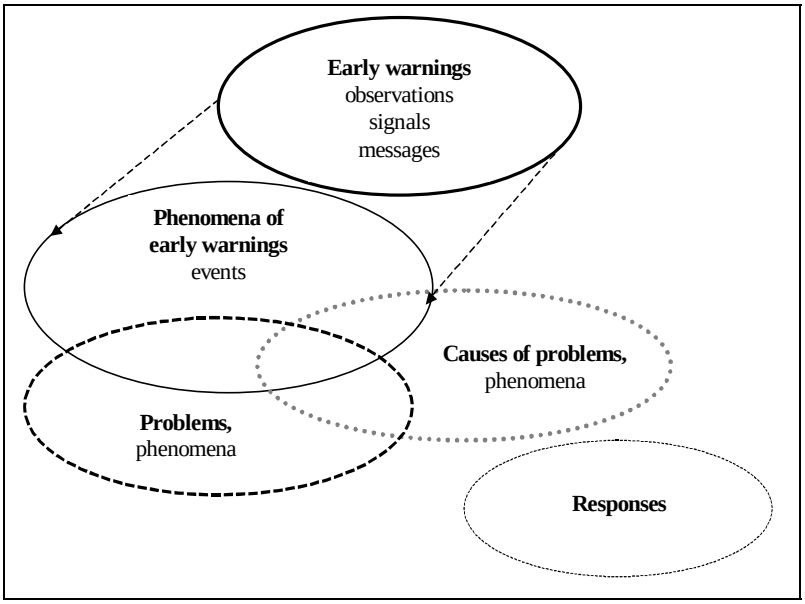

Early Warnings

A Phenomenon in Project Management

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Dissertation for the degree of Doctor of Science in Technology to be presented with due permission of the Department of Industrial Engineering and Management, Helsinki University of Technology for public examination and debate in Spektri in Luna Auditorium at Helsinki University of Technology (Espoo, Finland) on the 26th of April, 2002, at 12 noon.

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Doctoral Dissertation

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ABSTRACT

The emergence of Concurrent Engineering has caused growing demands on project management. The classic project management methods are often slow: problems may already exist when those methods are applied. The objective of the present study is to improve the opportunities of those responsible for a project's operational management to receive advance information about potential problems and final results through early warnings typical of the theory of weak signals by Igor Ansoff.

The research examines the background of Ansoff's theory, the way in which project theories treat project problems, the causes of problems, and possible early warnings. Other aspects of the phenomenon investigated in this study include its relation to project risk management and its communicational character.

A survey of the relevant literature shows that project literature contains some discussion of early warnings. However, only a few studies have the phenomenon as their main focus; similarly, research on the Ansoff theory is sparse. A number of studies concerning early warnings can be found in other fields, such as military science and general business economics. In addition, communications studies are familiar with the concept of weak signals, which is analogous to the concept of early warnings.

An examination of project literature shows that certain factors in a project - early warnings detected in project work, project problems, and the causes of those problems — may form chains. The interpretation of these factors may vary depending on the perspective and the time of observation. In addition, they can to some extent be considered subsets of one set (as defined by set theory).

The research was conducted using a qualitative research method. A total of seventeen project experts were interviewed using the semistructured (thematic) interview method, which was also used to identify and examine early warnings in four case projects. Almost 900 such statements were observed. These observations were grouped according to similar characteristics, after which the various factors were analyzed qualitatively as well as according to percent distributions, both individually and through multiple attribute examination.

The empirical research shows that stimuli (signals, messages) that comply with communications theory can be found in the project environment. These signals and messages are always to some degree inaccurate, and making decisions based on them is difficult. To clarify the meaning of these messages, the present study examines the general character of the early warnings phenomenon and designs an explanatory model that illustrates the communicative character of the phenomenon as well as the stages of decision-making. Further, the study develops a hierarchical classification of warning signals, complete with signal type categorization and descriptive typology, and draws up categorizations to help in signal identification. The categorizations are formed using eight (8) different factors. In addition, the relationship between early warnings, project problems, and problem causes is investigated; the dependence network designed of these three factors plus the responses they require furnishes some of the most important data for further utilization.

Furthermore, this study designs a fundamental model for the utilization of the early warnings phenomenon. This model, and the results of the present research in general, can be used to identify early warnings. For the present, the data provided by this research have to be handled manually, which may be somewhat laborious. To aid utilization in the future, the study proposes a way to incorporate early warnings to the Risk Management Knowledge-Based program created by Kiyoshi Niwa.

The study provides project management and project risk management theories with additional information about the early warnings phenomenon, which has not been extensively studied, but which is widely known among project management specialists. The study defines the phenomenon and makes it easier to comprehend. A broader utilization of the phenomenon, however, requires further research.

FOREWORD AND ACKNOWLEDGEMENTS

The basic idea of this research was born during the extended period the researcher spent working in varied industrial investment projects and in the employment of industry and consultancies. Seeing the practical side of that work awakened a wish to study the predictability of project problems and enhance the capacity of project management to use anticipating methods to make decisions about remedial responses to project problems.

The research was conducted as an independent project at the Department of Industrial Engineering of the Helsinki University of Technology, under the guidance of professors Eero Eloranta and Karlos Artto. The researcher worked on this study first on the side of his employment at a consultancy; later, the study became the principal task of his retired life.

The present study is heavily based on the results obtained in the researcher's licentiate's thesis, [Nikander -98]. The two studies should be considered continuous. As the earlier study is in Finnish, the relevant parts of it are reproduced here.

I wish to thank Professor Eloranta and Professor Artto for the guidance and good advice I have received from them. My special thanks to Professor Emeritus Tauno Olkkonen, whose counsel, critique, advice and encouragement have been crucial for the progress and results of my research.

I am indebted to all the interviewees for giving their time and interest to my research despite being busy with their own work. Special thanks to Professor Emeritus Osmo A. Wiio and Professor Leif Åberg (University of Helsinki) for their advice regarding communications theory. I also want to express my appreciation of the efforts of Kaarina Heiska, M.A. (HUT) who guided me through the communications studies labyrinth. Professors Veikko Teikari and Eila Järvenpää instructed me in the principles of qualitative research, for which they have my sincere gratitude. Thanks to Professor Eino Tunkelo for his advice regarding the quality of the manuscript.

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LAPPOHJA November 2001

Ilmari O. Nikander

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1. Introduction

1.1 Background

Since prehistoric times, man's activities have included project-type undertakings. The pyramids of Egypt, the road networks of Rome, and many ancient war expeditions match the characteristics of a project. According to historical records, these have even been implemented in conformity with surprisingly modern principles of project management [Lientz et al -95]. Great operations and undertakings by the Allied forces during the Second World War (such as the Manhattan Project and the north Africa and European landings) were apparently implemented using thoroughly developed project-type methods [Cleland -94].

When project theories were first beginning to be developed, a project was defined as an undertaking that accomplishes a set goal within a designated budget and a specified time frame. Nowadays the term project is understood in a broader sense; in PMBOK [-95] it is defined as follows: *Project: Any undertaking with a defined starting point and defined objectives by which completion is identified. In practice, most project depend on finite or limited resources by which the objectives are to be accomplished. [PMBOK -95, pp. 3.4]*. For more about project theories, see section 2.

The areas of usage for the now-classic project management methods have typically been construction, the development of weapons systems and industrial investments. In the United States in the 1960s, the direction of development was dictated by the needs of the U.S. Navy (the Polaris submarine project) [Cleland -94]. As a result of this, the Program Evaluation and Review Technique method (PERT) was developed, and the needs of industry taken into account in the form of the Critical Path Method (CPM). The project approach was widely used elsewhere in U.S. government undertakings as well, initially within the Department of Defense (DoD), the NASA (the Apollo Program) and the Department of Energy (DoE) during the 1970s; it is also extensively used today in all public undertakings in the U.S. [Cleland -94]. The 1970s introduced the so-called mega-projects, which entailed risks far greater and more complex than ever before [Bent -82]. Another new area of application during the 1970s was research projects, notably within the medical field [PMI-81].

Today, the project management approach is used in almost all areas of commercial and human life, in product development and in company restructuring. One significant area of application is the management of contracts, such as the construction and delivery of ships or factory equipment, as independent projects. The driving force in the course of development has been the effect that the theories of project management and project leadership on the one hand, and their areas of application on the other, have had on each other. When existing methods are tried in a new area, new requirements are perceived, leading to further development of the methods.

The character of projects varies greatly depending on the industrial field. Traditional building projects and industrial plant investment projects are, once the

decision to implement has been made, very static as regards the cost estimate and schedule. Delivery projects, as well, are static once the contract has been signed. On the other hand, research and product development projects are usually fairly well adjustable, especially in their early stages. The objectives of these projects can be recast completely as new ideas crop up. Once the work progresses the objectives are usually clarified; in that case it may be legitimate to view the later stages of that project as a new, clearly defined project.

The preliminary stages of investment projects (brainstorming, prefeasibility study and feasibility study) greatly resemble research and product development projects. When the management of a company decides to carry out an investment, the goals of that investment are defined. The investment project becomes final and "irrevocable" once the main equipment orders have been placed.

In the 1990s, projects have become increasingly important as a component of management methodology, as compared to the 1970s. Projects have become more complex and require ever-speedier implementation. Quick implementation will also generate savings in project costs. The availability of resources is more limited and cost pressure leads to a demand of their more effective use. In addition, the risk of failure has grown, especially within the field of product development.

1.2 Matters Affecting Project Work

Project work (see terminology: This term is used in the general meaning of “an undertaking carried out in the form of a project.”) has always been characterized by a short implementation period. Projects are bound and limited by time (this, indeed, is one part of the definition of a project). Implementation personnel appear to be taken by surprise as problems emerge during implementation, and these problems usually require a very swift reaction. They fulfill the characteristics of strategic surprises as applied to project work, outlined by Igor Ansoff [Ansoff-84]. Implementation due to the pressure for changes exerted by various factors requires great flexibility. Project management literature contains numerous presentations of trends that affect project management and project leadership, (see e.g. [Kezsbom et al. -89] [Lientz et al. -95] [Lewis -93] [Harrison-93] [Cleland -94] [Kerzner -95].

The concept of “fast tracking” is one of the commonly used devices, which the developers of project work have aspired to respond to the requirement of implementing projects in an ever-shorter time. A more modern term appears to be “concurrent project management” [Lewis -93]. The idea is to implement the various life-cycle phases of the project in an overlapping manner: simultaneously to a degree, instead of successively, as is the traditional practice in project implementation. Overlapping the main phases demands good cooperation between the various disciplines of project people (engineers, designers), suppliers and contractors, so that the next phase of work may be launched on the basis of initial, not fully confirmed data. Concurrent Engineering related thinking is employed here.

Concurrent Engineering, involves the various functional areas of a company working, as much as possible simultaneously, instead of successively. This approach has also been introduced into project work. For example the goal of Concurrent Engineering in product development is to save time. The methods of project management have proven to be advantageous in this type of activity, and therefore mutually enhancing.

1.3 Contemporary Challenges of Project Work

This chapter presents factors central to project management on an operational level. These factors form the main premises of this study.

The increasing expectations of the various parties, especially those of the project owner (the customer, the upper management, SEO), influence projects of all types. This, in turn, affects everything in project work. Above all, fierce competition affects product development projects, but it also plays a role in investment projects and in various delivery projects. The danger in product development projects is that the product is not ready in time, thereby allowing someone else to gain the market. The investment project must be completed under the date set by the competitive situation, with the highest possible quality and the lowest possible cost. Equipment suppliers will have to price their orders with ever-smaller profit margins and to implement them with ever-tighter schedules.

With the advent of the general trend of quality thinking, quality requirements as well as the implementation and the final result of a project have received added emphasis. Both the significance of quality as a competitive factor and the wide scope of quality have been recognized. The important issue is that the end users on the customer's side are satisfied, in which case the participants in the project can use the quality achieved as a valuable reference later on. The financial demands have tightened. Cleland [-94, pp. 15 and 105] presents several good examples of projects that have played a crucial role in the weak yield achieved by the company. Similar cases can also be found in Finland [Nikander-98]. The project director's personal goals with regard to profit and career development also affect the implementation of the project and the methods of management and leadership that he or she employs.

Due to the relatively short time span involved, abruptness has always been a characteristic of the problems that appear during the implementation of a project. These problems seem to come as a complete surprise to the implementation personnel. This impression is enhanced by the use of the method of Concurrent Engineering by project work professionals to counter the tightening schedule requirements, which leads to a situation where a disturbance in a particular activity of a project is more prone to influence other activities as well as the final result of the whole project. In addition, the activities must be begun with less and less initial data, and they are increasingly dependent upon the well-timed data produced by previous activities. Project problems have constantly more characteristics in project work that are similar to the strategic issues raised by Ansoff in corporate activities [Ansoff-84]. The apparently sudden emergence of problems is accentuated by the lack of reaction by project leaders (on account of reluctance or other reasons) to slight deviations from the plan in regard to schedules, costs, or technical details. In the experience of this researcher the leaders have in some cases even prohibited the noting of minor deviations in routine reports.

All of the aspects discussed above show how risks in project work have multiplied as awareness of those risks and project risk management have improved [Kezsbom et al. -89] [Lientz et al. -95] [Lewis -93] [Harrison-93] [Cleland -94] [Kerzner -95] [Artto -94] [Kähkönen -96] [PMBOK -95] [AACE -95] [Chapman and Ward -97]. The demand for ever-quicker implementation with ever-smaller resources is an essential issue in all situations. The basic problem is the lack of time and the fact that there is no room for failure. There is no time for remedial measures; moreover, these would mean additional costs. It would seem that project leaders need to more effectively anticipate the future; i.e., need proactive project management. They should be provided with tools that are more suitable to their needs than those offered in the contemporary literature on project management (see chapter 2 for details).

1.4 The Theoretical Foundations of This Study

The theoretical foundations of the research presented here are primarily rooted in project management literature. However, the cornerstone of the research questions posed in this study is provided by the theory of weak signals by Igor Ansoff.

The Theories of Project Management (PM)

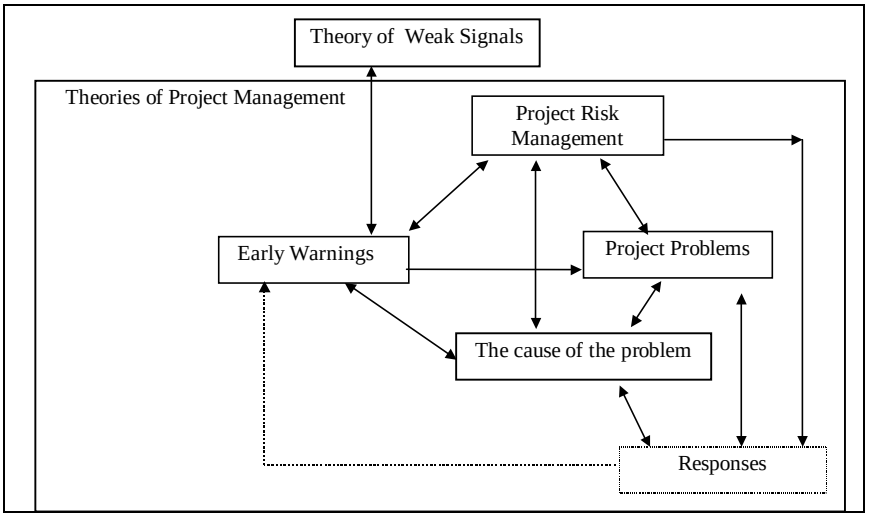
The theories of project management encompass everything that is included in project work and project management. PMBOK [-95] presents the following divisions of project management: project integration management, project scope management, project time management, project cost management, project quality management, project human resource management, project communication management, project risk management and project procurement management.

The present study follows the contents of PM as presented by Lewis [-93]. It focuses on those parts of the theories that are related to the anticipation of the future of a project in the form of predicting future events and possibilities. All areas mentioned in PMBOK [-95] contain a certain amount of prediction. The areas that most clearly contain prognosticative aspects are project time management, project cost management, project quality management, and project risk management. These are discussed in greater detail in chapter 2.

The Theory of Weak Signals

Igor Ansoff presented the first version of his theory in the mid-1970s [Ansoff-75] and further developed it in his book [Ansoff-84]. He contends that in the 1970s and 1980s, "strategic surprises" deviant from steady progress appeared with increased frequency in corporate environments. The management of such situations with the means of the then-popular trend-based business planning methods is fairly difficult. According to Ansoff, "strategic surprises" do not appear out of the blue; rather, they may be detected with the aid of preemptive signs. Ansoff calls these preemptive signs "weak signals." Additional information on this theory is provided in chapter 3.

The diagram in figure 1.1 shows the areas of emphasis in this study, as well as



The arrows depict the presumed dependencies

Figure 1.1 The Areas of Focus in This Study

their mutual dependencies. Theories of project management comprise the total frame of reference within which the research is conducted. Other important frames of reference influencing the study are Ansoff's theory of weak signals and the depiction of project problems and their causes in the project management literature.

1.5 The Premises of the Study

Research Problems

This study attempts to clarify the early warnings phenomenon. At first the following questions aroused in the mind, they need to be answered: When do early warnings emerge? What forms do they take? With whom are they found? The main issue is discerning how the vague information provided by early warnings could be used in project management.

The objective of the study is to examine the possibilities of increasing the ability of operative project management to collect preemptive information (early warnings in the form of weak signals) and to use these to make prognoses on future events and possible problems in the project, as well as on the project's final result. In other words, at issue is a method of leadership meant to anticipate future developments.

Research Perspective

The central research perspectives of the study are:

A) The phenomenon will be examined using the theory of weak signals as regards a) occurrence, b) state of knowledge, and c) models of application.

B) The perspective of project work is crucial. The phenomenon should be studied in regard to a) project problems, b) the temporal phases of the project, c) project participants, d) the causes of project problems and e) the theories of project management. The early warnings observations will be described from the viewpoint of the project leader, as a phenomenon related to project work.

C) The project risk management perspective is apparently significant as related to the utilization of early warnings.

D) It is important to examine the suitability of the leadership models provided by different theories as models of utilization of the phenomenon.

E) The research problem isn't studied as a phenomenon in communications; rather, theories provided by communications are used to explain the phenomenon.

Research Questions

The following central questions emerge:

1) Can information of the type of Ansoff's weak signals, referred to as "early warnings" in this study, be found in project work?

2) Is it possible to design a description of the early warnings observations and a categorization of the early warnings?

3) How do observable early warning signals apply to different project problems and/or causes of project problems?

4) Can observations of early warnings, project problems, and the causes of problems be chained together and networked, and can their character vary depending on the point and time of observation?

An actual interviewing question frame is developed in the section 6.3 (table 6.3.1).

Scope

Project methods are currently applied in very diverse areas of business activity. Building projects and industrial investment projects are the traditional fields, while newer areas of application include (as mentioned above) projects relating to research and product development, equipment and other deliveries, personnel, organizational development, and to arranging various events (festivals, exhibitions). Nowadays

even traditional project fields are understood in a broader sense, i.e. containing the brainstorming, prefeasibility and feasibility study phases.

The needs of the various areas where project methods are applied, as well as the applications they use, are significantly varied. As a result of this, the scope of the research has to be strictly limited. The study is mainly confined to exploring the early warning signals appearing in and around investment projects of industrial corporations after the decision to implement, that is, covering the implementation phase of investment projects from the decision to implement to start-up. The focus, in addition to project control and the utilization of early warnings, is on developing a decision-making procedure; other project management sectors are explored more superficially. The viewpoint adopted in this study is that of the owner (client) or the project manager of the main consultant.

The preliminary phases of an investment project, such as brainstorming and the prefeasibility and feasibility studies, are not included in this study because their character is very different from the actual implementation phase of an investment project (see section 2.1). Similarly, research topics like project leadership is excluded: such topics belong more properly to the behavioral sciences while the present study is concerned with industrial engineering and management.

1.6 The Structure of the Research

The first part, which surveys the literature on the research problem, views the early warnings phenomenon in the light of Ansoff's theory of weak signals, project control and especially project risk management. It also looks at certain communications theories, primarily as theories explaining the phenomenon.

A Survey of the Research Literature

Chapter 2 briefly inspects the contents of Project Management (PM), then moves on to explore those parts of PM, which attempt to anticipate future developments in the project. These include project control and project risk management.

Chapter 3 reviews Ansoff's theory of weak signals, the research supporting it, and its applications. The chapter examines the Weak Signals Strategic Issue Management (WSSIMS) method; in addition, theories in communications -- Wiio's "system theory of information" and Åberg's "facet theory of communications" -- are examined as complementary to understanding the phenomenon.

Chapter 4 defines the term "early warning" as it is used in this study, presents examples of early warnings in project management literature, and reviews some of the methods found in the literature for predicting the final result of a project. The chapter presents the preliminary type categorization of early warnings. The chapter also examines, still on the basis of project management literature, some factors that affect the success or failure of a project. Another area explored in this chapter is formed by the problems that may arise during a project, their causes, and the responses they require.

Chapter 5 summarizes the section on research literature.

Field Research

The part of this research dealing with field studies is divided into two sections: basic interviews and interviews within case projects. The final part of the research examines the results of this study, develops a model to help understand the phenomenon, and looks at a database model for project risk management that could perhaps be used with the results of the study. The purpose of the case interviews is to find out whether preliminary signals of the Ansoffian weak signals -type have been found in actual industrial investment projects.

Chapter 6 explains how the basic interviews were carried out, presents the case projects, and looks at the project and work experience of the people in both interviewee groups. The results of the interviews are presented in a combined form, i.e., with the material from the basic and case interviews pooled. The chapter lays out the scope of the interview material and presents the early warnings research elements analyzed from that material. The elements are classified hierarchically as the type categorization groups of early warnings.

With a view toward utilizing the results, the crucial point is to use the research material to analyze early warnings, project problems and their causes, and the interdependencies of the problems. These will be examined in chapter 7, creating the basis for a general description of the phenomenon. Using all of the interview material, the chapter lays out combination tables on the following pairs: early warnings/project problems; the problems/their causes. On the basis of the material, a web of interdependencies is drawn up between a) the main groups of early warnings, b) groups of project problems, c) the causes of the problems, d) the corrective measures (responses). These dependencies will also be examined on the level of early warning subgroups. The case project material will be used to draw up case-specific webs of dependencies. Finally, the reliability of the results will be assessed.

Chapter 8 interprets the obtained results. The first section examines the results from the point of view of the study's premises; the second answers the research questions stated in the introduction.

Chapter 9 develops a model that describes the nature of the phenomenon and proposes a utilization model for the phenomenon from the point of view of project management. The results are also studied in the light their implications for project risk management and project leadership. The chapter also examines how the results may be used in a modern project risk management system.

Chapter 10 assesses the area of validity for the research results and considers their application -- both their generalization potential and their limits. The chapter also appraises the effect of the research results on the theories that are used as premises, for this study, such as the Ansoff theory of weak signals. The chapter evaluates both the usefulness of the research strategy and how successfully the strategy has been used. Finally, further research areas are proposed.

The appendix C briefly reviews the descriptive typology of early warnings developed in the course of the study [Nikander-98].

2. Current Methods and Practice of Forecasting Potential Problems in Projects Management

2.1 General

The purpose of this chapter is to give the reader a short description of those project management methods that aim to anticipate the activities within a project. The experience of the researcher, almost 30 years in practical project work — first with project owners and later as a project specialist in a consulting firm — substantially influenced the choices and assertions made in this chapter.

The traditional, basic theories of project management that are currently in use may be said to have originated at the end of the 1950s and in the 1960s [Cleland -94]. One of the oldest techniques is the so-called Gantt Chart (Bar Chart) that was developed as early as the beginning of the 20th century. Its developer Henry Gantt died in 1919 [Lock -92]. The methods and techniques widely used today, such as CPM and PERT, were published in 1958. The principle of Earned Value (EV) was developed in 1963 [Lewis -93]. GERT (Graphical Evaluation and Review Technique) was devised in the mid-1960s [Chapman and Ward -97]. The US Department of Defense (DoD) C/SCSC (Cost/Schedule Control System Criteria) was completed in 1968 [Selogie -85 and Fleming -92]. Selogie has covered this development comprehensively. SCERT (Systems Criteria Evaluation and Review Technique) was developed in mid-1970s [Chapman and Ward -97]. It must be noted that e.g. the GERT and SCERT methods have not been widely adopted in practice; often they aren't even mentioned in textbooks. Selogie [-85] and Cleland [-94] present a rather extensive look at the growth of project management thought. The development of project work has also been discussed in [Adams -81], [Internet-81], [PMI-83], [Kezsbom et al. -89], [Nordnet-89], [AACE-90], [PMI-91], [Lewis -93], [Harrison-93], [Kleim and Ludin -94], [Kerzner -95], [PMI-94], [PMI-96].

Project Life Cycle

Different writers have rather different perceptions of project management, depending on what types of projects lie within their own interest and experience. The writers usually recommend the leadership methods of their time for use in both project management and project leadership. For example, the principles of Management by Objective (MbO) are singularly suited to project work: all projects naturally have objectives regarding performance, cost and schedule. Today, the combination of these three is said to comprise the quality of a project [Kezsbom et al. -89]. There are also other definitions for project quality; this subject has been more extensively discussed in the study [Nikander-98].

