

## **The role and dynamics of schemata in strategic sense making process**

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### **Abstract**

The aim of this paper is to understand the structure and dynamics of schemata and to describe information filters that dampen weak and potentially vital signals during a sense making process. We apply complexity theory, cognitive decision making theory and strategic management theory to describe both the information filters and the outcome of the sense-making process, the schemata. Two research propositions are tested by using a case study of two different risk scanning methods: the Failure Mode and Effect Analysis and weak signals analysis. Thus, this paper contributes to the existing theory on organizational sense making by developing a coherent model of information filtering phenomena in a decision making process.

## Introduction

A strategic plan has a dual impact on the organization. A well-defined vision, mission and strategy creates execution/implementation power (Minzberg et al 1995, Walsh 1995). However, a too strong strategy process can reduce the organization's sensitivity to adjust to changing environment (Minzberg 1995, Brown and Eisenhower 1999, Sanchez 2002). When volatility or complexity increases, flexibility becomes one of the key issues in strategy process (Sanchez 1995). In this context, strategy-building process is viewed as a dynamic system (Senge 1990).

From a cognitive perspective the strategy process is a sense making process (Weick 1995, Hendry, 2000). Cognitive decision making theories (Walsh 1995) view organizations as systems of meanings that are shaped by social processes of making sense. The key to understanding flexibility is the construction - or deconstruction - of meanings (Ericson 2001, Gioia 1986). These in turn are determined by a set of mental models or schemata. The schema is a set of mental models that includes the organization's current image of its operating environment, its internal rules, recipes of action as well as its rules for co-evolution with similar systems (Anderson 1999, Dutton 1997). ..

In order to reveal the dynamics of the schemata, we analyse a case where a project organisation used different means for analysing potential deviations from their strategic plan or schema. In this case the deviation analysis was prepared as a part of standard risk management practises (see e.g. PMI 2000)

The current paper focuses on the following question: What is the schema(ta) and the sense making process in particular when the risk stimulus is weak or tacit by its nature?

## 2. Theoretical framework

The theoretical framework of this study is a combination of four different basic sources.

First, complex adaptive systems (CAS) theory sets the requirements of the decision making and sense making processes in the unpredictable, complex context (Anderson 1999, Dutton 1997, Anderson and McDaniel 1999, McDaniel and Walls 1997). A decision making process is a process of acquiring data, processing it and forming or changing some of the current knowledge structures (Walsh 1995). The role of cognitive decision making is to reduce the complexity of the environment by establishing simplified knowledge structures of implementation plans (Weick 2001). In this respect decision making process is a sense making process (Weick 1995). Sense making includes both explicit and implicit mental processes of scanning, framing, interpreting and constructing a conception of the situation at hand (Ericson 2001). The process covers capturing of the stimulus, evaluating the meaning of it (plausibility compared to the current explanations) and then reconstructing the reality (Weick 1995). In the level of the organization, the sense making process produces a shared belief system that makes coordinated action possible (Bogner and Barr 2000) by providing a common framework for noticing and interpreting new stimuli and for coordinating appropriate action.

Second, the theory of social cognition describes the structure and dynamics of sense-making processes and the dynamics of mental models or schemata change (Walsh 1995). The cognitive frameworks or schemata are socially construed (Berger-Luckmann 1966) and they determine how organisations make sense of and within their environments (Fiske and Taylor 1991). Organizations use the current mental models of schemata as a reference for evaluation and to make sense of new information (Hasan and Gould 2001). Mental models and cognitive schemata are not only a point of reference, but they represent rules that direct information processing that guide the individuals' attention and memory towards scheme-consistency (Ericsson 2001). Also, they fill in white spots where information is missing (Gioia and Poole 1984).

A sense of threat or distress is a major obstacle in the sense making process (Weick 2001, Baumeister 1996). Organizations apply different interpretive defenses such as avoidance (retreat, isolation) and refutation (denial) (Baumeister 1996, McCaskey 1982). If the threat is severe (i.e. has a potential to threaten the existence of the organization), the basic mechanism of defending current schemata is even stronger (Weick 2001). There are several studies on the subject and one of the outcomes is that unpredictable risks are not evaluated at all (Tenbrunsel et al. 1996, Minzberg 1995).

