two (or more) sub-transformations changing the initial state into a sub-state and eventually transforms some sub-state into the end-state. When distinguishing one sub-state, this can be captured by (3):

(3) ---> T" ---> O' ---> T' ---> O

This may be read as: "a transformation T" realizes sub-output O' after which transformation T' realizes output O". From (2) and (3) it follows that T can be replaced by T" ---> O ---> T'. In this last string, the relation between T" and T' may be dependent (ie. T" must be performed before T') or it may independent (ie. there are not sequential demands). In the case of independent transformations, T can be replaced by both T" ---> O1' ---> T' and by T' ---> O2' ---> T" (notice however that the resulting sub-outputs differ). The above breakdown in sub-transformations may be performed again for the identified sub-transformations themselves. This stop until the observer reaches an adequate level of description, where adequate is defined in terms of the purposes of the observer. At this `adequate' level some transformations are broken up only to a certain extent, whereas others are decomposed in a very detailed manner. Thus, the description of transformations may differ in `depth'. If all (sub)transformations yield some (sub-)output, there is a suitable conjunction of (sub-)transformations realizing the (overall) output (end state). This conjunction is again a higher level transformation. A description in terms of transformations and outputs may take the form of a one row matrix as given in

S01	S02	S03	...	S0n
t1	t2	t3	...	tn

Table I

In this matrix SOi is sub-output i and ti is the transformation realizing SOi. When all the transformations are dependent, SOn is also the overall output. If not, one of the sub-outputs may be the overall output. As an example, when considering a factory producing cars, the end-state may be a car or a number of cars. In reaching this end-state, the `main' transformation is transforming raw materials into cars (producing). This main transformation can be broken down in sub-transformations, yielding sub-outputs. Some sub-outputs must lead to the design of the car, while others must lead to a motor and a coachwork. The last being independent of the second, but dependent of the first. As descriptions of the firm, different members of this car-producing firm will identify other strings of transformations and outputs. Managers will probably not be able to detail all transformations yielding a motor as output as can be done by the members actually carrying out (parts of) this transformation. Different members will have different descriptions of the firm - dependent on the purposes of description.

This discussion about observing a firm has been focused on what can be called the "descriptive stance". In this stance, the current realization of a transformation is important - it is a description of a firm in terms of the observed current realization of the (sub-)output(s) and transformation(s). Another important stance is the "design-stance".
The emphasis in this stance is on possible ways of describing, ie. on how outputs could be realized through transformations. In essence, in this stance, the descriptive matrix from above is extended with more transformations:

S01	S02	S03	...	S0n
t11	t21	t31	...	tn1
t12	t22	...		
t13	...			
	...			tnn'

Table II.

In the extended matrix, the transformation tij is said to realize sub-output i. For each suboutput a class of transformations (the column) can be identified. The design-stance matrix (see Table II) includes the current realization (table I) as a special case. It is the function of the transformation to lead to the sub-output. Therefore, the classes of transformations yielding the same output are said to be "functionally equivalent". The sub-outputs can serve as a generative mechanism for the transformations resulting in an equivalence class: all transformations that will produce the output will be allowed as member of the class. There are two kinds of criteria in constructing the matrix as a descriptive tool: one for deciding whether a transformation is a member of the equivalence class yielding an output; while the other has to do with the suitability of combinations of transformations.

The overall output can also be viewed as sub-output in yet an other transformation, yielding some output. In terms of output-transformation-strings the output O of string T"-> O' --> T' --> O can be a sub-output in another string:**T"** --> O --> **T'** etc., resulting in connected configurations of transformations and (sub-)outputs. In these configurations the same design-stance possibilities apply, resulting in several connected matrices. The overall output (the output not considered in another string of transformations and outputs) is described as a disjunction of conjunctions of sub-transformation. This is not less than saying that identifying an output plus transformation and next decomposing the transformation into sub-transformations and sub-outputs can be applied, recursively, to several levels: the overall output at one level can be viewed as a sub-output at another level. Thus while O can be observed to be realized through sub-transformations t1 and t2, it may also be realized by t3 and t4. The transformations (t1 AND t2) and (t3 AND t4) are member of the equivalence-class of transformation realizing O. As sub-transformations, however, they are also members of the class of transformations realizing the associated sub-outputs.