The variations in project management arise from the different phases of the project life cycle: the tone of a project changes with each new phase [Lewis -93] [Cleland -94] [Honko et. al. -82]. The main project phases used in this study are outlined in Figure 2.1.

The project phases used in the empirical part of this study are the following: The first main phase is engineering, which includes preliminary engineering, defining (project planning), and the actual implementation engineering. Procurement was chosen as the second phase, because of its major effect on the subsequent phases of the project and of the fact that the most vital decisions regarding costs are finalized during this phase. The subsequent phases are the delivery phase and the site phase.

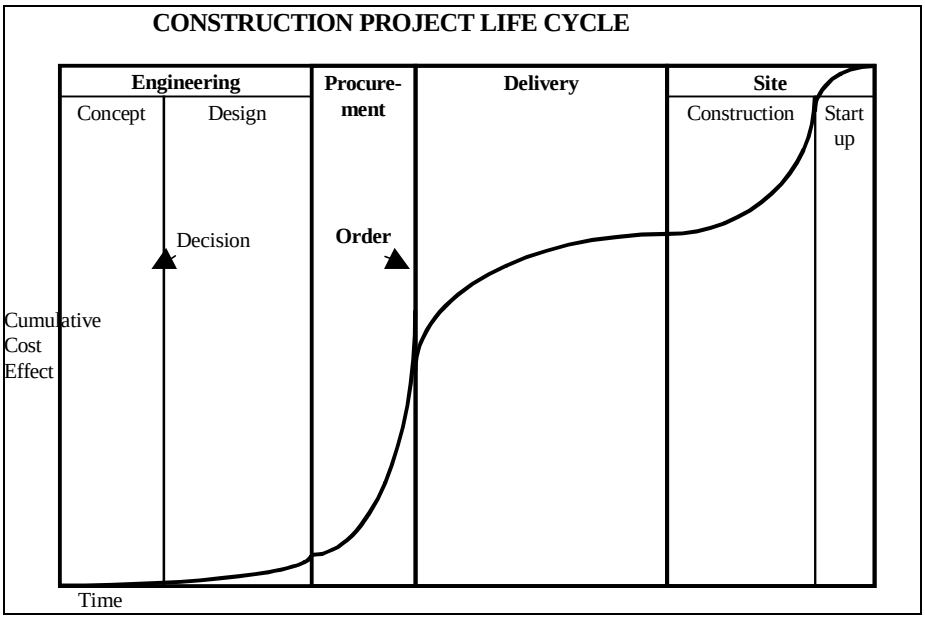


Figure 2.1 The **life cycle and main stages of a project**
Adapted from Lewis [-93, figure 2.4, p. 20]

The brainstorming, prefeasibility and feasibility study phases, which take place prior to the decision to implement, are excluded from this study. These preliminary activities often are (or should be) composed of continuous activity concerning product development, marketing, and business strategy. In the 1980s and early 1990s, these phases were seen as entirely separate from the investment project, which in turn was considered to begin with the implementation planning done in the pre-engineering phase -- or even later, with the decision to implement. Today, the commonly held view is much broader.

The central concern in the brainstorming phase is often the preservation of creativity. The prefeasibility studies are at first conducted as small-scale inquiries and memos, which are expanded to “mini-projects” if the management shows enthusiasm. Feasibility studies can be more extensive, but they too are conducted quickly and with strictly limited resources. Errors and deficiencies in these phases are extremely detrimental to the implementation project. If weak signals from e.g. the market are not interpreted correctly in the preliminary phases, the whole investment may founder. Examples of such cases are abundant both in the literature and in Finnish industry.

The character of the weak signals that appear in the preliminary phases is probably very similar to the character of signals found in innovative activity. However, studying such signals is such a rich area of research that it would provide material for an entirely separate dissertation; moreover, preliminary phases and innovative activity is largely carried out within corporations, which makes it difficult to get sufficient information about it.

Project actors

The external environment of a project, described by various writers Lewis [-93] Cleland [-94], is very similar to the operating environment of a corporation. Cleland connects the environment of a project to the role of project actors as internal and external stakeholders. His views are best illustrated by figure 2.2.

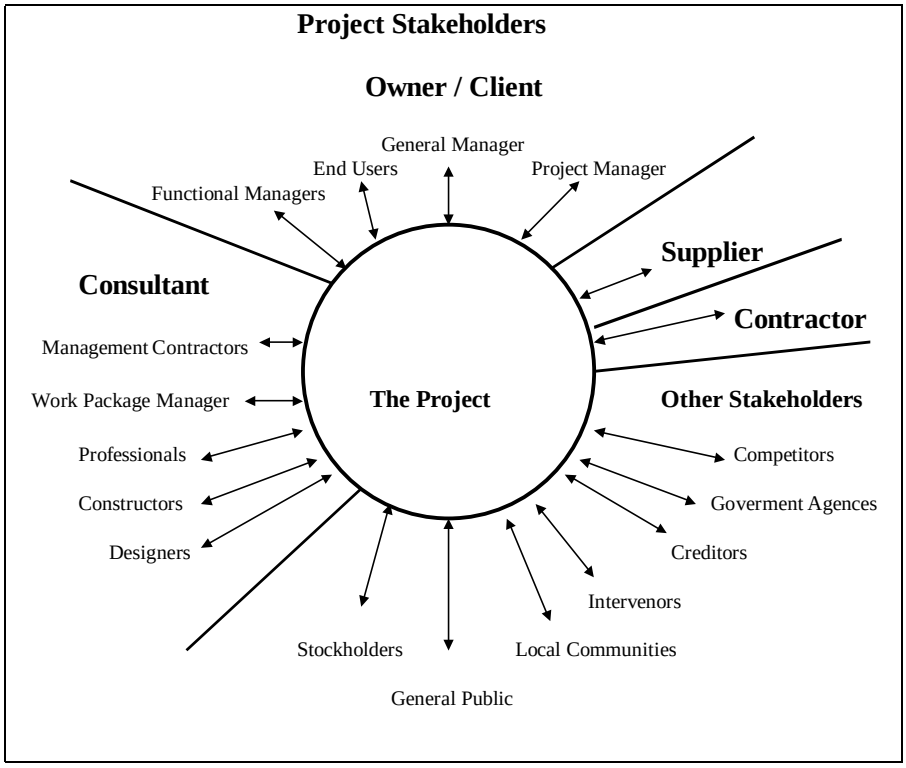


Figure 2.2 Project Stakeholder Network

Adapted from [Cleland -94, figure 6.2, p.147].

The activity in investment projects consists mainly of interaction between the project actors (both organizations and individuals). Naturally, projects also include the kind of interaction and relations between people that belongs to the area of general management. However, individual, private "projects", which are some individual person's idea are rare in the implementation phase of investment projects, though these may occur in the brainstorming phase.

Figure 2.2. shows the main interest groups of a project, which are owner/client, consultant, supplier and contractor (marked in bold). These are employed in the empirical part of this study as project parties; this is further discussed in the context of presenting the question frame.

According to Cleland, external stakeholders include government agencies, local communities, the general public, and creditors. In addition, it should be noted that the external and internal factors affecting a project vary greatly depending on the type and character of the project.

2.2 The Contents of Project Management

An important view of the contents of current project management is presented in figure 2.3.

In addition to controlling project planning, organization, control, and project techniques and methodologies, project management takes into account the effects of culture and human needs, and applies human approach leadership. Compared with its previous forms, current project management has been supplemented with a new emphasis on setting goals and objectives and on preparing strategic approaches; information management has also been incorporated into it.

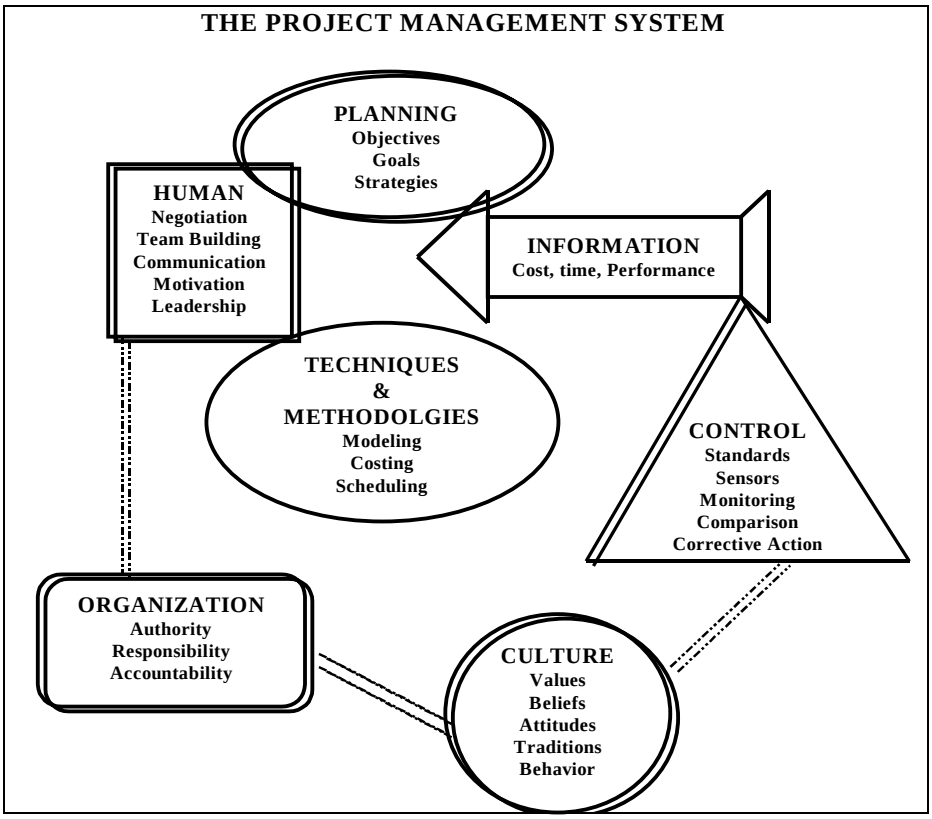


Figure 2.3 The Main Areas of Project Management

Adapted from [Lewis -93, Figure 2.5, p. 22].

The project plan creates a basis for the completion of the project. Moreover, the project is "simulated" during project planning; that is, the activity descriptions, schedule, and other documents required by the planning instructions are devised. At the same time, the project plan is usually the first blueprint of the project's future.
The project plan is the standard (called "performance measurement baseline") with which the progress of the project is compared during project control.

The basis of project control is always the project plan. The parts of a project plan are: 1) project definition and objective setting, 2) creation of the project organization, 3) the structure of the project (WBS), and 4-6) formation of the

schedule, the resource plan and the cost estimate, as well as the purchase plan, figure 2.4.

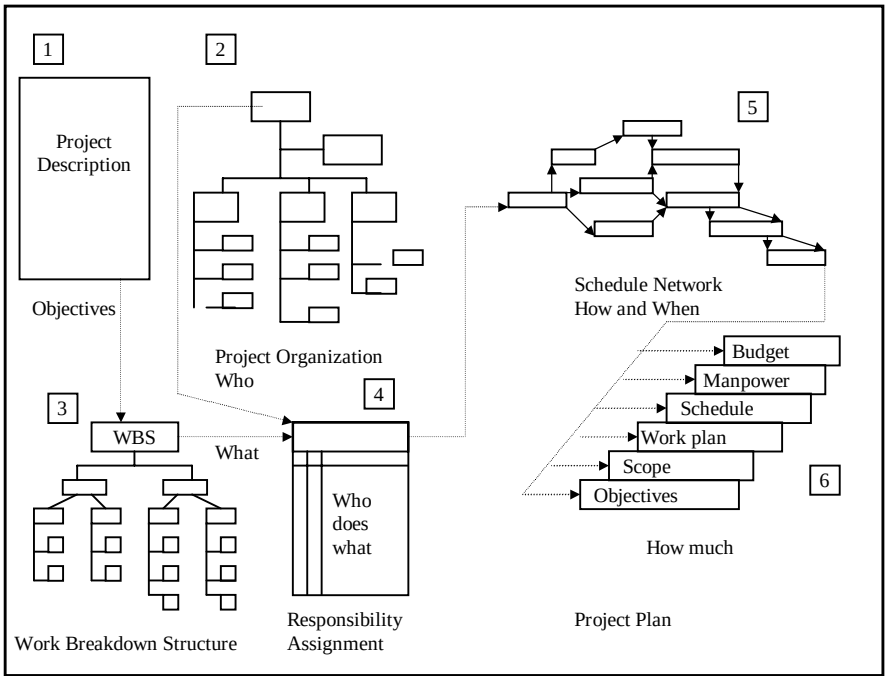


Figure 2.4 Planning Process Adapted from [Baker & Boyd -82, Figure 1]

During project planning, the following issues are settled: the tasks, their order, at what point each task will be carried out, and the person to perform the task. Nowadays, this is usually done using commercial project control programs. Extensive discussions on preparing a project plan can be found in e.g. Harrison [-93], Kerzner [-95] PMBOK [-95].

2.3 Project Control

Project control should be understood mainly as activity management. Project control very clearly contains possibilities for anticipating future developments in all the sub elements of the project (performance, cost, time). Project control methods belong to the so-called “management by deviation” group. All the methods that are in general use presume that there is a project plan to which activities and developments are compared. The methods report both positive and negative deviations from the plan; however, the effectiveness of the implementation depends largely on the users of the methods. They are the ones who decide what is to be monitored, followed up, and controlled, as well as what responses are necessary in case of slight deviations. In the experience of this researcher, it is by no means unusual for project leaders to be uninterested in slight deviations; they may even direct (or indicate by their behavior) that slight deviations are to be excluded from reports, with disastrous consequences.

The main phases of project control are a) planning, b) monitoring, c) cost and time control and d) reporting and, if necessary, proposing corrective measures. Cost and time control are usually performed separately in the early stages of the control

process, but in the later stages of analysis the data provided by these is generally combined in accordance with the Earned Value (EV) principle, and the information is used as a basis for decisions in project control.

For example Niemann [-91], Cass [-90], Cass [-94] have endeavored to present various improvements in regard to predicting the final result of a project. A somewhat separate field of activity is technical quality control, which is often assigned, where possible, to occur in connection with regular project meetings developed in a different context.

2.4 Forecasting Methods of Project Management

The Cost/Schedule Control Systems Criteria (C/SCSC)

On the basis of the earned value principle, United States government agencies have developed an exact method of reporting the progress of a project. This method is called the Cost/Schedule Control Systems Criteria (C/SCSC). Fleming outlines indicators of C/SCSC that can be interpreted as early warnings, and that best forecast if a project would exceed its budget [Fleming –92, pp. 220…222]. The actual C/SCSC defines various indicators that describe the project status in comparison with the project plan. These are also widely used in applications of the earned value principle. They convey the direction of progress of the project. The indicators include: 1) Schedule Variance (SV), 2) Cost Variance (CV), 3) Management Reserve (MR), 4) Cost Performance Index (CPI), and 5) Schedule Performance Index (SPI). The latter (CPI and SPI) are used in e.g. preparing the cost estimate of the project's final result (Estimate at Completion, EAC); SPI can also be used in formulating schedule estimates. A major drawback in using C/SCSC, however, is that the forecasts it provides are based on the past history of the project and hence are always somewhat late.

Some Methods for Predicting the Final Result of a Project

- Performance Measurement Baseline (PMB) as an early warning signal

Fleming [-92] notes that the performance measurement baseline, a comparative basis devised in the context of project planning, is a good prediction method.

- The 15 percent rule

As another prediction method Fleming [-92] suggests the 15 percent rule: the completion estimate of the project is reviewed when 15 percent of the implementation time has been used.

- Project implementation profile

Pinto and Slevin [-92] have developed a project evaluation method called project implementation profile. This method can be used in all project phases, and it may be possible to use it to predict the success or failure of a project. Forecasts are prepared in the project-planning phase. The project implementation profile should be useful for designing corrective action and even for after-project evaluation, when the question to be answered is why the project succeeded or failed.

Schedule Estimate

Predictions made using the schedule of the project are very efficient in giving information on potential future problems. In the practical experience of this author, they are the only functioning project status prediction method widely used in actual projects.

The PM literature does not provide instructions in similar detail on preparing schedule estimates as it does on preparing cost estimates. There are no formulae for computing the Projected Schedule Delay (PSD), which expresses the total delay of the project's final result. The reason for the omission of schedule estimates from the C/SCSC may be the fact that the effects of logical dependencies and resource

restrictions are crucial in predicting the final schedule of a project. Hence schedule estimates should always be calculated using project control programs rather than mathematical formulas as in the Estimate at Completion (EAC) methods.

Nevertheless, the prediction methods of EAC can be used to some extent in preparing a schedule estimate. The object is to improve the schedule estimate and to reveal new potential risky or problematic tasks.

"Optimistic" PSD

An optimistic prediction is made by simply recalculating the schedule according to the rules of CPM, using the activity data at the time of inquiry. The crucial issue is discerning which incomplete task will most affect the critical path. The schedule so devised is then compared to the original plan; PSD is the difference in the completion dates of the two schedules.

"The most credible" PSD

The most credible PSD represents the schedule, which is most believable. In actuality, this means that the schedule will be have to completely redraw: the schedule planning in all its phases is repeated. The person designing the schedule should take into account that the earned value principle expresses the project's schedule performance or SPI-index. The determining factor, however, is the view of the implementation personnel, engaged in the various parts of the project on how soon they can have their work ready. This new schedule is then processed in accordance with the instructions agreed upon within the project, and will after that be the new point of comparison (baseline "2").

2.5 Risk Management

2.5.1 General

Risk estimates are related to decision-making. According to the traditional interpretation represented by March and Simon [-58], decision-making in a risk situation means that the probability of alternative series of events is known. Keeping to this interpretation greatly reduces the chances of risk management in projects. A considerable singularity is characteristic of projects, meaning that exact, experience-based information of the probability of risks is not available; rather, projects must rely on inexact and often subjective information. Kerzner [-95] shows how decision-making varies in different risk management situations: *Decision making under certainty, Decision making under risk* and *Decision making under uncertainty* [Kerzner -95]. For the last-mentioned situation, he presents four basic criteria, among which the decision-maker must choose, often according to his ability to tolerate risk. The criteria are: a) the Hurwicz criteria, as the maximax criteria, b) the Wald criteria, as the maximin criteria, c) Savage criteria, as the minimax criteria and d) the Laplace criteria, which makes an a priori assumption based on Bayesian statistics.

There are several definitions and objectives of project risk management [Kerzner -95] and [PMBOK -95]. Paying attention to risks has long been an integral part of project planning. Recognizing and evaluating risks are included in project planning as early as in the preliminary planning phase and take a more definite form during implementation planning at the latest. The current trend is to strive for continuous planning during the whole project [PMBOK -95] and [Kerzner -95]. This obviously indicates an aspiration to constant anticipation of future events.

Project risk management has not yet become an everyday tool for project leadership. Ashley [-89a and -89b] expected a rapid change in this situation; he thought that information technology would have made project risk management as ordinary a tool for the project leader as CPM and schedule programs already had

made of schedule management. Levine [-95] also hopes for new views in project risk management and emphasizes the importance of such features in current projects. The development of project risk management has followed general risk management guidelines, and has been directed toward applying general methods to project work. This has been somewhat hard, however, as collecting statistics is tedious due to the uniqueness of every project. The early warnings phenomenon appears to be a part of project risk management as well [PMBOK -95].

Artto and others [2000] state that project management literature most commonly discusses project risk management as an activity of the implementation phase, in which case the observation perspective can be called "site-centered." This the authors see as a shortcoming. Their own observation perspective starts when the company receives an invitation to bid; therefore the whole business perspective of the supplier is observed [Artto et al. 2000, Figure 5)].

The perspective can be broadened. When risk management is examined from the perspective of the client, the starting point should be the company strategies that lead to the company's vision. Nascent or existing project ideas should be in agreement with this vision. This evaluation of project ideas is made in the prefeasibility study stage at the latest. Either in this stage, or in the feasibility study stage, first invitations to bid are prepared; this step initiates the supplier's business sphere. However, these pre-project owner stages are beyond the scope of this study.

For a thorough discussion of project risk management, see e.g. the following books on project management: [Kerzner -95, pp. 752...756, pp. 877...900], [Obradovitch -90] and [PMBOK pp. 111...121].

2.5.2 The Definition of Risk

There are several definitions of the term "risk" [Niwa -89]. Most often risk is associated with uncertainty and damage. Kerzner [-95] gives the following two definitions of a risk:

Risk = F (uncertainty, damage)
Risk = f (hazard, safeguard) [Kerzner-95] (p. 879)

When risk is defined in the later manner, the source of danger is the hazard. When the hazard increases, so does the risk; conversely, when the safeguard increases, the risk decreases. Artto [-94], Kähkönen [-96], PMBOK [-95] and AACE [-95] further define risk so that it includes opportunity.

Several authors use the concept of "issue", which includes both the notion of opportunities and that of threats [Ansoff –84a], [King -87] and [Lienzt et al. -95]. (See section 3.1.3 "Issue Life Cycle and Symptoms"). Webster's Dictionary [-92] defines these terms in the following pages: Risk (p. 859), Issue (p. 515), Opportunity (p. 704), Threat (p. 1029).

This study mainly employs the concept of risk. The rest of the above-mentioned concepts are used when referring to the works in question.

In connection with the early warning phenomenon, this study uses a definition of risk that according to Kerzner includes the notions of uncertainty/damage or threats, but does not include the notion of opportunities.

On the basis of the previous definition, the concept of "issue" seems to be as a parallel of the broader concept of risk (including opportunities), with a meaning very similar to it.

Kähkönen [-96] states that problems and disturbances are risks, which have come true. Ward, S. [-89] asserts that problems are embedded in the current situation, while risks indicate future possibilities. On the basis of the foregoing, and of the definition of risks, it can be further stated that the concept of "problem" can also seem to have family connection to the concept "risk"; the difference between the two resides in the time element and in the uncertainty of the realization of a risk.

2.5.3 The Elements of Risk

Risk Factor

Niwa [-89], among others, mentions the term "risk factor." This is related to the risk mechanism model he presents [Niwa -89, p. 43]. The same concept, to some degree, is discussed by Kerzner [-95]. Down, Coleman, and Absolon note the concept "primary question" as the actual source of a risk [Down, Coleman, Absolon -94, pp. 7, 52, 68, 91, 106, 107, 119]. The risk factors they cite can in some of the sample cases also be seen as anticipatory risk signals. This interpretation is feasible especially in the cases where the risk factor is noticed in a very early stage of the project.

Bufaied uses the same term, risk factor, in the summary table of his literature survey on the risks present in construction projects; he uses these risks later in his research as the risk variables in his model [Bufaied -87, table 5, p. 73].

All of the above definitions contain the view that a risk factor is the source or cause of the risk.

Risk Categories

Risks can be classified in several different ways, which makes discussing them easier. Such classifications are e.g. the slightly divergent risk categories cited in [Pasedag -89] and [Kerzner -95].

2.5.4 Project Risk Management

Risk management, in the project context, is the art and science of identifying, analyzing, and responding to Risk Factors throughout the life of a project and in the best interest of its objective's [Kerzner-95, p. 880].

Niwa [-89] argues that *(a) Managers want to be informed of the risks that actually happened during similar projects in the past. (b) They want to be able to recognize risks that correspond to the size of the work element they want. (c) They want risk alarms in advance. d) They want to be informed of risks from many aspects that can not be predicted in advance, if possible* [Niwa -89, *p. 20*].

The Stages of Project Risk Management

Project management literature uses varied terminology in discussing the stages of project risk management. Kerzner [-95] and PMBOK [-95] divide project risk management in four stages; the essence of these stages is much the same in both works, although the terms used to describe them are different. In the following, the terms used by Kerzner are underlined, while those used in PMBOK are *italicized*: risk assessment, *risk identification***;** risk analysis, *risk quantification***;** risk handling, *risk response development***;** lessons learned, *risk response control.*

Each of the stages presented in PMBOK includes three task units: 1) the input necessary for the completion of the stage, 2) the tools and techniques used in the stage, and 3) the output produced by the stage.

Kähkönen [-96] adds defining the objectives of risk management as the first stage of project risk management. In this stage, the questions to be answered are: Why is this done? What is the output? When and how?

Risk Assessment / *Risk Identification*

The sources and tools of risk assessment may be employable in refining the utilization of the early warnings phenomenon. PMBOK [-95] presents risk identification as input information: product description, other planning outputs, and historical information. Of the tools are mentioned checklist, flowcharting of the planning process, as well as interviewing, schedule analysis, expert judgment, brainstorming, scenario building, baseline cost estimates and technical performance measurement [Kerzner -95], [Ashley -89a], [Ashley -89b].

[Ashley -89a] strongly criticizes all methods that employ historical information. According to him, the greatest error results form the subjective interpretation of information and uses the expression ”hindsight bias” to describe a situation where the person who evaluates the information allows himself to add a positive or negative coloring to the past events he is recalling. When this happens the cause and effect chains are no longer real but imagined. Secondly, it is difficult to find projects that are similar enough to one another to serve as models, the problems of which could then be assessed. A third problem in employing historical information is that history cannot throw any light on ”unknown-unknowns” situations.