Third, strategic management literature on the identification and treatment of weak signals (Ansoff 1984) describes the role of filters in strategy process. In order to change the mental model of the decision-maker, the

stimulus has to survive through out the sensemaking process (Weick 1995). Ansoff (1984) defines three different types of filters which dampen the stimulus throughout the different phases of the decision making process; the observation, cognitive and power filters. The observation (or surveillance) filter narrows the field of observation which is often defined by the current strategy or a specific task. It tends to disregard discontinuities coming outside the commonly established focus. In the sense making process, the reduction criteria are based on the managers' experiences and their reference points. When the signal encounters a cognitive (or mentality) filter, acceptance of new ideas is hindered as it is not supported by the current mental model. The power filter can impede novel information captured from the operating environment if it risks to cause changes in the present power structures. The managers whose importance might be reduced by this signal use their power filters to neglect this possibly vital information.

The fourth element of the theoretical framework used in the current paper comes from project management literature, in particular the analysis of possible deviations from the original project (or strategic) plan and drafting of corrective actions (adjustments) to keep the project on track (see e.g. PMI 2000, McDermott et al. 1996, Stamatis 2003). Such tools provide quantitative risk evaluation procedures and tangible information about possible risks related to the execution of the project plan. It thus offers a complementary approach and a consistency check to risk analysis of tacit, weak signals described above.

### 3. Research propositions

In order to understand the dynamics of the schemata, this paper focuses on the structure of the sense making filters and describes a construct of them. If the information filter is narrow it means that the sources of the mental model elements are scarce. If the filter is wide, it means that there is a large diversity of different elements in the mental model. Therefore the deviation of different issues will be high. The information filter is deep if there are multiple decision making points during the process. A power filter is active when decisions are made on what signals are important enough to take corrective actions. The earlier a power filter influences the sense making process, the stronger its impact.

In this study the dependent variables are the depth and width of the filter structure.

- ✓ Width: diversity of participants, nature of the briefing, nature of the data collected and evaluated
- ✓ Depth: argumentation requirements, evaluation method, number of evaluation phases

The following two research propositions are put forward:

Proposition 1:

Diversity of participants produces a wider filter and thus increases diversity in the mental model.

According to the complexity theory, wide participation increases the complexity of the subsystem (Anderson and McDaniell 1999). Wide participation also increases the potential of diversity in mental models, thereby increasing the diversity of weak signals identified as inputs to the information process. *Ceteris paribus*, this should result in a larger variety of weak signals captured as process outputs (Weick 1995, Sharman 2000).

Proposition 2:

Well-defined briefs and argumentation requirements with exact evaluation criteria in multiphase process produce a deeper filter, which in its turn produces a focused mental model.

The current mental model rules and directs both the attention and the reference points in a sense making process (Ericson 2001). A more precise brief and clearer evaluation criteria produce less diversity in the scanning process (McCaskey 1982).

### 3.2. Methodology and description of case

The research approach of the present study lies in model building. It is feasible to combine a grounded theory with a case study, given that the relationship between the signals filters, mental models and strategic flexibility is a complex issue and suitable for using case studies (Yin 1984). The model building started off with collection and analysis of the actual data of the case study. In the next phase the dialogue between the review of theories of

organizational cognition and sense making was initiated (Eisenhardt 1989). The dialogue process was both iterative and communicative (Miles and Huberman 1984).

Triangulation (Eisenhardt 1989) was applied to enhance the validity and reliability of emerging theoretical generalizations. This study collected the material from different sources: interviews, document analyses and web-surveys. The web-based cognitive map method used diminishes the intervention impact of the researcher herself. All the conclusions were evaluated by the case organization's management.

The chosen case organization is the ATLAS project. ATLAS is an international scientific collaboration based at CERN, the European Laboratory for Particle Physics in Geneva, Switzerland. This organization was established in the early 1990s to design, construct and operate a particle detection device for the study of the ultimate structure of matter and the conditions that prevailed at the very beginning of the Universe.

