



HAL
open science

Cognitive mapping in managerial decision making - A case study

Anders Gaard Ohm, Dag Øivind Madsen

► **To cite this version:**

Anders Gaard Ohm, Dag Øivind Madsen. Cognitive mapping in managerial decision making - A case study . Business administration. University of Bergen, 2004. English. NNT : . tel-01306109

HAL Id: tel-01306109

<https://hal.science/tel-01306109>

Submitted on 22 Apr 2016

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.

UNIVERSITETET I BERGEN
PSYKOLOGISK FAKULTET



BACHELORPROGRAM I ARBEIDS- OG
ORGANISASJONSPSYKOLOGI
HØST 2004

BACHELOROPPGAVE

COGNITIVE MAPPING IN MANAGERIAL DECISION MAKING –
A case study

By
Anders G. ohm
Dag Øivind Madsen
Supervisor: Willy Haukedal

Abstract

This research is meant as a contribution to managerial cognition and decision making, in which an approach to cause mapping developed by [Fuglseth & Grønhaug \(2002\)](#) is applied. Three managers in a foreign subsidiary of a Norwegian industrial company were interviewed about an authentic decision situation they were facing at the time. The interviews were recorded and transcribed, and individual cause maps were constructed. Theoretical bases of the framework are [Kelly's \(1991\)](#) theory of personal constructs and theory of cognitive complexity ([Schröder, Driver, & Streufert, 1967](#)), and the analysis of the cause maps is mainly based on these theories.

Results are presented in the form of diagnosis of each manager's decision making, based on content and structural diagnostic constructs. Diagnosis shows significant differences between the managers, and identifies possible reasons. The diagnosis serves as basis for feedback to the managers.

CONTENTS

1	Introduction	4
1.1	Purpose and motivation	4
1.2	Definitions	4
1.3	Literature review	5
1.3.1	Management and Organizational Cognition (MOC).....	5
1.3.2	Cognitive mapping	6
1.3.3	Cause mapping	9
1.3.3.1	Cause mapping as a tool in decision support	9
1.3.3.2	Theoretical basis.....	11
1.3.3.3	Elicitation of concepts and beliefs	13
1.3.3.4	Analysis and diagnosis	15
2	Research method	18
2.1	Procedures	19
2.1.1	Data collection.....	19
2.1.1.1	Choice of stimulus.....	19
2.1.1.2	Sample/participants	20
2.1.1.3	Data collection method.....	22
2.1.2	Construction of cause maps.....	24
2.1.2.1	Analyzing the transcripts.....	24
2.1.2.2	Concepts, variables, and values.....	26
2.1.2.3	Feedback meetings	27
2.2	Analysis and diagnosis	27
3	Results and discussion.....	28
3.1	Analysis.....	28
3.2	Diagnosis.....	30
3.2.1	Content	30
3.2.1.1	Perception of causes and consequences	30
3.2.1.2	Action generation	35
3.2.2	Structure	37
3.2.2.1	Procedures for measuring complexity.....	37
3.2.2.2	Causes and consequences.....	39
3.2.2.3	Actions	42
3.2.3	Summary diagnosis	43
3.3	Discussion	44
3.4	Validity and reliability	46
3.4.1	Internal validity	46
3.4.2	External validity	48
3.4.3	Reliability.....	49
3.5	Concluding remarks and further research	50

[References](#)

Appendix 1 – Practical procedures for construction of cause maps

Appendix 2 – Cause maps

Appendix 3 – Concept lists

1 Introduction

1.1 Purpose and motivation

The practical purpose of the thesis is to help the participating managers to improve their general decision making, and specifically to assist them in the particular case used as basis for the thesis. Theoretically, the thesis is an application of an approach to cause mapping developed by [Fuglseth \(1989\)](#) and [Fuglseth & Grønhaug \(2002\)](#) to help managers gain further insight into a specific decision situation, in addition to improving their general decision making.

Previously, the approach has been used to analyze and diagnose the decision making of managers with strong decision power in shipping companies (cf. [Fuglseth, 1989](#)). In this bachelor thesis, the approach is applied to managers in a Japanese subsidiary of a Norwegian industrial company. The setting is different; with managers in a multicultural decision making team having restricted decision power because of influence from head office in Norway, and the applicability of the approach of [Fuglseth & Grønhaug \(2002\)](#) will thus be tested in a different context.

The thesis does not have a traditional research problem, as its main purpose is to apply an already developed method for decision support. Still, some research objectives can be defined:

- 1) Construct individual cause maps on the basis of interviews of three managers
- 2) Analyze, compare, and measure the level of complexity in the individual cause maps
- 3) Consider the applicability of the framework in a multicultural setting with managers with weaker decision power

1.2 Definitions

By the term “decision,” we are referring to a decision process. The concept of a difficult decision situation relates to the structure or lack of structure in a problem situation. Structure can be evaluated on a scale from unstructured to well structured, and a problem can be defined as the distance between an initial position and a target position ([Fuglseth, 1989](#)). A well structured problem situation refers to a situation in which both the initial and target positions, and also the procedures required for getting to the target position are known. An unstructured problem situation is

the opposite, in which the initial position, the target position, and the procedures required to get to the target position are unknown to the decision maker (Kaufmann, 1980, cited by [Fuglseth, *ibid.*](#)).

Lack of structure in a decision situation can be caused by the situation's complexity, for example when a large number of reciprocally dependent variables are involved, resulting in uncertain cause-effect relationships ([Fuglseth, *ibid.*](#)). The lack of structure can also be caused by uncertainty, for example because the situation involves unknown future actions and consequences, or by conflicting goals in the target position ([Fuglseth, *ibid.*](#)).

To complicate the picture, uncertainty can be seen as an aspect of complexity ([Campbell, 1988; March & Simon, 1958](#), pp. 139-149), but of course, complexity can also be considered an aspect of uncertainty. Still, it can be useful to make a distinction between complexity and uncertainty, and characterize decision situations or tasks by the two dimensions *complexity* and *uncertainty* ([Fuglseth & Grønhaug, 1999](#)).

1.3 Literature review

The literature review will start off with a short presentation of management and organizational cognition (MOC), in which cognitive mapping is an often used method. Next, cognitive mapping in general is briefly described, before cause mapping theory, focusing on the approach by [Fuglseth & Grønhaug \(2002\)](#), is presented.

1.3.1 Management and Organizational Cognition (MOC)

Management scholars working in a variety of disciplines, such as organizational behavior, organization theory, strategic management, human resources, etc., increasingly realize that understanding the cognitive aspects of managerial and organizational phenomena are essential to an adequate science of organizations ([Meindl, Porac, & Stubbart, 1991](#)). As a result, a significant body of research is developing directed toward the cognitive aspects of organizing and managing, and in 1990 the Academy of Management authorized a new interest group called "Management and Organizational Cognition."

In MOC-research, cognition is viewed as a key factor underlying social action and performance in organizations. By cognition, the field refers broadly to various individual- and organization-level phenomena, related to the acquisition, kinds, uses, and implications of knowledge, beliefs, or intelligence ([Laukkanen, 1994](#)). Examples of topics include environmental scanning, planning and issues diagnosis, cognitive categories and schemas, cognition in management teams or strategic groups, and decision framing and decision making ([Meindl, Porac, & Stubbart, 1991](#)).

Examples of commonly used methods include repertory grids, cognitive mapping, cognitive response analysis, content analysis, and interpretive analysis ([Meindl, Porac, & Stubbart, ibid.](#)). According to [Tegarden & Sheetz \(2003\)](#), cognitive mapping is the most frequently used method to represent managerial and organizational cognition. In this thesis the focus will be on cause mapping, which is a form of cognitive mapping. Use of cause mapping as a tool in decision making will be elaborated in chapter 1.3.3.1, after cognitive mapping has been introduced.

Although this thesis clearly uses theories and methods from management and organizational cognition, it might not be regarded a typical contribution to this field of research, as the focus is mostly on individual and group cognition. As indicated by [Meindl, Porac, & Stubbart \(1991\)](#), the MOC research tradition focuses organizational implications of cognition, which are only briefly considered in the discussion part.

1.3.2 Cognitive mapping

The label *cognitive maps* has been used for several decades, and originates, according to [Eden \(1992\)](#), from the ideas of [Tolman \(1948\)](#), who wished to develop an alternative to the stimulus-response model of man (cf. [Neisser, 1967](#)). The term cognitive map can be misleading as it implies that the map is a model of cognition, or a model of thinking, when in reality, few mapping methods can substantiate such a claim ([Eden, 1992](#), for a discussion, cf. e.g. [Russo, Johnson, & Stephens, 1989](#); [Biggs, Rosman, & Sergenian, 1993](#)). The ability of a map to be a model of cognition depends, according to [Eden \(1992\)](#), mostly upon two characteristics of the mapping method: 1) the adequacy of the cognitive theory which guides the modeling or representation technique and the extent to which that modeling technique is a good reflection of theory, and 2) the method of elicitation of cognition.

Even if a map very accurately describes a person's cognition, the proposition that cognition predicts behavior is problematic in several respects. While cognition, as associations between ideas, mediates action, association between situations and responses also influence behavior ([Eden, 1992](#)). The proposition is also problematic because it ignores the role of emotion. According to Eden, therefore, the only reasonable claim that can be made of cognitive maps as an artifact is that (1) they may represent subjective data more meaningfully than other models and so have utility for researchers interested in subjective knowledge, and (2) they may act as a tool to facilitate decision making, problem solving, and negotiation within the context of organizational intervention.

Cognitive maps, therefore, can function descriptively, and at the same time be a tool for improvement of the participants' decision making. The descriptive function can, according to Eden (*ibid.*), be described as simply a picture or visual aid in comprehending the subjects' understanding of particular, and selective, elements of the thoughts of an individual, group, or organization. This representation is, however, available for analysis by both the subjects and the interventionists or researchers.

Insights into managerial cognition in complex, real-life situations may be valuable to improve managers' decision making, and cognitive mapping is often used in research with the purpose of improving organizational action ([Cossette & Audet, 1992](#)). Before elaborating on the role of cognitive maps, and specifically cause maps' role as a tool in decision support, different types of cognitive maps will be described.

Different types of Cognitive Maps

The broad strategic concerns of managers may require a portfolio of different kinds of cognitive maps, and the interactions among these maps can be as important as the functions of each one separately ([Fiol & Huff, 1992](#)). Fiol & Huff suggest a classification system for cognitive maps based on the two dimensions use and type. They refer to [Tolman's \(1948\)](#), distinction between strip maps and context maps, and use this distinction as a description of the type dimension. Tolman defined strip maps as a sequence of clear choice points, and contrasted them with more complex cognitive maps, suggesting that the latter encompass not only specific choice points, but also

information about the context surrounding these points ([Fiol & Huff, 1992](#)). The more complicated maps provide a sense of the setting within which decisions are to be made. They provide details about features of the terrain, and about the way these features might be linked.

The second dimension of Fiol & Huff's classification system refers to the way the cognitive maps are used. They refer to [Weick & Bougon \(1986\)](#), who distinguish between maps as products and maps as tools. As products, they are designed to remain relatively stable over time; as tools they are modified or even abandoned over time. Maps as products can be simple strip maps, or complex maps used as an aid to understanding more difficult tasks ([Fiol & Huff, 1992](#)). The map as a product of past cognition or as an end product of an elaborate decision process, they suggest, is less useful, and instead, managers need sense-making tools that can generate inputs to a continuing stream of decisions.

The approach in this thesis utilizes complex cause maps both as tools and products. They are products of cognition from a specific decision situation, but are also used for eliciting general patterns of thinking, which can be used as guidelines for future complex decision situations.

In addition to presenting a two-dimensional classification of cognitive maps, [Fiol & Huff \(1992\)](#) also refer to [Huff \(1990\)](#), who identifies submaps of different aspects of cognitive processes. Three useful sets of submaps are mentioned; identity submaps, categorization submaps, and causal and argument submaps. Identity submaps offer frameworks for identifying key actors, events, and processes (critical features of the landscape), categorization submaps provide information about the interrelationships of these entities, and causal and argument submaps provide information about potential linkages among entities of importance to the organization through time ([Fiol & Huff, 1992](#)).

The type of cognitive maps used in this thesis is cause maps. They provide understanding of how individuals link events occurring at a particular time to events occurring at other times. The relational links these submaps convey capture judgments about the link between actions and outcomes ([Fiol & Huff, ibid.](#)).

Research on cognitive mapping has been disparate and loosely coupled ([Fiol & Huff, *ibid.*](#)). The presentation given does not aspire to being an overview of the field, but rather serves as a short introduction of important concepts and aspects. The remaining part of the literature review is devoted to research on cause maps.

1.3.3 Cause mapping

This section introduces research on cause maps. Section 1.3.3.1 discusses the role of cause maps as a tool in decision support research, and section 1.3.3.2 covers the theoretical basis of the specific cause mapping approach used in this thesis. Theory for elicitation of concepts and beliefs is treated in section 1.3.3.3, followed by theory for analysis and diagnosis in section 1.3.3.4.

Originally, cause maps referred to directed graphs (e.g., Hage & Harary, 1983, cited by [Laukkanen, 1994](#)), which consist of nodes (terms) and arrows that link them. This is, for representational purposes, the common way of drawing them ([Eden & Ackermann, 1992](#)). The nodes represent concepts and phenomena, which their owners, such as managers, subjectively seem to perceive in their domains ([Laukkanen, 1994](#)). The arrows represent their causal beliefs about efficacy (causal) relationships among the phenomena. A configuration of such interlinked concepts and beliefs can thus model the patterns of causal thinking of a person or a group ([Laukkanen, *ibid.*](#)). As [Fuglseth & Grønhaug \(2002\)](#) point out, however, cause maps can be no more than a representation of respondents' *verbalizations* of concepts and causal beliefs.

1.3.3.1 Cause mapping as a tool in decision support

Implied by the label *cognitive mapping*, it is normally assumed that we are in the business of studying cognitions ([Laukkanen, 1994](#)). However, it is possible to loosen at least cause mapping of that premise, positioning it as a generic tool for many representations and analytic tasks. Laukkanen (*ibid.*) mentions five examples: Cause maps can be used to (1) analyze a discourse itself, especially for the causal dimension, (2) model a domain of reality, its entities and their interrelationships, as represented in the knowledge/belief base of the respondents or of the researchers themselves (cf. [Diffenbach, 1982](#); [Roos & Hall, 1980](#)), (3) represent interlinked, domain-related knowledge and/or belief bases, e.g. an ideology or a worldview of a group, as

manifested in related communication, (4) model the cognitive structures of the respondents, called schemas, cognitive maps or mental models, and lastly, to (5) mirror cognitive processes, such as generating algorithms or heuristics, which the respondents may use when they produce their oral responses or some text data.

The perspective on the use of cause maps of [Fuglseth \(1989\)](#) is limited to visual representation of data and as a tool for analysis (p. 309, “there is a need for reducing the data to a form suitable for interpretation”). In this thesis, the perspective is somewhat wider, as cause mapping is considered a tool for helping managers directly (e.g. the “cathartic experience,” section 1.3.3.3, and developing a task model, cf. section 1.3.3.4), not only being a tool for analysis. Fuglseth (*ibid.*), does, however, also intend to use the map for construction of computerized decision support systems.

