CHALMERS

Mind the environment

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1 Introduction

This report presents the results from an exploratory study aimed at testing the feasibility of having the viewpoints of cognitive science on information management for sustainable development.

The work is performed in a joint PhD study in CPM within the research project "Databases in Networking" performed at the research unit Industrial Environmental Informatics.

The methodological approach and the conclusions drawn allow for scientific criticism, but the general approach may be regarded as successful, since it indicates that further studies in this spirit may be fruitful, from both industrial and academic viewpoints. Maybe the sustainable development is not within reach of what the human mind is capable of.

2 Theory and assumptions

2.1 Theories from environmental information management

Environmental information is for sustainable development. Figure 1 show the role of information in the context of sustainable development.

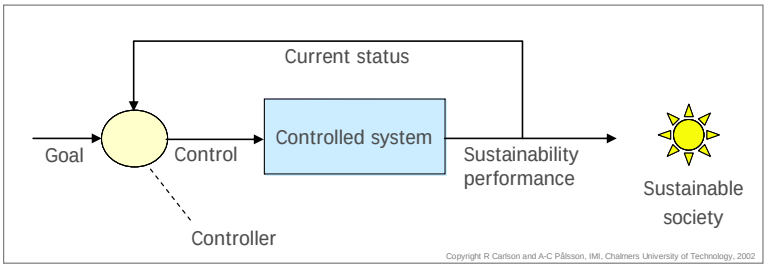

Figure 1. Environmental work in industry is performed to aid with sustainable development.

The choices made by a 'Controller', such as a product designer, strategic decision maker, consumer or policy maker have impacts on a 'Controlled system', through the consequences of the choices made. To make the choices, the controller needs a mind with ability to interpret information about environmental issues. The actual relationship between the preparedness of the mind of the controller and the presented information is part of this work. Generally, the information that the controller needs are:

- facts about the vision of a sustainable society
- a current goal
- the current status of the controlled system (in terms of how a decision will affect this status)

Since sustainable development concerns a compound relationship between human values, goods and functions provided by our societies and the natural prerequisites for life on earth, the information that the controller needs also have to address complex information that relates these areas to each other. Figure 2 illustrates the relationship between these different information.

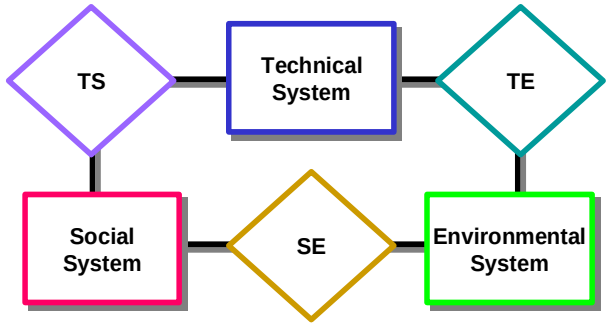

Figure 2. Model of the relationship between the three different scientific disciplines of environmental management. Copyright Raul Carlson, Chalmers University of Technology, 1997

The goods and functions provided from the societies are appreciated and valued by humans. In the figure this relationship is represented as the diamond TS in the figure. While producing these goods and functions, the downside is that resource extraction, emissions and waste and degradation of physical means leads to that the natural prerequisites for life on earth are challenged. This is represented as TE in figure 2. The challenges of the natural prerequisites need to be observed by humans else they will not be valued as sustainability issues to care about. In figure 2 such observations are represented as the diamond SE. The fact that describes that the satisfaction of human needs is associated with drawbacks concerning prerequisites of life is thus represented by complex information.

Only in rare occasions are humans presented with full satisfaction/drawback information of goods and functions from experiences. Examples are when exhaust fumes from the car makes the driver or passenger sick due to leakage, or when union strikes reminds us of the necessity of waste management systems, or when lakes turn dead due to water emissions from nearby factories. Most often, however, the satisfaction and the drawbacks are so separated in time and space, that people will not face the drawbacks of any of the goods or functions that they enjoy, or so that any of the negative changes to the environment can be associated with their own satisfactions. Scientific, logical, juridical, ecological, economical, etc. cause effect chains and mechanisms are needed to describe the relationships. Many satisfactions affect someone else's environment or are hard to immediately detect by common sense. The facts need to be mediated from minds with the knowledge, through different information channels into the minds of those that make the choices, and can change their behavior.