An observer can thus define a complex whole of outputs and transformations. This whole will be termed an `output transformation network' (OTN). Once an OTN is constructed (from a design-stance point of view) it can be subject to alteration. It may be that some transformations can no longer yield the desired (sub-)output (eg. some machine is out of order).
These transformations are no longer allowed as member of the equivalence class of the output. It may also be that some sub-outputs are no longer needed in the conjunction of transformations yielding the overall output. Also, new transformations can be added to the equivalence-class of an output. A further change of an OTN is the insertion of a new (sub-)output, because the overall-output changes. Next to insertion and deletion of outputs, they may also be "extended", meaning that an output can be replaced by an output that has an equivalence-class that among other transformations, includes the members of the class of the output that is replaced. When, eg. it is found, that besides a metal coachwork a plastic one will do just as well. The main point of introducing these OTNs is that it is asserted that they are used first, in the definition of the `current' structure of a firm (where the descriptive stance dominates) and second, in the description of the class of possible structures, deriving from the `current' structure (in which the design-stance dominates).

In defining a firm as a social systems - ie. as an autopoietic system of communications the OTNs serve as reference-points to decide what communications are thought to be `inside' and `outside' the system: OTNs serve the demarcation-criterion. As members of a firm, observers use their OTNs as rationales for communication. Having an idea of what the demarcation-criterion looks like, the question is how it can be used in defining a firm. This is answered with the aid of the general framework for defining systems (section 2). The framework stated that an observer distinguishes a unity from its background, and in doing so, has a sense of the organization and structure of the system that emerges. Within the limits of the defined organization a system may vary its structure by means of some transformation. As noted, the observer hypothesis about the possible transformations of the current structure, and so defines a class of possible structures ie. the result of the possible transformations. Later, a new structure is observed, (possibly a member of the set of structures, the observer hypothesised to be the outcome of a transformation) and thereby a transformation is inferred. This new structure becomes the starting point for new hypotheses concerning possible transformations.

In the definition of a firm the framework should be used at two levels: `external and internal'. First, at the level of the whole, an observer can define a firm, organizationally as an autopoietic system of communications, and structurally, as some instantiation of this organization. This yield as external definition of a firm. Second, at the internal level, each member of the firm has some idea of the organization and structure of the firm as a system. Thus, in the internal definition members of a firm have some view (in terms of the `general framework') of the firm they are member of. This definition is used as a rationale for further communication. In both definitions, a demarcation-criterion is needed to view a coherence of communications as a coherence of communications. In both cases, it is asserted, that the OTNs play an important role. In defining a firm externally, an OTN is used as an ordering-principle, ie. it is used to draw the border that is needed to decide what communications belong to the firm: each communication that can be linked to this OTN (ie. coupled to a (sub-)transformation or (sub-)output is viewed to be an element of the system). In an internal definition, an OTN is not only used as an ordering-principle as in the external definition, but also as a reference-point for further communication. As such, OTNs may be viewed as part of communications ie. as part of the information-selection.

In both internal and external use of the framework an OTN is used to form the current structure of the system. Only the descriptive stance is needed and a coherence of communications is identified as coherence because of it perceived `fit' to an OTN. To describe the possible transformations to the current structure, the design-stance is needed: all (sequences of) communications are taken into account that can be `matched' against the possible options as described by an OTN. The match between `structure' (a particular coherence of communications) and OTN can only be specified by an observer. When a new communication has been made, a different coherence of communications emerges and thereby a different structure of the firm. This also influences the OTNs of observers of the firm, who use the changed OTN, again in hypothesizing about transformations of the structure. OTNs and the structure of the firm are therefore mutually dependent.

To summarize this section, it was asserted that in order to define a firm as an autopoietic system of communications, one needed a demarcation criterion. This was set up by means of transformations and outputs, yielding connected structures: output-transformation networks. These networks, in turn, were used as ordering principles (demarcation criteria) in the external definition of a firm and in the internal definition whereby they are part of the communication. In the next section the emphasis will be on how these definitions may be used to describe flexibility, anticipation and learning.

4. Learning, Flexibility And Anticipation

The learning of a system has something to do with knowing what behaviour is viable. Viability assumes adaptability, and, following Ashby (1958): the generation of sufficient (`requisite') variety. As such, learning fits in our scheme. In the OOS-triple, the reference point for defining learning is the sequence of structures, and observer identifies.