[Fuglseth & Grønhaug \(2002\)](#) point out that few researchers consider explicitly *how* cognitive mapping can be used for the purpose of improving organizational action. To become valuable, cognitive mapping must be *relevant* and *valid*. In this thesis, relevance is related to the challenge of helping managers improve their decision making, mainly for a specific decision situation, but also in the long run. This implies evaluation of decision making related to the specific task, requiring both a description of current decision making and a comparison with an “ideal” representation of decision making in the task studied (cf. task model, section 1.3.3.4). An important assumption that relates cause maps to decision making is that decision makers’ concepts and causal beliefs are central to understanding of decision outputs, particularly in complex tasks (Weick & Bougon, 1986; Holsti, 1976, cited by [Fuglseth & Grønhaug, 2002](#)).

The ideal representation of decision making is needed to give advice to and even maybe criticise the decision maker. To be useful to decision makers, advice and criticism should be related to the specific task and domain (Stabell, 1983, 1979, cited by [Fuglseth & Grønhaug, *ibid.*](#)). In the approach by [Fuglseth & Grønhaug \(*ibid.*\)](#), such an ideal representation is represented by a task model (cf. section 1.3.3.4). To limit the scope of this thesis, a task model has not been developed.

For cognitive mapping to be valid, in addition to relevant, it has to capture what it intends to capture. This criterion has at least two implications; one methodical, and one theoretical. Methodical

validity problems were briefly mentioned in section 1.3.2, and will be further elaborated in section 3.4.1, about internal validity. Theoretical validity requires a link to be established from the theories selected to the method used. For cause mapping, the theoretical basis is rarely made explicit ([Eden & Ackermann, 1992](#)). As [Eden et al. \(1992\)](#) suggest, adequate analysis – including construction of cognitive maps – requires a link to a theory of cognition. [Fuglseth & Grønhaug \(2002\)](#), however, suggest that this link also includes the method for elicitation of cognition. In the following sections, therefore, the theoretical basis for the cause mapping procedure used in their approach will be described, followed by theory for elicitation of concepts and beliefs, and analysis and diagnosis.

1.3.3.2 Theoretical basis

Cognitive mapping as a research tradition has been characteristically method-driven, and many practitioners in the field saw the basic CM-techniques as heaven-sent for fascinating new research ([Laukkanen, 1994](#)). The approach by [Fuglseth & Grønhaug \(2002\)](#), however, is theory-driven, with the theories of Kelly's personal construct theory ([Kelly, 1991](#), originally published in 1955) and cognitive complexity theory ([Schröder, Driver, & Streufert, 1967](#)) underlying the approach. These theories are selected because they explain how individuals make sense of their environment, and because they are helpful in identifying areas in which individuals may improve their decision making, as well as giving directions of improvement ([Fuglseth & Grønhaug, 2002](#)).

The presentation of Kelly's personal construct theory is based mostly on [Fuglseth & Grønhaug \(ibid.\)](#), and the presentation of cognitive complexity theory is based on [Fuglseth \(1989\)](#), [Davidson \(1996\)](#), and [Green \(2004\)](#).

Kelly's personal construct theory

Knowledge structures are mental templates consisting of interrelated concepts that individuals impose on their environment to give it form and meaning ([Walsh, 1995](#)). Because knowledge structures influence what individuals capture and how they understand their environment, the structures also influence their decisions and actions. A concept is a way in which an individual construes elements (things and events) as being alike and yet different from others ([Kelly, 1991](#), p. 74), and Kelly uses the notion construct to indicate the personal nature of concepts. In its mini-

mum context a construct is a way in which two elements are alike and different from a third. Concepts are linked to each other through several types of relationships, for example hierarchy.

Constructs are communicated using words and other symbols. Since constructs are personal, people may not attach the same meaning to identical words, and they may express similar constructs using different words. When a decision maker mentions a specific construct, the researchers cannot assume that their own perception of the construct is identical with the decision maker's perception. In order to improve the interpretation of decision makers' constructs, the researcher should be aware of the bipolar nature of constructs ([Kelly, *ibid.*](#), p. 81).

Kelly sees man as a scientist with the ultimate aim to predict and control events. Causal understanding is a prerequisite for predicting consequences, and thus to influence and control events. Kelly thus assumes that the universe really exists, and that individuals may differ in their understanding of it, implying that some ways of interpreting and handling events may be more effective than others ([Kelly, *ibid.*](#), p. 11). Kelly further assumes that individuals are constantly testing their constructs against new events in order to increase causal understanding. In this process their knowledge structures are also improved ([Kelly, *ibid.*](#), pp. 7, 55-57).

Both Kelly's theory and the theory of cognitive complexity emphasize the usefulness of well-developed, flexible knowledge structures in handling complex tasks in changing environments. However, cognitive complexity theory also explains how development of knowledge structures influences individuals' interpretation and handling of such tasks.

Cognitive Complexity Theory

Cognitive complexity theory ([Schröder, Driver, & Streufert, 1967](#)) is a well-known theory for studying humans as information processors ([Green, 2004](#)). The perspective suggests that there are differences in individuals' ability to differentiate and integrate parts of information stimuli (Schröder et al., 1967, cited by [Green, *ibid.*](#)), and explains human information processing levels by the development of cognitive structures ([Fuglseth, 1989](#)).

Cognitive differentiation represents an individual's ability to dissect information into smaller units, and cognitive integration is the ability of an individual to combine smaller units of information into a whole unit ([Green, 2004](#)). Porter & Inks (2000, cited by [Green, *ibid.*](#)) describe the distinctions as categorization and evaluation of information (cognitive differentiation) vs. the ability to form conceptual frameworks that organize complex situations (cognitive integration). The nature and extent of integrating information is often deemed the more important component of cognitive complexity (Stabell, 1978, cited by [Green, *ibid.*](#)).

A person's ability to differentiate and integrate depends on the development of his or her cognitive structure. Cognitive structures consist of dimensions and relations, which are reciprocally interconnected ([Fuglseth, 1989](#)). The dimensions represent the contents of the cognitive structures, and the relations direct how information is combined ([Fuglseth, *ibid.*](#)). According to Schröder et al. (1967, cited by [Fuglseth, *ibid.*](#)), development of relations is especially important for people's cognitive development, but the more dimensions, the more likely the development of more complex relations.

In their book, [Schröder et al. \(1967\)](#) describe four levels of development (simple, moderate, moderate-high, high), and explain the interplay among each development level and the corresponding information processing behavior ([Fuglseth, 1989](#)). For a description of these levels, see [Fuglseth \(*ibid.*\)](#) and [Schröder et al. \(1967\)](#). In this thesis, well-developed cognitive structures will refer to cognitive structures on a moderate-high or high level of development. Persons with well-developed cognitive structures are assumed to be more able to deal with continuously changing complex situations than persons with less developed cognitive structures. They are therefore more able to perceive and exploit information, giving a more comprehensive and multi-faceted understanding of the situation, and making them able to generate more solutions ([Fuglseth, 1989](#)). As [Green \(2004\)](#) mentions, many researchers argue that managers need to develop their cognitive structures, e.g. Miller (1993), and Yiu & Saner (2000).

1.3.3.3 Elicitation of concepts and beliefs

Validity is, of course, critically dependent on the method of elicitation. A variety of methods have been suggested and applied to retrieve data for constructing cause maps (Axelrod, 1976b;

Bonham & Shapiro, 1976; Huff, 1990; Bougon, 1983; Laukkanen, 1994, cited by [Fuglseth & Grønhaug, 2002](#)), but all have inherent limitations (McGrath, 1982, cited by [Fuglseth & Grønhaug, 2002](#)). A method should be selected that most adequately captures managers' verbalization of concepts and causal beliefs according to the theories selected to guide the answering of the research questions ([Fuglseth & Grønhaug, ibid.](#)).

In this thesis, the personal interview has been chosen as method for elicitation of concepts and causal beliefs, in accordance with the approach of [Fuglseth & Grønhaug \(ibid.\)](#). This method allows the managers to express their concepts and causal beliefs in their own language, which may increase content validity ([Jenkins, 1998](#)). Still, the ability to accurately express one's thoughts and way of thinking can vary substantially, both intra- and inter-personally. Remembering the aphorism of Karl Weick, that we do not know what we think until we hear what we say, implies admitting that articulation influences thinking, and vice versa. This reciprocity means that elicitation of cognition by articulation will always be out of step with cognition before, during, and after the elicitation process ([Eden, 1992](#)). This view is supported by e.g. [Argyris & Schön \(1978\)](#), who argue that people cannot talk about their *theories-in-use* as differentiated from the *espoused* ones, which we hear. However, it is often this process of reflective mapping that gives mapping its utility ([Eden et al., 1979](#)). To provide "added-value," and to change thinking, the elicitation process can be designed as a cathartic experience, a proposition cognitive therapy depends on ([Eden, 1992](#)).

Although it is important to choose a method that adequately captures the managers' verbalizations of concepts and beliefs, the method for elicitation of beliefs should also be designed to fit the chosen approach to construction of cognitive maps. The interview method used for elicitation of beliefs in this thesis follows the approach suggested by [Fuglseth & Grønhaug \(2002\)](#), which builds on work by [Heradstveit & Bonham \(1981\)](#) and [Shapiro & Bonham \(1973\)](#), which used the method for mapping identification and handling of international events by foreign policy decision makers. The method has been adapted and expanded to business situations by [Fuglseth \(1989\)](#), and it has also been expanded to include diagnosis (building on work by Stabell, [1983](#), [1979](#)), an expansion related to the purpose of finding out how managers can improve their decision making ([Fuglseth & Grønhaug, 2002](#)). The interview method is described in section 2.2.1.2.

1.3.3.4 Analysis and diagnosis

When the purpose of cause mapping is to help decision makers improve their decision making, it is essential that the analysis of the maps is related to measurement and comparison perceived useful for the decision makers in this respect (Jenkins, 1998, cited by [Fuglseth & Grønhaug, 2002](#)). In the approach by Fuglseth & Grønhaug (*ibid.*), use of theory-based dimensions (diagnostic constructs) and development of a task and domain-specific standard (task model) for evaluation of the concepts and beliefs represented in each map is emphasized.

In addition to analysis of the individual cause maps, comparison is also conducted. Different approaches exist to comparative analyses of cause maps. An approach by [Laukkanen \(1994\)](#) emphasizes the respondents' concept bases and causal thinking patterns. Concept bases can be analyzed and differences and similarities of term usage studied, included the incidence patterns of terms over groups/clusters of respondents. Causal thinking patterns are the traditional focal object of analysis, and this method emphasizes studying the domain- and problem related cognitions using the device of focal and domain maps ([Laukkanen, *ibid.*](#)).

The first area, concept-usage, has according to [Laukkanen \(*ibid.*\)](#) been neglected in cognitive mapping studies. Laukkanen suggests that managerial and organizational thinking is action-oriented and functional. Therefore, especially in studies of organizational performance, a critical factor to understand is the interface of key actors like managers in relation to the context, where the action takes place and which is both an object and determinant of action. The expressions embedded in the raw data serve as an indication of this interface and the ontology of the respondents (Regoczei & Plantinga, 1987; Rouse & Morris, 1986; Sowa, 1984, cited by [Laukkanen, 1994](#)).

To evaluate and diagnose the current decision making, a set of diagnostic constructs is needed. Diagnostic constructs are theory-based dimensions along which researchers can plot current decision making and the changes that may occur. The constructs also allow researchers to evaluate decision makers' interpretation and handling of an event and to indicate improvements according to the theory, and compared with other decision makers handling the same task ([Fuglseth & Grønhaug, 2002](#)).

A number of variables can be used to measure the information processing level of the manager. The diagnostic constructs used in this thesis have been developed by [Fuglseth & Grønhaug \(ibid.\)](#), and are listed in the following table:

Content

- Interpretation of event
 - Causes-consequences
 - Internal-external
- Generation of actions
- Knowledge of goals

Structure

- Number of causes and consequences
- Number of dimensions in interpretations
- Perception of uncertainty
- Perception of weak signals
- Complexity in interpretations
- Number of actions
- Number of dimensions in actions
- Complexity in evaluations and choices of actions
- Expression of hypothetical events
- Expression of task theories

Table 1.1

A distinction has been made between content and structural constructs. Content constructs indicate superordinate concept categories that decision makers are expected to use when interpreting and handling an event, and structural constructs indicate the way an individual combines information perceived from the outside world, as well as internally generated information.

Content constructs

The content constructs are primarily derived from Kelly's view of man as a scientist attempting to predict and control events (see section 1.3.3.2). Important assumptions underlying this view are that decision makers are able to interpret events, i.e. identify causes and predict consequences, and to generate actions to handle the events. When cause mapping is used for interpretation and handling of a business situation decision makers are expected to distinguish between external and internal causes (or constraints), and consequences. In business situations decision makers are also expected to know the goals of the organization and act to attain these goals.

The content constructs indicate content categories that decision makers are expected to use, but they do not identify the relevant causes and consequences for the specific task at hand. As mentioned, a task and domain-specific model of the causes and consequences that should be considered in order to handle the task effectively is needed. This will be elaborated after commenting on the structural diagnostic constructs.

Structural constructs

The structural diagnostic constructs are derived primarily from cognitive complexity theory (cf. section 1.3.3.2). According to this theory, people with well-developed knowledge structures are able to generate more possible causes and consequences of events because they interpret the events using more dimensions (e.g. economic, technological, political, industrial and geographical dimensions). They are also more aware of uncertainty because they see that alternative consequences exist, and detect possible problems and opportunities at an early stage because they are more sensitive to weak signals. In addition, they generate more complex interpretations due to their ability to generate and integrate alternative interpretations. Examples of complex interpretations are to develop both short and long-term consequences, to view an event from both a positive and a negative perspective, and to see an event from the viewpoints of different actors.

The interpretations of an event are essential for development of actions to handle the event. People with well-developed knowledge structures are supposed to be able to generate more actions, because they interpret events using more dimensions, and because they apply more dimensions in generation of actions. They are also supposed to make more complex evaluations and have more complex choices of actions, i.e. effects of alternative actions are evaluated considering uncertainty of environmental development, and actions are moderated to permit flexible adjustments. In addition to complex interpretations of actual events, they prepare for environmental changes by generating alternative scenarios and developing strategies for handling such possible future events, i.e. they express hypothetical events. They may also express “general laws” related to the task, i.e. theorize. This generation of task theories represents the most advanced form of planning.

The structural constructs give theory-based guidelines for diagnosing decision making. For example, a decision maker who is able to detect weak signals is according to theory of cognitive

complexity expected to handle a changing environment more effectively than a decision maker who is less sensitive to such signals.