Ideas and knowledge are mediated between minds. A common language is needed, and if the information shall be communicated over time and distance, the language may need to be conveyed through an information system. Figure 3 describe how such an information system relates ideas, language, concept models, data models and information systems during design and during use.

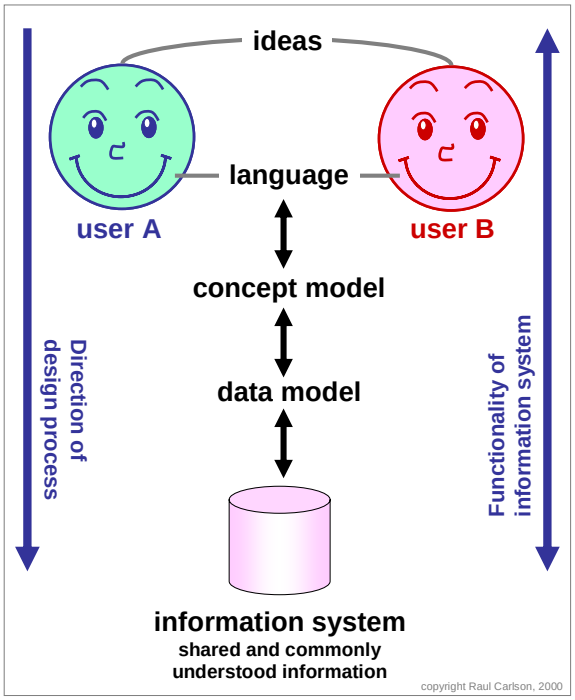

Figure 3. The scope of informatics, ranging from human ideas, through natural communication, down to computerized information and communication systems.

The theoretical concepts represented by figures 1, 2 and 3 isolates the domain of this study; to convey ideas of complex information for sustainable development. The study will be further limited through our choice of interviewees and their organizational contexts (see section 3, below)

2.2 Theories from cognitive science

Cognitive science is a new inter-discipline that is based on that the mind processes information, and that this information processing can be structurally described and measured. The knowledge can be used for understanding why and how information is perceived and interpreted by humans. The disciplines most commonly addressed in cognitive science are philosophy, psychology, linguistics, anthropology, artificial intelligence, and neuroscience [5] [3]. From the viewpoint of sustainable development the four first disciplines may be of high relevance, but here we will only touch the three disciplines of philosophy, psychology and linguistics. We consider them as central for posing the question whether cognitive science provides a feasible toolbox to elevate the understanding about information for sustainable development, and to relate the questions of complex information to the capabilities of the mind of human environmental expert or decision makers.

A short introduction to the three disciplines follows.

Cognitive psychology concerns aspects that are partly associated with social capabilities of the mind, such as remembering faces, names and interactions with other people [6] [7]. Without such mental constructs of relationships shared language and feelings of social belonging and participation will not develop. The practical consequence is that a person who lacks such experiences will not contribute effectively in the social interaction. For example, an organization may not be able to

effectively utilize an expert that is socially isolated in his everyday task due to social barriers.

The schools of philosophy that especially draw attention to cognitive scientists concerns for example idealism and realism, and ontology and epistemology, i.e. questions and theories of the nature of the world, and of the nature of our knowledge and perception of it [1] [3]. The Controller in the bubble in figure 1 is isolated from the world he controls, as most people are isolated from the physical environmental consequences from choices and actions (see section 2.1). His idea of what he is doing in the bubble, and what in the physical world that is affected by his choices is central to whether he actually can control or not. If he does not understand his role as a controller, or if he has an idea that too much deviates from scientific, logical, juridical, ecological or economical facts, he is in fact no controller at all, but is rather a disturbance or noise for the real control mechanism.