An interesting concept for this study is the output concept ”risk symptoms” found in PMBOK and defined there as follows: *Risk Symptoms, sometimes called triggers, are indirect manifestations of actual risk events.* PMBOK also provides some examples of this: *For example, poor morale may be an early warning signal of an impending schedule delay or cost overruns on early activities may be indicative of poor estimating.* [PMBOK, p. 114]

Risk Analysis / *Risk Quantification*

As with the tools of risk identification, the tools of risk analysis may also be useful in fine-tuning the utilization of the early warnings phenomenon. The literature contains several well-known assessment methods for evaluating risks: these include e.g. the Monte Carlo simulation, regression analysis, sensitivity analysis, scenario techniques, network analysis, and Delphi techniques [Franke -89] and [Kerzner-95]. Kähkönen [-96] states the methods vary depending on the situation and the risk. He recommends the use of checklists in risk identification and the use of the following six levels in risk analysis: 1.) A list of risks, 2.) A verbal description of each risk, 3.) The dependencies between the risks, 4.) An assessment of the effects if the risk materializes, 5.) An assessment of the effects of responses, and 6.) A computer simulation of the comprehensive model. Kähkönen only suggests two methods for assessing the effects: scenario building and range evaluation.

PERT in Risk Management

Older project management literature usually presents the opportunities offered by the PERT method as the only effective way of preparing for risks. However, applying this method is such arduous work that it is rarely used more than once during a project. The PERT method contains a statistical possibility of preparing for risks that aren’t defined in detail. The method can be applied to costs as well, in which case it is called the PERT/Cost method.

Commercial Risk Management Computer Applications

Kähkönen [-96] lists a number of notable commercial risk management applications that were available in Finland at the time. He has examined six of these applications: Range Estimating Program-REP, Futura, @RISK, Risk+, Opera, and MONTE CARLO.

Nevertheless, nearly all of the methods presented in project management literature, as well as the commercial risk management applications, have a certain old-fashioned quality, which is exemplified by their emphasis on one-time risk

identification, assessment and examination. This is evident in the laboriousness and heaviness of the methods, which may derive from the history of risk management. The presented methods do not seem to favor simple, quickly applicable risk assessments; instead, they require a fair amount of work.

Knowledge-Based Risk Management Model

Niwa [-89] presents an interesting model, based on an application of an interactive database, suitable for project risk management. He asserts that current artificial intelligence methods cannot by themselves clarify the varied problem- and risk situations present in projects. Consequently, Niwa incorporates a human control element to a kind of expert-system program with a database foundation. He calls his model "Human-Computer Cooperative Systems." Niwa's views are explored in greater detail in section 2.5.5 under the heading "Risk Mechanism Model," as well as in chapter 9.

2.5.5 Project Risks Chains

Project risk chains can be detected in some studies and publications concerning project risk management. A study by Bufaied [-87] and a Risk Mechanism Model of Niwa [-89] are discussed below.

The Bufaied Model

Bufaied [-87] examines the risks in project management, as well as their causes and their effect on projects. He compares the risks of construction projects in the UK and Libya. Bufaied [-87] shows in his study that the fundamental cause of the external signs (Cost, Time, Quality) of project failure risk lies in the risk of failure of the project management. On the basis of his literature surveys, Bufaied has developed six subsystem dependency models as one of his hypotheses. These subsystems form, according to him, is the secondary source of risk. The subsystems are the following: the environmental risk subsystem; contractual arrangement subsystem; resource risk subsystem; information risk subsystem, organization structure risk subsystem; and personnel quality risk subsystem.

As an example of the subsystems, the organization structure risk subsystem (2.5) is shown in figure 2.5. The figure illustrates seven groups or stages that all the models contain. In addition, the models include independent variables, which the project management cannot influence. In his results, Bufaied presents a comprehensive model in which all the subsystems are collected together; this is very complex and contains numerous dependencies.

For this study the main interest lies in the results found by Bufaied concerning the variable list, the structure of the risk model, and the abundance of dependencies in the model. Of note is the formation of chains of risks into long and multi-segmented dependency networks.

The Changing Character of Risk Factors

Another relevant point of Bufaied's risk factors is the fact that as the risk materializes, the risk factor becomes observable or becomes an event. Hence, according to the example presented in figure 2.5 the risk factor 5.8 (Poor job performance), when materialized, apparently becomes an observable event; i.e., it has become a detectable problem. It can be caused by one or more of the preceding 4.xx-level risk factors (i.e. 4.16; 3.13; 4.17; 4.19). At the same time, when the risk factor 5.8 materializes it points to the possible materialization of one or all of the 6.xx-level risk factors (6.6); i.e. the risk factors of this level may become problems. Similarly, the factors 4.17 and 3.13 affect the risk factor 5.11 (Ineffective decision), which in turn affects the risk factors 6.2 and 6.6. In addition, it should be noted that

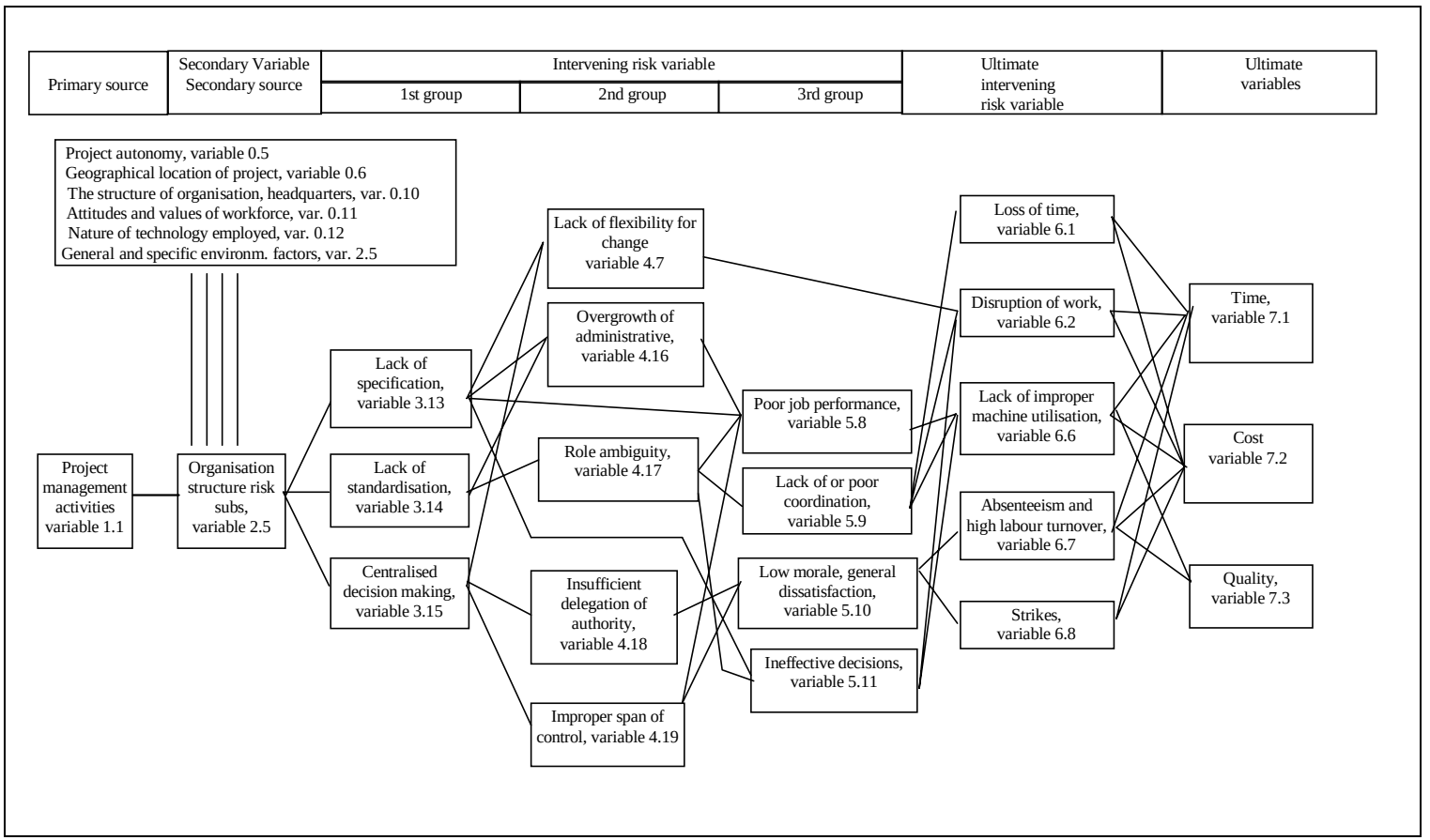


Figure 2.5 A Causal Model for Organizational Structure Subsystem [Bufaied -87, Figure 14, p 212]

other subsystems might contain such dependencies on other variables in this subsystem as are missing from the example subsystem.

It is noted that the character of the risk factor varies depending on the perspective and time of observation. The factor may be a) a cause, the source of the problem or risk, when it precedes the problem or contributes to the risk. It can be b) a detected problem (an observation), when the factor is currently active, or c) an effect (problem, risk), when the factor is the result of a preceding factor. Here can be again noted the phenomenon observed earlier in the context of examining project problems and their causes. Several of the matters represented by Bufaied's variables are observations, some of which can be made quite early in the project; the rest of the factors are detected later during the project.

An interdependency of project risks similar to the one used by Bufaied [-87] is also found in Kähkönen [-96]. Niwa [-89] develops risk chains in a similar manner in his risk mechanism model (figure 2.6). Ashley [-89a] also mentions the causal relationship of two risks. A similar chain theory is also presented in the "weak signals" hierarchy by Webb [-87]. These contribute to the clarification of the quite discontinuous picture of project problems and causes of failure, and of their occurrence, that emerges on the basis of the various sources.

Risk Mechanism Model

The risk mechanism model by Niwa is best illustrated by figure 2.6 [Niwa, p. 42, figure 41]. In the figure, as well as in the way Niwa defines the concept "risk

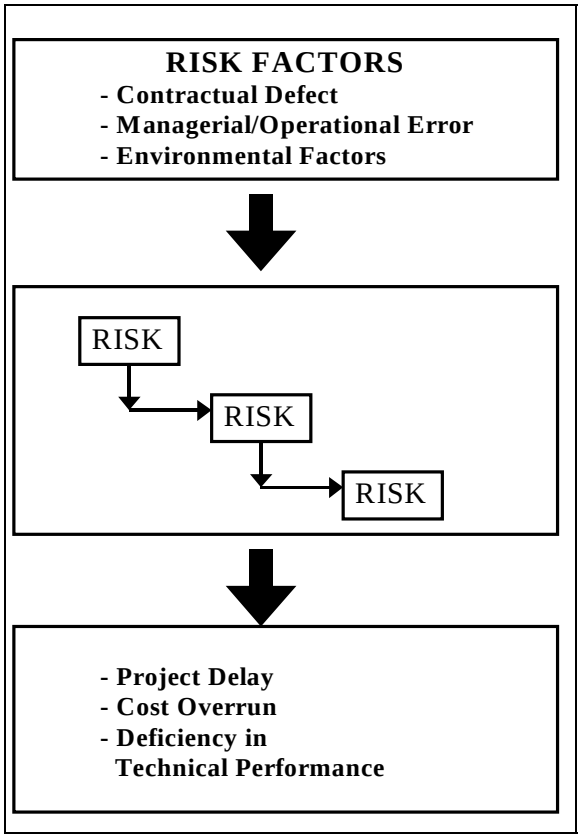


Figure 2.6 Risk Mechanism Model [Niwa, p. 42, Figure 41]

factors," it is possible to observe the idea presented by Bufaied that a risk can cause (or influence) another risk especially if no responses are taken. The concept "risk factors" is discussed above in section 2.5.

2.6 Summary

Project Control

The available, commonly used project management and control methods have not improved substantially during the recent decades, with the exception of project risk management. The experience of this researcher is that schedule estimates are, despite their shortcomings and awkwardness, the best current tools for examining the future developments in a project and for anticipating new potential schedule problems or risks. The weakness in all the available methods is that they are based on data from the project history, and are forced to extrapolate future situations. Surprise factors are usually excluded from examination. At the same time, both the vulnerability of projects and the demands placed on them have increased.

Therefore, in this as well as in the earlier study by this researcher [Nikander -98], to investigate, first, whether the theory of weak signals, developed by Igor Ansoff [Ansoff -75], can be applied to project work and second, whether the principles of this theory can be employed to find a new leadership philosophy or to develop tools for the often surprising situations that arise in a project.

Project Risk management

In section 2.5 has discussed the project risk management fairly broadly. Today, risk management strives for the kind of anticipating management aspired to in this study as well, though the practical methods that risk management provides for this are not fully developed as of yet. The current methods still favor a kind of "one-time" risk management, and have not become as everyday project management tools as e.g. the computer applications for schedule management. Several researchers and writers, however, expect risk management to become as common a tool as project cost and schedule management has been for the past two decades. The concept of "risk symptoms," discussed in [PMBOK], apparently links early warnings to risk management.

On the basis of Niwa [-89], it can be stated that there apparently exists a causal relationship between risk factors and risks. Bufaied [-87], Niwa [-89] and Ashley [-89a] form chains of risks that affect one another. Niwa [-89] states that risks can influence one another and that they have sources and causes (risk factors). The risk variables presented by Bufaied [-87] (figure 2.5) seems to be very similar to the problems presented in the table 4.4. Problems are linked to the present, where as risks refer to the future [Kähkönen -96] and [Ward, S -89].

The concepts "risk" and "problem" seems to be related to, but they are separated from each other by the time available and by the uncertainty of the materialization of a risk. According to the observations of Bufaied [-87], the character of risk factors varies depending on the perspective adopted in the observation. They can be interpreted as causes of problems and risks; they can be detected problems; or they can be risks that may materialize in the future (potential problems).

3. Putting Early Warnings into Perspective

3.1 The Theory of Weak Signals

3.1.0 The Background of the Theory

A central premise of this research is the theory of weak signals by professor Igor Ansoff, which appears to contain the kind of anticipation of surprising future events in the business world that is one of the research objectives of this study. If Ansoff's thoughts on the uses of vague or inexact information can be applied to project work, there may be good possibilities of developing the sought-for tools for project leaders.

This chapter clarifies the background and content of the theory of weak signals as presented by Ansoff. Research in business economics supporting the theory is meager, and the theory has been criticized severely. Yet numerous writers seem to suggest that the existence of some form of presignals is self-evident.

The theory is well known in communications. There are also linkages to state and military strategic security and intelligence research, as well as to some other areas of business economics and also futures studies. Some research in support of the theory is also presented in this chapter.

This study uses the term "weak signals" in the context of Ansoff's theory or in connection with those writings and studies that use this term. In the section 3.1.3, "Research in Support of the Theory," the term used in the research being discussed is employed. In other contexts the term "early warning ", or an abbreviated form of that term, is used. The term weak signal is defined in section 3.1.2 and the term early warning in the section 4.2.

Ansoff's theory can be divided into two parts. The first part deals with the existence of weak signals and the level of information they embody. The second part encompasses the use of weak signals in the form of the Weak Signals Strategic Issue Management Systems (WSSIMS), discussed in a separate chapter. Observation procedures called environment scanning and source of strategic information/issue, closely related to the observation of signals, are also considered. They are related to project risk management methods. It should be noted that Ansoff uses the term "issue" in his theory, which includes both threats and opportunities, and not the terms "problem" or "risk;" in other respects as well, this chapter follows the terminology used by Ansoff. The term "issue" has already been discussed in section 2.5.

3.1.1 General Remarks on the Theory

Ansoff's Views on Business Management

The development of business management can be presented in several quite different ways. Ansoff has divided it into four main units as regards the 20th century:

(1) *Management by (after the fact) control of Performance, which was adequate when change was slow.*

(2) *Management by extrapolation, when change accelerated, but the future could be predicted by extrapolation of the past*

(3) *Management by anticipation, when discontinuities began to appear but change, while rapid, was still slow enough to permit timely anticipation and response.*

(4) *Management through flexible/rapid response, which is currently emerging, under conditions in which many significant challenges develop too rapidly to permit timely anticipation.* [Ansoff -84a, pp. 14...15]

These management strategies are tied to a time scale in figure 3.1, which is directly from Ansoff's book, in which he also presents the detailed contents of long range planning and subsequent management strategies [Ansoff -84a, pp. 15...25].

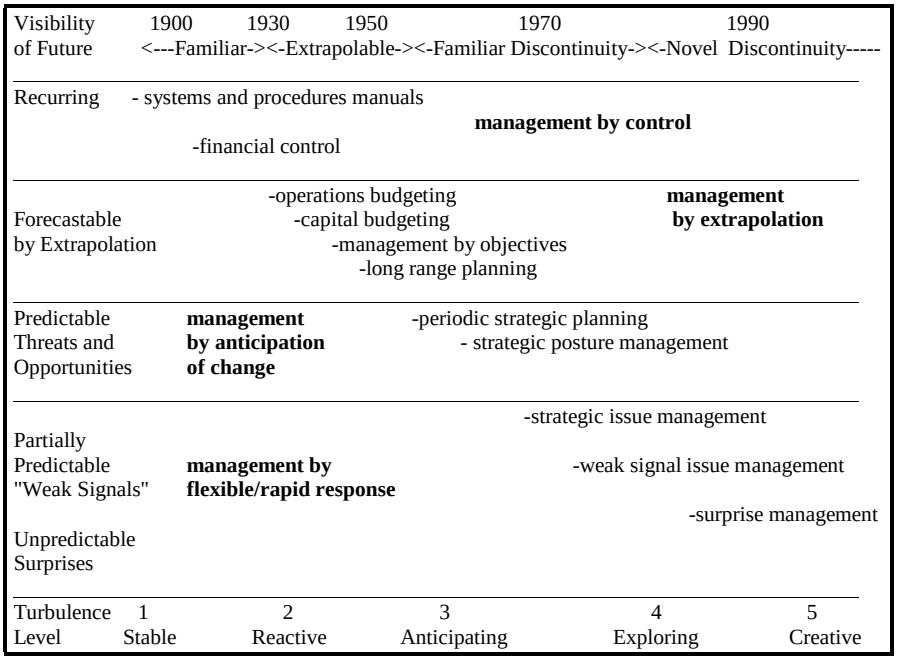


Figure 3.1 Evolutions of Management Systems [Ansoff-84a, p. 14]

According to Ansoff, the management strategies shown in figure 3.1 are principally business methods of strategic management. The theory of weak signals links to the time scale of "management through flexible/rapid response" in the form of weak signals issue management. Ansoff's thoughts on weak signals are closely connected to strategic business management, which may, especially as regards mega-corporations, be compared to political leadership and its need for information. This, in turn, is linked to the strategic security and intelligence studies in the military sciences [Betts -82], [Herman -96] and [Sivonen -98].

The Origins of the Theory

Igor Ansoff presented his theory of weak signals in business economics in the mid-1970s [Ansoff -75]. His idea was to seek an improvement to the strategic planning method, as this method didn't work satisfactorily when sudden changes or unanticipated discontinuities in development occurred in the business environment; the environment showed turbulence. Ansoff also uses the term "strategic surprise" to describe these discontinuities. An example of such a discontinuity is the oil crisis in the early 1970s, when OPEC raised the price of oil so that it was several times what it had been earlier. In such cases, according to Ansoff the usual method of

monitoring trends and basing planning on them was not sufficient. Strategic planning requires the information provided by the environment to be available for use sufficiently early and in an adequately exact form. These requirements caused by sudden changes in the business environment cannot be fulfilled by monitoring trends, as this is based on information accumulated over time. Strategic planning is inevitably late.

Premises

Ansoff asserts that strategic surprises give advance information of themselves; there are signals or symptoms of surprises to come. This information is initially inexact: the signals are vague, fuzzy, and difficult to interpret, but gradually they become more distinct and easier to decipher. Even on the basis of the initially inexact information some action can be taken. However, e.g. Heiskanen [-88] warns against doing this. Webb [-87] states that it is not possible to obtain messages or information of the future; instead, anticipatory events or the like must occur, and these provide the advance information presumed by Ansoff. A good example of such anticipatory events is the existence of numerous early warnings (signs of preparation) of military "surprise" attacks, mentioned in Betts [-82].

Research Foundations

Ansoff presents no research results to support his theory; he only refers to discussions with several persons [Ansoff -75]. In 1987, Makridakis and Heáu [-87] stated that the subject has remained academic idea. In the same year, also Webb [-87] states that there is no earlier foundation for Ansoff's research; according to him, it is important to investigate whether weak signals even exist. Webb´s comment is also applicable to the research at present research, and therefore the first objective of this study is to demonstrate the existence of weak signals/early warnings.

Other Researchers

Although research results are scarce, quite a few writers link early warnings with strategic planning and strategic management. Articles and literature published in business economics suggest that the existence of early warnings is on some level taken for granted. Terms used to refer to these warnings are varied: early warnings, early indicators, symptoms, weak signals, soft form of information [Ansoff -84a], [Webb -87], [Weschke -94], [Michman -89], [Mintzberg -94a], [FitzGerald -94], [Sharma and Mahajan -80], [King -87], [Taylor-87], [Juran-95] and [Åberg-93]. A comparison of the content of these different terms shows that the authors are referring to identical, or very similar, phenomena. When surveying the literature on the subject the present study uses the terminology employed in the work being discussed.

The section 3.1.3 presents studies that show the existence of early warnings and weak signals. Research from other fields familiar with the existence of early warnings and weak signals is discussed in greater detail in the same section.

Denying the Phenomenon

Ashley [-89a] claims that no warning phenomenon exists, but rather the "detection" is made afterwards and is based on hindsight bias, which often occurs in interpreting past events. After an event has occurred, people wish to see warnings and in some respects defend their actions. Ashley [-89a] bases his view on the opinions of some historians. In addition, he mentions an article discussing the historical examination of the Pearl Harbor attack at the beginning of the Second World War.

Mintzberg debates the necessity of strategic planning and strategic management with Ansoff [Mintzberg -94a] and [Ansoff -94]. Betss [-82] also mentions the wisdom of hindsight, but at the same time he confirms the existence of warnings.

The problem isn't detecting early warnings; rather it concerns interpreting them and believing in the analyses made [Betss -82] and [Heiskanen -88]. Sivonen [-98] cites some comments critical of the existence of early warnings, but seems to himself hold the view that warnings can be detected. R. Morris [-97] mentions the wisdom of hindsight, which may distort research findings.

3.1.2 Strong or Weak Signals

Ansoff's starting point is the information a company receives from its environment; the accuracy of that information and the knowledge provided by it the knowledge of what is about to happen in the environment possibly. Ansoff refers to the level of information as having two extreme stages: strong signals and weak signals.

Ansoff gives the following definition of strong signals:

Issues identified through environmental surveillance will differ in the amount of information they contain. Some issues will be sufficiently visible and concrete to permit the firm to compute their impact and to devise specific plans for Response. We shall call these ***strong signal issues.*** [Ansoff -84a, p. 22]

Weak signals he defines as follows:

Other issues will contain ***weak signals****, imprecise early indications about impending impactful events.....all that is known (of them) is that some Threats and Opportunities will undoubtedly arise, but their shape and nature and source are not yet known.* [Ansoff -84a, p. 22]

Connected with the level of signal strength is the problem of the credibility of signals. Strong signals are easy to detect, credible and rational; it is easy to agree about their interpretation. However, according to communications theories, a unanimous interpretation is not self-evident, since each person interprets the received message in his own fashion (see section 3.2, Communication). According to Åberg [-93], weak signals are usually so vague that they are easily missed altogether. It is difficult to believe in them; in other words, they are uncertain, irrational and not credible. They resemble the custom of ancient (according to some claims, even modern) heads of state to consult clairvoyants, Pythias, or prophecies interpreted by priests from the flight of birds or the entrails of sacrificial animals. Similarly, most of us occasionally read our horoscope in the paper, though how much we believe in it is a different question.

The question of the rationality of signals may be linked to the conceptual dimensions of anticipation discussed by Turtiainen [-99, table 1]. He defines five roles of anticipators, which are prophet, astrologer, seer / witch, researcher and visionary. In this scheme the knowledge of prophets and astrologers has a mythological that of witches a mystical, and that of researchers and visionaries a cognitive basis.

The core questions of weak signal detection, presented by Åberg, are linked to detecting and accepting weak signals:

-Is the detected signal: a message, a change in the situation, a symptom of a significant, relevant change, or merely arbitrary changes or scattered information?

-How can signals be detected in as early a stage as possible, when they are still weak, so that there will be as much time as possible for responses necessitated by the threat? (Cf. the time available in 3.1.5, figure 3.4) [Åberg-93, p. 250].

Kuusi [-99b] examines the weak signals of technological progress. His viewpoint is very different from Ansoff's. He links strong signals to risks and their

probabilities, and considers the ways in which weak signals can appear in the context of a technological innovation. Of especial significance is his statement that if weak signals are not detected and responded to, a session of “shock learning” is to be expected once the development anticipated by the weak signals begins, i.e., once the signals become strong [Kuusi, -99b].

Bryan S. Coffman, who works for the MG Taylor Corporation, published a series of very commercially oriented articles on the Internet. According to him, a weak signal is:

1) An idea or trend that will affect how we do business, what business we do, and the environment in which we will work

2) New and surprising from the signal receiver's vantage point (although others may already perceive it).

3) Something difficult to track down amid other noise and signals

4) A threat or opportunity to your organization

5) Often scoffed at by people who "know"?

6) Usually has a substantial lag time before it will mature and become mainstream

7) Therefore represents an opportunity to learn, grow and evolve.