Aggregation and development of a task model

Aggregate cause maps can be used for many purposes, for instance to describe the organizational context, in form of the shared parts of the individual maps ([Laukkanen, 1994](#)). In the approach by [Fuglseth & Grønhaug \(2002\)](#), the main purpose of the aggregate map is to establish a task model. When an aggregate map has been constructed, each individual map is analyzed, compared to the aggregate map, and related to the structural diagnostic constructs in order to interpret strengths and weaknesses. In this paper, diagnosis and comparison is made without an aggregate map, and is based on concepts lists and structural quantitative measurements.

The content diagnostic constructs shown in Table 1.1 and explained above indicate the categories decision makers are expected to use, but they do not tell which are the relevant causes and consequences for the actual task being investigated. A task- and domain-specific representation of the causes and consequences that should be considered in order to handle the task effectively must be developed. The task model is developed during a second round of feedback meetings, on the basis of the aggregate cause map. For a suggestion of how to establish a task model based on an aggregate cause map, see [Fuglseth & Grønhaug \(ibid.\)](#).

2 Research method

In this chapter, stimulus, participants, and procedures for data collection and analysis are presented. As description of the participants must be related to the description of the stimulus, we will start with choice of stimulus and move on to describing the participants. Data collection method follows next, and practical procedures for construction of cause maps can be found in appendix 1.

2.1 Procedures

2.1.1 Data collection

2.1.1.1 Choice of stimulus

The original method by [Heradstveit & Bonham \(1981\)](#) aims at eliciting concepts and causal beliefs related to international crisis situations. The cause mapping approach by [Fuglseth & Grønhaug \(2002\)](#) can be used both to assist managers in dealing with a specific situation, and to help them improve their decision making in a wide array of business situations. Also when the purpose is to improve decision making in general, crisis situations are chosen as stimuli. The choice of crisis situations as stimuli is related to the characteristics of such situations. [Fuglseth & Grønhaug \(ibid.\)](#) provide the following description on p. 365:

“Crises are vivid and dramatic events characterized by great danger, difficulty or uncertainty. They are more or less industry specific, and most managers have experienced crises. They are “life events” that can be recalled decades later. Coping with crises is at the heart of managerial duties. The ability to handle crises is a distinguishing characteristic between excellent and mediocre managers. Moreover, crisis situations are complex; there are no a priori “correct” explanations or “socially acceptable” solutions, which may influence the subjects’ reporting. Thus, we believe that exposing decision makers to relevant crisis situations represents “influential stimuli” which will adequately elicit the subjects’ concepts and causal beliefs underlying their decisions and actions.”

In the approach by [Fuglseth & Grønhaug \(ibid.\)](#), the purpose is not only to understand, but also to improve decision making. It is therefore necessary to find a crisis situation that makes it possible to uncover differences among the decision makers. The situation has to be relevant for all participants, and motivate all the interviewees to think creatively. It also has to be general enough to elicit perspectives wide enough to give insight in the managers’ decision making in general ([Fuglseth, 1989](#)). In the project for this thesis, an authentic crisis situation was chosen by the managers because the managers were eager to work on the situation.

Description of the crisis situation

E, the company of the managers, offers a product called S, in Japan. S is a patented version of an industrial material, and E is the only producer offering S in Japan. E has only a few customers for this product, and two of these buyers represent almost 90% of E's sales of S in Japan. It is being said that one of these buyers, T, has acquired the necessary technology to be able to produce a product similar to S, and if T starts using this technology, E will lose about 50% of their sales in Japan. It is, however, not known for certain whether T has acquired this technology or not, since the information sources are somewhat unreliable. It is also not known, if T actually has acquired the technology, why they have not started production yet. E has a contract with T lasting until 2007. If T decides to produce a product similar to S themselves, they can buy cheap raw material from China. T is currently processing E's S into finer materials, and is accustomed to industrial processing.

A complicating element is that a certain amount of E's sales to T is handled by a trading company "TH." This trading company buys and sells products from all over the world, and sells many different products to T. T wants to keep buying a certain amount of S through TH, and the reason for this is according to E's sales people that T uses TH as an agent for their products, and that they want to reduce their credit risk. TH is able to offer T raw materials from China in case T wants to start producing a product similar to S. Another complicating element is that E's mother company in Norway has suggested that maybe it would be better to funnel all sales of S through the trading company instead of through E, thereby possibly threatening E's existence in Japan.

As can be seen from the description, the situation has not yet developed into a crisis. In addition, there was some disagreement among the managers about the degree to which the rumors could be trusted. To make the situation more specific, thereby giving the managers the same situation to evaluate, we decided to assume that E receives reliable information that T has acquired the necessary technology to produce a product similar to S.

2.1.1.2 Sample/participants

All participants having the same information access and authority would, of course, be optimal. E is, however, a small company, and only three employees in a position to influence decision mak-

ing related to the case had sufficient knowledge about it. They will be numbered according to the order in which they were interviewed: 101 – the sales manager, 102 – the delegate, and 103 – the manager. A short description of their work responsibilities follow:

103 – The manager (male, 50 yrs old)

In addition to administrative work, the manager uses about half of his time on sales activities, and often travels abroad. He therefore does not follow everyday operations closely, but has the overall responsibility for all of E's operations in Japan. He has had contact with managers in T for many years, but is currently not directly involved in managing the customer relationship with T. He recently learned about the rumors that T may have acquired the technology for producing S or equivalent. In total he has been managing the E's division in Japan for 5 years.

102 – The delegate from E's mother company (male, 40yrs old)

The delegate from E's mother company in Norway has been in Japan for about a year. He came to work on a special project, but his engagement got extended, and he got engaged in general business operations. Although he formally has no decision authority, he functions almost like a manager when manager 101 is out of office. He also functions as a communication medium between the mother company and E's division in Japan, and has become involved in the situation with T because of the disagreement between the mother company and the division in Japan about the role of TH in relation to T. He participates in strategic decision making together with the manager and the sales manager.

101 – The sales manager (male, 50yrs old)

The sales manager is Japanese, and has worked in E for 27 years. In addition to his administrative work as a sales manager, he has been especially assigned to manage the relationship with T since 1983, and should therefore be in a position to have the most information about T's plans and intentions. As sales manager he participates in strategic decision making together with the manager and the delegate from Norway, but the actual decision authority lies with E's manager.

2.1.1.3 Data collection method

The elicitation method chosen is based on an interview method originally developed by [Heradstveit & Bonham \(1981\)](#), further developed by [Fuglseth \(1989\)](#), and [Fuglseth & Grønhaug \(2002\)](#). This method allows the managers to express their concepts and causal beliefs in their own language, and builds on a cognitive process model by [Shapiro & Bonham \(1973\)](#).

The questions are supposed to elicit both structural features of the manager's interpretation process and the content the manager considers. [Fuglseth & Grønhaug \(2002\)](#) suggest the following general interview scheme, and explain how the questions are related to the diagnostic constructs:

1. *Which aspects of [the crisis] are/were most essential for [the task]. Why are/were these aspects essential?*
2. *What are/were the causes of [the crisis]?*
3. *Was [the crisis] expected? If expected, which signals augured [the crisis]?*
4. *What were the consequences of [the crisis]?*

The interview starts with a question about the background for the crisis situation. The question is asked to help the managers structure their thoughts about the situation and to stimulate them to give reasons for their view of the situation. The second question aims to elicit the managers' perception of causes of the situation, and both question no. 2 and 4 correspond to the diagnostic content construct "causes – consequences." The third question asks whether the situation was expected, and if there were any signals. This question is also asked to uncover differences between the participants in the ability to perceive environmental cues and signals (one of the structural diagnostic constructs). Question number four is directly related to the content construct *consequences*, and the managers are expected to be able to distinguish between long-term and short-term consequences, a distinction related to the structural construct *complexity of interpretations*.

The diagnostic constructs suggested by [Fuglseth & Grønhaug \(2002\)](#), include the content construct "generation of actions" and "expression of task theories." These constructs do not seem to be elicited by the interview questions suggested above. The example of adaptation of the questions to a specific crisis situation, however, contains a question about action generation, which

we have included in our interview questions. The general interview scheme has been adapted to the crisis situation used in this thesis:

1. How would you characterize the current situation? How is the information about T's acquisition of this technology a problem for E?
2. What are the causes of this situation?
3. Did you expect T to acquire this technology, or was it a surprise? If it was expected, were there any signals?
4. What may this lead to? What are the consequences for E?
5. What can/will you do, and why?
6. Have you considered other measures?
7. What kind of information would you like to acquire concerning this situation?

Questions 1-4 resemble the general questions suggested above. Questions 5 and 6 are asked to elicit the managers' thoughts about possible courses of action, or decision alternatives, and to make them give reasons for choice of decision alternative. Question 6 is also asked to motivate the managers to think about alternatives generated but not chosen, and alternatives they should have thought about. The last question is asked to make the managers think about what kind of information they need, and to make them think more closely about the situation before making a decision.

The interviews were conducted during individual meetings with the managers, and all participants were asked the same questions in the same order. The time limit was set to about one and a half hour. For the delegate and the sales manager, the interviews were completed within the designated time. The manager, however, became very enthusiastic and spent almost two hours.

A tape recorder was used, and as a rule, the managers were not interrupted. Notes were also taken, however, and when many lines of thoughts were pursued at the same time, but only a few of them completed, the managers were reminded of lines of thoughts they had not completed. After each question, the manager's answer was summarized, and he was asked whether he had anything to add. The managers were only asked to explain unfamiliar concepts and constructs, to make sure

that the researcher's perception of the situation did not interfere with the managers' perceptions. The interviews were transcribed after each interview.

2.1.2 Construction of cause maps

The construction of cause maps in this thesis follows the approach described by [Fuglseth & Grønhaug \(2002\)](#), which builds on work by [Fuglseth \(1989\)](#), and [Wrightson \(1976\)](#). The procedures of Wrightson have been revised and expanded with the purpose of using them for decision support.

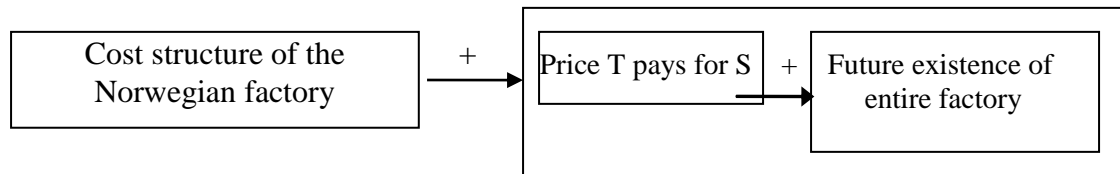
2.1.2.1 Analyzing the transcripts

When analyzing the interview transcripts, we are generally looking for expressions having the general type: "Phenomenon/entity A leads to / causes / is followed by / influences /etc. phenomenon/entity B" or, "B is an outcome of caused/effected/preceded/influenced/etc. by A." ([Laukkanen, 1994](#)) These are causal assertions which are taken to indicate that the subjects (a) possess and in some cases use concepts (A, B) to refer to some phenomena in their domain, and (b) think (believe, know, assume, argue, etc.) that there are certain efficacy relationships between the phenomena ([Laukkanen, ibid.](#)). These may be called the subjects' phenomenological and causal beliefs (Sproull, 1981, cited by [Laukkanen, ibid.](#)), or manifestations of their subjective ontology (Shutz, 1962; Sowa, 1984, cited by [Laukkanen, ibid.](#)).

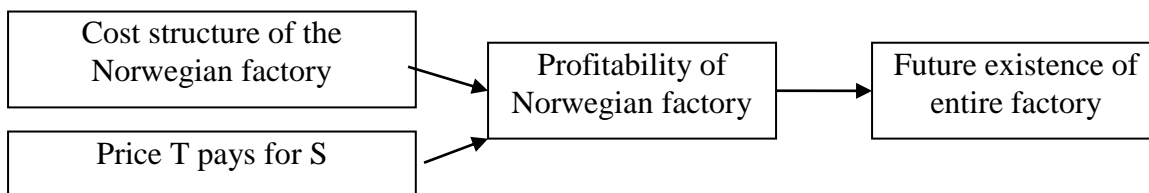
Analyzing the text, the researchers also look for statements implying implicit causal relationships. Wrightson (1976, cited by [Fuglseth & Grønhaug, 2002](#)) particularly draws the attention to what she terms "utility relationships." A statement such as "fortunately we cooperated when renegotiating the contract" does not contain any explicit causal relationship, but the statement indicates that the cooperation was useful to the company. In such situations Wrightson recommends the introduction of a utility concept, so that the statement is coded with a positive causal relationship between the concepts *cooperation during contract renegotiation* and *utility of the company* ([Fuglseth & Grønhaug, ibid.](#)).

Sometimes it is necessary to read and interpret the contents of several sentences in context to derive causal beliefs. On some of these occasions, managers describe causal beliefs about relations

and not only concepts. For instance, as manager 103 explains, the cost structure of the Norwegian factory makes the future existence of the entire factory, although it contains two separable production lines, dependent on the price T pays for product S. At first, it seems necessary to represent this relationship like this:



This kind of box-in-box-representation is not recommended, however, by [Fuglseth \(1989\)](#). In this case, the concept *price T pays for S* is related to many other concepts, and it is difficult to represent these relations when the concept is located within another box. In a case like this, [Fuglseth \(ibid.\)](#) recommends creating a new concept. A possible solution in this case is to introduce the concept profitability, and relate the concepts to each other like this:



Whenever new concepts are introduced by the researcher, the managers are consulted, to make sure the new representation is also a valid representation of their causal beliefs. In this example, the new representation was accepted, but in the end it was not included in the cause map because the outcome would be the same regardless of the cost structure of the factory.

Fuglseth’s suggestions about making the cognitive maps easy to read and representing the managers’ thoughts in a way that makes them easily able to recognize them may sometimes interfere with strict adherence to rules for cause map creation. However, for the tools to be useful and relevant to the managers involved, practical application and ease of use arise as more important considerations than adhering to formal rules. Of course, when “creative” coding is used, the managers are consulted during feedback meetings.

2.1.2.2 Concepts, variables, and values

The cause maps are constructed with two fundamental types of elements: *verbalizations of concepts* (constructs) and *causal relationships*. According to Wrightson (1976, cited by [Fuglseth, 1989](#)) and Axelrod (1976, cited by [Fuglseth, ibid.](#)), it is important to represent concepts as variables. A variable is an entity that can have at least two values. Concepts like *Japan* or *Norway* are not variables, while *price of S* is a variable because it can assume a range of values. Wrightson also writes, however, that the original language should be maintained as precisely as possible, but she does not describe the proper procedures for cases in which the interviewees do not formulate their concepts as variables ([Fuglseth, ibid.](#)).

In the approach by [Fuglseth \(ibid.\)](#) and [Fuglseth & Grønhaug \(2002\)](#), the importance of formulating concepts as variables is somewhat downplayed, and the focus is on making the managers recognize the language and concepts used in the maps. The reason for this somewhat different focus is that the cognitive maps are not constructed to be directly transferred to models for decision support. In addition, non-variable concepts can be formulated with fewer words without causing misunderstandings, and short concept formulations are important for getting the overview of the maps as they are drawn in Fuglseth & Grønhaug's approach. A concept like *crisis in the semiconductor market* can be formulated as *drop in the prices of semiconductors*, but when the manager uses the first formulation, this version is also used in the map.