Linguistics is essential to cognitive science, for many different reasons. Language is a tool for our thinking and our communication. It also serves as a model of the mental structures, and it conveys keys to how to interpret both psychological and philosophical states of minds [1][2][3][6]. But here we will specifically look at semantics, i.e. which meaning information have to experts, and whether experts in the same field have the same meaning and language.

These three disciplines of the cognitive science are in fact both very broad and indefinitely deep, but here we will use them in a rough and somewhat unskilled way, to indicate whether cognitive science provides sustainable development with a useful toolbox.

3 Empirical method

To explore the feasibility of cognitive science as a toolbox for sustainable development a number of interviews were performed with environmental experts in the field of LCA in five Swedish industrial companies. The interviews consisted of four parts with questions that were formed to give qualitative answers. The first part was intended to establish the background and organizational role of the interviewee. The three following parts concerned the three disciplines of cognitive science as presented above: cognitive psychology, philosophy and semantics.

Much room was given for the interviewees to speak freely within the scope of the question, and the response was recorded and handwritten notes were taken as well. The interviews were held over the telephone and each interview took about an hour. The authors of this report shared a conference telephone to be able to co-operate during the interviews.

The interviewees were employed at the companies:

- ABB Corporate research
- Akzo Nobel Surface chemistry
- ITT Flygt
- SCA Hygiene products
- Stora Enso

The selection was based on companies with an interest to support research in these areas. Therefore we do not argue that the interviewees are statistically representative for all industrial companies. We are aware of the bias introduced by our own interest in the area, and by the positive interest of the interviewees. However, all questions and the selected viewpoints from which the questions were organized were indeed new to all interviewees. We therefore acquired quite new and previously unknown reactions to most of the questions. We assume that this somewhat compensates for any other bias.

4 Interviews interpreted

4.1 The interviewees

The interviewees were asked about their education and their experience in the field. The field in which they work ranges from LCA, DfE, chemical regulations and safety and environmental management systems. Their educations were similar, but not equal; four engineers and one biologist. Two of the engineers are chemical engineers, one is a mechanical engineer, and one is a civil engineer. Two had licentiate exams in their field of profession and expertise. Number of years of experience from the field ranged from 13 years to a little over one year. Combined with that they are employed in different companies (see chapter 3) these facts show the range of the interviewees; some properties are very similar and some are very different.

4.2 Psychology

The interviewees were asked to describe their relationship with the organizational environment in terms of:

1. the main purpose of the organization they work for
2. the activities in the organizational unit in which the interviewee work
3. communication surfaces towards different stakeholders

4.2.1 The main purpose of the organization they work for

The interviewees describe their employer in terms of functions and activities, rather than in terms of the overall business idea. This may have been caused partly due to where the question was posed in the interview structure, but it is anyway remarkable that none of the interviewees described their company in terms of the overall business. On straight questions, all interviewees had difficulties with answering how their specific expertise contributed to the overall business idea.

4.2.2 The activities in the organizational unit in which the interviewee work

The interviewees describe the work that they perform in terms of the work that they perform. This tautology or circular reasoning is here made intentionally, to stress that the experts did not use a two-sided language to describe on the one hand what they do within their unit, and on the other hand who they do this for and for what purpose. This may be because the relationship with the interviewers is open and familiar, and that the interviewees therefore do not make an effort to shift languages. Another explanation may be that the interviewees have only the internal expert-language to describe their work.

4.2.3 Communication surfaces towards different stakeholders

The interviewees describe the communication outside of their expert unit as scarce, driven by themselves and sporadic. According to the interviewees, the successful path is to take their own responsibility to communicate results and possibilities of their tools to in-house 'customers' or to participate in the natural flow of actions in e.g. the design process. Communication with environmental policy setting and strategic work is generally lacking. None of the interviewees were convinced that decision was based on their results.

4.2.4 Conclusions from this part

The interviewees express themselves to be separate from the business side of the company. It may be that they are linguistically isolated due to lack of organizational and psychological integration. This may be bad from the viewpoint of company efficiency, but it may be regarded as good if the environmental expert should represent 'the others'.