[Hiltunen -99]

3.1.3 State of Knowledge

The concept “issue,” a central concept in the theory presented in Ansoff [-84a], was defined in section 2.5, in the context of risk definition. Ansoff generally refers to this concept as a “strategic issue.”

Ansoff describes the signals with a scale containing five states of knowledge, the level depending on the information content provided by the signal. The scale is clarified in Figure 3.2.

States of Knowledge / Info Content	(1) Sense of Threat/ Opportunity	(2) Source of Threat/ Opportunity	(3) T/O Concrete	(4) Response Concrete	(5) Outcome Concrete
Conviction that discontinuities are impending	yes	yes	yes	yes	yes
Area or organization is identified which is the source of discontinuity	no	yes	yes	yes	yes
Characteristics of threat, nature, of impact, general gravity of impact, timing of impact	no	no	yes	yes	yes
Response identified: timing, action programs, budgets	no	no	no	yes	yes
Profit impact and consequences of responses are computable	no	no	no	no	yes

Figure 3.2 States of Knowledge under Discontinuity

[Ansoff -84a, Figure 5.4.1, p. 353]

Level (1) The lowest state of knowledge is the sense of threat/opportunity, where there is only a conviction that discontinuities are impending [Ansoff-84a, p. 353]. This is simultaneously the highest state of ignorance that can be used in managing a corporation. Ansoff asserts that in the "*political and economic fog of uncertainty*" prevalent in the mid-1970s, many companies found themselves in such states of ignorance, however he gives no specific examples [Ansoff-75]. As an example of the second and third levels of knowledge Ansoff points to the development of the transistor. In the 1940s, when it was known on the basis of physics that transistors might work, this information was level (2) in strength, and the source of threat was known because the source of discontinuity was identified. When researchers succeeded in developing the first functioning transistor, the information was strengthened to level (3).

Webb [-87] emphasizes that *Level 1 is the highest state of ignorance that can be of any use to management.* On Level 2, *Threats and Opportunities are recognized and from what direction become clearer. Level 3 is still insufficient for the company to make a Response.* On Level 4, *the knowledge is now sufficient for a Response to be made. Level 5 contains all the information necessary to make a strategic planning decision.* [Webb -87, pp. 68.69]

Webb [-87] points out some reasons for the fact that signals only provide weak knowledge of the final threat or opportunity. One reason is that despite strong signals, we are unable to receive the information or only register a negligible amount of it. Another is that we filter the available information to such a degree that it loses its significance. In addition, external disturbances may affect the situation: a signal is very short-lived and quick, which leaves it weak [Webb -87, pp. 12…14]. These reasons are related to the communications concepts of "filter" and "noise." (Communications theory is discussed further in section 3.2, and filtering in section 3.1.5).

In his Ph.D. thesis, Kuusi [-99] introduces the concept of "epistemic value" for assessing the credibility of Delphi studies. The concept is geared toward specifying the significance of the information content of detected signals, and toward examining it from several viewpoints. Kuusi [-99] divides the assessment in four parts: One, the (at least in principle) measurable impact (I) of the signal on the matter under investigation (the project). Two, what the signal indicates can be accomplished, i.e. feasibility (F). Three, the likelihood of the accomplishment, or validity (V). Four, the relevance (R) of the accomplishable effects. When a value is assigned for these factors, for instance on a scale of 0-5, and their product IFVR is calculated, the value of the product indicates the credibility of the detected signal. If one of the factors is very small (or zero), the total value of the product is also small (or zero) [Kuusi, 99a and 99b].

This method may be very useful in project work when there is time and personnel available for the assessment. Using the method is probably possible and even recommendable in e.g. research and product development projects, as well as in the preliminary stages of investment projects (brainstorming, prefeasibility, feasibility). It has not been possible to test the method in the empirical research conducted for the present study, as it was not available at the time.

3.1.4 Studies in Support of the Theory

As mentioned earlier, Ansoff's theories are controversial. In this controversy basic problem is whether the "weak signals" type information is ever detected in practice. Outlined below are some studies and papers from different fields that support Ansoff's theory; these show that Ansoff is no longer alone in his views. (On

the use of terminology in discussing different studies, see section 3.1.1, "Other researchers").

3.1.4.1 Research Directly Related to Ansoff's Theory or to the Concept of Early Warnings

Weschke [-94] presents a group of early warnings in relation to economically risky enterprises. Weschke´s article, which is based on other studies and articles, discusses seventy examples of early warnings. Weschke divides warnings into three main groups, each of which has subgroups, and provides examples. The main groups are: 1) long-term patterns, 2) ownership issues and 3) immediate danger signs. Some, but not all, of the examples of warnings are clearly applicable to project work.

In his doctoral dissertation, Webb [-87] investigates the future of the development of a limited technical operations sector (laser technology) of a company. Can "weak signals" (quotes in the original) be identified in this development? The research is divided into two parts.

First, Webb uses interviews with nine eminent experts in the field (researchers and professors) to explore directions of development in the field, and the "weak signals" that can be identified in them. The "weak signals" that Webb identifies and uses in his research are potential new products and/or operating methods. He notes, that as many as twenty such signals were identified, but only 9 were accepted to the second part of the research. The accepted "products" were the ones that were of the greatest interest from the standpoint of the company that had commissioned the research. These "weak signals" Webb calls "primary weak signals."

The second part of the research consists of a poll on the possibility and significance of the existence of these nine "primary weak signals." Based on the poll, Webb analyzes signs of market development of particular interest to the client company. These "weak signals" Webb calls "secondary weak signals."

According to Webb, the results of his research are that:

1) Discontinuities in development can be brought about by turbulence in the technological environment
2) A method for observing, enhancing and filtering "weak signals" has been arrived at
3) Nine possible devices or methods that can become significant for the field in the future, have been identified
4) Depicts details in the operating environment of the field researched has been clarified
5) The sources of "weak signals" are hierarchical, "*each source being 'triggered' into action by the combined effect of the 'weak signals' being emitted by these sources above it in the hierarchy.*" [Webb -87, p. 351]

With the exception of the research method, Webb's results are difficult to generalize. Even his observation of the hierarchy of the sources for "weak signals" may be caused by the research method he used. The first part of the research comes close to a product development estimate, where as the second part resembles marketing research.

Leidecker and Brono [-87] note the effect of the critical success factors in a company's activities as they examine the import of individual intuition. This idea can be associated with observing weak signals or early warnings.

Pinto and Slevin [-92] have developed a project implementation profile - a method for predicting the likelihood of success or failure of a project - which can also be regarded as research in support of the existence of early warnings or weak signals. The assessment questions presented in the method strive to both map the

current situation of the project and estimate its future states or the final result. When the assessment is done in an early stage of the project, such as the planning phase, almost all assessment questions regard future events or the views of the person making the assessment (such as the project manager) on what actions will be taken in the project.

3.1.4.2 Futures Studies

The anticipation of technological progress has been internationally popular in the 1990s. In Japan, Expert Foresight Studies have been conducted regularly since 1971. In these studies, so-called topics are sought for and the basis for the assessments of the experts is formed by the weak signals they are familiar with. In Finland, more than a hundred practical anticipation research projects were carried out in the 1990s. These studies were conducted under the supervision of the Ministry of Labour and funded by the European Social Fund. According to Turtiainen [-99] they did not attempt to acquire an in-depth understanding of the issue, but rather had the character of small-scale, case-type projects. They have, however, created a need for the development of a theoretical base for anticipation [Turtiainen -99]. To facilitate this, discussion of weak signals has been initiated within the field of Finnish futures studies [FUTURA -99]. Defining and researching weak signals has emerged as an extremely interesting field of study. One part of this attempt to find a definition for weak future signals was the Delphi study, which was conducted in the spring of 2000 [Kuusi et.al. 2000]. The study revealed substantial differences in the perceptions of experts.

Mäkelä [-99], in discussing methods and practices of anticipation, links weak signals to megatrends. Weak signals are also sometimes linked to implicit anticipatory knowledge (observed at work places and educational institutions). In addition, they are a central factor in the TOP10 cluster analysis, which links them with megatrends. Weak signals should be used with qualitative methods. They indicate future events in the short term (under two years) [Moisseinen et al. -99] and [Mäkelä -98].

In his book, Mannermaa [-99] combines the concepts ”wild cards” and ”weak signal,” and implies that wild cards are the only type of weak signals. In doing this, he sees weak signals as a progressive phenomenon, even though they have no previous history or time series; he seems to expect them to form one. In Mannermaa’s opinion, weak signals may rise to central significance in the future.

Mannermaa [-99] sees wild cards and weak signals as unique and non-repeating strange phenomena. They may seem ridiculous and only exist for a short while, and many experts scorn them. He points out, however, that not all strange phenomena can be counted as weak signals of real developments; methodologically, weak signals are problematic, as modeling them is difficult — due, for example, to the absence of history or time series. All Mannermaa’s examples are of phenomena that have developed into something “real,” such as the Internet and the demand for ecologically sustainable development.

In the present researcher’s opinion, developing phenomena of this type have not necessarily ever been weak signals; instead, they are the result of various developments. The phenomena in Mannermaa’s text that can be seen as actual weak signals are the “first signs” he mentions, such as ARPANET and the report of the limits of growth [Mannermaa -99a, pp. 87.92], [Mannermaa. -99b] and [Mannermaa, -2001]. To some extent, both ideas (wild cards and developing time series) reject single and apparently random observations, signals and early warnings. In the opinion of this researcher, the ”wild cards”-phenomena may be seen as weak

signals, though not necessarily vice versa. Later in this study, it will be shown that there are also other types of weak signals.

Metsämuronen [-99] examines the possibilities of using mathematical methods to detect weak signals from interviews with experts, conducted at different times. The interviews should be as closely parallel as possible, as well as sufficiently far apart in time. Metsämuronen analyzes the results using the Markov chain theory, which gives significance to the changes from one interview to the next. He states that there are two types of weak signals in research of this kind: weak signals that are about to emit a future attribute, and signals that indicate that an old attribute is losing its significance. The experts who are "visionaries" are interesting, though it is difficult to distinguish those who are visionaries from those who are merely fanciful [Metsämuronen -99].

3.1.4.3 Communications Research

Åberg proposes external and internal scanning as one part of organizational communication (discussed in more detail in section 2). This resembles the environment scanning method used in business economics. Åberg mentions "mapping and interpreting weak signals" as one purpose of scanning Åberg [-93, p. 246]. He states that external weak signals may include: the weakening or strengthening of the demand for products or services; a decrease in the quality of work done by subcontractors; an increase in advertising by competitors; strange questions from consultants or competitors; letters to the editor in the press discussing the professional community or the competitors; public changes of earlier stands by politicians; work acquaintances avoiding one's company.

Examples of weak signals of internal changes are, on the part of the personnel, an increase or a decrease in attendance, turnover, or number of work stoppages, as well as changes in the atmosphere of the organization, work motivation or in the communications atmosphere. In finance, they may include changes in the economical key figures; in production- and other technology, the number of flaws identified during preventive maintenance and periodic check-ups. In logistics, weak signals may include pile-ups or breaks in the production chain, or an increase or decrease in the efficiency of the machinery and appliances. [Åberg -93, pp. 247…248].

3.1.4.4 Military Science and Research on International Security

In their books, [Betts, -82] and [Herman, -96] discuss international strategic intelligence, conducted to satisfy the needs of political and military leadership. Betts [-82] presents early warnings (weak signals) of the onset of attack that can be observed in several assaults during the Second World War and in the early stages of later wars. He contends that there is no scarcity of early warnings; rather, the problem lies in the interpretation of the warnings, and especially in convincing political leaders of the existence of a threat. As mentioned earlier, Betts also notes the danger of hindsight bias in interpreting and examining early warnings after the fact. Herman [-96] discusses the aims, organization, working methods and other matters relating to intelligence agencies. Both writers assert that predicting potential threats forms the very core of intelligence work. The issue at hand is anticipating the future [Sivonen -98].

In intelligence work, the relevant stages are identifying, observing, collecting and interpreting early warnings, as well as adapting the information to the needs of the leaders. The emphasis in a national intelligence agency is on international relations; in the business world, parallels include at least the strategic management needs of mega-corporations. In smaller businesses, adapting strategic management to the size of the company should be considered. Regarding projects, the principles

of intelligence work can possibly be applied, but not the methods, sources of information, etc.

From the perspective of this research, it is significant that both writers (Betts and Herman) state that the research field examined by them already recognizes the existence of early warnings. They show, as do Sivonen [-98], Nurminen [-98] and Davies and Gurr [-98], the extent of research and literature in these fields. In their book, Davies and Gurr [-98] enumerate about 60 national or international Open Access Early Warning Projects. Apparently the research covers nearly everything in the area of war and conflict: there are studies conducted under the auspices of the United Nations, national studies and studies by various organizations and universities. Subjects ranging from terrorism to hotbeds of ethnic conflict to food crises and environmental problems are researched [Davies and Gurr -98]. One can only wonder how little influence all these activities seem to have; could it be that they, by virtue of being so numerous, have turned into communicational noise?

An examination of the literature in this area supports Ansoff's belief in the existence of weak signals. Heiskanen presents eleven assertions regarding attitudes dangerous both for military intelligence and for decisions made on the basis of intelligence information [Heiskanen -88, pp. 289…291]. With only minor alterations, several of these claims are applicable to project management.

3.1.4.5 Predicting Bankruptcies

R. Morris [-97] has examined broadly the issue of prediction of corporate bankruptcies. He surveys exhaustively previous studies on bankruptcy predicting, different methods, and the theoretical backgrounds of these methods. He has also conducted an extensive empirical study of British companies that have gone bankrupt, and of the likelihood of predicting these bankruptcies using various methods.

Morris notes that there are significant variations in the manner and accuracy with which different methods predict the approaching bankruptcy. From selected data (where 50 percent are problem companies) all of the methods are able to select the problem companies fairly accurately. According to Morris, the greatest weakness of the methods is their ineffectiveness in picking out problem companies from unselected data (where 2 percent are problem companies). One of the reasons for this, he believes, is the fact that the prediction methods examine the symptoms of bankruptcy, not the causes of the actual problems. Morris´ conclusions can be interpreted to mean that the prediction potential of causes may be greater than that of symptoms.

The focus of the methods is mainly on economical key figures, which in reality are symptoms of problems. A negative development visible in these is always caused by something else, not by the figures themselves. For the present research, the main interest lies in the fact that Morris cites a number of studies, which have examined various qualitative (non-numerical) factors as forecasters of bankruptcy. Morris' own observations of qualitative variables are also noteworthy. Some surprising variables seem predictive the failure of a company several years in advance [Morris, R -97, p. 256 Table 11.4]. The results of Morris' study as regards these areas are in table 3.1.

The table shows how "changes in lines of business" and "changes in registered charges" may provide signals of future problems years before the bankruptcy. In Morris' view, another very good indicator is the "audit qualifications" factor. Changes in the financial status of the company ("changes in financial year end"), according to Morris, show the problems clearly only a couple of years before the

bankruptcy. For the present research, it is interesting to note that qualitative early warnings of the kind presented by Morris indeed appear to be observable.

Table 3.1
The Significance of Selected Dichotomous Qualitative Variables

Event window: years prior to failure	Audit qualifications	Changes in lines of business	accounting policies	registered charges	auditors	company name	financial year end
1	5.5 ****	4.8 ****	-0.5	5.0 ****	1.4 *	1.3 *	-
2	1.5 *	4.1 ****	-0.7	3.2 ****	2.1 **	0.3	3.5 ****
3	1.5 *	3.6 ****	-0.2	2.5 ***	2.2 **	0.3	2.3 **
4	1.4 *	2.6 ***	-1.0	2.2 **	2.3 **	0.3	2.3 **
5	1.7 **	2.1 **	-2.4 ***	1.9 **	1.9 **	0.8	2.1 *
6	1.8 **	2.1 **	-2.3 **	2.4 ***	1.7 **	0.9	1.3

Notes
1. Event windows cover five-year intervals.
2. Figures are t-statistics.
3. Significant at 99.90% level ****; at 99% level ***, at 95% level **; at 90% level *.
4. There were no instances of a change in financial year-end in the non-failed sample for the final window before bankruptcy.

[Morris, R., p. 256, Table 11.4]

3.1.4.6 Issue Life Cycle and Symptoms

Carroll and Hall [-87], King [-87] and Lientz et.al. [-95] discuss the life cycle of issues and the concept of symptoms embedded in it, both of which are included in Ansoff's theory of weak signals and are related to the idea of a state of knowledge presented in that theory. Ansoff's definition, as well as a more general definition, of the term "issue" can be found in section 2.5. The term "symptoms" is defined in section 4.2.

Especially the awareness of social and public issues occurs as an S-curve. The symptoms of issues appear much earlier than the issues themselves. At first, symptoms (or indicators, another term often used in the literature) are bits and pieces of data, e.g. statements in comments made by leading experts. Even if all this awareness were to be gathered together, information provided by it would seem arbitrary and would not indicate any trend. When the awareness increases, the number of groups interested in it increases as well. The stages of public issues are "conversation, contention, legislation, and regulation" [King -87, pp. 254...255]. In the business world, strategy changes planned by competitors are reflected in the behavior of the competitors' staff before the change of plan is publicly announced [King -87].

Lientz et.al. [-95] refer in several sections of their book to the existence of issues and symptoms and to their interdependence in project work. They write:

Suppose that an issue surfaces. Problems and opportunities don't often just appear from thin air. There are Symptoms of the issue that surface first....

[Lientz et.al. -95, p. 21]

The weak point of Lientz et.al. [-95] is that their book provides no references; hence it is impossible to know whether their assertions are based on previous research or on their own observations and conclusions.

3.1.5 Weak Signals Strategic Issue Management Systems

3.1.5.1 General

Ansoff states that the Strategic Issue Management (SIM) thinking that he developed earlier does not take into account the ever faster-occurring strategic surprises in the business environment, nor the changes that occur in a very turbulent environment. To mend this defect he develops further the possibility of taking advantage of weak signals in strategic management. He notes:

...at high turbulence levels, it becomes necessary to start the firm's Response while the environmental signals are still weak. [Ansoff-84a, p. 22]

Ansoff calls this management method Weak Signals Strategic Issue Management.

Starting Point

Ansoff uses as his starting point the state of knowledge (figure 3.2) and uses it to specify the strength of the signal. The actions necessary after the recognition and evaluation of the signal depend critically on the time that is estimated to be available for responses.

3.1.5.2 Detecting Weak Signals

The process of detecting weak signals should be examined, since the same observation procedures may be useful in the utilization of early warnings in project problems. Detection can be carried out either on an individual level or as a more detached Environmental Scanning activity. Ansoff [-75, -84], Juran [-95], Webb [-87], Taylor [-87] and Åberg [-93] discuss individual-level signal detection. Åberg [-93], King [-87] and David [-91] put forth various models of Environmental Scanning (often with a different name). King [-87], Rhyne [-87], Webb [-87], Cleland [-94] and Herman [-96] examine the topic "source of strategic information/issues." All of these merit investigations, as the detection and existence of early warnings are one of the core questions of this research. These activities are also analogous to the risk identification procedures of project risk management.

The Basic Problems of Detection

Åberg notes that the fundamental questions in weak signal detection are (as mentioned in the section 3.2.1 Strong / Weak Signals):

-Is the detected signal: a message, a change in the situation, a symptom of a significant, relevant change, or merely arbitrary changes or scattered information?

-How can signals be detected in as early a stage as possible, when they are still weak, so that there will be as much time as possible for responses necessitated by the threat? (Cf. the time available in 3.1.4). [Åberg-93, p. 250]

Individual Detection

According to Ansoff, the detection of weak signals requires listening to the environment "with an ear to the ground." This demands sensitivity from everyone in corporation. Detection of weak signals should not be left to only a few key persons; everyone should participate in it -- leaders, social, political, economical and technological experts, sales personnel, buyers, researchers, etc. Even drivers of distribution vehicles should be heard. Detectors of weak signals internal to the company are all employees who have wide contacts within the corporation [Åberg -93]. As sources of weak signals, Webb [-87] mentions the "organisational environment" and "the rate of change in the environment" [Webb -87, p.43].

Juran (in a chapter on "sensors" in the book *Managerial Breakthrough*, where he presents his model of management) discusses early warnings and their detection.

The concepts he uses must be seen as identical with early warnings. Juran states that a ”sensor” is “*...a detective device, highly specialised to recognise certain stimuli,....*” [Juran –95, p. 281].

Sensors can give information prior to the event, during the event, or after it. When sensors give information prior to the event, they may be clear early warnings. Sensors can function either defensively (control) or offensively (breakthrough). The latter is an active method of making predictions. In addition to these, Juran also mentions the concept “the early-warning principle.” [Juran –95, p. 284].

Juran emphasizes that it is expensive to procure early warnings. He recommends thorough consideration of what aspects should be monitored with constant anticipation; the 20/80 (Pareto) rule should be kept in mind at all times. According to Juran, the most important sensor is a human being. It is true in all cases that a human being compares the actual event with his expectations (his standard) and notes the difference (cf. communications). In most cases, however, people function as incidental sensors, and it is normal human frailty that they are not very accurate. People can give false information intentionally (e.g. with a view toward fraud), for their personal comfort, because of erroneous or misleading information etc.

In the first phase of his research, Webb [-87] used an interview-based weak signals detection procedure that is in conformity with the New Paradigm Research trend; in the second phase, he used a questionnaire method. Webb’s research has already been discussed in section 3.1.3. (Studies in Support of the Theory). In the context of examining the preparation of scenarios as a part of strategic planning [Taylor -87], combines weak signals with environmental scanning, especially in regard to social and political changes.

3.1.5.3 Environmental Scanning

Strategic management models usually include environmental scanning in the stage where issues are identified [Ansoff-84a], [King -87]. Different writers use different terms to describe the same concept; for example, David [-91] discusses such concepts as to “perform external audit to identify key opportunities and threats” and “perform internal audit to identify key strengths and weaknesses.”

Environmental scanning, a term used e.g. by Åberg [-93], is often associated with examining sources of issues and of information; different systems and observation procedures, as well as environment analysis, are explored. Such tracking of the project environment, as well as of the internal events and developments in the project, are also obviously important in detecting early warnings. According to Åberg [-93], scanning has six stages: recognizing relevant external and internal factors, developing a monitoring system, interpreting weak signals: and if necessary, making recommendations on responses, carrying out the responses, and tracking and supervising the responses.

For this activity, forums should be created within the professional community where weak signals (the term is used by Åberg) can be compared and their significance evaluated. These forums function as sources of weak signals for the professional community. Such forums for the company’s external scanning include e.g. product responsibility groups performing scanning; unit meetings performing scanning; business travel reports and interviews of those who have been on business trips; the distribution of professional magazines by the information service; persons mobile in the market field (including even the drivers of distribution vehicles); and customer panels.

According to Åberg [-93], external scanning can also utilize the semiotic analysis method, also called “myth analysis.” This method compares the “official story” to the “bazaar story” ("rumor mill"), thereby uncovering the trends of thought

that are still under the surface, only just emerging in people's minds. Åberg [-93] states that the technique has been successfully employed by certain international corporations in building scenarios of the political and cultural changes in areas of operation important to them. For example, Shell used this method to anticipate the Iranian Islamic revolution earlier than the state intelligence agencies [Åberg-93, pp. 251...253].

The greatest problem with scanning, Åberg notes, is the difficulty of separating those detected signals that refer to real and permanent changes in the environment from those that indicate only temporary, arbitrary changes. He mentions only one method, parallel verification, of dealing with this problem.

Internal scanning of a company, Åberg contends, is more complicated than external scanning. The units or persons engaged in internal scanning can be negatively labeled, i.e. become unpopular within the organization, which makes their task more difficult. Despite this, he recommends that internal scanning be carried out in some form.

3.1.5.4 Filtering

Ansoff [-84] states that a message or a piece of information has to go through various filters upon arriving to a firm from the environment of that firm. These filters can either hamper or facilitate the reception and processing of the information. Ansoff notes three filters: the surveillance filter, the mentality filter and the political/power filter (figure 3.3).

The first stage, exemplified by the surveillance filter, requires the company to choose what kind of information is needed and what kinds of techniques should be employed to procure it. Ansoff presents a table of different techniques and their suitability in various environmental turbulence levels of the company [Ansoff -84, figure 5.2.1]. He also discusses the limitations of procuring information and the significance of the use of experts.

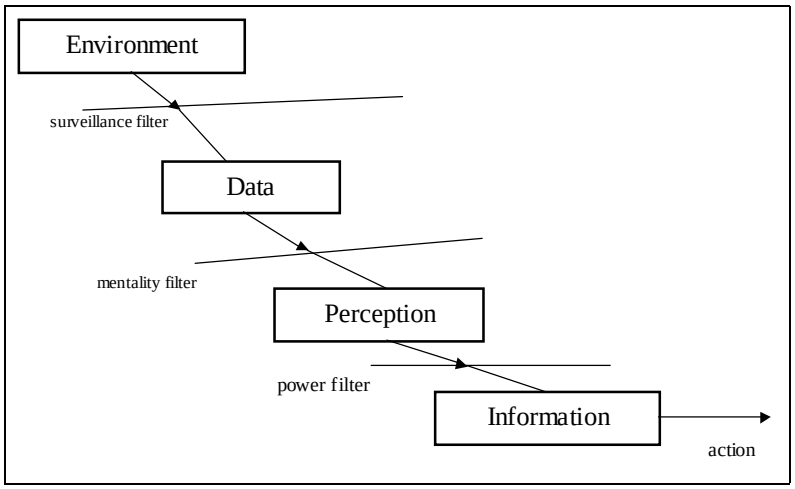


Figure 3.3 Management information [Ansoff -84, figure 5.2.3]

The second stage, the mentality filter, is sociological and psychological in character. At this point the receiver of information evaluates the arrived information and decides what to accept and what to discard because it is unrealistic, unnecessary, of little use, or otherwise irrelevant. Ansoff explores the way in which different

mentalities relate to turbulence in the environment, and discusses the characteristics of a mentality that furthers strategic management.