Of course, using the managers' formulations may make the map difficult to read for people not involved in the case. Several implicit assumptions are made, and basic facts/events known to all the involved managers may not always be specified. As the researcher is involved in the case, he or she will usually come to understand the formulations used by the managers, and the maps will be easy to read. In fact, while working on the case, the researcher's ability to evaluate the readability of the maps and concepts lists for people not involved in the case may become significantly reduced. This is not a problem if the map is to be used only by the managers involved. If others are to use the maps, measures must be taken by the researcher to assure basic readability for outsiders. This may include reading the concept list without looking at the cause map, and check if each concept formulation makes sense without much knowledge of the case.

According to Wrightson (1976, cited by [Fuglseth, 1989](#)), the range of possible values of the variables do not have to be specified unless the variables can be misunderstood. If the alternative values can not be clearly extracted from the formulations, however, they must be explicitly included in the description of the variables. In the approach by [Fuglseth \(ibid.\)](#), the language of the manager is preserved. When the manager relates values to the variables, these values are included in the map. When the concepts are formulated only as variables, and with no related values, the formulation is included in the map without any value. Practical procedures for construction of the cause maps are described in appendix 1.

2.1.2.3 Feedback meetings

An important feature of the approach by [Fuglseth & Grønhaug \(2002\)](#) is that the maps are fed back to the decision-makers. During the first meeting the individual map is systematically validated by the decision-maker, checking concepts and beliefs. Misunderstandings are corrected, and meanings of concepts are discussed to remove synonyms from the concept list. The transcripts contain a large number of concepts and causal beliefs which are somewhat related to the case, but including all of them in the map is not necessary. This implies, however, that the researcher must choose which concepts and beliefs are relevant enough to be included. Caution is used to avoid excluding concepts and beliefs that could be relevant, allowing the managers to be consulted to find out which concepts and beliefs to include.

2.2 Analysis and diagnosis

A concept list containing all the verbalizations of the concepts used by the participants is generated. The concepts are grouped using the categories from the construction of the individual cause maps. Then the concepts within each category are sorted, and concepts expressed using similar words are grouped together for further evaluation of which wordings represent the same concept and which have different meanings. The managers are consulted to validate the meaning of the concepts. The procedures for measuring complexity by reference to the structural concepts described in section 1.3.3.4 will be described in section 3.2.3.1, to be able to relate them to the problems that occurred during analysis.

In the second round of feedback meetings the validated individual maps are used for diagnosis of each manager's decision making. Attention is drawn to concepts missing in individual cause maps compared to the concept list, and to concepts mentioned by only one manager. Reasons for discrepancies are discussed. This second round of feedback meetings was not carried out, as the managers were not available before the deadline for this report.

3 Results and discussion

The results will be presented in the form of diagnosis of the managers' decision making. Analysis will be referred to as the necessary preparations for diagnosis, and involves analysis of interviews, construction of concept lists, and constructing the necessary tables for diagnosis of content and structure. Diagnosis means evaluating the current decision making to find ways of improving the decision process and to identify the factors that should be changed in order to develop a more effective decision process in complex decision situations ([Fuglseth, 1989](#), p. 264).

Some examples from the data analysis are given in appendix A1, and only a few summarizing comments are made here. After summarizing the analysis process, diagnosis of the individual cause maps follows. The diagnosis section is divided into content and structure, in correspondence with the diagnostic constructs presented in section 1.3.3.4.

3.1 Analysis

Manager 101

A problem with manager 101's transcript was how many steps in the line of reasoning to include. If a concept has only one outgoing connection, and all the ingoing connections to a concept could be directly connected to the next concept in the line of reasoning, the concept in-between may seem superfluous, especially when it does not indicate passage of time. For manager 101 this problem occurred several times, and in-between concepts were sometimes excluded. On one important occasion, however, the in-between concepts were preserved: *stable business between E and T* → *T looks for other suppliers* → *T gets the technology for producing S or equivalent*. This decision was made because the manager very seldom expressed direct connections to T getting the technology, but almost always mentioned the in-between concepts *stable business between E*

and *T* and *T* looks for other suppliers, and because he throughout the entire interview focused on these two concepts.

Manager 101 also expressed a causal connection between a future hypothetical event and a cause of the crisis situation (*T* looks for other suppliers). This is obviously impossible, if the time dimension of the map is to be taken seriously. However, as *T* may look for other suppliers at any time, connection from the future hypothetical event *E* does not accept new conditions in renegotiation of contract was allowed.

Manager 102

When analyzing the transcript of manager 102's interview, we noticed a tendency to look for the same concepts found in manager 101's transcript. Trying to avoid this, and reading objectively, the resulting concept list and causal beliefs turned out quite different from the ones of manager 101. A potential problem noticed already during the interview was the imprecise use of references to the company "E." In manager 101's case, all references to "E" were to E Japan, and when E Norway was referred to, wordings like *head office* or *management in Norway* were used. In manager 102's case, references to "E" sometimes meant E Japan and sometimes the entire company. The crisis situation was perceived only as a crisis for E Japan, but as manager 102 was sent from Norway, he often took the perspective the entire company. Apart from this, no problems not already encountered when analyzing the transcript of manager 101 arose.

Manager 103

Manager 103's concepts and beliefs were fairly easy to elicit and transfer to the cause map, as the structure turned out to be very simple because of few elements in the lines of reasoning. In addition, no general or hypothetical concepts were used. As the manager had a PhD in material technology, a large amount of technical details were given, and it was impossible to make him explain all the details during the interview. This did not cause any difficulties, as he also managed to express the essence without using technical jargon.

The reason for including both *cost of S in percentage of T's total production costs* and *cost of S in percentage of T's total material costs* in spite of the positive co-variance between them is that

manager 103 perceives them as influencing T's acquisition of the technology inversely. Although S is by large the most costly raw material, raw materials represent only a fraction of the total production costs for T. A more important cost driver is cleaning of equipment, and S requires less cleaning of equipment. The cost of S in percentage of total raw material cost is still relevant, however, especially as it dominates the costs, and since T's competitors are using cheaper raw materials.

3.2 Diagnosis

To evaluate and diagnose the current decision making, the set of diagnostic constructs presented in section 1.3.3.4 is used. As mentioned, these constructs are theory-based dimensions along which researchers can plot current decision making and the changes that may occur. The constructs also allow researchers to evaluate the individual decision makers' interpretation and handling of an event and to indicate improvements according to the theory, and compared with other decision makers handling the same task ([Fuglseth & Grønhaug, 2002](#)).

3.2.1 Content

The content constructs indicate the superordinate concept categories decision makers are expected to use in interpreting and handling an event, and analysis and diagnosis of content comprises perception of external and internal causes and consequences, in addition to action generation.

3.2.1.1 Perception of causes and consequences

To get an impression of the contents of the managers' concept repertoire, table A3.1 contains all concepts mentioned by the managers, sorted by content category instead of by causes and consequences. Situational descriptions have been replaced with content-neutral descriptions. As diagnosis is based on categorization into internal and external causes and consequences, the concept list preserving these categories is also used (table A3.2). Together these two tables and the individual cause maps (appendix 2) make up the basis for diagnosis of each manager's decision making in regard to content constructs.

Concepts mentioned only by one manager dominate completely concepts mentioned by two or three managers. 43 concepts are mentioned only by one manager, 18 are mentioned by two managers, and only 6 are mentioned by three managers. Reasons for this may involve the differing work responsibilities of the managers, and will be discussed after diagnosis of the individual managers.

Manager 101

Manager 101 is the only manager who mentions the possible existence of alternative supply sources for S or equivalent materials. This may be related to the fact that the other managers think of S as non-substitutable. This causes him to suggest that T may look for other suppliers, a process including considering starting in-house production.

As opposed to the other managers, however, manager 101 does not seem to think of T starting production as a probable consequence. Consideration of many of the concepts related to general market conditions are triggered by considering the possibility of T starting production, and as manager 101 does not consider this an option for T, neither does he think of concepts like price of Chinese material, power prices in Japan etc.

In the same way as he does not consider T starting production as an alternative, other radical consequences like giving the technology to others or threatening E in any way are not considered. Instead, he mentions more cooperative consequences like reducing the amount of S in their material input mix, and trying to negotiate with E. The only internal consequences he mentions are changes in contract conditions and loss of turnover and profit because of T's possible reduction of their use of S in their material input mix.

In essence, manager 101 sees T as very cooperative and the possibility of opportunistic behavior by T as very low, and this causes him to overlook important consequences of T behaving opportunistically. It also makes the cause map look simpler, as the amount of concepts used is limited, as can be seen in the cause map in figure A2.1. Conversely, as he sees T as cooperative, he sees E as somewhat uncooperative, and he differs from the other managers by mentioning several possible internal causes of T's technology acquisition. E's uncooperative attitude is men-

tioned several times, and a strong wish to keep profit is suggested as a cause for the lack of cooperation and flexibility. In addition, he identifies E's head office in Norway as a restricting factor in E's ability to be flexible toward T. Throughout the entire interview the long term contract and business relationship between E and T were focused, and the resolution of the crisis situation is seen as depending on these factors. This focus is reflected in the concept lists and the cause map in figure A2.1.

Manager 102

Manager 102's cause map is the most difficult to read (cf. figure A2.2). Internal causes related to the long term contract and quality problems are identified, but external causes are focused. The external causes mentioned relate mainly to T's financial situation, especially cost concerns. Influence from the trading house is also mentioned as a possible cause of T's acquisition of the technology.

As manager 102 focuses the possibility of T starting production of S or an S-like material an important external consequence, he also considers concepts related to the external market, like the price of Chinese material, the power price in Japan, and the general cost level in China and Japan. Managers 102 and 103 identify mostly the same consequences related to T starting production, and both mention the problems this will cause for E's Norwegian factory producing S.

Causes related to the business relationship between E and T are not identified, except that T paying a premium for S when E expanded the factory in Norway some years ago may indicate that they intend a long-term business relationship with E. He does, however, suggest that this technology acquisition may affect the business relationship with T, and expects T to initiate negotiations leading to a change in contract terms, especially a reduction in the price of S.

Altogether, manager 102 identifies both internal and external causes and consequences, and also provides background information to the crisis situation, such as previous negotiations and changes in contract terms and conditions. In addition, he considers the possibility of alternative technology, such as companies trying to replace S-like materials with plastic, and relates this to

the possibility of T starting production. Manager 102 mentions concepts from all categories in the aggregate concept list.

Manager 103

As basis for content analysis of manager 103's concepts and causal beliefs, the cause map proved more useful than the concept lists, as it is very easy to read, and contains no complex relationships or mediating factors. The map is presented in figure A2.3.

Manager 103 focuses T's research and production costs as possible external causes. The contract is also mentioned as unfavorable to T, and the trading house is seen as a possible source of influence. He suggests that T could have got the technology from the trading house, or vice versa. As he describes how T willingly agreed to the contract terms in the past, it is somewhat unclear whether he perceives the unfavorable contract an internal or external cause of the situation. Apart from the unfavorable contract he finds no internal causes for the crisis event.

In regard to external consequences, his focus is on T, the trading house, or others starting production, and where production would be started. The Norwegian factory producing S is mentioned as an internal consequence because it would suffer from almost any outcome he can think of. No other internal consequences are mentioned. Due to his technical knowledge of the production processes of E and T, he gives a large amount of information about how T could set up a simplified production process in China.

Although manager 103 does not mention negotiations or talks as a consequence of the situation, he suggests E taking initiative to talking to T. Actions are covered in section 3.2.1.2, but it is worth mentioning here that while managers 101 and 102 expect changes in contract conditions as a result of negotiations with T, most probably a price reduction, manager 103 expects the price to remain unchanged.

Altogether, manager 103 focuses on technical aspects of T's production possibilities and T's financial reasons for acquiring the technology for producing S or an equivalent material. The

business relationship between E and T is not commented on to any particular degree in relation to causes and consequences.

Summary of and reasons for similarities and differences

Concepts mentioned by all managers were very few. All managers mentioned the contract as a possible internal cause of the situation, although manager 103 said that T willingly had entered the contract, and suggested it was not really an internal cause. Similarities among managers 102 and 103 can be found, and especially worth mentioning is their focus on the possibility of T starting production of S or an equivalent material, and the consequences this will have for E and E's factory in Norway.

In general, managers 102 and 103 focus on financial and technological causes of the situation, while manager 101 clearly is concerned with the business relationship between E and T, and sees problems with the way E has handled negotiations with T both in the past and in the present. Reasons for these differences may be found in the managers' work responsibilities. Manager 101 has been responsible for customer relations with T since the start of the relationship, and knows all the details of the contract and what T wishes to change. His decision authority is limited, and he may feel forced to be inflexible in negotiations with T. In addition, he is Japanese by nationality, and he may therefore have a different understanding of the importance of sustaining a good business relationship with T. On the other hand, the heavy focus on the business relationship makes him overlook the possibility of opportunistic behavior by T, even though the acquisition of E's technology can be regarded as a form of opportunism. A strong focus on long-term relationships is also a well-known characteristic of Japanese business culture and practice.

Although not mentioned explicitly in the above, manager 102 repeatedly talks about the relationship between E Japan and head office in Norway. He was originally sent from head office to assist E Japan in implementing a BPR-program, but his stay was extended and his area of responsibility was expanded. His connection to E Japan seems to have been strengthened, and he expresses both understanding of E Japan's problems in relation to T, and frustration with the behavior of head office in Norway. Still, when talking about causes of the situation, his focus is on T's wish to reduce costs.

Manager 103 has the overall responsibility for E Japan, even though half of his work responsibility involves sales representation in countries like Korea and China. His decision authority and the fact that he does not follow the daily operations closely may lead him to overlook internal causes of the situation. His technical educational background (PhD in material science) may explain his focus on T's research on alternative materials and production processes.

None of the managers mention goals of the organization. This may be because the interview did not contain any questions regarding this. Spontaneously talking about the organization's goals may not be common, unless the organization focuses explicitly on goals. Checking for knowledge of organizational goals can be done during the second round of feedback meetings.

3.2.1.2 Action generation

Actions mentioned during the interviews are listed in table A3.3. The concept *action* is used for not only concrete measures, but also monitoring and analysis of environment and strategy building, like suggested in [Fuglseth \(1989\)](#).

The actions are structured according to the phases of the decision model of [Simon \(1977\)](#), as described by [Fuglseth \(1989\)](#). The phases have been limited to only including categories relevant for the interview method used in this thesis. The actions have been elicited from the concept list, cognitive maps, and from re-reading of the interview transcripts.

Diagnosis

Monitoring of environment is not specifically related to an interview question, but the question about whether the crisis situation came as a surprise or if signals were perceived is indirectly related, and could elicit relevant information. None of the managers mention anything about information search related to monitoring of environment. As perception of signals of the crisis, only events not related to monitoring of environment were mentioned, for instance that T expresses dissatisfaction with the contract conditions. Analysis and interpretation of data is mentioned briefly by all managers, for instance manager 102 who says "there has been some discussions," but no structured analysis has been carried out. Expectations and beliefs were mentioned, but the only one who mentioned any evaluation of internal consequences was manager 102. A

passive attitude toward changes in the environment seems to be the norm, unless they are very significant.