4.3 Philosophy

The interviewees were asked to describe their view of their domain of responsibility and expertise in terms of:

- The schooling of the expert
- The domain of work and responsibilities
- Push or pull problem solving

4.3.1 The schooling of the expert

The interviewees are educated in traditional natural science disciplines (see section 4.1), and are well familiar with their own toolbox. Of course, the differences in experience have provided them with matching differences in familiarity with each tool and its applications. With this taken into regard, it is expected that each expert have a schooling that is appropriate for understanding the responsibilities they are given.

4.3.2 The domain of work and responsibilities

The interviewees express a somewhat split affection, on the one hand towards the company and its products, and on the other hand towards the environment. This ambiguity seems to neutralize the experts, rather than to utilize them as partners in the decision making processes. All experts express that the 'decisions are taken somewhere else'.

4.3.3 Push or pull problem solving

The interviewees does not express that their work is about problem solving. Some express that it is in their responsibility to identify potential problems, and if accepted, to acquire the necessary information about a potential problem. How the information is actually used is not well known. Since the information is often produced without knowledge about the information user, the relevance of the information and its format is not well known.

4.3.4 Conclusions from this part

The experts are well trained to understand their domain of responsibility. They are not part of the control mechanism that they feed with information (compare figure 1). This may tamper both the quality and the efficiency of their work and results.

4.4 Semantics

The interviewees were asked to describe how they perceived that they are understood within their organizations, in terms of:

- Understanding of the work and responsibilities in the rest of the organization
- Understanding of environmental statements in the rest of the organization

4.4.1 Understanding of the work and responsibilities in the rest of the organization?

The interviewees have different view of how well their own work is understood in the organization. Some express that their field of expertise is well known and even understood in detail to certain parts. Others express that they are considered as experts without anyone knowing in detail what they do. Regardless of how they are understood, they are generally regarded as competent and positive contributions to the company expertise.

4.4.2 Understanding of environmental statements in the rest of the organization

The interviewees have different view of how well their results are understood in the organization. The differences mainly concerns whether the results meet an understood and well-perceived demand and to which degree the results include complexities. Examples of complexities that are difficult to understand are uncertainty in data, degree of matureness of the different tools, as well as abstract expert jargon (LCA, DfE, COD, etc.).

4.4.3 Conclusions from this part

In spite of the fact that the interviewed experts have similar roles in their companies as well as somewhat similar expertise, they are understood to different degrees. This is much due to the disciplines of the core business (chemical, forestry, mechanical, etc. sector), and also due to that the individuals have different strategies for communication. Successful are those that have a constant voice in relevant rooms, others listen to learn what is politically possible, while yet others respond readily to needs. Less successful are those that communicate with expert jargon and lack adaptive reflexes.

5 Conclusions

The responses were strikingly consistent on the core issues concerning the cognitive viewpoints. This gives some stability in the conclusion that it is feasible to apply cognitive science to these types of questions. From this conclusion, the following three general conclusions could be drawn:

1. Companies may decide on whether the environmental product expertise should be merged with or remain separate from the business organization. This depends on which role such a person shall have concerning the overall environmental strategy.

2. Companies should clarify the role of the environmental product expertise so that the work can be appropriately dimensioned as well as better suit the intended needs.
3. Whether the environmental expertise is understood or not is not important, but it is important that the experts can be communicated with. Companies should support the development of in-house communication strategies for the environmental product expertise.

The approach of analyzing environmental information and reporting from the angle of cognitive science seem yet to have much potential to result in practical, productive and industrially useful results.

It is worth noting also that the interviewees perceived the interviews as valuable, since it posed new valuable questions from new and relevant angles.

6 Recommendations for research

The findings during the interviews are that further studies in some specific areas might be practically important for industrial environmental work, environmental information handling and environmental reporting. This specifically concerns the linguistic studies and the studies of communication in terms of cognitive psychology. Linguistic studies, for example, allow for assessment of to which degree aggregated and not commonly used terms and concepts are used or referred to in the experts' description of their work and results. Communication studies could be performed to better understand the consequence of complexity of information with regards to the capacity of the minds of the receivers. It seem, however, difficult to study the relationship between experts and the rest of the corporate environment using interviews since the results are vague and can be interpreted in many different ways.

7 References

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