The third stage, the political/power filter, is the filter that is used especially by the decision-maker. This filter determines what information is allowed to influence the decision-making of the company.

The study of communications is familiar with the same phenomenon in the form of communication noise. Wiio's [-89] examination is somewhat different than Ansoff's, but the connection is nevertheless clear. Wiio divides disturbances in communication into four groups: barriers, loss, distortion and noise.

A) Communication barriers include the following problems: the message goes to the wrong address, the message gets lost on the way, the message doesn't get noticed, the message is delayed, or the communication participants lack the ability to communicate. B) Communication loss is divided into two groups by Wiio: disappearance and rejection. Disappearance of communication can occur either when our senses fail to perceive the message or when information disappears from our internal information processing system. Rejection, on the other hand, is clearly linked to Ansoff's ideas. Wiio divides rejection into three subgroups. a) The first disturbance subgroup that causes rejection consists of individual rejection factors. These include having no need to communicate and therefore perceiving the message as useless, and wanting to preserve our psychological equilibrium (homeostasis). The latter case can lead us to reject uncomfortable messages, distrust the source, or disbelieve the message. These reactions can be caused by an overload of similar messages (immunization), differences between the message and information we already possess, the message being contrary to our norms, or the fact that our expectations are different from the message. b) The second subgroup is formed by social rejection factors. These include group pressure (i.e., our group of reference does not accept the message) and community norms and customs. c) The third subgroup contains technical communication problems: the message is sent either through the wrong channel or in the wrong form. C) Distortion in the message is caused by misunderstanding or misinterpretation. The causes of misunderstanding and misinterpretation are related to other disturbances in communication: the receiver is incapable of communicating, the message is ambiguous, the receiver wishes to preserve his psychological equilibrium, the sender and the receiver have different experiences and interpretation of the information, or the message gets altered on the way. D) Communication noise occurs when the significant, useful part of the message gets buried in irrelevant, interfering information. The channel contains noise, other messages, random disturbances etc.

Ansoff's ideas and Wiio's division do not entirely concur. In the surveillance filter stage, communication barriers and losses do influence the reception of the message, but the main emphasis is on communicational factors, especially on the decision that we make on how to procure information. In the mentality filter stage the most important factors are rejection and its counter phenomenon, emphasizing messages agreeable to us. In the power filter stage the main factor is apparently the rejection of the message in order to preserve psychological equilibrium, though other factors, related to the exercise of power rather than to communication, are important as well.

One explanation for the filtering phenomenon may be the facet theory proposed by Åberg (see section 3.2.4). Apparently, such matters as cognitive maps, futures maps, and the interests and beliefs of different stakeholders can be interpreted as facets. These questions, however, are outside the scope of the present study, and more extensive research on them belongs to the area of behavioral sciences.

Nevertheless, the topic is very interesting and it might provide a fertile field for further research.

3.1.5.5 Source of Strategic Information/Issues

The sources of information and issues are important contributing factors in scanning; these merit study, as they may also be sources of early warnings. The following list divides the sources according to King [-87].

a) *Internal Source, such as the "boss", the board, the planning process, superiors, the accounting system, subordinates, inside reports, specific MIS, project team members, key managers, and annual corporate reports*;
b) *Operative Source, such as the union, creditors, suppliers, trade associations, outsiders, and customers/users*;
c) *General Source, such as public interest groups, the technological environment, outside publications, outside studies, business periodicals (such as the Wall Street Journal, Fortune etc.), business reference services (Moody´s Industrial Manual etc.), professional associations, trade associations, the local press, the trade press, articles and papers presented at professional meetings, public meetings, government sources*;
d) Some groups of sources can belong to several contexts (e.g. stockholders) [King -87], [Rhyne -87] and [Cleland -94].

The foregoing shows the primary role of people as sources of information. The next-mentioned sources are usually document sources and the company as a source. The relationship between human intelligence and official intelligence in the business world is similar to the one encountered within intelligence agencies (where the official sources of information include e.g. attachés with different fields of expertise) [Herman -96].

The definitions of information sources used by Webb in his study are rather different from those used by other researchers. They are a) verbal presentations, e.g. by customers, salesmen, or university workers, b) written presentations, e.g. reports and journals, and c) other, e.g. meetings, conferences, and discussions [Webb -87, Fig. 3.2 p. 107]. This classification is akin to the classification used in communications. Webb does not mention non-verbal sources, but this is understandable as his study is concerned with long-term instead of short-term information. Webb also shows how the use of information sources varies between different studies as well as between different user groups. Generally, it seems that written sources (documents) are more widely used than verbal (human) sources. In most cases both are used simultaneously.

3.1.5.6 WSSIMS Procedures and Model

Estimating the Impact

In Ansoff's model the next step is to estimate the impact of the impending issue on the company. This can be done one Strategic Business Area (SBA) at a time. As assessment methods in simpler cases, Ansoff recommends e.g. the Delphi technique as an assessment method appropriate for fairly simple cases; in more complicated situations, he suggests quantitative forecasting and modeling.

The Time available and the Choice of Responses

The most important issue in utilizing signals is choosing the proper response. This is done on the basis of acquired information: as the signals grow stronger and the information provided by them gets more precise, responses can also be chosen more accurately. When the signals are weak (level 1 or 2), it may be necessary to settle for environmental awareness and surveillance, but when the signals are strong (level 4 or 5), direct action can be taken. The other response options are self-

awareness, internal flexibility, external flexibility, and internal readiness (described in more detail in [Ansoff -84a, pp. 356…365]. The crucial factor in choosing responses and issue management is the amount of time estimated to be available until the issue reaches full impact on the corporation. When time is scant, even weak signals should be reacted to. This is best described in figure 3.4. In figure, 'T' represents the *normal response time*, while 'T_1' indicates a *crash response*. 'δ' is the available time, extending from the detection of a level 5 signal to the time of full impact of the issue/threat.

Curve A represents a situation where the estimated development speed is slow and there is enough time for normal responses. Curve B describes a case where an alarming situation, indicated by strong signals, requires a reaction; nevertheless, it is doubtful that an exceedingly swift response would be necessary. The development of Curve C is so rapid that even an alarm given by weak signals should be reacted to and a response enacted. In the case of Curve D, responding is already too late when the first weak signals are detected; the situation requires crisis management.

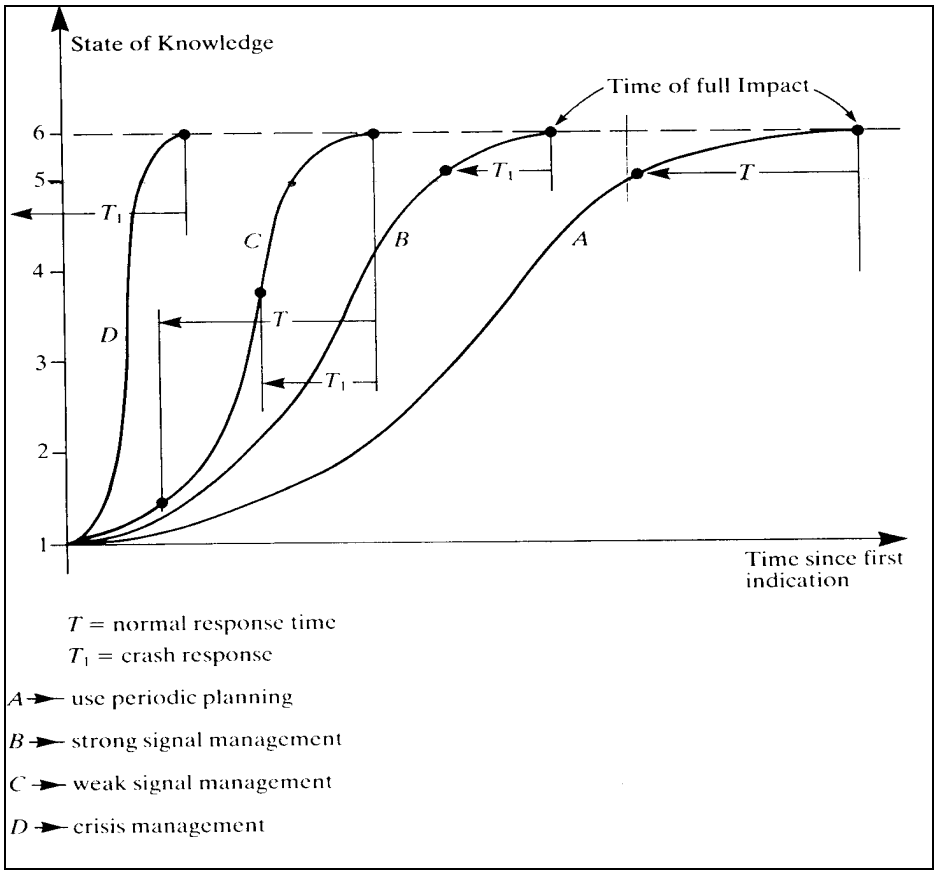


Figure 3.4 Choosing the System [Ansoff -84a, Figure 5.4.9, p. 367]

According to Ansoff, the situation can be defined mathematically as follows:

…normal response time is (T), issue management response time is (T_1).

If we label the time remaining from level 5 to full impact (level 6) δ, and the time from the inception of threat to full impact F:

(i) $T < \delta$, *use only periodic planning*
(ii) if $T > \delta$ and $T_1 < \delta$, *use strong signals issue*
(iii) if $T_1 > \delta <$ F, *use weak signal management*
(iiii) if $T_1 >$ F, *use Crisis management* [Ansoff -84a, p. 368]

The model presupposes that while assessing a signal the issue it refers to can be identified and its impact on the corporation estimated. Subsequently the strength and urgency of the signal will be analyzed, and a decision formed on the basis of this information.

A Decision-Making Model

Figure 3.5 depicts the Weak Signals Strategic Issue Management decision-

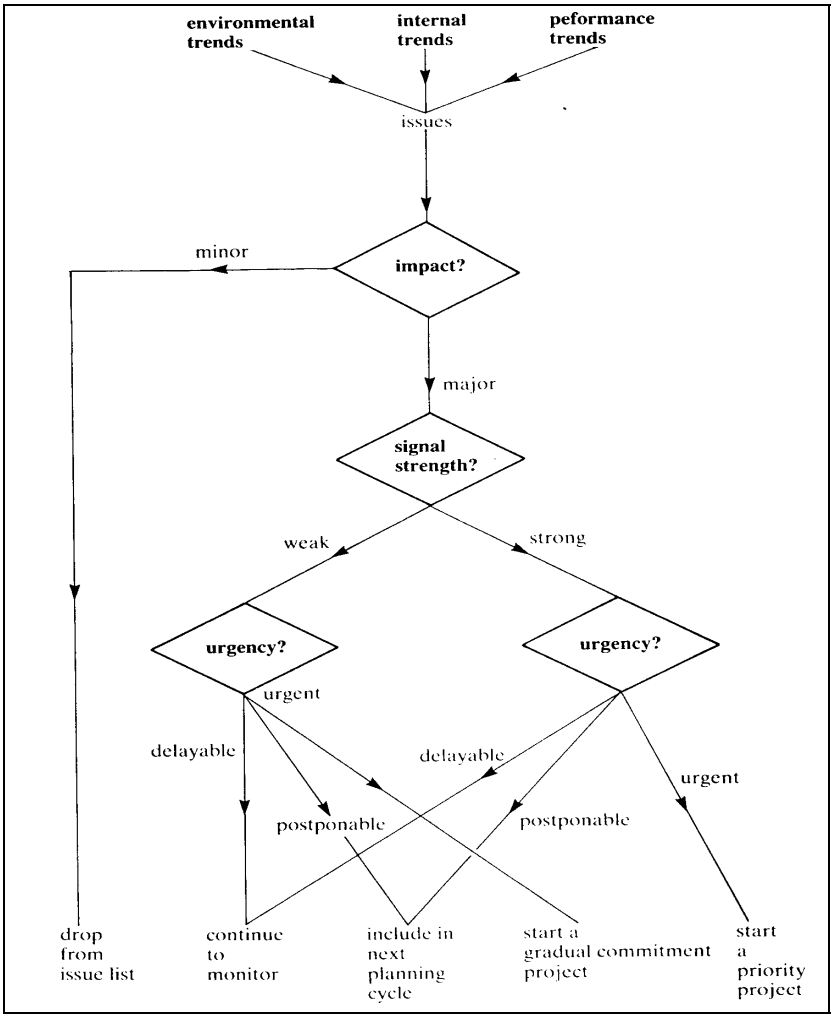


Figure 3.5 Priority Assignments in Weak Signal SIM
[Ansoff-84a, Figure 5.4.8, p. 366]

making model by Ansoff. In his model, Ansoff concludes that if the effect of an issue expressed by a signal is a minor one, it can be left out of the response analysis.

If, however, the effect is a major one, it is necessary to estimate the signal strength (Figure 3.5).

In the case of a strong signal, depending on how urgently a response is required, there are three alternatives: (i) response is delayable: continue to monitor the situation; (ii) response is postponable: include responses in the next planning cycle; (iii) response is urgent: start a priority project to cover the responses. When the signal is weak, the options are: (i) delayable → continue to monitor; (ii) postponable → include in the next planning cycle; (iii) urgent → start a gradual commitment project.

Webb summarizes weak signals management as follows:

1) With increased levels of environmental turbulence, Threats/Opportunities arise so rapidly... The response must be initiated while only partial information is available. This is "Weak Signals Management." 2) There is a hierarchy of strengths of the incoming signals, ranging from a vague sense of turbulence... 3) Managing by "Weak Signals" requires: - a close attention to all incoming information, - The classification of the incoming signals into the appropriate "state of knowledge"... 4) "Weak signals" enable a firm to make progressive responses... 5)"Weak Signals Management" is the third alternative management strategy open to a company in the light of impending Threats/Opportunities, the other two being strong signals management and periodic planning..... [Webb -87, pp. 81...85]

The Ansoff model contains some of the same elements as the models of project risk management. The greatest differences between these lie in the state of knowledge, the time available, and especially in the fact that the Ansoff model does not recognize the concept of a realization probability of an issue/a risk.

3.1.5.7 Other Models

The Communications Model

[Åberg-89] describes external and internal scanning as a continuous process, and gives a corresponding model of weak signal scanning. The model (Figure 3.6)

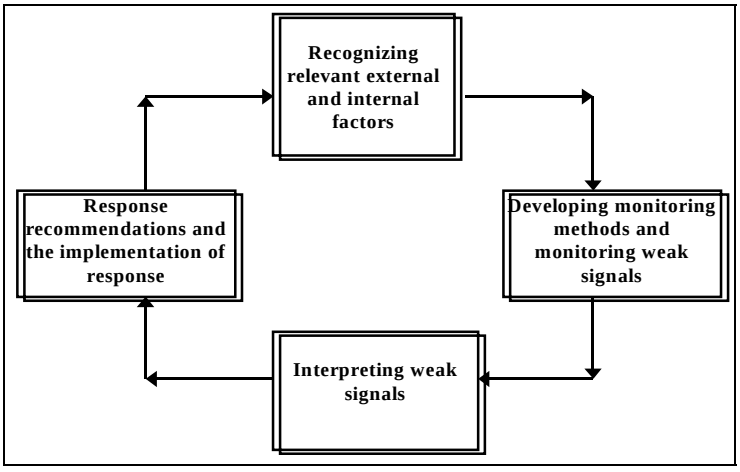


Figure 3.6 External and Internal Scanning as a Continuous Process
[Åberg-89, p. 250]

contains the following stages: a) "Recognizing relevant internal and external factors", b) "Developing monitoring procedures and monitoring weak signals", c) "Interpreting weak signals" and d) "Response recommendations and the

implementation of responses," which leads back to the first stage. According to Åberg the external and internal scanning should not be arbitrary: forums for weak signal assessment should be created.

A Structural Model of Social Action

According to Heiskala [-90], in his work *The Structure of Social Action* Talcott Parsons presents the basic concepts of an action frame of reference (Figure 3.7) and a unit act. The latter concept can possibly be applied as an explanation and a utilization model of weak signals. Heiskala writes:

The basic components of a unit act are an actor (the detector of signals), an objective (or objectives), normative orientation, situational factors, and alternative strategies. The actors are presumed to make the most rational choices possible regarding strategies in the light of the situational factors, normative orientation, the information they possess, and their own commitment to goals.

[Heiskala -90, p. 11]

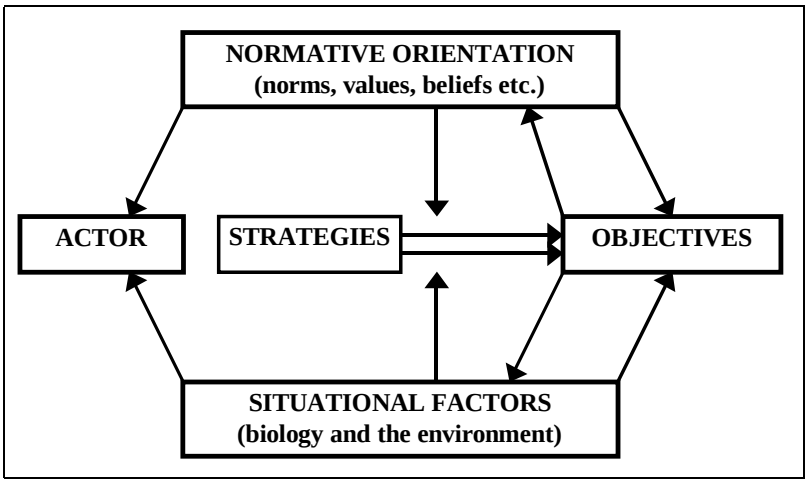


Figure 3.7 A Structural Model of a Unit Act of Social Action
(Source: Turner 1974, 32) [Heiskala -90, p. 11]

3.1.6 Summary

In the mid-1970s, Ansoff introduced his theory of weak signals, which is concerned with sudden changes in the business environment; in the mid-1980s, he developed a management model based on the strategic management of companies applying the theory of weak signals. He presented no research basis for his proposals, and consequently the theory is quite controversial. Nevertheless, numerous writers associate phenomena resembling weak signals or presignals with strategic management. Although the terminology is remarkably varied, this does not seem to be of much consequence as long as the substance of the terms is the same. There are very few studies or works directly supporting Ansoff's theory.

Communications research is familiar with weak signals. Within the field of military science, the study of intelligence activities is well acquainted with early warnings; indeed, all intelligence service work is based on a type of information gathering that could use advance information of prospective threatening surprises. This is the same idea that is included in Ansoff's theory. The principles of intelligence activity are very similar to those of the environmental scanning procedure used in corporate strategic management; this procedure is also known in

communications. The scope, objects, and methods of national intelligence activities are nevertheless very different from their counterparts in the business world. In the field of business economics, early warnings have been discussed at least in connection with predicting bankruptcies. The studies concerned with early warnings also note the risk of hindsight bias.

In the light of the research supporting or alluding to the theory, the conclusion can be drawn that the early warnings phenomenon can be observed in strikingly varied contexts. This shows that the first part of Ansoff's theory (the existence of weak signals) is apparently justified. Despite criticism that has been brought against the theory, research related to it in the area of project work is worth continuing.

When Ansoff's theory in its broader form is compared with the focus of the research (figure 1.1), it can be seen that Ansoff's theory partly covers the foci in the area of business activities. However, Ansoff's theory does not examine risk management, and the nature and typology of the weak signals phenomenon is discussed only in passing. In addition Ansoff's weak signals provide information of a potential issue; this coincides with the meaning of the concept of early warnings (defined below in section 4.2). Therefore, the "weak signals" concept used by Ansoff appears to be synonymous with the concept of early warnings; hence, Figure 1.1 can be expanded to the form of figure 3.8.

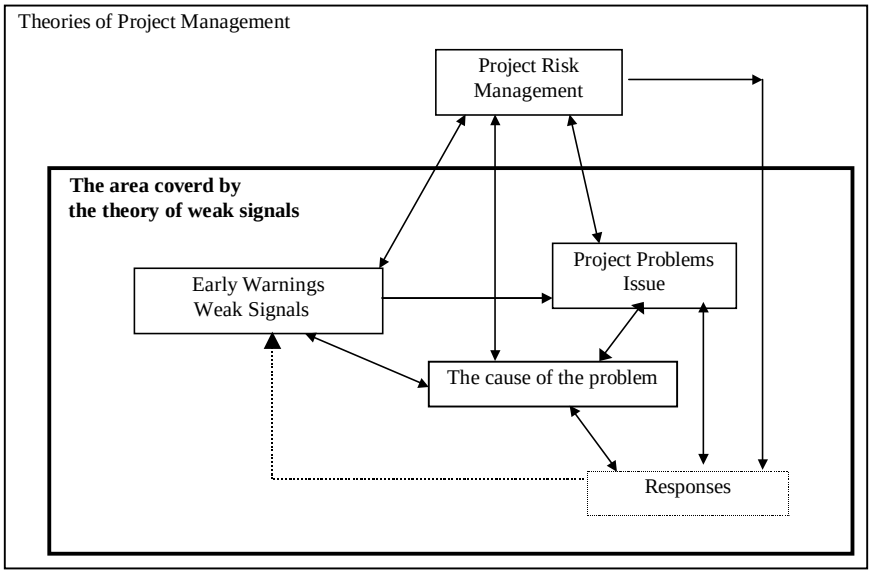


Figure 3.8 The Theory of Weak Signals in the Research Field

(see: Figure 1.1)

3.2 Communications

3.2.1 General

In examining the theory of weak signals, a connection to communications has clearly arisen. Ansoff states that the salient issue is obtaining information. In his presentation, he uses the same concepts as communications theory; examples of such concepts are ”signals” and ”filters.” The latter corresponds to the concept of ”noise” in communications. The framing of the objectives of this research, …*to obtain anticipating information*… can be regarded as attaching a communications element to the research.

This chapter surveys the communications theories, which complement the theoretical basis of this study. These theories are treated as theories explaining the phenomenon to be examined. Explanation for the phenomena that have appeared in the course of this research will be sought mainly in recent Finnish communications theories, including the system model and the facet theory of communications. The fundamental concepts of communications used in this chapter are clarified in section 3.2.2. These issues should be noted in the next chapter, exploring the occurrence of early warnings in project literature.

Definitions of Communication

Professor Osmo A. Wiio defines that information (1) diminishes uncertainty of an issue by decreasing the choices; (2) brings order to disorder; (3) entails surprises [Wiio -89]. Communication signifies the sending of messages between a sender and a receiver. Communication is an event, a process [Åberg -93]. Communication is the exchange of information between people [Wiio -89].

3.2.2 Concepts in Communications

Several factors affect communication: the individual and his needs, different background factors (individual and social) and the stimuli of communication [Wiio -89]. Wiio identifies the internal communication of an individual as a separate branch of communication; this is explored further below.

Of the concepts used by communications, the ones relevant for understanding the results of the present research warrant examination. Knowledge, or data, is organized information, and it is gathered from other information. Information can be signals or stimuli transmitted to us by our senses, or a result of our own thinking. It is linked to the receiver. Information is a change occurring in the control system; this change can be permanent or temporary [Wiio -89, p. 63, Figure 3.9]. A message is any series of stimuli that results in the receiver’s having cognitive events: thinking, reasoning, and remembering. For example a wilting flower communicates to us [Åberg -93]. A message is a combination of signs consciously constructed by the sender [Åberg -93]. At the same time, a message is a combination of signs that forms a body of thoughts [Åberg -93]. Signs, or signals, include sounds, letters, computer language etc. [Åberg -93].

Almost anything that can be detected with the senses is a potential stimulus. For a stimulus to turn from potential to actual, it must meet four requirements:

(1) Observability: the stimulus must be strong enough for the senses to notice it; (2) Change: the senses note a change; (3) Suddenness: the senses cannot detect slow changes [Åberg -93]; (4) Sender: in interpersonal communication, there is always a sender whose behavior the message depends upon [Wiio -89]. According to Åberg, we are not limited to interpersonal messages but receive others as well (e.g. the wilting flower communicates with its appearance).

Assisted by communication, experience, worldview, and context, a person strives to give a meaning to a message he encounters. The roles of the receiver and the

sender are inevitably intertwined in forming the meaning. The bulk of the information and knowledge that produces meaning is non-verbal, hidden information. Aula states that according to Ikujiro Nonaka, two thirds of the capability within an organization is hidden, tacit knowledge. In creating know-how within the organization, this tacit knowledge holds a key position: tacit knowledge is knowledge held by the members of the organization, which they use in their tasks and in understanding their environment [Aula -00].

Medium and message: The medium and the message are separate, even though they are often used interchangeably in everyday speech. A medium is the tool that transmits the message. Using it always requires energy, force. The range of media is great and they can be used concurrently [Wiio -89].