Action generation involves several stages. Managers 102 and 103 suggest getting more information about the situation, i.e. finding out how T actually acquired the technology and extracting information from the sales people. As the situation has occurred before with a customer in Europe, manager 102 suggests gathering information about how this happened. Manager 101, however, specifically states that no information is necessary, because the situation could and should be handled by E alone. He suggests analyzing the contract and T's material costs before resolving to any actions, but these are analyses based on data already in E's possession.

The next phase of action generation involves making plans for action. Action plans are characterized as strategic, general, or concrete. In addition, strategy building is defined as the most advanced form of planning. No managers generated plans in a way that can be characterized as strategy building, because almost no variables representing uncertainty was considered. Manager 102, however, did express plans that clearly are strategic in nature. Distinguishing from cheap producers is described as essential in the competition against Chinese producers, and the only way of keeping T from looking for alternative producers. As there are strong indications that an important reason why T is still buying S, except for the existence of a long term contract, is the high quality of the product, keeping this competitive advantage seems strategic important. Maintaining the quality advantage is therefore essential, especially as a significant drawback of the Chinese suppliers is unreliable quality. Managers 101 and 103 do not mention any plans that can be characterized as strategic.

The next levels of action plans are general and concrete plans for action. It seems that the general plans can be described as efforts to prevent T from doing anything drastic, like starting production of S or an equivalent material. The concrete plans are generally actions relevant only if the general plans do not work. Manager 101 does not have many suggestions for actions, but this is clearly related to his focus on the long term contract, and his plan to address the problem to head office is only related to the problem with the contract. In essence, manager 101 sees this situation

as related only to contract conditions, and the only relevant actions are those that can make both parties satisfied with the contract conditions.

Manager 102 is represented with several actions devised to prevent T from doing anything drastic, such as maintaining a good relationship, hiding production costs, and reducing E's production costs to be able to be flexible toward T in contract negotiations. If these measures do not work, he resorts to actions like manager 103 focuses, e.g. building a plant in China together with T. Manager 102 generates plans both to prevent T from doing anything drastic such as starting production, and for what to do if these plans do not work. Manager 103, however, mentions no plans for how to prevent the situation to escalate, but suggest many options for what to do if the situation escalates. Manager 102 seems to have the most complete perception of the situation in regard to causes and consequences, and he is also the only manager who generates strategic action plans.

The table should be interpreted with caution, as the interview questions were very general. When reading the transcripts and analyzing the data it appears it would have been better to ask more specific questions, and address for instance information search directly. Still, it seems clear that as none of the managers consider hypothetical future events, they are not capable of strategy building. Of course, considering hypothetical future events does not automatically lead to considering these events as variables in generation of action plans.

3.2.2 Structure

While the content constructs indicate the superordinate concept categories decision makers are expected to use in interpreting and handling an event, the structural constructs indicate the way in which an individual combines information perceived from the outside world, as well as internally generated information. The structural diagnostic constructs are described in section 1.3.3.4.

3.2.2.1 Procedures for measuring complexity

The first construct relates to the number of causes and consequences. Counting of concepts is started at the beginning of the line of reasoning. For causes, this means at the first concept, and for consequences the first concept means after the concept representing the crisis situation – T's technology acquisition. Consistent use of this rule does not, however, make fair comparison

possible. The rule has therefore been modified in accordance with the guidelines of Fuglseth (1989, p. 162), which comprise the following:

- The managers are not credited more causes or consequences because the reasoning begins a long time ago, or because they begin the reasoning with a very wide concept.
- No credit is given for detailed formulations of the same concepts.
- For superordinate concepts with subordinate specifications, credit is given only for the subordinate concepts, except when the superordinate concept is directly connected to other consequences.
- Credit is only given for causes and consequences related to the concept representing the crisis event. Concepts related to past events or used for making the reasoning more detailed than necessary are not credited.

Complexity in interpretations is divided into differentiation and discrimination, like indicated by cognitive complexity theory. Differentiation is measured by the number of dimensions in interpretation. *Dimension* is not a precise concept, but like [Fuglseth \(1989\)](#), we used the categories from the concept list (table A3.1) as dimensions. Discrimination is measured as the number of concepts mentioned within each dimension. Consequences of actions are not included, even though they sometimes can be described as actions. The results are presented in table 3.1.

Table 3.1 - Quantitative analysis of structural diagnostic constructs

	101	102	103	mean	st.dev.
Number of causes and consequences					
# causes	15	11	13	13,00	2,00
# consequences	5	11	6	7,33	3,21
Sum	20	22	19	20,33	1,53

Perspective

Differentiation (number of dimensions)

Market/external to E and T	1	1	1	1,00	0,00
Technology and production	1	1	1	1,00	0,00
Financial matters for T	1	1	1	1,00	0,00
Financial matters for E	1	1	1	1,00	0,00
Business relationship between E and T	1	1	1	1,00	0,00
Internal matters for E	1	1	0	0,67	0,58

Sum	6	6	5	5,67	0,58
-----	---	---	---	------	------

Discrimination (number of concepts)

Market/external to E and T	1	3	3	2,33	1,15
Technology and production	4	5	7	5,33	1,53
Financial matters for T	1	6	4	3,67	2,52
Financial matters for E	1	2	1	1,33	0,58
Business relationship between E and T	12	2	4	6,00	5,29
Internal matters for E	1	4	0	1,67	2,08
Sum	20	22	19	20,33	1,53

Number of actions	101	102	103	mean	st.dev.
# actions	4	10	7	7,00	3,00

Perspective

Differentiation (number of dimensions)

Market/external to E and T	0	1	0	0,33	0,58
Technology and production	0	1	1	0,67	0,58
Financial matters for E	0	1	0	0,33	0,58
Business relationship between E and T	1	1	1	1,00	0,00
Internal actions	1	1	1	1,00	0,00
Sum	2	5	3	3,33	1,53

Discrimination (number of concepts)

Market/external to E and T	0	1	0	0,33	0,58
Technology and production	0	3	3	2,00	1,73
Financial matters for E	0	1	0	0,33	0,58
Business relationship between E and T	1	3	3	2,33	1,15
Internal actions	3	2	1	2,00	1,00
Sum	4	10	7	7,00	3,00

3.2.2.2 Causes and consequences

Number of causes and consequences

According to cognitive complexity theory, the number of causes and consequences mentioned is expected to increase for higher levels of information processing. As in the diagnosis of content constructs, manager 102 is represented with the highest number of concepts, although manager 101 mentions more causes.

Number of dimensions in interpretations

All managers mentioned concepts within all dimensions, except for manager 103, who did not identify any internal causes or consequences. According to differentiation, therefore, no signifi-

cant differences between the managers can be identified. In general, the impression from content analysis is confirmed.

Manager 101's involvement in the relationship with T since its initiation explains his ability to identify the largest number of concepts for this dimension, and manager 103's technical background may explain why he mentions many technical concepts. Manager 102's work responsibilities cannot explain why he in general scores high on discrimination. He has previously worked as controller, which might explain why he identifies many financially related concepts for T, but as he does not identify many financially related concepts for E, this explanation is not convincing. It is also worth noting that manager 102 has no specific weak points. This confirms the impression from the diagnosis of content constructs.

Perception of uncertainty

Indications of uncertainty can be found in the cognitive maps in concept formulations, relationships between concepts, and by expression of hypothetical concepts ([Fuglseth, 1989](#)). Concepts may be formulated with words and phrases related to uncertainty, like unstable Chinese supplies, or volatile market for semiconductors. None of the concepts of the managers interviewed contained formulations like this. The instability of Chinese supplies is actually constant, because the instability to a large degree refers to quality-related characteristics of the material delivered.

Uncertainty expressed through relationships can be found in relationships marked with a question mark. Manager 101 expresses uncertainty related to the actions of head office in Norway, and the relation *T acquires the technology* → *S sales volume* is also marked with a question mark. The latter relation is more an expression of worry than of uncertainty, and should possibly not have been marked with a question mark. Uncertainty related to market development is not mentioned at all. The only hypothetical event mentioned is related to the behavior of head office in Norway.

The maps of managers 102 and 103 contain no hypothetical concepts, and the map of manager 102 has only one relation with a question mark: whether T will start production of S or a similar material as a consequence of their technology acquisition. This uncertainty is also included in the

map of manager 103, who also uses a question mark to indicate that E could consider taking legal action if it is discovered that T has acquired the technology illegally.

Perception of weak signals

This construct is directly addressed by interview question nr. 3 – “Did you expect T to acquire this technology, or was it a surprise? If it was expected, were there any signals?” In section 3.2.1.2 the managers’ answers to this question were used to assess their monitoring of the environment. Monitoring of environment is clearly related to the ability to perceive weak signals, and indications have already been seen of the managers’ ability to predict the crisis event.

As answers to question no. 3, manager 102 is very clear that he did not see any signals. Manager 103 also describes the incident as a surprise, but while thinking about it, he recalls events he characterizes as signals, and realizes he should have thought more about it. For example, he remembers that T tried to develop a process that could have rendered S unnecessary as a raw material. They did not succeed, but clearly they were trying to adjust their processes to avoid using S, which is the most expensive raw material in their production process.

Manager 101’s focus on the business relationship between E and T, and especially the long term contract, is also reflected in his answer to the question about signals. He mentions T expressing dissatisfaction with the contract, and wanting to change the terms.

In general, none of the managers seems to have perceived any signals before information about T’s possible acquisition of technology was received. This may be related to lack of monitoring of environment. Estimating T’s competitors’ raw material costs, keeping an eye on prices of Chinese metal, and calculating T’s profit could have given indications of when and why they would like to adjust their production processes to get away from using S.

Complexity in interpretations

Complexity in interpretations is described by [Fuglseth \(1989\)](#) as a composite construct including alternative interpretations of an event, perceiving a situation from multiple viewpoints, thinking independently of immediate stimuli, and theorizing. Alternative interpretations of an event means

for example realizing that an increase in raw material price is both negative for E because it leads to higher material cost, and positive for E because it increases T's estimated production cost for an S-like material. This cannot be found in any of the maps. Manager 102 mentions during the feedback meetings, however, that alternative technology (producing circuits in plastic) could open up new business opportunities, in addition to the negative effect of rendering S useless.

Perceiving a situation from multiple viewpoints means thinking of implications for many actors, for instance E, T, the trading house, E's other customer, or considering several aspects, like technological and financial implications. The only example of this is manager 102, who during the second feedback meeting mentions that manager 101's concept "E wants to keep profit" is seen from the perspective of T, or from a Japanese business perspective. Seen from a European perspective, E expecting T to adhere to a written contract is not to be considered overly uncooperative because of a strong wish to maintain profits.

Thinking independently of immediate stimuli implies generating consequences based on several possible future conditions, for instance material prices, or developing alternative scenarios. It also implies forming analogies and predicting consequences based on these. Again, manager 102 is the one exhibiting interpretation complexity, as he talks about a European customer who managed to substitute a cheaper material for S, and the general trend of moving production to China, making the future of the Norwegian factory producing S somewhat uncertain irrespectively of what happens with T.

Theorizing is described by cognitive complexity theory as the highest level of information processing. On this level, general laws are expressed and applied to the situation. Use of general concepts is related to this. Manager 101 mentions that acquiring technology is a general trend, which is the closest the managers come to theorizing.

3.2.2.3 Actions

The results from counting of actions were presented in table 3.1. Using the same dimensions for actions and causes and consequences proved to be somewhat difficult. *Financial matters for T* had to be removed, as E cannot do anything directly to influence T's financial situation, except

reducing the price of S. Sorting the actions still proved difficult, and the discrimination measure should therefore be interpreted with caution.

In general, the impression from diagnosis of content is strengthened. Manager 102 generates 10 actions, while managers 103 and 101 generate 7 and 4 actions, respectively. Manager 102 also generates actions in all 5 dimensions, while managers 103 and 101 generate actions in 3 and 2 dimensions, respectively. Because of sorting difficulties, discrimination will not be used to draw any conclusions, except that manager 101 again scores high on internal matters. The actions he generates are, however, only related to the contract.

For complexity in evaluations and choices of actions, expression of hypothetical events, and expression of task theories, no additional information can be elicited from structural analysis than has already been already commented on. Expression of hypothetical events is missing, and no strategy building takes place. Considering actions in relation to each other is an indicator of complexity in evaluations and choices of actions. As mentioned, however, the actions developed seem to indicate two types of actions: 1) actions to prevent T from using S, 2) actions relevant if T acts opportunistically. It would be unfair to say that the actions are completely unrelated, because they can to some degree be combined. For instance, cooperating with T on improving the production process for S can be combined with building a factory in China. Other possibilities exist, but none of these are mentioned by the managers.

3.2.3 Summary diagnosis

The managers' perception of the decision situation has been described using the content constructs, and the structural constructs have been used to measure the complexity of the managers' information processing, based on cognitive complexity theory. By indicating the managers' focus and span of attention, the content constructs may predict the results from complexity analysis, which is clearly the case here. Manager 101's focus is on internal matters, both related to causes, consequences, and actions, and he also scores higher than managers 102 and 103 on information processing complexity for internal matters (discrimination).

The conclusion seems to indicate that the managers' perception of uncertainty is not very developed, and that they tend to elaborate only the chains of events they consider most likely, which are: T giving the technology to other companies, starting production, or possibly threatening E with starting production. Successful commercialization of alternative technology was not considered plausible in the nearest future, and T adjusting their production process to get render S unnecessary as a raw material was not elaborated.

As a reference for evaluation the individual managers' decision making, an aggregate map would have been a useful supplement. To evaluate the decision making of the managers in general, a separate reference group is needed, like a group of researchers doing research on the market in which T and E operate. Creating an aggregate map for the researchers and comparing it with the aggregate map of the managers could provide useful input to how the managers could improve their decision making, and also how they could benefit from contact with the researchers. This assumes, of course, that the researchers are able to provide a more complex perception of the crisis situation. For a discussion on using groups of experts as an evaluation standard, see [Fuglseth & Grønhaug \(1999\)](#).

3.3 Discussion

As described in the introduction, the framework developed by [Fuglseth \(1989\)](#) and [Fuglseth & Grønhaug \(2002\)](#) has previously been applied in a setting with managers in Norwegian shipping companies. The results summarized in the previous section show some similarities with the results of [Fuglseth \(1989\)](#), but also some important differences. Similarities are related to the managers' tendency to elaborate only on the most probable development (consequences of the crisis event), and their non-use of hypothetical future events. The most notable difference is the degree of shared understanding that seems to exist among the managers. Even though the managers of E function as a decision making team, the degree of shared understanding of the crisis situation, indicated by the number of concepts mentioned by more than one manager, is far lower than what was expected, and lower than what appeared in the results of [Fuglseth \(1989\)](#).