A sequence of two structures can take two forms: either the structures are identical[1] (S1 = S2, `situation A) or different (S1 # S2 `situation B'). We reserve the term `learning organization' for the latter case in which an observer can positively attribute learning to an organization, given the observed difference in structures. In both cases however, an observer can assume that `organizational learning' has occurred. Organizational learning can be defined using the structure-cycle of the OOS-triple. Four different situations can be described, as given below:

1. The equivalence-class doesn't change AND the selection-function doesn't change.
2. The equivalence-class doesn't change AND the selection-function changes.
3. The equivalence-class changes AND the selection-function doesn't change
4. The equivalence-class changes AND the selection-function changes.

When no change in structures is observed (`situation A'), these four situations mean that:

- A1. all remains stable (structure, equivalence-class and selection-function)
- A2. a change in the selection-function has occurred but didn't lead to a change in structure. The consequence may be a later change in structures.
- A3. the change in the equivalence-class didn't lead to a change in structure, but many lead to this later on.
- A4. both A2 and A3 apply.

[1] Identical structures reflect the criteria an observer uses, which apply to the level of the configuration of communications but not the actual communications themselves -otherwise no structures can be judged as the same.

When a change in structures is observed (`situation B'; a Learning Organization is recognized), these four situations can be understood as follows:

B1. A change in structure cannot occur when the equivalence-class and the selection function remain the same. This situation doesn't apply.
B2. A change in the selection-function has lead to a change in structure.
B3. A change in the equivalence-class had lead to a change in structure.
B4. Both B2 and B3 apply: both a change in the selection-function and a change in the equivalence-class have lead to a change in structure.

Learning, in an organization context, can now be differentiated accordingly. First the difference between the `learning organization' and `organizational learning' can be established. The learning organization concerns the observed difference in structures (see above). Organizational learning, at the other hand, concerns a change in equivalence-class and/or a change in the selection-function. Second, in the case of organizational learning, a change in the equivalence-class is termed `1st order learning', while a change in the selection-function will be called `2nd order learning'.

As stated before, a structure is a member of the (OOS-triple) equivalence-class if it can realize the defined organization and if there exist plausible hypotheses about it generation from the current structure (ie hypotheses concerning structure-determinism). These hypotheses, in turn, might be linked to the networks of output and transformation. OTNs were used to describe the current structure of a firm (descriptive stance), and to arrive at possible other structures, ie. in constructing the equivalence-class of structures associated with the current structure (design stance). Now suppose that one has an OTN as demarcation criterion for deciding what counts as a structure of a firm, and, hence, for deciding what communications are part of that structure. In this case, only those communications that the observer can associate to this OTN will be allowed as (possible) member of the structure (coherence of communications). One could say that the more complex the OTN, used as demarcation, the more transformations of the current structure are allowed and, therefore, the larger the class of equivalent possible structures that can be acknowledged.

Given the relation between OTNs and the (possible) structure(s) of a firm, it may be seen that if an OTN is changed, the structures that will be allowed in the equivalence-class will also change: the eqivalence is relative to the transformation as allowed by the OTNs.
A limited OTN, for example, will allow an observer only a limited amount of equivalent possible structures, as a result of the transformation of the current structure. It is asserted that if the OTN is changed (by eg. recognizing more sub-outputs and sub-transformations see section3) and thereby the demarcaion-criterion for what is to count as a structure, the observer can relate more communications of the structure of the firm. The result is a change in the equivalence-class of possible structures. Learning can thus be related to changes in the OTNs.

As members of a firm, individuals have some demarcation criterion in the form of an OTN. These OTNs result for every individual in an equivalence class of possible structure. These classes are probably not identical. which reflects different OTNs and/or different capabilities to transform (given an OTN) the current structure. In order to keep on making sense of what is going on around the individual members of the firm, they will probably engage in changing their OTNs and/or finding new ways to transform the current structure (resulting in a change in equivalence-class). They can also change the selection-function. With members of the firm, the construction of the equivalence-classes plays a role in communicating: it serves as a background against which one communicates and, hence, against which a new structure can be established. As a new current structure is established, it serves for all participants as a new starting point for generating a new class of possible structures. As such, it may induce further change in OTNs and therefore in the equivalence class and so on.

When one uses the framework for describing a firm externally, and thus arrives at a firm as a (n autopoietic) system of communications, one also needs an OTN as demarcation-criterion. Again, it serves as a rationale for constructing the equivalence-class of possible structures. However, these structures are not used in the communication process itself. If an observer needs to change the OTN that is used, or searches for better hypotheses concerning transformations of the current structure in order to make sense of his/her observations, learning may be attributed to the firm. This means that learning of a firm - as a whole - is dependent of the observer. Indeed, different observers having different OTNs in relation to the firm and having different capabilities in generating possible structures, may observe different learning capacities.