The ATLAS detector is a capital investment of some 400 m\$, involving 1800 scientists, engineers and students from 150 laboratories in 34 countries. ATLAS is set to start in 2007. The implementation of the project follows from the discovery potential in new physics. The vision of the new fundamental physics discoveries has resulted in the selection of critical technologies needed to identify the new particles. This, in turn, dictates the competencies needed and the way ATLAS is organized and managed. Due to the complexity of the detector, comprising some 10 million components touched by human hand, the planning of the assembly sequence must take into account all possible deviations or technical difficulties encountered. The installation sequence is irreversible and critical components, once they have been inserted in place, cannot be dismantled without significant cost, delay or damage to the project. The overall ATLAS planning and implementation incorporates a dynamic feedback loop to quickly react to deviations in the plan and to re-adjust the planning accordingly.

This case study investigates two different methods for ATLAS risk management: the weak risk signals measurement run in January 2003 and January 2004 and a Failure Mode and Effect Analysis (FMEA; see e.g. McDermott et al.1996) in 2001 and updated in 2003.

The weak signals collection was web-based. The participants were project management, installation project management and senior experts. The enquiry 2003 had 19 respondents (70 % of invited respondents) and in 2004 there were 16 respondents (reply rate 50%). In the first phase the participants were asked to evaluate the Atlas project and give as many potential risk signals as they wanted (2003: 83 signals, 2004: 52 new signals). The format was a free field story format. In the second phase the collected signals were sent as such to the same respondent group for evaluation. Each of the respondents was asked to evaluate the potential relevance of 40 collected risk signals on the simple application of visual cognitive map to illustrate the relative significance of the displayed signals. No argumentation was required. The results were discussed in the installation management team meeting.

The FMEA process was initiated by dedicated meetings and later on run by e-mail. The participants were project leaders and the installation management team. The detector component manufacturing and installation risks were assessed separately. For methodological purposes, only the installation risks were included in the present analysis (i.e. the update made in 2003).The issues for evaluation resulted from the meetings attended by the installation management team and a member of the project management. Using the installation sequence plan as a basis, one failure mode and possible risk (and corrective actions) was identified per installation step per given sub-system. Each of the risk issues was scored from 1...10 by their potential frequency (impossible ...certain), detectability (immediately...not likely at all) and gravity (nil...catastrophic). The participants were asked to justify their scoring and re-evaluate the issues if needed. Issues that got a high deviation in the FMEA process were analyzed in more detail.

The two approaches (FMEA, weak signals) are comparable. The FMEA procedure was last run in mid-2003 and the first Weak Signals survey early 2003. During that period there were no prominent changes either in the context of the project or its operations, so the results are comparable (Walsh 1995). It was possible to compare the results of the Weak Signals survey between 2003 and 2004. Unfortunately for the present study, the FMEA procedure was continued on an informal (e-mail) basis and the documentation available for 2003 was not sufficient for a proper analysis.

#### 4. Empirical results

The case data was documented in an observation matrix that includes both the filter structure variables and the outcome variables describing the mental model explicated by the results of these risk surveys.

Dependent variable	FMEA 2003	Signals 2003	Signals 2004
Diversity of participants	Risk issue identification and evaluation carried out by installation management	Risk issue collection prepared by 19 participants with different backgrounds, evaluation by the same group	Risk issue collection by 16 participants with different backgrounds, evaluation by the same group
Nature of the briefing and evaluation criteria	Exact briefing, purpose (risk budget), evaluation criteria and scoring well defined	ambiguous	ambiguous
Nature of data	Fact-based issues Evaluation quantitative, qualitative comments	Stories as issues	Stories as issues
Argumentation criteria	Argumentation was required (anonymous)	No argumentation	No argumentation
Number of evaluation phases	Two	One plus reporting	One plus reporting
Number of categories	Categorized material 7 categories,	Categorized material, 13 categories,	Categorized material, 12 categories
Number of units in category, evaluation distribution	79,6% comments in 3 categories Relevance strong in technology and process-related issues. Deviation high in process issues, otherwise low	81,0 % of signals in 6 categories Relevance strong in systems, processes, human attitude and human knowledge. Deviation high in systems, technology and human attitude categories.	78,5% of signals in 6 categories Relevance strong human error, systems, technology and process signals Deviation high in Human error and process categories even distribution other issues

Table 1: Case data and summary, empiric results matrix.