Receiver: Every message requires a receiver (without a receiver, there is no message and no communication). Without a receiver, sending an interpersonal message becomes announcing. The receiver is always the one that decides how the message arrives and how it is interpreted [Wiio -89].

Noise: noise includes obstacles, loss, distortion; these can be either internal or external to the individual. (see 3.1.5, Filtering)

Feedback: Communication includes feedback. The actual communication process is bidirectional.

Multiple stimuli: Every communication event is multi-stimulied. Multiple stimuli disturb communication, but it can also be effectively utilized [Åberg -89, p. 25].

3.2.3 System and Contingency Models

Wiio treats communication as a system; Åberg finds this revolutionary, because Wiio defines information both as an event and as a process. In communication, a message always has a sender. It also has content; because there is the message itself. In addition, there is the medium through which the message is transmitted; and there is the receiver. An instance of communication also includes feedback. Hence, the system model of communication is very similar to process control models in technology.

In this study, it is important to understand what happens at the receiver's end when the message is received and processed. The receiver has to have, among other things, the need and the ability to receive the message. The interpretation and processing of the message depends wholly on the receiver [Wiio -89]. Wiio's "detailed model of communication" describes effectively both the stages of the message's formation and the process stages at the receiver's end [Wiio -89, p. 77, figure]. However, the stages where the message is formed and sent are not of interest to this study, and so will not be discussed here despite the fact that communications studies are very focused on them. Instead, the emphasis will be on the reception of the message. The reception of the message occurs with the aid of the senses, and is therefore a physiological phenomenon. There are theories on the processing of the message in the brain, which belong to the fields of physiology and psychology.

Wiio's "detailed model of communication" depicts those relevant factors and stages in communication through which the received message (stimuli) takes form as conscious knowledge. Wiio calls this stored knowledge. The model shows that in all stages of communication, noise disturbs the formation of the message, its progress as well as its interpretation. Noise can occur both at the sending and the receiving end of the message, as well as in the medium. In addition, all the stages of the communication process are affected by individual or social background factors.

Contingency models are developed from the system model. These are some of the most advanced models in the field of communications. There are several of these

as well [Wiio -89]. However, their subject areas are so general that they are hard to apply to this research, and won't be discussed further.

The Means of Communication

It has already become apparent in surveying the literature concerning weak signals that signs or signals that are observed in different situations can be very dissimilar. For this reason it is relevant to examine what communications research has to say about the means of communication. According to Wiio [-89] it can be stated that human communication typically uses two coding systems: nonverbal communication and language. In addition to these, media are a central set of tools from the viewpoint of communications research.

For this study, nonverbal communication is extremely interesting. A) Nonverbal communication includes 1) communication with gestures, which is probably the oldest form of communication; the impulse to communicate is actually genetic. Another old and important form is 2) communication with pictures. B) Another categorization of nonverbal communication, according to Wiio, is a) communication through showing: facial expressions and gestures; b) communication through things: objects, clothing, buildings; c) communication through messages: pictures, tables; d) communication through time and place: punctuality, distance to the person one is speaking with. Other way of categorizations, too, are described in the literature.

Language, both written and spoken, is probably the most important means of communication in interpersonal relations. Language is not, however, a tool used solely by humans; expressions that can be interpreted as language have been observed among animals, and even insects, as well. The study and properties of language is too broad a field to be included in this study. If the reader is interested in the subject, he should consult the literature in the field, e.g. the works by Wiio and Åberg.

Internal Communication of the Individual

One of the most useful theories explaining the detection and interpretation of early warnings is Wiio's "System Model of Information and the Information Process," figure 3.9.

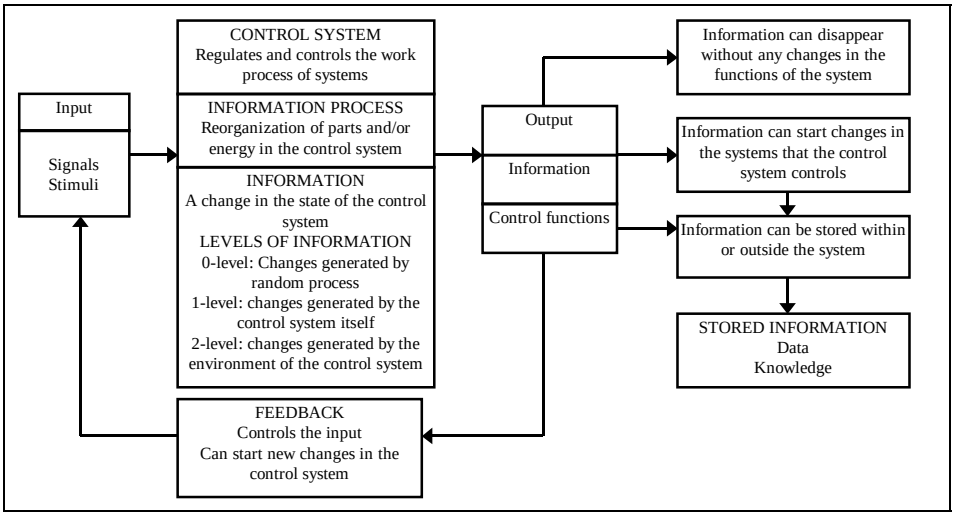


Figure 3.9 System Model of Information and the Information Process
[Wiio-74, p. 15]

According to the model, there exists so-called ”input information,” which occurs in the form of signals and stimuli. The actual information may have three levels (Figure 3.9). As a result of the information process, output information is formed; this can disappear from the system, cause feedback or be stored.

The explanation provided by this model for the reception of information, messages and observations is extremely important for this study. Early warnings and weak signals appear often to be observations, non-verbal (unintentional) communication, etc. [Webb -87]. The basis of Wiio’s model lies in theories about how the human brain operates: how it functions as an information processing system. This is discussed in more detail in [Wiio -89, pp. 25…66].

3.2.4 The Facet Theory of Communications

Åberg [-89] introduced his facet theory of communications in 1988. The theory is based on the theories or regularities in a person’s internal communication noted in various studies, e.g. the one by Wiio discussed in the previous section. Åberg uses as his starting point the structure of the human brain and the brain’s immense capacity, flexibility, ability to store information by associating it with prior knowledge, and the ability to recall information. He further states that the stimuli used by the brain in processing a message are either a) external, or received through the senses; b) internal, or previously stored stimuli used in thinking; or c) random noise.

External stimuli are received through the senses. Different senses transmit different stimuli. Each occurrence of stimulus is multi-stimulied. Even though different senses give us different stimuli simultaneously, the magnitude of our response to them varies. In psychology, this is called the single-channel theory: compared to the channel that is the centre of attention, the other channels subside and become peripheral. However, the reception situation forms a unit, and the level of peripheral action of the channels can vary notably from moment to moment [Åberg -89, pp. 3…9].

A facer is an impotent concept to help us better understands all of this. Åberg defines a facet as follows:

A facet *is a multidimensional image in our mind. A facet can be operationalized physiologically or information-theoretically. Physiologically it is a combination of those synaptic connections, which are activated in connection with a certain stimulus process. Communicationswise it consists of those images, which are activated, in processing a certain stimulus. Parallel concepts to facet are cell population, cognitive map, and schemes, often used by brain researchers (e.g.…).*

Facet is a multidimensional surface, which consists of images or associations. Facet has some point, which is clearer or more distinct than others. This is a core matter, an idea that for one reason or another has stayed in mind as an image in a certain stimulus environment. Weaker, more faded memory traces are connected to the core. They can be other parts of an incoming message or matters previously existing in our brain, which are activated together with the core idea. [Åberg-89b, p. 11].

An association is either a piece of information or an assumption, combined with an attitude. Associations are activated in the context of processing a specific stimulus. Facets change; they expand and contract, new input can be connected to old facets. Thinking is the activation of facets: a good example of facet activation is creative thinking, where two previously unconnected facets intertwine.

Stimuli are not fragmented; rather, they are perceived as forming a unit of thoughts. Stimuli transmitted by all of the senses influence the interpretation of the

”core message.” More information on the facet theory of communications and the arguments supporting it can be found in Åberg [-93] and in Åberg’s lecture abstract on the facet theory of communications [Åberg -89]. The hypotheses of Åberg’s facet theory of communications are presented in Åberg [-89, pp. 25…27].

3.2.5 Summary

The phenomenon of early warnings and weak signals appears to contain communication-related elements, which include receiving signals and stimuli and interpreting them, as well as receiving messages. The ”knowledge” already exists in our environment in the form of signals; it becomes information when it has been received and interpreted. The knowledge itself consists of individual pieces of information.

Wiio [-89] states that information can be knowledge transmitted to us by our senses, or it can be the result of our thinking. It can consist of various observations of the environment, or it can be verbal knowledge. Information is a relative concept, and it is connected to the receiver: what is surprising and what is uncertain depends on the receiver. Information comes about only when a signal is realized, that is, when it becomes conscious. Wiio gives the following definition of information:

Information is a change that occurs in the control system. The change may be permanent or temporary. [Wiio-89, p. 59].

The ”System Model of Information and the Information Process” (Figure 3.9) presented by Wiio depicts how an individual processes the signals and stimuli he receives [Wiio -74]. Åberg’s facet theory of communications complements the picture of how a person processes information and how this information becomes knowledge and stored information [Åberg -89]. According to Åberg, every communication event is multi-stimulied [Åberg -93]. Stimuli received through all of the senses affect the interpretation of the ”core message.”

The process of understanding and interpreting messages and information is always more or less vague; according to Wiio there are no absolutely exact interpretations of a message, only relatively exact ones [Wiio -95]. Understanding a message strongly depends on the receiver and his interpretation of it. Each of us has his own way of interpreting the messages and other information he receives; possibly all of these ways are different from one another. In interpreting and applying the results of the present research one should be mindful that the results represent interpretation of one person, not results arrived at through a statistical research method.

4. Previous Studies on Early Warnings and Related Phenomena

4.0 The Contents of the Chapter

As the examination of the theory of weak signals showed, signals of the type described by the theory can be detected in the context of various activities. The purpose of this chapter is to depict how current project management literature treats the early warnings of project problems. The chapter begins by defining what is meant with the term "early warnings" in this study. Next, certain studies concerning early warnings, examples of early warnings found in the literature, as well as the preliminary type categorization of early warnings are presented. The complex of problems to be examined is also studied from the perspective of project problems and related factors (figure 1.1). Other foci of the chapter include the criteria of success or failure of a project, project problems and their causes, the interdependencies between these factors, as well as steps taken to minimize the effects of the problems.

4.1 About Early Warnings

A comprehensive, unified study of the early warnings phenomenon wasn't found in the survey of project management literature. As noted earlier, only Lientz et al. [-95] have discussed the occurrence of symptoms and issues, which are related to the phenomenon to be studied. PMBOK [-95] mentions the concept "risk symptoms." Almost every book on project management contains statements that can be interpreted as early warnings, even though the writer himself rarely refers to them as such. In the context of this study, very rough criteria have been used in collecting quotes of early warnings from literature. Emphasis has been placed on the links between Ansoff's theory and project management literature in general. Some of the varied terms for the concept of early warnings, which were discussed in the general part of the theory of weak signals (see section 3.1). Other researches can be found in project management literature as well Lientz et al. [-95], Kerzbom et al. [-89], Cleland [-94] and Kerzner [-95].

4.2 The Definition of Early Warnings

Dictionaries of different languages give somewhat different definitions of the terms used in this study. For example, Nykysuomen Sanakirja [-80] (Dictionary of Contemporary Finnish) defines the term *oire* (symptom) in a way that is both broader and better suited for this study than the definition given in Webster's [-92]. Webster's Dictionary's definitions are found on the following pages: warning, [Webster's -92, p. 1109]; symptoms (Webster's associates the word with medicine) [Webster's -92, p. 1002]; signal, [Webster's -92, p. 925].

The Delfoi study by Kuusi et al. [2000] has strived to both define the concept of an "early signal of the future" and to devise a kind of anti-definition for the same. The study gave a group of twelve experts twenty claims that they were asked to comment. The study was conducted as an Internet discussion. The research report includes a wide selection of the arguments the experts made to support their

comments. The definition arrived at contains central features of early signals of the future, including a wider selection of the characteristics of such signals than the definition of early warnings used in this study.

The main concepts that will be used in this study are “early warning” (and its abbreviation, “warning”) and its parallel concept “preliminary signal.” The term “symptom” will not be used, as this word is associated with medicine both in common parlance and according to Webster’s Dictionary. As noted earlier, the use of the concept “weak signals” will be limited to discussion of Ansoff’s theory and its derivatives, as well as to cases where the work cited uses this concept. This concept is defined in section 3.1.

The concept of an early warning is defined in this study as follows:

An early warning is an observation, a signal, a message or some other item that is or can be seen as an expression, an indication, a proof, or a sign of the existence of some future or incipient positive or negative issue. It is a signal, omen, or indication of future developments.

The definition is based on the definition of the word “*oire*” (symptom) in Nykysuomen Sanakirja [-80] (The Dictionary of Contemporary Finnish). Hence, in accordance with the definition, it is typical for early warnings that:

- They give information. - The matter, phenomenon or issue on which information is received might come to pass in the future.

Of the above definitions, the former is related to communications while the latter ties the phenomenon to project risk management.

4.3 Examples of Early Warnings

Project management literature includes a few remarks that can be interpreted as examples of early warnings or even as weak signals as described in Ansoff’s theory.

Kerzner presents a number of examples that in the opinion of the present author are examples of early warnings [Kerzner -95, pp. 284...286].

Communication traps

-There may suddenly appear an exponential increase in the flow of paperwork, everyone is writing "protection" memos. Previously, everything was verbal...

In this example, a change in behavior is the alarming early warning that should be paid attention to. Apparently something has happened in the project since there has been a change in its atmosphere, though what has happened cannot be inferred from the example. In addition, the situation in the example tells of something that has already happened; apparently it warns that leadership problems may arise in the project, and even the final result of the project can be imperiled. From this example it is possible to infer a situation similar to the formation of a chain of problems discussed in section 4.8 Cause-Problem Chains.

Cleland also presents an excellent example of the detection and utilization of early warnings:

I can walk onto any project site anywhere in the world and within a short time tell you if that project is going to be a winner. It’s easy; I just look at the people, what they are doing and how they are doing it. If the project people look determined, confident, enthusiastic, and busy, it’s a good bet that you’ve got a

winner team. If people respect each other, help each other and things seem to be getting done with a minimum amount of confusion, then you can be fairly certain that they have their act together and they will pull it off without much strain. [Cleland, -94, p. 462]

In this example, group behavior reveals the mental state of the workplace to the observer. The observation can be positive or negative. The example does not directly discuss a problem or its cause but it gives also a procedure with which one can actively observe early warnings (*I can walk... I just look at the people...).*

In addition, the works by Kezsbom et al. [-89], Obradovitch and Stephanou [-90] and Whitten [-95] give examples, which can be seen as early warnings of problems.

The Study by CII

The Construction Industry Institute (CII) of the United States conducted a study in the early 1990s [Zeitoun and Oberlender -93]. The outcome of the study was that matters noted in the bidding phase of the project could possibly be utilized in assessing the realization of the project's final result in terms of cost and schedule.

Other Groups of Early Warnings

The following sources include more consistent discussions that can be considered examples of early warnings regardless of the term used in the original text. Kleim and Ludin [-94] present a list of indicators (their term) that express the poor morale of the project group; these they call "Indicators of Poor Morale." The book by Lewis [-93] includes a ten-page list called "Checklists for Managing Projects" (chapter 24). Nearly every item noted in it, if absent or poorly handled, can be a sign or cause of future problems. Kerzner [-95] and Cleland [-94. p. 405] present nearly identical lists of signs that characterize an effective and an ineffective project group. In addition, Cleland's work includes several other statements that can be interpreted as warnings. Lientz et al. present a table called "Symptoms of Problems" [Lientz et al. -95, p.186]. Some of the causes of project failure discussed in Honko et al. [-82] can also be regarded as early warnings, depending on how early in the project they are recognized.

4.4 Analyzing the Examples

Preliminary Type Categorization of Early Warnings

The two first research question are (section 1.5): 1) Can information of the type of Ansoff's weak signals, referred to as "early warnings" in this study, be found in project work? 2) Is it possible to design a description of the early warnings observations and a categorization of the early warnings? These are the questions that the present analysis is especially concerned with.

For the study Nikander [-98] it was possible to select quotes from project management literature, which could function as examples of early warnings. For the table 4.1, this researcher accepted, on the basis of the definition presented in section 4.2, a total of 91 examples of early warnings, divided into 8 main classes and 21 subclasses. The example material collected from research literature can be found in full in table 4.2, appendix A. This table gives bibliographical information for the quotes and a brief text sample of each quote.

The choice of quotes has been made substantially more difficult by the lack of basic, case specific examples. Summaries of broader studies, often conducted for purposes other than the analysis of early warnings, comprise the majority of the quotes. The present researcher has interpreted the results as early warnings.

The largest main class, i.e. the one having the greatest number of examples, is formed by examples of preliminary signals (early warnings) expressed by the

personnel (41 % of examples). The second largest class is the collection of examples relating to project control and reporting (19 % of examples). Of the individual groups, the largest number of examples (19 %) concerns "interpersonal behavior." The next largest group of examples concerns "attitudes and commitment to the project" (12 %). This does not necessarily mean that early warnings of these types are the most abundant in practical project work; rather, it indicates that the interest of the writers has been greatest in these areas.

Table 4.1
Main Type Groups of Early Warnings on the Basis of Project Literature

	Literature references
Warnings expressed by personnel, project group	**40.6 %**
Interpersonal behavior	
Non-verbal information	
Concealing difficulties	
Attitudes and commitment to the project	
Turnover rate of personnel	
Professional competence of personnel	
Personnel resources	
Project manager, management	10.9 %
Project manager as a person	
Management	
Insufficient management resources	
Project planning and objectives	8.8 %
Preliminary planning, errors made during the brainstorming phase	
Ambiguous objectives	
Project planning	
Observations in the bidding phase	
Project control, reporting	**18.7%**
Progress of the project, quality level	
Labour effectiveness	
Delay monitoring systems	
Changes in the cost estimate	
Working on the project	5.5 %
The character of the work initiation	
Changes and disturbances in workflow	
Repetition of the same work	
Organization	
Communication	4.4 %
Expressed by the project parties	6.6 %
Participation of the client	
Support of the upper management, CEO	
Contractor's problems in devising a schedule	
Documents, reporting	4.4 %
Quality of the reports	
Delay of the project	
Total quotes	91 + (Honko)

[Neil -89] [Kezsbom et al. -89], [Obradovitch -90], [Kerzner -95] [Fleming -92], [Bent -82], [Cleland -94], [Kleim and Ludin -94], [Smith -83], [Harrison -93], [Lientz et al. -95], [Zeitoun and Oberlender -93], [Honko et al -82]

In certain situations, the causes of project failure presented by Honko et al. [-82] can possibly be also seen as some types of early warnings. They can also be interpreted as early warnings in the case that they are detected sufficiently early.

They include e.g. errors in the preliminary planning phase (35 pcs), the lack of various types of resources (31 pcs), several errors in the project planning phase (44 pcs) and some problems in the implementation phase. As the material in Honko's study is already in a summarized form, the figures may be incorrect.

Other Characteristics Observed in the Examples

Occurrence

The examples that most plainly can be seen as early warnings contain a clear indication of their warning-like character. This seems to indicate that early warning observations, which comply with the definition, can be detected in the project environment. Most of the citations examined are already in a summarized, list-type form. The source itself characterizes some of them as warnings, whereas this researcher interprets others as early warnings on the basis of the context in which they are presented.

The majority of the examples are observations of individual occurrences, which nevertheless can either reoccur in an identical or at least similar form, or can refer to the same problem. If this happens it is even possible to observe the formation of a chronological series. Some examples depict a continuous phenomenon, e.g. the actions and managerial style of the project leader. Clear chronological series can be observed especially in the context of deviations from the plan.

Communicative Character

In analyzing the examples found in literature, it can be readily observed that all of them give information of some type to the person receiving them. The examples discussed in greater detail are obviously communicational situations (cf. the citations above). See section 3.2, Definitions of Communication.

The State of Knowledge and the Time Available

The exactitude of the information provided by warnings seems to vary. Information received from non-verbal communication is apparently quite inexact, where as the information furnished by cost and schedule management can be very exact and can be expressed in figures. This leads to the conclusion that the state of knowledge presumably varies, as maintained by Ansoff in his theory. However, it isn't possible to devise a scale of the states of knowledge on the basis of the material; moreover, it is difficult to form a judgment of the time available as described by Ansoff's theory in the light of the examples.

The Character of the Material and Categorization

The material doesn't support the framing of an actual categorization of early warnings. Several of the examples are of a very general character; only a few states, which project parties, they relate to or in which project phase they can be applied. In addition, the project problem referred to in the example is, in several cases, left for the reader to infer or guess; the writer doesn't necessarily report what the problem is that his example pertains to.

A number of situations are described that at the moment of observation can be regarded as problems as well. These include: sabotage of other people's work; hidden feelings; conflict avoidance at all costs; poor quality of workmanship; low productivity.

The Link to Project Risk Management

The project management literature doesn't make a direct connection between project risk management and the examples or lists interpreted as early warnings. Only some of the more extensive quotes include a clear reference to the potential problem. The link to project risk management can be inferred from the context in which the example is discussed in the original text. For example, [Niwa -89] presents his concept "indicators/hint" together with the concept "keyword" in the context of his model (see section 9.3.). His "indicators/hint" concept and the concept of early warnings cannot be considered identical. The literature on project risk management doesn't appear to contain references to early warning type phenomena. [Artto-94], [Ashley -89a], [Ashley -89b], [Bufaied -87], [Chapman and Ward -97], [Down, Coleman, Absolon -94], [Franke -89], [Internet-89], [Kähkönen -96], [Levine-95], [Levine-96] and [Pasedag -89].

4.5 Failure Assessment Criteria

The dividing line between the success and failure of a project is subjective and vague. Different interest groups and different people have divergent views on the matter. The criteria for success or failure may vary depending on the times [Lientz et al. -95]. Project objectives can be used as assessment criteria, e.g. performance, cost, and schedule objectives (PCT) [Lewis -93]. There can also be other criteria, such as security factors, constructional factors, buildability, various quality appraisals etc. The subject has been discussed extensively by several researchers, e.g. [Kerzner -95], [Lewis -93], [Broaddus -91], [Jaselskis -88], [Cleland -94], [Struckenbruck -82], [de Wit -85] [Tuman -83], [Salapatas -86], [Murphy et al.-74], [Ashley -89a], [Migh -85] and [Pinto and Slevin -92].

A project can be said to have succeeded at least in the case that, once it is completed, it fulfills the expectations of its owner (client, end users, interest groups) [Harrison-93] and [Honko et al. -82]. Common and unambiguous assessment criteria that would be satisfactory for all interest groups and in all cases are impossible to define; no single figure can depict the end result. Qualitative concepts and verbal assessments must suffice.

4.6 Causes of the Success and/or Failure of Projects

The prerequisites of a project's success include those things that have to be in order before the project is initiated, and/or those matters that need to be attended to during the initial phases of the project (defining and project planning) [Lewis -93, Checklist of PM]. The causes of failure are factors that have been handicaps during the project. In Nikander [-98], the assertion is made that the causes of success and the causes of failure are opposite sides of the same issue.

The matter has been commendably discussed from very distinct perspectives by numerous writers, including [Cleland -94], [Lewis -93], [Harrison -93], [Baker et al. -83], [Lientz et al. -95], [Morris, P. -94] and [Jaselskis -88]. In his doctoral dissertation, Lim [-87] examines, as a cause-effect network, which behavioral factors affect construction project performance. Honko et al. [-82] investigated in 1982 the failure of Finnish industrial investments.

A summary, aided by various sources, is attached to table 4.3 (Appendix A). When the causes of failure are compared with project problems selected from project management literature, several common factors are found. The main difference lies in the writers' assertion that the causes of failure directly or indirectly affect the criteria of success/failure (PCT).

4.7 Project Problems and Their Causes

Project problems provide another perspective from which the issue of the success and failure of projects has been examined in project management literature. The word "problem" is defined in Webster's Dictionary [Webster's -92, p. 797].

In this study, "project problems" signify phenomena that interfere with the completion of a project. They usually bring about immediate concerns for the project management.

However, the problem may only become tangible in the future. In that case, if it is detected "in the present," it is a potential problem and therefore fulfills partly the definition of risk. Project management literature and various studies explore these difficulties in project management in several management areas and using a somewhat varied terminology.

A third approach is to examine the causes of problems. "Cause" is defined in [Webster's -92, p. 156].

The causes of problems in this study signify those factors or phenomena that are perceived to have led to the problem.

The cause of a problem may be a past event that is impossible to alter. In this case, the cause is 'history.' The cause may also be outside the influence of the project management.

The study Nikander [-98] examines the project problems and their causes found in project management literature. Table 4.4. These problems and causes are divided into main groups and subgroups; this can be found in table 4.5. (Appendix A).