It is tempting to attribute this discrepancy to higher cultural heterogeneity in the decision making group. A culture factor influencing the results was indicated in content diagnosis, but as the

shared understanding seems to be limited also among the two Norwegian managers, differing work responsibility and decision authority are other possible explanations.

Researchers have hypothesized that the greater the shared understanding that exists between individuals that work together, the greater the team's effectiveness (Cannon-Bowers, 1990, cited by [Tegarden & Sheetz, 2003](#)). Based on this and the previous definitions, a reasonable goal for a learning organization would be to maximize the shared understanding among individual managers. One approach to increase the shared understanding between individuals is to reduce the equivocality of information by making it explicit, i.e., revealing the existence of different interpretations of the same information for all to see (Daft & Weick, 1984, cited by [Tegarden & Sheetz, 2003](#)). A figure from [Laukkanen \(1994, p.325\)](#) may serve to illustrate the concept of shared cognition. The intersection depicts the fully shared causal elements:

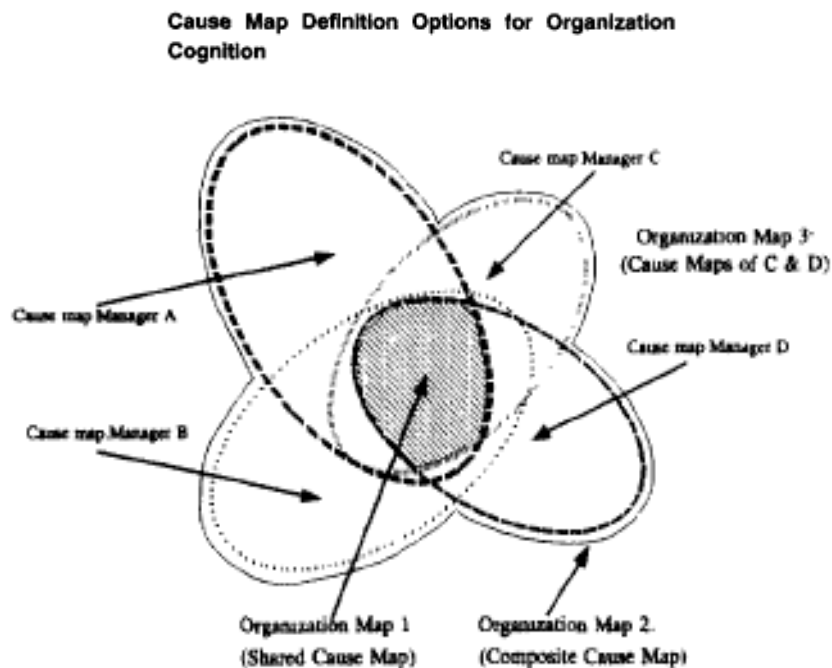


Figure 3.1

From an organizational learning perspective, to be capable of maximizing organizational cognition, it is critical to capture and evaluate both similarities and differences found in the individuals' cognitions. Using the cause mapping approach for the purpose of organizational learning, therefore, seems like a possibly fruitful endeavor. The use of a crisis situation as stimulus, is, as

mentioned, motivated by the purpose of eliciting cognition as accurately as possible, and the elicited information may be used to derive general similarities and differences in the individuals' cognitions independently of the stimulus situation.

[Fuglseth & Grønhaug \(2002\)](#) have used their cause mapping approach in research involving design and implementation of computerized decision support systems (DSS). In this case, the crisis situation was very specific, and although general tendencies in the managers' decision making are observed, construction of a computerized decision support was not considered. The managers were, however, very enthusiastic about the maps we constructed, and wondered if it would be possible for them to construct similar maps for other situations. Although the approach by [Fuglseth & Grønhaug \(ibid.\)](#) is less strict and more practical than similar approaches, it is too time-consuming and complicated for the managers to employ without training and assistance. Developing a computer program enabling managers to carry out the procedures for constructing cause maps or other types of cognitive maps might be worth considering.

3.4 Validity and reliability

The research design used in this thesis is based on an already developed set of methods and techniques. Validity can therefore be evaluated on two levels: 1) validity of the methods in general, 2) validity of the particular implementation of the methods in this thesis. In the following sections, internal validity, external validity, and reliability will be considered on these two levels.

3.4.1 Internal validity

Internal validity is usually used to describe to what degree a causal relationship exists between two variables ([Reve, 1985](#)). In this section, the degree to which the diagnosis summarized in section 3.2.3 gives a good picture of the relationship between the managers' perception and behavior is evaluated, i.e. whether the maps represent the causal beliefs the managers use when managing their action domains ([Laukkanen, 1998](#)). Topics include validity of respondents' responses, the role of the interviewer, and aspects related to construction of the cause maps. Determining causal relationships is beyond the scope of the method used ([Fuglseth, 1989](#)).

As described in section 1.3.3.3, many researchers hold pessimistic views of the validity of the respondents' responses, e.g. [Argyris & Schön \(1978\)](#) and [Eden \(1992\)](#). According to [Laukkanen \(1994\)](#), a cautiously optimistic view has surfaced, suggesting that validity depends on the type of cognitive elements acquired, and on the methods' appropriateness. Assuming no filtering, people are regarded as capable of producing valid data on their declarative knowledge, either by accessing memory or by reconstructing ad hoc the requested explanations (causes) or predictions (effects) (Bandura, 1986; Evans, 1988; Gordon, 1992, cited by [Laukkanen, ibid.](#)). Laukkanen also mentions that many researchers have experiences how managers talk astonishingly openly, producing authentic, sincere data. Moreover, Laukkanen adds, filtering is often random, whose effects may be assumed to cancel themselves when several respondents are interviewed. [Brown \(1992\)](#) argues that the interview process often resembles "laddering," in which the researcher and the respondent work backwards to antecedent conditions or forward to anticipated effects, a process that makes it difficult to not tell the truth.

An important aspect of the data collection method used here is the attempt to establish conditions under which individuals are able to be accurate in their reports about the causes of their behavior, namely exposing the decision makers to a crisis situation ([Fuglseth & Grønhaug, 2002](#)). The formulation and sequence of the open-ended questions used for elicitation of concepts and causal beliefs are tied to the theories on which the approach is based. The method thus aims at satisfying the requirement by [Axelrod \(1976\)](#) that concepts as well as causal links should come from the data and not from any a priori assumptions of the researchers. As noted, when generating individual concept lists, effort was made to avoid looking only for the concepts found in the previous transcript. Furthermore, the managers expressing their concepts and causal beliefs using their own language should also increase validity ([Jenkins, 1998](#)). In general, the respondents were astonishingly open, and their motivation also seemed to be more than sufficiently high, possibly because the crisis situation was authentic. All interviews were conducted in a meeting room, and no mobile phones were brought.

As the interviewer does not remain passive during the interview, but rather asks for explanations of concepts and continuation of lines of reasoning, the impact on the resulting data cannot be neglected. The interviewer will become more experienced for each interview, a factor which may

explain why the first interview was the shortest. Understanding of the situation also increases for each interview, and more hints may have been given to managers 102 and 103 than to manager 101.

The validity of cause maps also relates to the procedures for constructing the maps. The procedures of [Fuglseth & Grønhaug \(2002\)](#) are based on procedures described by [Wrightson \(1976\)](#), which have attained a high level of intercoder reliability. Another important aspect that may increase internal validity is that the cause maps are systematically checked by the managers during feedback meetings.

As the managers did not use any aids during the interview, an important question is whether they would have come up with more concepts and provided a more detailed analysis of the decision situation if they were able to access their database or to use other information sources. In fact, no restrictions were made related to use of information sources during the interview, and during feedback meetings, none of the managers indicated any wish to add anything (except manager 102 who added a few concepts) or to use any information sources.

3.4.2 External validity

External validity in case studies is usually low. In this case study, external validity may be considered in relation to similar situations, similar industries, or similar managers. The approach aims to elicit not only decision making behavior related to the crisis situation, but also in general, which is a form of external validity. The choice of a crisis situation as stimulus is meant to increase external validity, so that the elicited decision making behavior is valid across a number of management situations, thus reflecting the managers' general decision making.

Relating the results to theories of decision making behavior can also indicate the generalizability of the results. Cyert & March ([1992](#), originally published 1963) suggest that managers tend to focus their attention on immediate concerns instead of developing long term strategies in which uncertainty is considered. This can be said to correspond to the results in this case. In addition, the managers interviewed do not seem to monitor the environment to any significant degree, which is also in line with suggestions of [Cyert & March \(ibid.\)](#) that information search is problem

focused. These observations may indicate a certain degree of generalizability to both similar industries and managers.

3.4.3 Reliability

With complete reliability, different researchers would get the same result, and/or the method would produce similar results on different occasions. For cognitive mapping, reliability is a relevant issue to consider for several phases of the method. [Brown \(1992\)](#) expects the inter-rater reliability to be very low, as cognitive mapping carried out interactively depends considerably on the interviewing skills of the researcher. This problem is the same, however, for any essentially interview-based technique.

The inter-rater reliability corresponds to data elicitation, which basically means the interview process. Coding of data from the interview process is also subject to reliability problems. The coding procedure used in this thesis follows, as mentioned, the procedures described by [Wrightson \(1976\)](#), which have attained a high level of intercoder reliability ([Axelrod, 1976](#)). Intercoder reliability could have been checked by letting both of us code the interview transcripts.

Repeated-test reliabilities are more difficult to assess because people learn and remember, a problem that contaminates the results. What might be expected of cognitive mapping is that the proportion of respondents' concepts that are similar on a second occasion would be variable but lower ([Brown, 1992](#)). Some of these differences will be due to new events that have occurred in the meantime. Others will be due to focus of attention being different on the second occasion, and yet others will be functions of human memory ([Brown, *ibid.*](#)).

Ideally, the decision makers should be presented for more than one crisis event, like [Fuglseth & Grønhaug \(2002\)](#) suggest. This may provide an opportunity to check whether the decision making behavior of the managers is consistent across situations, thereby indicating the reliability of the method.

3.5 Concluding remarks and further research

In this paper, an approach aiming to link the method of knowledge elicitation and construction and analysis of cause maps to cognitive theories has been used in a new context, and the results show both similarities and differences compared to the study of [Fuglseth \(1989\)](#). Although generation of a task model was not conducted, the results indicate possible areas for improvement. Asking more specific questions has been mentioned, e.g. to address information search directly.

The approach by [Fuglseth & Grønhaug \(2002\)](#) is an attempt to handle the challenge of combining scientifically valid procedures based on adequate theory with the need for the managers to perceive outcome of the research as useful. Using the managers' own formulations, and avoiding strict requirements like formulating concepts as variables seems to be a step in the right direction.

As the stated goal of their approach is to help managers improve their decision making, however, the focus on measuring and comparing the managers' information processing complexity could be somewhat downplayed. Refraining from giving the managers too many hints in order to avoid imposing the interviewer's perceptions on them may prevent them from elaborating on areas in which they possess extensive knowledge. The managers being able to generate more causes, consequences and actions could, given the goal of improving their decision making, compensate for the reduced scientific value of the research. In other words, a suggestion for further research is to construct interview questions that give stronger cognitive support (cf. cognitive process model of [Shapiro & Bonham, 1973](#)) could be a suggestion for further research.

Cause maps represent causal beliefs only, and cannot provide a complete representation of a situation. Beliefs about e.g. possibilities, probabilities, strengths, and weaknesses are not represented. Especially in relation to strategy building, aspects like internal strengths and weaknesses seem important (cf. strategic management literature, e.g. Ansoff, 1979). To handle this challenge, [Fiol & Huff \(1992\)](#) suggest using a portfolio of maps, utilizing the benefits of interactions between the different types of maps.

Cause maps can also be used for other purposes than decision making. Using cause maps to reduce the equivocality of information by making it explicit may also be fruitful, thereby increasing

the understanding between managers and increasing team efficiency, like suggested by [Tegarden & Sheetz \(2003\)](#). In addition to assisting the managers in handling the specific crisis situation and providing suggestions for improvement of their general decision making, the results in this paper might be used to extract information about shared cognition and understanding, thereby increasing it.

References

- Ansoff, H. I. (1979). *Strategic management*. London: Macmillan Press.
- Argyris, C., & Schön, D. A. (1978). *Organizational Learning*. Reading, MA: Addison-Wesley.
- Axelrod, R. (Ed.) (1976). *Structure of Decision: The Cognitive Maps of Political Elites*. Princeton, NJ: Princeton University Press.
- Biggs, S. F., Rosman, A. J., & Sergenian, G. K. (1993). Methodological issues in judgment and decision-making research: Concurrent verbal protocol validity and simultaneous traces of process. *Journal of Behavioral Decision Making*, 6(3), 187-206.
- Brown, S. M. (1992). Cognitive Mapping and Repertory Grids for Qualitative Survey Research: Some Comparative Observations. *Journal of Management Studies*, 29(3), 287-307.
- Campbell, D. J. (1988). Task Complexity: A Review and Analysis. *Academy of Management Review*, 13(1), 40-52.
- Cossette, P., & Audet, M. (1992). Mapping of an idiosyncratic schema. *Journal of Management Studies*, 29(3), 325-347.
- Cyert, R. M., & March, James G. (1992): *A Behavioral Theory of the Firm*, 2nd Edition. Oxford: Blackwell.
- Davidson, R. A. (1996). Cognitive complexity and performance in professional accounting examinations. *Accounting Education* 5(3), 219-231.
- Diffenbach, J. (1982). Influence Diagrams for Complex Strategic Issues. *Strategic Management Journal*, 3.
- Eden, C. (1992). On the Nature of Cognitive Maps. *Journal of Management Studies*, 29(3), 261-265.

- Eden, C., & Ackermann, F. (1992). The Analysis of Cause Maps. *Journal of Management Studies*, 29(3), 309-324.
- Eden, C., Ackermann, F., & Cropper, S. (1992). The analysis of cause maps. *Journal of Management Studies*, 29(3), 309-324.
- Eden, C., Jones, S., & Sims, D. (1979). *Thinking in Organizations*. London: Macmillan.
- Fiol, C. M., & Huff, A. S. (1992). Maps for Managers: Where are we? Where do we go from here? *Journal of Management Studies*, 29(3), 267-285.
- Fuglseth, A. M. (1989). *Beslutningsstøtte: metode for diagnose av leders informasjons- og situasjonsoppfatninger*. Doctoral Dissertation, Bergen: Norges Handelshøyskole.
- Fuglseth, A. M. & Grønhaug, K. (1999). Task Characteristics and Expertise. In Green, B. (Ed.), *Risk Behaviour and Risk Management in Business Life*. Kluwer Academic Publishers, Dordrecht.
- Fuglseth, A. M. & Grønhaug, K. (2002). Theory-driven construction and analysis of cause maps. *International Journal of Information Management*, 22, 357-376.
- Green, G. C. (2004). The impact of cognitive complexity on project leadership performance. *Information and Software Technology*, 46, 165-172.
- Heradstveit, D., & Bonham, G. M. (1981). *Decision-making in the face of uncertainty: The Russian boat episodes in the Northern areas of Norway in 1978*. NUPI Report No. 56. Oslo: Norwegian Institute of International Affairs (NUPI).
- Huff, A. S. (1990). *Mapping Strategic Thought*. Chichester, England: Wiley and Sons.
- Jenkins, M. (1998). The theory and practice of comparing causal maps. In Eden, C., & Spender, J.-C. (Eds.), *Managerial and organizational cognition* (pp. 231-249). London: Sage.
- Kelly, G. A. (1991). *The psychology of personal constructs*, vol. I. London: Routledge.
- Laukkanen, M. (1994). Comparative cause mapping of organizational cognitions. *Organization Science*, 5(3), 322-343.
- Laukkanen, M. (1998). Conducting causal mapping research: opportunities and challenges. In C. Eden, & J.-C. Spender (Eds.), *Managerial and organizational cognition* (pp. 168-191). London: Sage.
- March, J. G. & Simon, H. A. (1958). *Organizations*. John Wiley & Sons, Inc. New York.
- Meindl, J., Porac, J., & Stubbart, C. (1991). Announcement – Call for Papers. *Scandinavian Journal of Management*, 7(1), 71-72.
- Neisser, U. (1967). *Cognitive Psychology*. New York: Appleton-Century-Crofts.