The nature of the filter in the FMEA case was narrow (few participants with homogenous background, exact briefing, exact evaluation criteria, factual data) and two phase argumentation rounds. Whereas the filter of weak risk signals collecting was wide (diverse participants, ambiguous briefing and full qualitative data) and flat (only one evaluation round).

The outcome or the mental model is described with two elements: the number of categories (Hodkinson and Johnson 1994, Bogner and Barr 2000) and the units in each of the category. The profile of the mental model was narrower in the FMEA method (fewer categories) and the number of issues focused on fewer categories than in the weak risk signals surveys.

## 5. Conclusions

The aim of this paper was to understand the structure of schemata and especially to describe information filters that filter weak risk signals during a sense making process. The empirical evidence comes from the case study of two complementary risk scanning methods: the FMEA method and risk signals scanning in weak signals context.

The case study provided the following result: a sense making process with a narrow, deep information filter produces a simpler mental model. Also, a sense making process with a wide, flat information filter produces a more complex mental model.

The two research propositions were empirically tested. Proposition 1 stated that diversity of participants produces a wider filter and thus increases diversity in the mental model. And proposition 2 claimed that well-

defined briefs and argumentation requirements with exact evaluation criteria in the multiphase process produce a deeper filter that, in its turn, produces a focused mental model. The empiric results strongly support the first proposition. Wide participation increases the diversity in the sense making process and produces a more complex mental model as an outcome of the process. The first part of the second proposition concerning the nature of the briefing was supported. Exact, well-defined briefing produced a stronger, shared mental model (less deviation in evaluation). The latter part of the proposition remains open – the case material did not produce enough evidence about the impact of the phases on the filter and mental model. Differences of phases in the cases were not sufficient for drawing conclusions.

The need for investigating the dynamics and structure of schemata arose from the requirements for strategic flexibility. The cognitive complexity of schemata will improve (Bogner and Barr 2000, Anderson 1999) organizations' capability effectively to respond to environmental turbulence. The information filters described, are moderating the flexibility of organizations' schemata. According to the results of this research it is presumed that if the filters are narrow and deep the sense making process produces more stable schemata. When the filters are wide and flat the sense making process will deal with more diverse information and thus produce more diverse schemata. For strategic management this information is essential; if the management is aware of the mechanism described above, a sense making process may be modified according to the strategic needs, to close the filters when strong sense making process is required (in the case of merger) or open them if the organization is too stable for the volatile environment (in the case of risk management).

## 6. Discussion

Several potential sources of bias remain in this study. The key variable of the mental model description is the categorization of the issues and signals. The FMEA reports in particular, because of their quantitative nature, provide only limited qualitative material for a classification process. For research control purposes, one of the members of the ATLAS organization was asked to categorize the weak signals based on the template provided by one of the present authors (L Ilmola). The deviation in results between the researcher and the ATLAS member was 5 %. However, following clarifying discussions the deviation reduced to 3%. Although this bias does not have a prominent impact on results, it would be beneficial to run the similar case study where all the independent key variables could be tested in a totally comparable research setting.

This study revealed some of the features of schemata construction and information filters in the sense making process of decision making. In line with Weick 1995, Minzberg 1995 there were indications that the nature of the analysis method in risk management has a strong impact on the mental model the management acquires during the process. But this is only a very limited contribution to a deeper understanding on strategic flexibility and the dynamics of the schemata that govern the organization.

Despite these shortcomings, the current paper seeks to make several distinctive contributions to the literature on strategic flexibility and organizational cognition. First, in its ambition is to apply the CAS framework to a concrete decision making process. Second, in describing the process of weak signals sense making during the risk management decision making process and in providing a rare glimpse into organizational information filters in operation. Third, in employing this rich data, a coherent model of organizational cognition and schemata is established. Fourth, this approach may provide an alternative generic framework for strategic planning process. In a specific environment, the concept of dynamic schemata may replace the traditional strategic planning procedure.

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