Table 4.4
Project Problems and their Causes, Main Groups, on the Basis of Project Literature

	Problems	Causes
Schedule problem, delay, time	**11,8 %**	-
Cost-related problem	5,9 %	-
Delivery problem, performance	10,8 %	-
Project environment, consultant	4,9 %	7,2 %
Ambiguous objectives	10,8 %	10,5 %
Client with no CEO support	6,9 %	8,0 %
Management problems, combined	**12,7 %**	**8,6 %**
Project manager as a person	6,9 %	7,5 %
Organization / Staff	**14,7 %**	6,4 %
Personnel problems in general	**21,6 %**	**18,8 %**
Project planning in general	8,8 %	**20,6 %**
Monitoring and project control	4,9 %	5,4 %
Communication	4,9 %	4,0 %
Engineering	2,9 %	4,3 %
Total quotes	102	373

The table shows the total number of citations (462), as well as whether the writer has considered the citation a problem (102) and/or a cause of problems (373). This shows that all main groups include both problems and causes of problems. Causes of problems are discussed much more frequently; cases where the writer considers the citation to exemplify both a problem and a cause are very few.

Although the problem and cause categories seem to overlap in the above table, project literature does consider these concepts separate. That model is followed in the present study as well, although the similarities are recognized.

The example material collected from research literature can be found in full in study Nikander [-98], section 5.3 (partly in Finnish), in appendix 5.1, and bibliographical code in the end of references. The appendix gives bibliographical information for the quotes and a brief text sample of each quote. The present author has, in addition to the above, examined each factor presented in the citations from the perspectives of warnings, problems, and causes of problems. For each citation, the researcher asked: Can the observation in some circumstances or at some time be interpreted as a) an early warning, are the phenomenon in other circumstances and at a different time as b) a problem, and in still other circumstances and at a still different time as c) a cause of problems? Figure 4.1 illustrates this analysis of the interpretation of the meaning of the observation from various perspectives of the subject under examination. This is a research method, which can also be considered an observation.

The analysis is made more difficult by the fact that most of the material is composed of the results of different studies and analyses; it consists of summaries of broader primary data. Due to the general character of the material, examining it can derive no detailed categorization. Nevertheless, when the material gathered from the literature is examined in greater detail, it is clear that quite a few citations can be interpreted differently when placed in a different context of project circumstances.

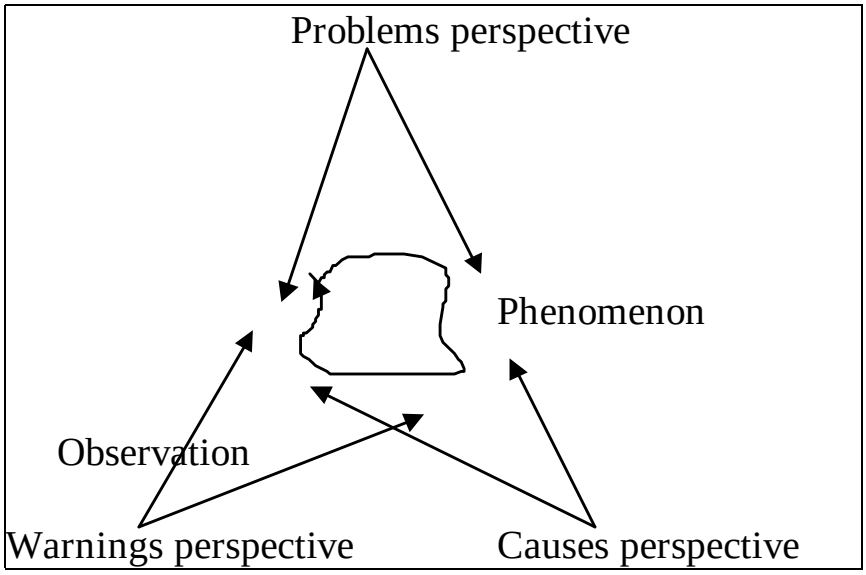


Figure 4.1 The Possibilities of Interpretation of the Meaning of the Observed Matter from Different Perspectives

4.8 Cause-Problem Chains

Several authors have presented clear cause-problem chains. Kerzner [-95] discusses several causes of personnel problems, which immediately creates cause and effect chains [Kerzner -95, pp. 200...201]. Lientz et al. [-95] discuss causes and effects in two different sections of their book: ”Problems and Opportunities within the Project Team” and “Opportunities and Problems in Project” [Lientz et al. -95, pp. 123...124 and pp. 183...197). Kerzbom et al [-89] examine barriers to effective teamwork and the causes of those barriers in their chapter “Barriers to Team Performance” [Kerzbom et al -89, pp. 285...289].

The study Nikander [-98] discusses some hypothetical cause-problem chains, which are partly based on the literature mentioned above and partly formed through inference. These show that cause-problem chains can be long and have several offshoots. A crucial finding is the fact, noted earlier as well, that the character of the interpreted causes and problems varies depending on the perspective adopted in the observation; similarly, the causes and problems surface at different times in the project. They are detected in different ways: either as a current problem, as a past cause for a problem, or as a potential future problem (risk). A broader analysis of these, with the aid of the information provided by project management literature and of inference, would be rather theoretical, as the literature only furnishes summary-type results.

4.9 Responses and Observation Procedures

General

Generally speaking, a response will in the present study denote all those actions taken by project management that are related to the early warnings observation. Such actions include e.g. detecting and analyzing warnings, remedial efforts in decision-making or in response to problems, etc. The former can best be described as monitoring. Remedial efforts are the steps that the project management takes in order to eliminate or minimize the detrimental effects of a project problem for the project’s end result. This is one of the study’s focus areas, presented in figure 1.1. The term “observation procedures” denotes those actions that strive to procure additional information about the problems.

Responses

Possible remedial responses to the effect of problems form an extensive subject in the literature; due to the limited resources of this research, it cannot be here discussed in great detail.

Project management literature contains consistent presentations of problems and the responses related to them; e.g. the following sources are useful: [Kerzner -95], [Kerzsbom et al -89], [Lewis -93] and [Lientz et al. -95]. Often these studies are based on the research and publications of Slevin, Pinto, Thamhain and Wilemont.

The structure and content of books on project management, however, is in itself an account of the content of project problems and of the techniques that can be used to avoid them. The books instruct their reader in sound project management and leadership; usually they are textbooks. In addition, the literature discusses general methods of problem analysis and approaches to problems, (see Table 7.3.1), [Lewis -93], [Kezsbom et. al. -89], [Kerzner -95], [Harrison -93], [Lientz et al. -95], [Whitten -95].

Observation procedures

The different levels of detection techniques presented in section 3.1.5, Detecting Weak Signals, can be considered observation procedures. The surveyed literature discusses several systematic observation procedures for detecting weak signals and

early warnings and for environmental scanning. The methods of risk identification can also be useful (see section 2.5.4). These observation procedures are often laborious and require specially trained personnel; this is unlikely to please the project owners, as it will increase project costs. The section 3.1.5 emphasizes the significance of people as observers, "sensors," and the fact that detecting warnings is something all personnel should be engaged in. A survey of communications yields a simple observation procedure that seems suitable for project work, and that endeavors to employ already existing forums (parts of the project organization). The section also points out that people are important as sources of signals. Other sources mentioned include documents, papers and corporations.

4.10 Summary

The early warnings observations described in figure 1.1, as well as project failure and project problems and the causes of these, are in this chapter examined from the perspective of project management literature and theories. The perspectives of other fields were previously discussed in chapter 3.

4.10.1 Early Warnings

The treatment of early warnings relating to project problems seems to be quite scattered. Only one source, Lientz et al. [-95], takes the existence of warnings into account a more systematic fashion. The theories of project management do not appear to be thoroughly familiar with the early warnings phenomenon of problems. The first part of the definition of early warnings alludes to communications, while the second part links early warnings to project risk management. The definitions found in dictionaries have been augmented by adding, positive issues, or opportunities, to the definition according to the model of Ansoff's theory.

Although the literature yields citations that can serve as examples of early warnings, good examples of early warnings are scarce. The preliminary type categorization of early warnings is presented in the chapter. Material provided by the literature seems to give clear indications that warnings of different types of problems can be detected during projects; these warnings are observed to have a communicational character. All "phenomena" selected as examples of warnings give the observer additional information on the project situation and/or on potential problems. The chapter analyzes examples found in literature and designs a summary of them in the table 4.1 (included also in table 6.7.1). The relation of warnings to project risk management remains unclear; according to their definition, warnings can be included in project risk management, but on the basis of the literature the manner in which this inclusion is to be made remains ambiguous.

4.10.2 Project Problems

Assessing project success is subjective and can be "measured" in several ways. The assessment criteria vary depending on the interest group and the time of assessment. Probably the most common practice is to measure the level of success using the project objectives (Performance, Cost, Time). A number of writers state that failure in these objectives (PCT) is a cause of project failure. However, failure in these objectives is always caused by one or more preceding events or project problems. The material collected from literature seems to indicate that project problems and the causes of problems are at least to a degree parts of the same factor group even though they can be interpreted differently when observed from different perspectives or at different times. The results of the literature survey have been included in the table 4.4 and the table 4.5 in Appendix A. The observations of

phenomena that may be interpretable as early warnings seem to at least partly belong to the same group.

An important point is that while comparing Bufaied's risk factors (variables) (see figure 2.5) to the project problem lists and causes of failure found in other sources, a clear similarity can be observed both in terminology and in content. His risk variables presented seems to be very similar to the problems presented in the table 4.4

Chains of early warnings, problems, and problem causes can be found in project literature and research. These chains can apparently be quite long and have several offshoots. The chain phenomenon is similar to the phenomenon observed in project risk management studies. These observations, too, connect the project problem phenomenon and the project risk phenomenon with each other. The chain is illustrated in figure 4.2.

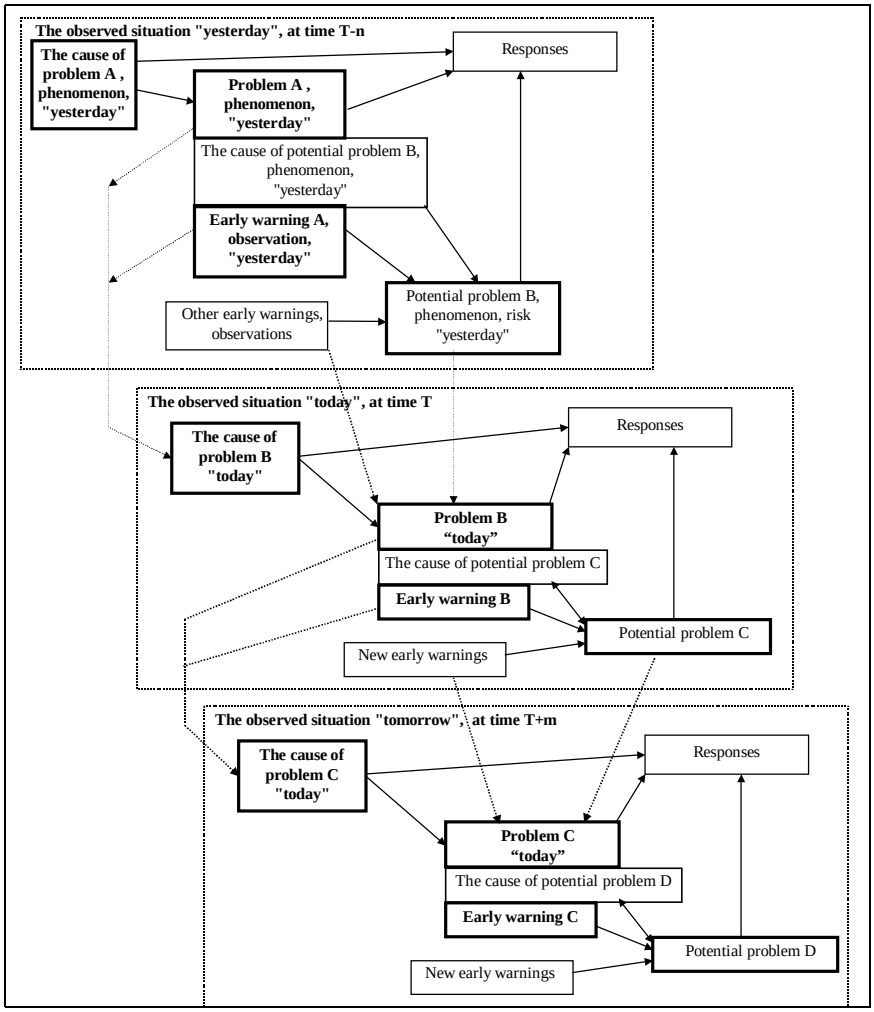


Figure 4.2 The Chain of Problem Causes, Problems, Early Warnings and Responses

Problem (A), detected at a time T-n (“yesterday”), has its causes. This problem (A) can give rise to a potential problem (B); hence, it is the cause of (B). If this causal relationship is detected immediately, the observation of problem (A) can also be regarded as an early warning of the potential problem (B). When problem (B) materializes at a time T (“today”), (A) has become the cause of problem (B). Nevertheless, when (A) was detected at the time (T-n), the observation of it was an early warning of problem (B). Such a situation may recur at the time T “today,” in which case detections anticipate a situation at the time T+m “tomorrow” and give early warnings of a potential problem (C). The chain can be extremely long, even nearly endless. Additionally, studies of project risk management show that the chain may branch. Different responses should also be added to the chain.

Project literature appears to discuss the responses related to separate problems in a very limited manner. The structure of the literature itself includes recommendations of actions that can be taken to avoid project problems. The aim of the literature is to instruct readers in “correct” project management. This chapter examines the relationship between remedial responses to the phenomenon under examination. The purpose of these responses is to minimize the negative effects of project problems on the progress of the project, as well as to detect possibilities for the utilization of positive opportunities. Table 7.3.1 presents a brief summary of the way that project literature interconnects project problems and response recommendations.

5. A Summary of the Literature Survey

5.1 The Existence of Early Warnings

The literature survey appears to have given a partly positive answer to the first of the research questions posed in section 1.6.1. Project literature seems to contain examples that can be interpreted to fulfill the definition of early warnings and to provide the project management with information that is of the type of Ansoff's weak signals. Presumably the concept of "weak signals" used by Ansoff and the concept "early warning" are parallel concepts. In agreement with the definition, it is typical for early warnings that:

- They give information.
- The matter, phenomenon or issue on which information is received may come to pass in the future.

On the basis of the literature survey a summary and a preliminary type categorization of early warnings could be made. The type categorization and the summary are representative to a very limited extent, due to the narrowness of the material; to acquire further information, empirical research is needed. It is interesting to note that both communications studies and the research on strategic intelligence in military science are ostensibly familiar with the early warnings phenomenon. The examples collected from literature really do seem to be of a communicational character; they give information to the observer. The literature survey gave only ancillary information concerning the remaining research questions.

5.2 Project Management

Of the so-called classic methods of project management, the cost and schedule control methods are probably the best tools for mapping potential future problems of a project. The currently available commercial computer programs have made these methods so easy to apply that they have become everyday tools for project managers. The main handicap of these methods is that they are based on information from the project history, which means that a forecast made with them is extrapolative and always somewhat late. In addition, the methods can't effectively take the possibly changing project circumstances into account.

In recent years, project risk management has been the fastest-developing area of project management. High expectations are placed on project risk management: it is hoped that it will become as everyday a procedure as schedule management has been so far. This, however, has not yet been achieved.

At the time of writing, the most common of the currently available project management methods do not seem to offer effective tools for turbulent project environments where unexpected changes may occur.

5.3 The Applicability of the Theory of Weak Signals to Project Work

Section 3.1.3 examined what part of the focus areas in the study which related to Ansoff's theory of weak signals, and concluded that Ansoff's theory encompasses

much the same area as this study, but places more emphasis on corporate activity and especially strategic management. On the basis of reviewing studies that support Ansoff's theory, which report several kinds of early warnings, a need arises to examine the suitability of Ansoff's theory to all project work, not only project control. Some studies indicate that the phenomenon under examination might be applicable in the human leadership of projects.

Table 5.1 compares operational ranges of Ansoff's theory with those of project work. A noteworthy point is a certain difference in scale and in the management environment: Ansoff's theory is mainly concerned with the strategies of corporations (especially large ones), while the focus in project work lies in the daily management of activities and personnel. Another significant difference is the duration of the operations.

Table 5.1 The Operational Ranges of Ansoff's Theory versus Those of Projects

Ansoff's theory	versus	Projects
Both look for additional information about future events.		
Both include the need to anticipate the future.		
The external operating environment of a company.		The internal and external environment of projects.
Strategic management		Daily management and project control
Unexpected significant changes		Unpredictable events, even small changes
Continuous activity over several years		The short implementation time of projects
Continuity in activity		One-time event, no repetition

On the whole, the difference in scale is so great that Ansoff's theory can hardly be applied as such to project work. However, the principles of the theory should be applicable, and some parts of the theory may possibly be utilized as such; one of these is the state of knowledge of early warnings.

5.4 Preliminary Type Categorization of Early Warnings

Section 4.4. presents a preliminary type categorization of early warnings on the basis of the examples (quotes) from research literature. This categorization contains eight main groups, divided into twenty-one subgroups. The categorization has been designed on the basis of the content of the quotes. However, categorizing the examples has been complicated by the fact that the writers who are quoted have not necessarily meant their statements to be examples of early warnings; instead, these statements are usually summaries of broader studies. Actual case specific examples are very few.

5.5 Project Problems and Their Causes

On the basis of the formulation of the research problem, early warnings are closely connected with project problems. Examination shows the similarities between project problems, their causes, and in part even early warnings. Nevertheless, all observations found in the literature do not fulfill the definitions of all the concepts; some only fulfill the definition of one or possibly two concepts. On the basis of the literature survey, it looks like project problems and the causes of these problems can be seen as parts of the same class of variables. Apparently this class can also include those events that lead to observations, which can be interpreted as early warnings. Responses, on the other hand, are a completely

distinct class of variables. A set theory presentation of this can be found in figure 8.2 (chapter 8).

The examples from literature, as well as some studies concerned with project problems, form long and branching chains or networks of problems and their causes. In examining such a network it can be noted that the same thing (event) can be interpreted at once as a project problem or as the cause of another problem; or the observation made of the event can function as an early warning of a potential future problem. A similar phenomenon can be observed in project risk management. The character of the interpretation of the detected factors (phenomena) seems to vary depending on the perspective and time of observation. This helps explain the above-noted set theory view (or vice versa).

5.6 The Relation between the Phenomenon and Project Risk Management

The concepts "problem" and "risk" can apparently be considered to be related to each other. The difference between them is mostly composed by the uncertainty of the materialization of risks, and by the association of risks with the future. Normally risks have sources and causes (risk factor; cause of risk). Similarly, these concepts are parallel to the causes of project problems. Risks and risk factors are observed to have the capacity to form long and branching causal chains or networks; in such a case the risks influence one another. The early warnings phenomenon can apparently be included as a part of project risk management theories, since an early warning provides information about a potential impending problem. The links between the various concepts are illustrated in figure 7.15 (chapter 7).

5.7 A Model Illustrating the Character of the Phenomenon

As pointed out in section 1.6, one of the research objectives is to design a model and a categorization of the character of the phenomenon under examination. Ansoff's theory cannot satisfy this condition (figure 3.8). On the basis of the material collected from the literature, it is possible to devise a preliminary model illustrating the character of the early warnings observations (figure 5.1).

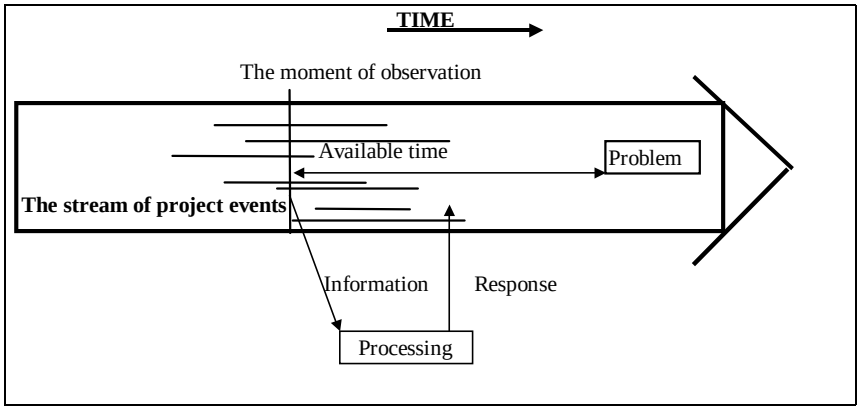


Figure 5.1 A Preliminary Model Illustrating the Character of the Phenomenon

The model views project events as a time-bound continuous stream of events. At a given moment, information about this stream can be procured (e.g. early warnings

of potential future project problems). This information is processed in some manner, and responses are required in order to influence the flow of the project. It should be noted that decision-making takes time, and responses can be implemented only in the future. In addition, responses are always concerned with future events: due to the time-bound character of a project, past events can no longer be affected. Only remedial responses are possible. A crucial factor in choosing a response appears to be, according to Ansoff, time available for responses before the potential problem significantly impacts the project.

5.8 A Utilization Model

The literature does not appear to provide a model that could as such be applied to the utilization of early warnings in project work. There are, however, several models designed for different situations and that can be used as starting point for the utilization of early warnings in project management. The SIMS models, presented by Ansoff and other writers, have potential, but can in practice be too cumbersome, slow, and expensive for use in project work. All these models are intended to be used in activities that stretch continuously over several years. The slowness of the operation causes a delay in the acquisition of information, which isn't desirable in fast-paced project work. The models also seem to require creating new organizational functions; because of the extra costs this entails, the project owners will be averse to it unless indisputable added value for the project can be shown.

On the basis of the information gathered from the literature, a preliminary model of the early warnings of project problems have been devised; the model is shown in figure 5.2.

The starting point of the model is the stream of project events illustrated in figure 5.1. The observer notes of these events and receives messages and signals. He either accepts a message as an early warning or disregards it. In the affirmative case, he determines the content of the information he has received, its significance for the project and the time available for responses. At this point at the latest, another person may enter the picture — a decision-maker who determines the possible responses. According to the model of social action, all this is influenced by situational factors as well as by norms, values, and beliefs. In addition, the model shows that responses influence project events. The model contains two anticipations of the future, the first when estimating the effect of the early warnings, and the second when estimating the impact of the responses.

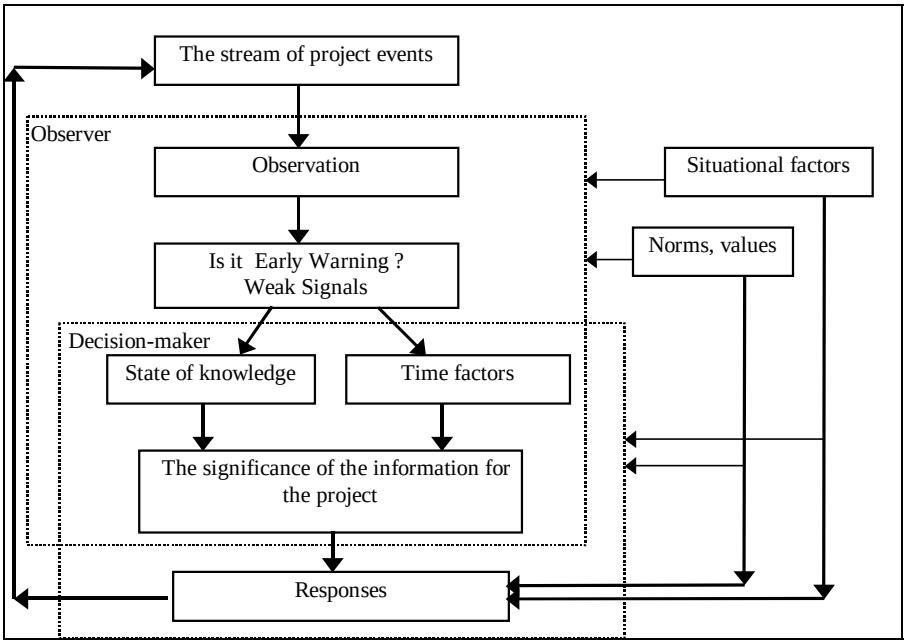


Figure 5.2 A Preliminary Model for the Utilization of Early Warnings.

6. The Field Studies

6.1 The Choice of Research Method

The literature survey shows that there appears has been little research done on the theory of weak signals [Webb -87], [Weschke -94]. Only one study concerning early warnings in actual projects was found [Zeitoun and Oberlender -93]; however, this does not appear to be an academic paper. In project management literature, the subject has been discussed in a rather sporadic manner, although studies that touch upon the subject matter do exist [Bufaied -87] [Broaddus -91] [Morris, R -97] [Betts -82] [Herman -96]. For these reasons, the qualitative research method, rarely found in traditional research literature on industrial economics, was selected for this study. However, quantitative methods were included within the qualitative analysis.

The research process follows the course outlined by Patton [-90]: 1) the collection of raw findings, 2) the interviewing methods, 3) preliminary estimates (conceptualization), 4) designing a categorization (coding), 5) description, 6) the analyses, and 7) generalization. As sources of information, the research mainly uses interviews (activities and structured interactions). In addition to this, especially case studies use archived documents, files and records, as well as monitor the events in the course of a case project (informal interactions and unplanned activities).

The method of field studies is a semistructured (thematic) interview approach [Hirsijärvi and Hurme -93]. Categorization is designed as one phase of analysis together with the description of the phenomenon. In the actual qualitative analysis, material is processed using phenomenological analysis on the one hand and logical analysis on the other, employing tables drawn up on the basic of quantitative analysis.