Reve, T. (1985). Validitet i økonomisk-administrativ forskning. In Grønhaug, K. (Ed.), *Metoder og perspektiver i økonomisk-administrativ forskning*. Universitetsforlaget AS, Oslo.

Roos, L. L. Jr., & Hall, R. I. (1980). Influence Diagrams and Organizational Power. *Administrative Science Quarterly*, 25.

The Royal Swedish Academy of Sciences (2002). *Foundation of behavioral and experimental economics: Daniel Kahneman and Vernon Smith*. Advanced information on the prize in economic sciences 2002, 17 December 2002.

Russo, J., Johnson, E., & Stephens, D. (1989). The validity of verbal protocols. *Memory and Cognition*, 17(6), 759-769.

Schröder, H. M., Driver, M. J., & Streufert, S. (1967). *Human information processing*. New York: Holt, Rinehart and Winston.

Shapiro, M. J., & Bonham, G. M. (1973). Cognitive process and foreign policy decision-making. *International Studies Quarterly*, 17(2), 147-174.

Simon, H. A. (1977). *The New Science of Management Decision*. Prentice-Hall, Inc., Englewood Cliffs, NJ.

Stabell, C. B. (1979). *Decision research: Description and diagnosis of decision making in organizations*. Working paper No. 79.006. Bergen: Institute for Information Systems Research, Norwegian School of Economics and Business Administration.

Stabell, C. B. (1983). A decision-oriented approach to building DSS. In J. L. Bennett (Ed.), *Building decision support systems* (pp. 221-260). Reading, MA: Addison-Wesley.

Tegarden, D. P., & Sheetz, S. D. (2003). Group cognitive mapping: a methodology and system for capturing and evaluating managerial and organizational cognition. *Omega*, 31, 113-125.

Tolman, E. C. (1948). Cognitive maps in rats and men. *Psychological Review*, 55, 189-208.

Walsh, J. B. (1995). Managerial and organizational cognition: Notes from a trip down memory lane. *Organization Science*, 6(3), 280-321.

Weick, K. E., & Bougon, M. G. (1986). Organizations as cognitive maps: Charting ways to success and failure. In: H. P. Sims Jr., D. A. Gioia, & Associates, *The thinking organization* (pp. 102-135). San Francisco: Jossey-Bass.

Wrightson, M. T. (1976). The documentary coding method. In R. Axelrod (Ed.), *Structure of decision* (pp. 291-332). Princeton, NJ: Princeton University Press.

APPENDIX 1 – Practical procedures for construction of cause maps

The main procedures for constructing individual cause maps are as follows: First a list representing the verbalizations of concepts is generated. The concept variables should maintain the original language as faithfully as possible. All concepts are assigned a code that indicates the page number of the interview transcript and a unique identifier such as a letter combination or a number. The concepts can also be grouped according to the categories of the diagnostic constructs, like external/internal causes, consequences, actions, and so on ([Fuglseth & Grønhaug, 2002](#)). In addition, they may be grouped according to categories relevant to the case, like causes related to T, causes related to the trading house, and so on.

When all causal assertions have been found and coded, merging of concepts should be considered when they are believed to express the same meaning. If similar terms have different causes and consequences, it can be a clue that they should not be merged. Cases of doubt can be noted and discussed with the managers in the feedback meetings. Next, the direction and signs of the causal relationships are analyzed and represented as signed arrows between the concepts. The following symbols are used:

+ affects positively, leads to, causes, influences (default, not included in the maps)

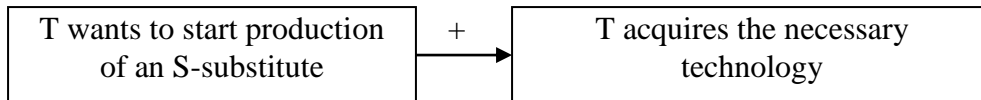
- affects negatively, does not lead to, prevents

⊕ will not hurt, does not prevent, is not harmful to, “in spite of...”

⊖ will not help, does not promote, is of no benefit to

? indicates either/or relationships

The final step in construction of a cause map is to transfer the identified concept variables and causal relationships into a graphic representation. The cause maps are constructed with two fundamental types of elements: verbalizations of concepts (constructs) and causal relationships. In the map the verbalized concepts are presented in boxes and treated as variables, and the causal beliefs are presented as relationships between the variables. The beliefs are presented graphically by arrows between the variables to indicate the direction of cause-effect relationships. The arrows are signed in order to show positive or negative relationships. A simple example is this:



[Fuglseth \(1989\)](#) has extended Wrightson's notation to visualize interpretation of the map according to the structural diagnostic constructs. For example, assertions regarding hypothetical events are represented in the map by italics, and general assertions, strategies, and task theories are represented in bold text. An example of a general assertion, as opposed to assertions about specific situational cause- and effect-relationships is "Japanese customers want to understand the production process of the products they buy."

Beliefs about future events will by definition always be hypothetical, and are not indicated by italics. The types of hypothetical concepts indicated by italics are alternative historical events, and alternative assumptions about future events. These concepts are related to the structural norms for thinking independently from immediate stimuli ([Fuglseth, *ibid.*](#)), as described in section 1.3.3.4. The purpose of representing hypothetical events is partly to indicate that the managers have mentioned this type of concepts, and partly to make the cognitive maps easier to read. If hypothetical events are not singled out, confusion may arise in regard to what the managers think actually happened.

Fuglseth also suggests indicating what she terms *significant concepts* in bold frames. No specific guidelines are given in regard to procedures for singling out significant concepts, except choosing the concepts the managers themselves characterize as significant. When the managers do not describe any concepts specifically as significant or important, Fuglseth suggests that the researcher himself selects the concepts that most accurately characterize the cause- and effect paths. These concepts will usually be focused when discussing the cause maps with the managers during the feedback meetings.

The last distinctive feature of [Fuglseth's \(1989\)](#) extension of Wrightson's work is to arrange concepts hierarchically. Superordinate abstract concepts are related to the diagnosis concepts listed in section 1.3.3.4. A structural norm like viewing a situation from many perspectives implies that several superordinate concepts cover some of the same subordinate concepts. Subordinate con-

cepts may also be operationalizations of abstract concepts. For instance, several managers mention the concept *contract conditions*, and operationalize it into *price* and *volume*. Subordinate concepts are divided into specifications not used later in the interview and specifications used later. *Examples* is another type of subordinate concepts, that may serve as indicators of the span of perceptions of a situation, for example geographically. The representation of different types of concepts is summarized in table 1, from [Fuglseth \(1989, p.316\)](#).

concept	Ordinary concept – cause, effect, historical or future
significant concept	significant concept
superordinate concept - specification 1 - specification 2	superordinate concept with specifications not used later in the interview
superordinate concept subordinate concept 1 subordinate concept 2	superordinate concept with specifications used later in the interview
concept - example 1 - example 2	concepts specified with examples not used later in the interview
general concept	general concept used in theorizing or strategy building
<i>hypothetical concept</i>	concept describing hypothetical event or action not carried out

Table A1.1 – types of concepts in cause maps

Coding combinations may also appear. A subordinate concept used later in the interview can be a significant concept, and it will thus be represented with bold frames. When the superordinate concept and the subordinate concepts are both regarded as significant concepts, they are both represented with bold frames, and the frame enclosing both the superordinate and the subordinate concepts is kept in regular font.