The account of learning as change, as developed so far, lack an important aspect: that of direction. Learning is mostly associated with `better performance', or stated more systemically: `maintain viability'. In investigating learning, `wrong behaviour', ie. changes in the direction of disintegration of the system, should be avoided. Statements like `he learned the wrong behaviour', are always stated against hypotheses about the viability of the system that learns - which, in this case, may not be the same (hypotheses) the system itself developed. Thus, in defining learning with respect to a firm, one also needs to have set of plausible hypotheses about the viability of the firm and about how structures are associated with maintaining viability. Although these viability-hypotheses concerning structures, are highly dependent on specific situations, it may be possible to give two general maxims for the generation of these structures. The `flexibility-maxim' and the `anticipation-maxim' serve viability in that they suggest certain modifications of the OTNs, which may lead to the generation of more structures, to which viability may be attributed.
Viability can be maintained by these maxims in two different ways. First, flexibility suggests the generation of as many structures as possible given the current situation. This reflects the idea that `one should always try to act in such a way that the number of options to handle some situations increases'. Secondly, the anticipation maxim directs the generation of structures in order to obtain a **specific** situation. Following this maxim, structures should be chosen that realize this situation. The anticipation-maxim, then, is a specific application of the flexibility-maxim. Also, flexibility can be conceived as `non-specific anticipation'. Translated to OTNs, this means for flexibility: try to enlarge the network as much as possible. The more complex an OTN, the more structures that can be generated. This increases the chance of finding a viable structure. Next, concerning anticipation, an OTN should be chosen that can lead to a set of structures that realize the anticipated situation. At the same time one should maintain the ability to anticipate. This ability increases with the chance to identify more specific, future situations. The more complex an OTN, the greater the chance to identify these situations. The ability to maintain anticipative, therefore, depends on flexibility.

5. Summary and Conclusion

It was the aim of this paper, to contribute to the discussion on learning in the context of organizations (firms). To arrive at a definition of learning, it was argued that a systemic framework could be used. This framework enables one to identify the object to which learning could be attributed. Learning concerns maintaining the viability of a system, ie. the ability to adapt to differing environmental circumstances and concerns, therefore, change. The framework for defining systems should thus account for stability (at the level of the object: its organization) and for dynamics of a system (structure). To use this framework for defining a firm, it was suggested that the autopoietic notion of communicative systems as proposed by Luhmann could be used. To define a firm as a coherence of communications, the OTN-concept functioned as a demarcation criterion. With these elements it was possible to define learning in the context of firms: a distinction could be made between `the learning organization' and organizational learning'. Furthermore, within organizational learning, 1st and 2nd order learning were distinguished. Finally, to accomplish the definition of learning, flexibility and anticipation served as directive mechanisms.

It could be concluded that this approach yields a coherent concept of learning, in which several aspects, on which agreement seems to be lacking, can be consistently specified. This concept of learning may serve as a reference-point for the development and judgement of managerial measures with regard to learning.

6. Literature

Ashby, W.R. 1958. *Introduction to Cybernetics.* London: Chapman & Hall.

Beer, S. 1979. *The heart of the enterprise.* London: Wiley

Checkland P and Scholes J. *Soft systems methodology in action.* London: Wiley.

Glasersfeld, E von 1992. Konstruktion der Wirlichkeit und des Begriffs der Objectivitat In *Einfuhrung in den Konstruktivismus.* H Gumin and H Meier, 9-39 Munchen: Piper.

Luhmann, N 1984. *Soziale Systeme.* Frankfurt am Main: Suhrkamp.

Luhmann, N 1988. *Organisation in Mikropolitik* Ed. W Kuppers and G Ortmann, 165-186. Opladen: Westdeutscher Verlag.

Maturana, H R and Varela F J 1980. *Autopoiesis and Cognition.* Dordrecht: Riedel.

Maturana, H R and Varela F J 1988. *De boom der kennis.* Amsterdam: Contact.

Senge, P 1992. *The fifth discipline.* London: Random House

Spencer Brown, G 1969. *Laws of form.* London: Allen and Unwin.

Schwegler, H 1992. Systemtheorie als Weg zur Vereinheitlichung der Wissenschafften? In *Emergenz: die Entstehung von Ordnung, Organisation und Bedeutung.* Ed. W. Krohn and G Kuppens, 27-56, Frankfurt am Main: Suhrkamp.

Weick, K E 1991. The nontraditional quality of organizational learning. *Organizational Science 2* (1): 116-124.