APPENDIX 2 – Cause maps

Figure A2.1 - Cause map manager 101

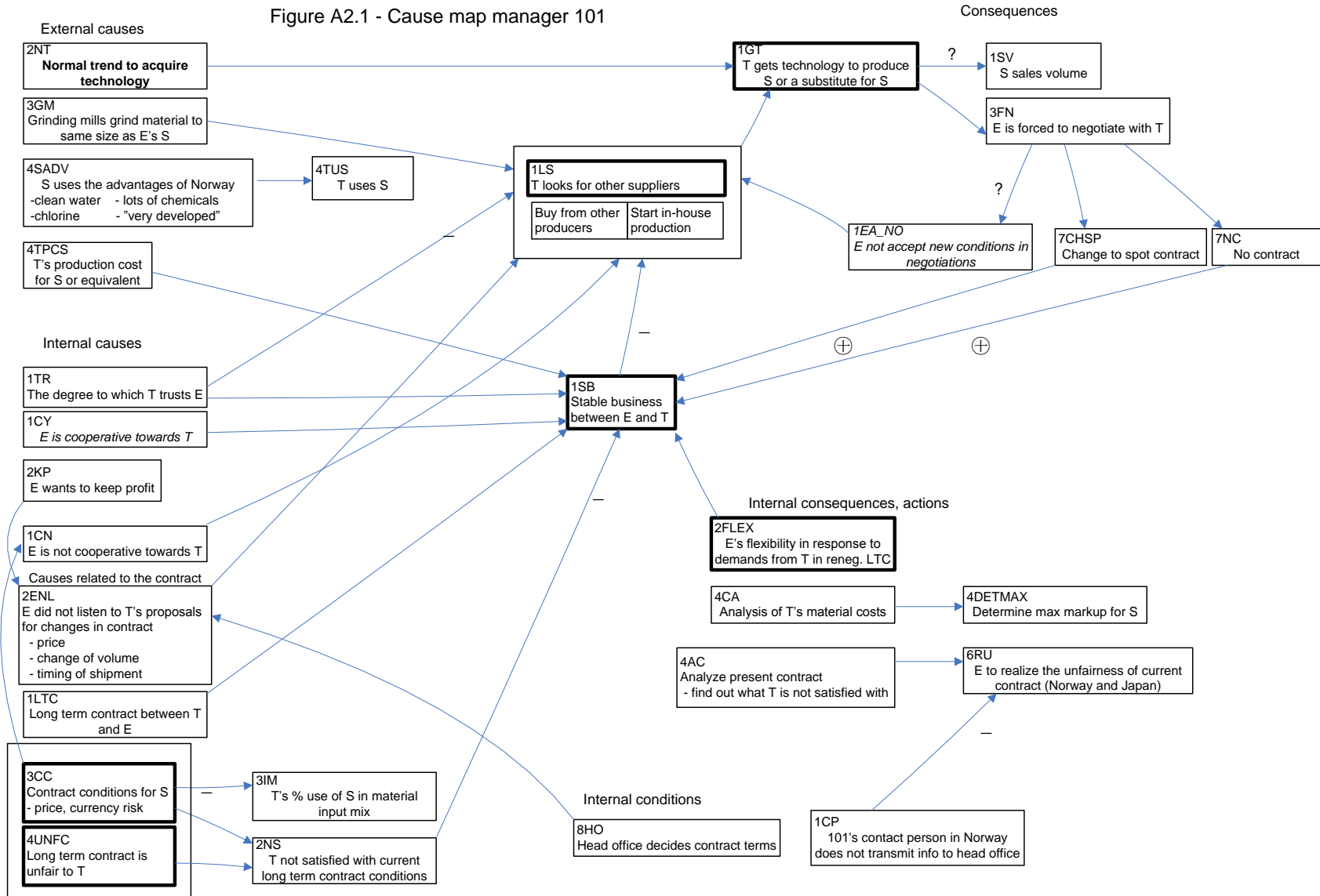


Figure A2.2 - Cause map manager 102

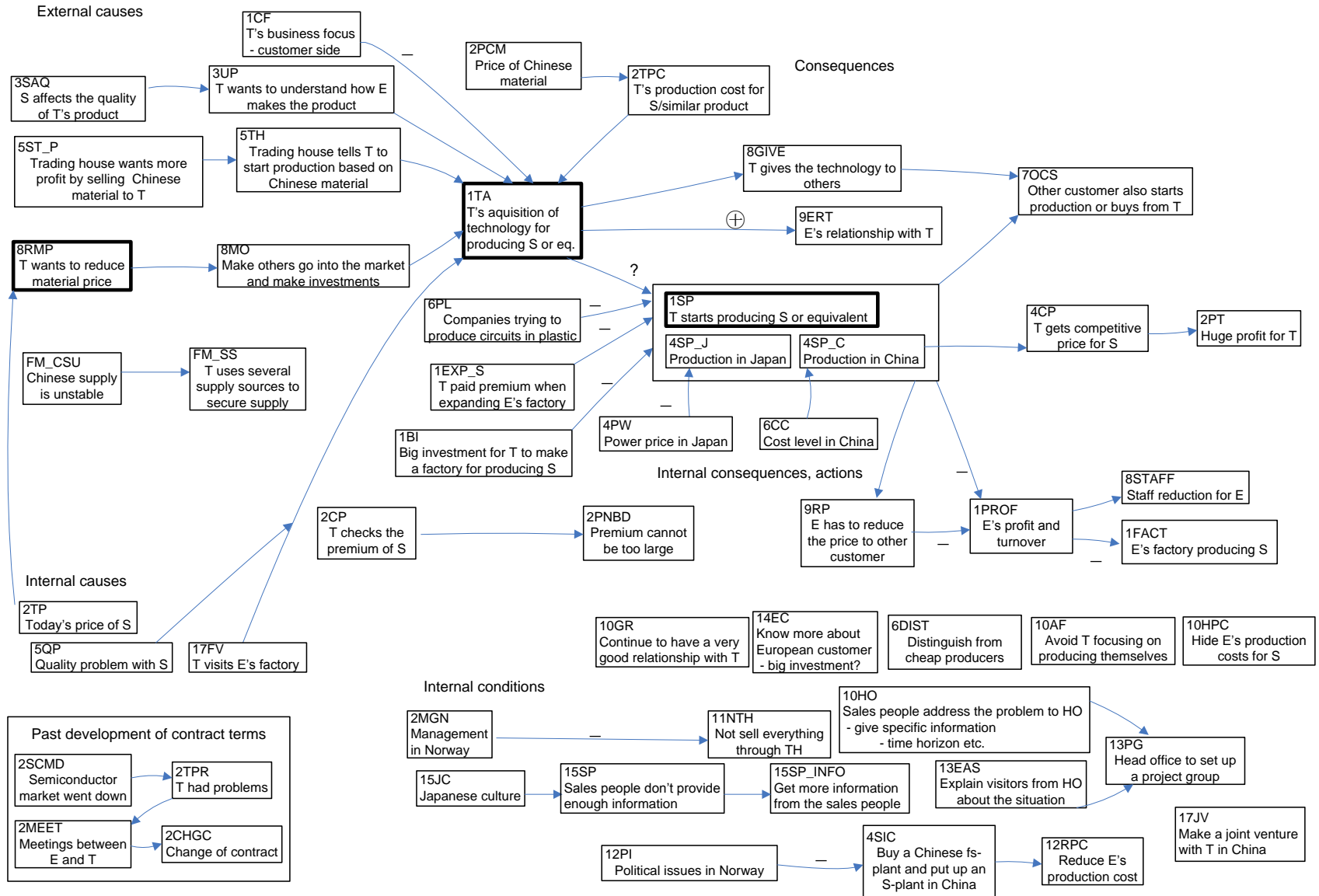
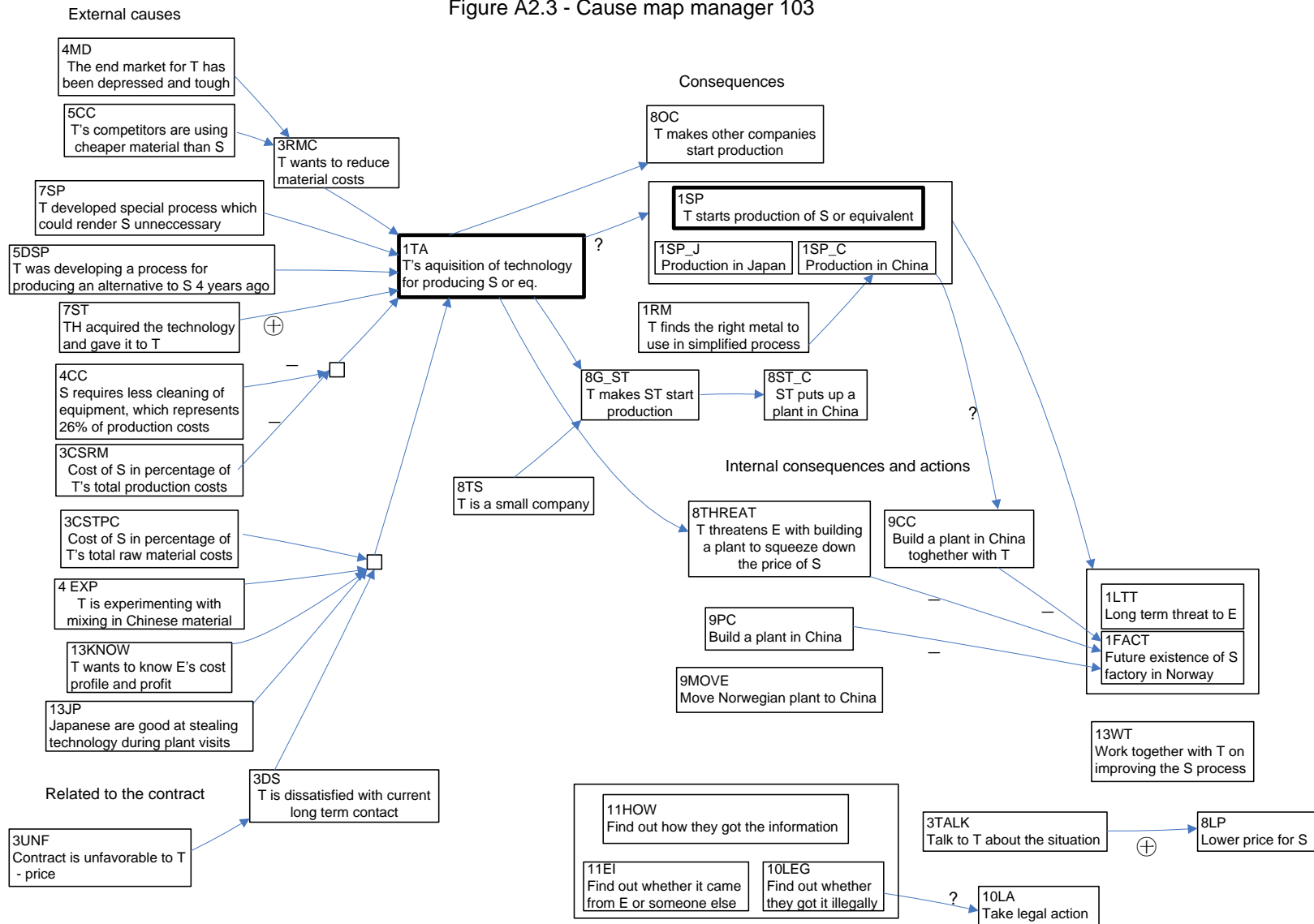


Figure A2.3 - Cause map manager 103



APPENDIX 3 – Concept lists

Table A3.1 - Concepts arranged by category				
	Mentioned by mgr. no.			
	101	102	103	all
Market / external to E and	1	1	1	3
Market trends	1			1
Alternative supply sources for S-like materials	1			1
Japanese culture and business habits	1	1	1	3
Stability of Chinese supplies		1		1
Political issues in Norway		1		1
Power price in Japan		1		1
Cost level in China		1		1
E's other customers' behavior		1		1
Condition of T's end market		1	1	2
Behavior of and influence from trading house		1	1	2
Others starting production of S or equivalent		1	1	2
Trading house starting production		1	1	2
Technology and production	1	1	1	3
Alternative materials to S	1			1
S' competitive advantages	1			1
T's use or non-use of S in production	1			1
Amount of S used in T's material input mix	1			1
T's knowledge of E's technology	1	1	1	3
T's wish to understand E's production process		1		1
S affects the quality of T's products		1		1
Alternative technology		1		1
Stability of supplies to T		1		1
T's handling of the technology for producing S		1	1	2
T starting production of S or equivalent material		1	1	2
Production in Japan		1	1	2
Production in China		1	1	2
T's technological research			1	1
T finds the right metal to use in simplified process			1	1
Financial matters for T	1	1	1	3
T's estimated production cost for S or equivalent	1	1		2
Price of Chinese material		1		1
Financial consequences for T of starting production of S or eq.		1		1
Investment capacity		1		1
Sunk cost for T in relation to E		1		1
T's overall financial situation		1		1
Premium of S (price S - T's estimated production cost for S)		1		1
T's costs		1	1	2
T's material costs		1	1	2
Cost of S in percentage of T's total production costs			1	1
Cost of S in percentage of T's total raw material costs			1	1

Cost of cleaning of equipment			1	1
T's competitors' raw material cost			1	1
T wants to know E's cost profile and profit			1	1
Size of the company			1	1
Financial matters for E	1	1	1	3
E's turnover and profit	1	1		2
Price to other customers		1	1	2
Factory producing S in Norway		1	1	2
Consequences of T starting production		1	1	2
Staff reduction		1		1
Negotiations with T	1			1
Business relationship between T and E	1	1	1	3
E's behavior in negotiations with T	1			1
E's past and current cooperative attitude toward T	1			1
Trust between T and E	1			1
Quality stability of S		1		1
Factory visits		1		1
T's business focus		1		1
General business relationship	1	1	1	3
Long term contract	1	1	1	3
Existence of long term contract	1			1
Contract terms and conditions	1	1	1	3
Price	1	1	1	3
Time span	1			1
T's negotiation power			1	1
T's satisfaction with long term contract conditions	1		1	2
Internal matters for E	1	1	0	2
Information flow between E Japan and HO	1	1		2
Head office' decision authority	1	1		2
Information flow from E's sales people		1		1

Table A3.2 - Concept list for diagnosis - causes and consequences				
	mentioned by mgr. no.			
	101	102	103	All
External causes				
Market / external to E and T	3	3	3	8
2NT – Normal trend to acquire technology	1			1
3GM – Grinding mills grind material to same size as E's S	1			1
4SADV - has advantages because of Norway's special features	1			1
5CC – T's competitors are using cheaper material than S			1	1
13JP – Japanese are good at stealing technology on plant visits			1	1
2SCMD – Semiconductor market went down		1	1	2
2PCM – Price of Chinese material		1		1
FM_CSU – excluded because not connected to crisis situation		1		1
Financial matters for T				

4TPCS – Production cost for S or equivalent	1	1		2
2CP – T checks premium of S (price S - T's estimated production cost)		1		1
2TPR – T had problems		1		1
3RMC – T wants to reduce material costs		1	1	2
3CSRM – Cost of S in percentage of T's total production costs			1	1
3CSTPC – Cost of S in percentage of T's total raw material costs			1	1
4CC – S requires less cleaning of equipment			1	1
Other concepts related to T				
1LS - T looks for other suppliers	1			1
start in-house production	1			1
buy from other producers	1			1
2NS/3DS – T is dissatisfied with current long term contract conditions	1		1	2
1TA/1GT – T's technology acquisition	1	1	1	3
1CF – T's business focus		1		1
3UP – T wants to understand how E makes the product		1		1
3SAQ – S affects the quality of T's products		1		1
1EXP_S – T paid premium when expanding E's factory producing S		1		1
FM_SS – T secures supply by using several sources		1		1
4EXP – T is experimenting with mixing in Chinese material			1	1
5DSP – T was developing processes for producing an alternative to S			1	1
13KNOW – T wants to know E's cost profile and profit			1	1
Trading house matters				
5ST_P – ST wants more profit by selling Chinese material to T		1		1
5TH – Trading House tells T to start production based on Chinese material		1		1
7ST – ST acquired the technology and gave it to T			1	1
Internal causes				
Related to E				
1CN – E is not cooperative towards T	1			1
1CY – E is cooperative towards T	1			1
1TR - The degree to which T trusts E	1			1
2KP – E wants to keep profit	1			1
5QP – Quality problems with S		1		1
17FV – Factory visits		1		1
Related to the contract				
1LTC - E has long-term contract with T	1			1
2ENL – E did not listen to T's proposals for changes in contract cond.	1			1
3CC – Contract conditions for S between T and E	1	1	1	3
2TP – Today's price of S		1		1
External consequences				
Consequences related to T				
3IM – Percentage of S used in T's material input mix	1			1
4TUS – T uses S in their production	1			1
1SP – T starts producing S or equivalent product		1	1	2
1SP_J – T starts production in Japan		1	1	2
1SP_C – T starts production in China		1	1	2

2PT – Huge profit for T		1		1
8GIVE – T gives the technology to others		1	1	2
8G_ST – T makes ST start production (specification)			1	1
Other consequences				
7OCS – E's other customer also starts production or buys from T		1		1
8ST_C – ST puts up a plant in China			1	1
Internal consequences				
1TO – E's turnover and profit	1	1		2
3 FN – E forced to negotiate with T	1			1
7CHSP – Contract changes into 1-year spot contract	1			1
7NC – No contract between T and E	1			1
2EA_NO – E not accept new terms/cond. during renege. of LTC in 2007	1			1
1SB – Stable business between T and E	1			1
8STAFF – Staff reduction for E		1		1
2PNBD – Premium cannot be too large		1		1
2MEET – Meetings between E and T		1		1
2CHGC – Change of contract conditions		1		1
9ERT – E's relationship with T		1		1
9RP – E has to reduce the price to other customer		1	1	2
1FACT – Future existence of E's factory producing S		1	1	2
8THREAT – T threatens E with building a plant to reduce price of S			1	1
Concepts mediating consequences				
4PW – Power price in Japan		1		1
6CC – Cost level in China		1		1
6PL – Companies trying to produce circuits in plastic		1		1
1BI – big investment for T to make a factory for producing S		1		1
8TS – T is a small company			1	1
1RM – T finds the right metal to use in simplified process			1	1
Internal constraints				
1CP – 101's contact person in Norway does not transmit info to HO	1			1
2MGN – Management in Norway	1	1		2
15JC – Japanese culture	1	1		2
12PI – Political issues in Norway		1		1
15SP – Sales people don't provide enough information		1		1

Table A3.3 - Concept list for diagnosis - actions

1=mentioned. Does not mean the number of actions mentioned	Mentioned by mgr. no.			
	101	102	103	all
Monitoring of environment				
information search				0
analysis and interpretation	1	1	1	3
sensitivity analysis				0
structured analysis				0
expectations and beliefs	1	1	1	3

Evaluation of internal consequences				0
Action generation				
information search	1	1	1	3
Find out more about European customer		1		1
Investment amount		1		1
Find out how T got the technology			1	1
Find out whether they got the technology illegally			1	1
Find out if the information came from E or someone else			1	1
Get more information from the sales people		1		1
Head office to set up a project group		1		1
analysis and interpretation	1		1	2
Consider whether to take legal action			1	1
Analyze T's material costs	1			1
Analyze present long term contract with T	1			1
Find max markup for S	1			1
Plans				
strategy building				0
strategic plan for actions		1		1
Distinguish from cheap producers		1		1
Not sell through the trading house		1		1
general plans for actions	1	1	1	3
Address the problem to HO	1	1		2
Get more information from the sales people		1		1
Continue to have a very good relationship with T		1		1
Avoid T focusing on producing themselves		1		1
Work together with T on improving the S-process			1	1
Reduce E's production cost		1		1
Hide E's production costs for S from T		1		1
concrete plans	1	1	1	3
Flexibility in response to demands from T regarding LTC	1			1
Build a plant in China		1	1	2
Move Norwegian plant to China			1	1
Make a joint venture together with T in China		1	1	2
Talk to T about the situation			1	1
Take legal action			1	1

Explanation of concepts used in table of actions

The explanation of the concepts from the list is taken from [Fuglseth \(1989\)](#). *Analysis under monitoring of environment* encompasses the concepts *sensitivity analysis*, *structured analysis*, and *expectations and beliefs*. Sensitivity analysis implies quantitative computer analysis in which data for non-controllable variables are changed systematically across a certain interval. Struc-

tured analysis means qualitative analysis following a specific pattern (i.e. Lund & Lorentzen, 1976, cited by [Fuglseth, 1989](#)). The managers' concepts are placed in *expectations* when the managers do not give any information about analyses that will be carried out.

Under plans, the concepts strategy building, general and concrete plans for action are mentioned. Strategy building means preparing a set of action alternatives depending on market developments, or constructing strategies that takes rapidly changing environments into consideration. Strategy building is the most advanced form of planning, and was explained in section 1.3.3.4. General actions plans specify a type of actions, and gives guidelines for how actions are to be carried out until the guidelines are changed. An example is to have the sales people give more detailed information from each meeting with T. Concrete plans refer to plans for concrete measures, for instance establishing a factory in China. Sometimes general and concrete plans can be difficult to separate, and sometimes a plan can be both general and concrete. Getting more information from the sales people, for example, refers both to getting more information right now, as an attempt to gather information about the current situation, and to an effort to improve the general information flow from the sales people, especially in relation to meetings with T. The concept get more information from the sales people is therefore placed both under general plans and concrete plans.