In qualitative research, no demands, at least not a priori ones, can be set for measuring the material. In this study, the material itself will indicate whether it is possible to measure the time available as used by Ansoff or the state of knowledge in a single observation element. In other respects, the observation element either does or does not belong to the observed group.

6.2 The Implementation of the Field Studies

The field research section is divided into two parts: 1) the basic interviews, and 2) the interviews and research within the case projects. The reasons that led to the choice of the semistructured interview method have been explained in the preceding section. The focus of the basic interviews is 1) to find out whether information akin to Ansoff's weak signals, called early warnings in this study, can be detected in project work; 2) if early warning signals can be detected, to form a description and a categorization of the phenomenon and 3) to discover how early warning signals relate to different project problems.

The objective of the case projects is to test whether the results obtained in analyzing the material from the basic interviews can be found in actual projects. Another important reason for collecting the case material was that no reliable

information on the causes of project problems could be gathered from the participants during the basic interviews. Especially the following research questions are emphasized: 4) Can observations made of early warnings, project problems, and the causes of problems be chained together and networked, and can their character vary depending on the point and time of observation?

The group selected for the basic interviews was small, but at the same time it was widely representative of the different areas and parties within the professional project field in Finland. The selection of the case projects was dictated by their availability, i.e., the willingness of the owners to take part in the study.

Both interview periods were conducted as semistructured interviews by the researcher. The basic interviews were conducted in the fall of 1993 and the case project interviews in the spring of 1995. All those who participated in the basic interviews were asked essentially the same questions. In contrast, the questions used in the case interviews were mainly concerned with events in the case project and therefore varied from case to case. All interviews were taped and transcribed in part by the researcher and in part by outside help. Between the interview periods, the researcher preliminarily analyzed the basic interview material. The final analysis was conducted after all the interviews had been completed. Only the researcher took part in the actual analysis.

6.3 The Basic Interviews

6.3.1 The Interviews Question Frame of the Research

The final set of questions was determined after two test interviews. The questions are summarized in the question frame (Table 6.3.1). The matrix shows which areas, project phases, project parties, and project problem areas the questions targeted (indicated by the shaded area in the matrix).

Table 6.3.1
The Question Frame

Project phases / **Project parties**	Engineering	Procurement	Delivery	Site
Owner / Client				
Consultant				
Supplier				
Contractor				
Project				
Problems	Project culture			
	Objective			
	Project manager / management			
	Project team / organization			
	Personnel / motivation			
	Project planing / control			
	Communication			
	Change of project / Technical details			
	External factors			

The project phases and parties in the upper portion of the table are based on project management literature and on the experiences of the researcher in projects. The lower portion is mainly concerned with project problems.

The project phases are typical of investment projects in industrial establishments. They are, in a simplified form, the phases of a project life cycle as presented in the literature (Figure 2.1) [Lewis -93], [Kezsbom et al. -89], [Cleland -94]. a) The engineering phase includes the preliminary engineering, design and project planning phase conducted prior to the actual decision to implement the project, as well as the engineering and design carried out during the project. The main part of the engineering phase comes before orders are placed; due to the overlapping of project phases, however, engineering and design today continues nearly throughout the project. b) The procurement phase is in this study considered to last from the invitation to bid to the placing of the order. Despite its fairly short duration, this period has been selected as a separate phase, because during it the final implementation of the project is largely determined. Mistakes made during this phase often crucially affect the subsequent phases of the project. c) The delivery phase
covers the time from the ordering of the equipment to their delivery to the site. d) The site phase includes all activities in the actual construction site. Project parties include the most important of the project stakeholders (Figure 2.2) as described by Cleland [-94] and Kerzner [-95]. a) The client is the owner of the establishment under construction, the person or firm (including the personnel) that has commissioned the project. b) The consultant is the main consultant or the project management consultant whom the client has employed to manage the planning of the implementation of the project, as well as (in many cases) the management and/or the main technical engineering of the project. The consultant can be either an independent firm or a separate result unit within the client's firm. c) The supplier group includes all companies that manufacture and supply equipment for the project. The suppliers can also be responsible for the installation of their equipment. d) The contractor group includes those companies that carry out construction or installation work at the construction site. The contractors do not actually manufacture anything outside the site. The line between a supplier and a contractor is somewhat vague.

The lower part of the question frame is formed by the project problems and causes of project failure summarized in the literature (table 4.4). The scope of the project problems presented in the question frame was narrowed down on the basis of the test interviews; questions concerning project culture, [Cleland -94], [Kerzner -95] and project changes were added. The questions about problems regarding the owner and the support of the upper management are situated in the upper part of the frame. The questions regarding the project manager include questions on project management and functional organization. Questions about project planning, monitoring, and control can also be referred to as questions on project techniques. Technical details are included in the group of questions regarding project changes.

6.3.2 The Questions Used in the Interviews

The body of the basic interviews consisted of a list of questions, prepared in advance, that the interviewees answered freely. The foundation for the list of questions is formed by the question frame (table 6.3.1), to which were added more detailed project situations and problems. First, two test interviews were conducted, on the basis of which the list of questions was then revised. The complete list of questions is included in table 6.3.2, appendix B.

The questions are not divided evenly across the question frame of research (table 6.3.1). Different questions from the complete list were selected for different interviewees, depending on the interviewee's experience in projects and his or her role as a project party. For example, the questions from group C, "problems caused by the client," were not asked of persons whose role in projects had always been that of a representative of the client.

The questions are divided into three groups (see table 6.3.2, appendix B):

- Group A questions explore the interviewee's knowledge of project management theories and his views of projects
- Group B questions endeavor to map the project experiences of the interviewee, using very open questions
- Group C questions include fully open semistructured interview questions. Most of the questions in-group C, though open in their format, relate to the question frame, both the upper part (project phases/project parties) and the lower part (project problems). The questions focus on: 1) the problems caused by the client and the early warnings of these problems in different phases of the project (engineering, procurement/delivery, and site phases); 2) the consultant-related problems and their early warnings in the same project phases; 3) the equipment supplier; 4) the construction site contractor. A subgroup of questions concerned the various areas of project work and the problems related to these areas, such as differences in project culture, project management and management styles; organization and personnel; project techniques; communication; changes; and external factors in the project. When necessary, follow-up questions were asked during the interview.

6.3.3 The Persons Interviewed

The sample of persons selected for the basic interview was small (17 persons), but sufficient for a qualitative analysis (cf. the recommendation by Järvenpää [-96]). The selection was influenced by the wish to interview persons in different planning and industrial fields, as well as representatives of construction firms, project consultancies and clients. In addition, a range of persons engaged in different project tasks was sought. Another factor dictating the choice of interviewees was the willingness of the parties to give interviews; this was usually aided by acquaintance.

The interviews were conducted in the fall of 1993 either at the home or the workplace of the interviewee. The time used for the interview varied from one hour to several, depending on the interest of the interviewee, as well as on how much time he or she could spare. The project and work experience of the interviewees is shown in table 6.3.3 (appendix B). The information in the table is based on the resumés submitted by the interviewees.

Of the interviewees, eight (8) were engineers and nine (9) held a degree of Master of Science in engineering. The age of the interviewees ranged from 36 to 64 years, and the amount of work experience (the time from graduation to the interview date) varied from 12 to 41 years. The project experience of the interviewees (years in project work) ranged from 4 to 27 years. The type of experience varied greatly between different interviewees. Work experience and project experience may not correlate, since all the interviewees had not worked exclusively in projects. To refer to the division of parties presented in the question frame, interviewees included persons who had worked only with one project party (client, consultant, or supplier) as well as persons who had experience working for several parties.

Divided by industrial fields, the interviewees had experience in wood processing industry, construction, traditional and nuclear power plants, base metal industry, processing industry and engineering industry. Most of the interviewees had mainly

worked in Finland, but about half of them also had experience of overseas commissions.

The objective in all of case projects was to interview representatives of each project party: the customer, the consultant, the supplier and the contractor. This could not be accomplished in every case, as the relevant persons were unavailable or abroad. In total, 32 people were interviewed in the case projects, the number of interviewees varying between six (6) and ten (10) within each project. In case project 4, all the interviewees were employed by the same firm, but represented different offices or different divisions of the firm, in addition to having different tasks. Four (4) of these persons had already been interviewed during the basic interviews, and thus were already familiar with the idea of weak signals. The idea was explained to the others in the course of the interview. Of the interviewees, 13 held a degree of Master of Science in engineering, 17 were engineers, and two (2) had been trained as technicians. The age, years of work experience and years of experience in projects of the interviewees were within approximately the same limits as those of the persons interviewed for the basic interviews.

The Project Experience / Expertise of the Interviewees

Various perspectives can be adopted in assessing the expertise, experience and professional skills of a person. He may possess in-depth knowledge and extensive experience of one aspect of the profession, but be relatively ignorant of other aspects: for example, an experienced lathe operator may be an expert in his own craft while not mastering other areas of machine operation. On the other hand, a machine operator may be able to work successfully with all the machine tools in an engineering shop. The expertise of such a person is broad rather than deep. This applies to all professions, skills, and fields of science. It is possible to speak of deep, vertical expertise on the one hand, and broad, varied, horizontal expertise on the other.

All the persons interviewed for the present research possess at least an average level of expertise in project work: all of them have participated in at least one larger project. This project experience apparently varies depending on the type of project: what the scope of the project was, whether it was domestic or international, how long it lasted, etc. The interviewees' project experience also depends on the duties they had in the project. Their duties may have been limited to one area of their technological expertise, such as process or electrical engineering, or they may have worked in one or more areas of project technique, such as planning and monitoring the schedule. On the other hand, they may have needed to work with several different project stakeholders, in which case they would have acquired experience in various fields.

Several interviewees also possessed various degrees of experience in the functioning of their company. The depth/breadth division could be detected in this area as well: the interviewee might have in-depth experience in one area (or a few areas) of technology, or he may have been employed in the managerial functions of the company and obtained experience in several fields and come into broader contact with different company stakeholders. This is clarified in figure 6.1, which shows the work and project duties presented in the explanatory section of table 6.3.3 (Appendix B). In addition, an attempt can be made to estimate the amount of experience that a person has in the different cells of the figure.

Estimating the experience of interviewees is complicated by qualitative differences in that experience. The experience of some interviewees has to be first estimated in several cells of the figure, after which the effect these cells have on one another needs to be assessed. Some of the interviewees are primarily project

	Corporate activity Stakeholders	**Both**	**Project work**
	Owner's (client's) personnel	**Personnel of the supplier and the contractor**	**Consultant's personnel**
Multi-field Broad Horizontal	**CEO Plant manager Division manager**	**Project mgr Project supervisor (client)**	**Project mgr**
Both	**Production mgr Departmental mgr Marketing director**		**Site manager Installation mgr**
Single-field Limited in scope Vertical (in-depth)	**Planning engineer Departmental engineer**		**Project engineer Project services Planning engineer**

Figure 6.1 Expertise / Work Experience of Interviewees

experts, possibly with experience of corporate activity; some are primarily corporate experts who have also participated in projects. The latter are usually employees of the company that owns the project (the client). There is apparently variation in the extent to which the corporate experience of these persons has influenced the views that they have of project work, as well as their functions within the project. The rest of the interviewees are employed by companies where projects are the main mode of operation: this includes consultant and planning agencies, equipment suppliers and contractors.

A set of interview questions (Group A, table 6.3.2, Appendix B) was used to test the interviewees' familiarity with the basics of project work. All interviewees mastered these basic issues. The broader project experience of the interviewees was estimated in this study on the basis of the following factors: age, years of work experience, years of project experience, the size and number of projects, the type of projects (versatile or one-sided, domestic or foreign), the position in the project and in other work, whether the tasks of the interviewee in projects have been varied or uniform, and whether functional tasks have influenced the interviewee's project experiences. No formula was designed for the calculation of the project experience of interviewees; rather, the researcher made an estimate. The project work experience of those interviewed in the case projects was estimated according to the same principles that were used in the basic interviews (see table 6.3.4, appendix B). And alphabetical list of all the interviewees can be found in table 6.3.5 in appendix B.

Project experience was rated on a scale of 1 to 5 (5=extensive project experience, 1=little project experience). This scale is completely arbitrary and does not represent the relative project knowledge of the interviewees; rather, the scale should be seen as a way of grouping the interviewees. The summary of these ratings is shown in table 6.3.6; the average is 3.82. In the case projects, the average is 3.50, which is somewhat lower than that in the basic interviews (3.82).

Table 6.3.6
The Distribution of Project Experience

	Basic	Case
5. Extensive project experience	5	10
4. Substantial project experience	4	5
3. Average project experience	6	7
2. Some project experience	2	6
1. Little project experience	2	2

Interviewees' Views of Early Warnings

During the interviews, an attempt was made to inquire into the interviewee's view of the early warnings theory. Several interviewees (8 in basic group) used early warnings monitoring in their everyday work, while others (2) dismissed the theory. In the context of the basic interviews, it was noted that all interviewed project personnel had observed and recognized early warnings of project problems (in the same sense as they are used in this study) in project work.

In estimating the results of the inquiry, "uses in everyday work" was given the value of 5, while "dismisses the theory" was denoted with 1. Table 6.3.7 shows the summary of the views of the interviewees regarding the early warnings theory. The average is 3.82. The view of the interviewees in the case projects toward early warnings was quite positive, and therefore an assessment of similar accuracy was not performed in that context.

It should be noted that there is no correlation in the interviews between a positive view of the theory and extensive project experience, although the averages are identical (table 6.3.6). Reasons for the different views were not examined; as such examination belongs to the field of psychology and is thereby outside the scope of this research.

Table 6.3.7
The View of Early Warnings, Basic Interviews

5. Uses in everyday work	8
4. Has often perceived signs and made use of them	3
3. Has sometimes perceived signs and even made use of them	3
2. Has perceived signs now and then but not made use of them	1
1. Dismisses the theory	2

6.4 Case Projects

6.4.0 Objectives

During the basic interviews, the causes of the project problems discussed with the interviewees could not be reliably investigated, as problem situations were hypothetical. In the case projects, assessing the causes of the problems was fairly successful, because the problem situations were real and experienced. This researcher was also well acquainted with the history of the case projects, which helped in determining the causes of the problems.

Another aim of the case project interviews is to verify the observations made during the basic interviews, such as whether the phenomena discussed in the research have been apparent in the case projects, how these phenomena have been reacted to and what responses have been adopted during projects. In addition, the objective of the case studies is to explore research questions 3 and 4.

6.4.1 General

The research in the case projects focused first on exploring the problems that had surfaced during the project. After this was done, different parties of the project were interviewed. The main questions concerned the way that different persons had experienced and recognized the problems. The selection of case projects was dictated by their availability. The oldest case project was begun in 1987, and the information received from the interviews regarding this project is very much dependent on memory. All the case projects were industrial investments, though they differed from one another significantly regarding the industrial field and the success of the project.

The researcher participated in all the case projects, which means that he was already acquainted with both the interviewees and the project events; this facilitated the interviews, as both parties "spoke the same language." However, this could also be a source of error: interpretations of the interviewee and the researcher may be too similar and subjective, and an outside researcher might have observed something relevant that now escaped notice. This has to be taken into account in estimating the research method as well as the results.

Table 6.4.1 shows a summary of the case projects.

Table 6.4.1
Case Projects

Case 1	Power plant project	Successful, easy
Case 2	Light process plant project	Successful, problems
Case 3	Renovation project	"Failed", numerous problems
Case 4	Industrial plant delivery project	Almost successful, problems

The success and failure criteria of projects have been discussed in section 4.5. The estimates in table 6.4.1 are based on the view of the project owner.

6.4.2 Preliminary Analysis of the Case Projects

First, the problems that surfaced during case projects were investigated with the aid of the researcher's notes and of available archives. Archival material included minutes of meetings, memoranda etc.; for the older projects, however, these were scarce. Documentary material has been significantly diverse, because archiving practices have varied from project to project. Project problems were verified with the interviewees during the course of the interviews.

6.4.3 The Case Projects

Case Project 1

This was a power plant project carried out in Finland, involving 125 MW electricity, 100 MW heating. This successful Greenfield power plant project had no particular problems. The project was carried out in the late 1980s and early 1990s and took about three years to implement. Customer participation was very strong: the future manager of the plant was the customer project manager, who was in charge of the project from beginning to end. The foremen of the entire plant were hired approximately six months before test runs began and took part in installations as supervisors.

Case Project 2

This project remains anonymous in accordance with the request of the project owner (client). The project was a light processing industry Greenfield plant project carried out in Finland. It was implemented a few years before the interviews, and its

duration was approximately three years. The end result was very successful: the cost estimate held up, the schedule was maintained to the day, and the plant operates flawlessly. Nevertheless, numerous difficulties were encountered during the implementation of the project.

Case Project 3

This project consisted of the complete renovation of an overseas processing plant owned by a Finnish consortium (about 70-80 percent of the plant was rebuilt). The owner wished the project to remain anonymous. The project was implemented a few years before the interviews and it was very challenging technically, in its schedule, and in its management. The cost estimate was exceeded by about 30-40 percent, and the schedule was extended by 6 months; the total time spent on the project was 2.5 years.

Case Project 4

This project consisted of the delivery of an industrial plant to Indonesia by a Finnish engineering industry company. The delivery encompassed the power plant block of a chemical pulp factory, including boilers and turbines, as well as the storage of chemicals complete with auxiliary devices, following the FOB principle. The plant was delivered in the mid-1990s and the delivery took about 2.5 years. Shipping, installation, etc. were handled by the client. The delivery project was quite successful.

6.4.4 Problems in the Case Projects

Project problems of the case projects are outlined in table 6.4.2.

When analyzing the factors that have been problematic in a project, a number of questions arise: To whom is the phenomenon a problem? Who sees it as problematic? Who will have to take care of the problem? With which party does the phenomenon emerge? In problem analysis of the preliminary material from the case projects the focus has mostly been on the client's and/or the consultant's views of the problem. This is in large part due to the fact that a consultant employed the researcher during the projects.

Because two of the case projects are to be maintained anonymous, the problems examined in the preliminary analysis of the case projects have been combined and treated in a more generalized form. The same need for combining also pertains to the results of the interviews.

The problems noted in the preliminary analysis have been grouped according to the question frame into problems concerning a project party or phase and other problems. In doing this, it was noted that the project problems in the question frame do not cover all problems that emerged; therefore the question frame was extended during the analysis of the interview material. The case project 4 was about to be completed at the time of the interview, and therefore no precise list of questions was prepared. The primary questions in the interviews were: How did you become aware of the problems you faced in the project? Did you have any doubts in advance? (See more, appendix E)

Table 6.4.2
The Case Projects, Problems Examined in the Preliminary Analysis - Project Parties / Project Phases

Customer / at any time during the project
Financial problems of the customer
Customer project management
Customer / planning phase
Customer project experience limited
Customer / procurement phase
How a contract is achieved
Consultant / at any time during the project
The project experience of the project leaders
Substantial differences in the project cultures of consultants
Consultant / planning phase
Low quality level of schedules
Planning problems
Supplier / delivery phase (planning)
Receiving initial information for other planning
Low level of supplier schedules
Delivery problems of the equipment supplier
Supplier / site phase
Installation work late
Scheduling changes
Low technical level of the equipment supplier
Contractor / site phase
Work coordination problems
Contractor late
Technical difficulties
Other problems
National cultural differences
Differences in project culture
Difficulties in project organization
Personnel relations
Changes in personnel
Numerous changes

6.4.5 The Interview Questions in the Case Projects

The interview questions dealt with the same project matters as the questions in the basic interviews. Questions A and B were the same. Case-specific questions were centered on problems encountered in the project; these were first approached from a general perspective, e.g. asking what factors could have caused the failure of the project.

The complete list of questions cannot be attached to this study due to the sensitive nature of some of the matters concerning the projects. Certain project owners have elected to keep their projects anonymous.

6.5 The Applicability of the Material

The strong point of using material from the semistructured interviews is the freedom it offers to interviewees to express their thoughts; their answers are not completely tied to the questions. At the same time, this is one of the greatest weaknesses of the material: the material expresses the views, opinions, and assumptions of the interviewees, and possibly includes even intentionally misleading statements [Olkkonen -93 p.82]. In other words, semistructured interviews do not give a fully objective view of the phenomenon. (This is clearly shown in the material when the interviewees make statements of the type "I think…" or "In my understanding…" etc.). This influence is decreased by the fact that the early warnings discussed in the basic interview material can be considered traditions, as presented by Alasuutari [-93]. This conjecture can be made at least in those cases where several interviewees have described an identical early warning. If the answer is obviously an opinion or experience of the respondent, the answer is a remnant according to Alasuutari [-93] and can be considered reliable, even in individual cases.

Keeping them open reduces the suggestive influence of the questions and applying the approach presented in the question frame (table 6.3.1), i.e. moving from general project situations to specific problems. Because of this, the interviewee has had the opportunity of initially presenting the early warnings that first come to mind. After this, he has been led to problem situations indicated by the questions and the early warnings that have characterized these situations.

The material may be one-sided as all the interviewees are Finnish and therefore share a common cultural sphere. This effect is decreased in the basic interviews by the fact that 10 out of 17 interviewees have had experience in international projects, as well as by the fact that all of the case projects have included international parties. In addition, two of the cases can be regarded as international projects.

The basic interviews were continued until clear repetition could be observed in the answers of different interviewees. This was most clearly distinguishable in the last three interviews, and improves the representativeness of the sample. The representativeness is also enhanced by the varied work and project experience of the interviewees as well as by the fact that companies in different fields employed the interviewees.

One of the weaknesses of the material is that the early warning elements are selected by one person (the researcher) from the total interview material. This is a decisive characteristic of the semistructured interview method. The same weakness influenced all other analysis, as well as the processing and analysis of the case project interview material.

The material can be considered sufficient for the representation of the phenomenon, but with regard to broader generalizations the material of the basic interviews is fairly narrow, especially as concerns the causal analysis. There were only 17 interviewees, in addition to which all the interviews weren't fully identical.

Only four case projects are included in the study. However, the projects differ substantially from one another in their character as well as in their level of success, and this can be considered to have improved the quality of the material. In the case project interviews, nearly all of the questions are based on the project problems found in the preliminary analysis; hence the analysis of this material should be problem-oriented. It should not be used for mapping project problems, which is not an objective of this study. The focus of the questions on project problems has also led to the questions being different for different case projects. This, too, can be seen as a kind of weakness. Answers in the case project material can mainly be

considered remnants as presented by Alasuutari [-93]: the interviewees have faced the situation in question during the project. Therefore, according to Alasuutari, even individual answers are reliable.

The weakness remains that the implementation of the projects was in part carried out several years ago. Therefore, the interviewees' recollection of the project events and the early warnings they possibly detected may already have faded and become distorted. (Cf. the views of Ashley [-89a] and other researchers on hindsight bias, section 3.1.1, Denying the Phenomenon).

In the case projects, not all parties of the project could be interviewed due to practical problems or great distances (overseas stays) etc. This decreases the possibility of forming a complete understanding of the phenomena present in the case projects.

The total number of interviewees in the case projects is fairly large, 49 persons. This can be considered fairly sizable for a qualitative study. Combining the materials yields a better chance of generalizing observed "warning-problem-problem cause" chains.

6.6 Early Warnings, the Results of the Interviews

The Contents of This Chapter

This chapter presents the results of both the basic and the case project interviews. It briefly outlines how the interview material was processed and how the interview elements were selected from it. The results have been discussed in greater scope and detail in the study Nikander [-98].

The first part of the analysis is the type categorization of early warnings. In the study Nikander [-98] have created parallel descriptive typology of early warnings. In this study are presented subsequently, the division of the elements into descriptive attributes and the cross tabulations between these elements in Appendix C.

For the utilization of the research results, the most important parts of the analysis are the processing of the result attributes, the relation between early warnings and various project problems, and the examination of project problems and their causes.

The material from the case interviews was processed in the same way as the material whereas in the study Nikander [-98] they were first discussed separately. Further, the chapter examines other observations made during the interviews, such as the observation procedures for detecting early warnings and the responses prompted by the detection of a problem. With the aid of the combined material, a dependency web is formed between early warnings, project problems, and the causes of problems. The chapter also includes some qualitative examination of multiple attributes. Finally, the reliability of the results will be assessed.

The Processing of the Interview Material

The interview tapes were transcribed partly by the researcher and partly by outside help. The outside help transcribed the answers given by the interviewees word for word. From this material, the researcher selected as separate answer elements that which he considered the core thought of the answers given by the interviewee. During the analysis the researcher also listened to the tapes. While transcribing the tapes himself, the researcher wrote down directly the core thoughts of the interviewees. The answer elements were inserted into a database program for more detailed processing. From the gathered material, the researcher first analyzed the similar elements representing early warnings; the character of these was then explored in simple percent distributions and cross tabulations. Solely the researcher did the analysis.

The Answer Elements

The core thought of an interview answer, in as brief a form as possible, was selected as an answer element. The answer elements that were especially sought were the interviewee's thoughts on early warnings present in the project. A general definition of warnings can be found in section 4.2; examples of warnings found in the literature are described in section 4.3 and the preliminary type categorization in section 4.4. In addition to early warnings, the answers were found to contain elements, which can be described as observation procedures: these are ways of looking for early warnings in practice. A number of remarks were also made on how to respond to early warnings. "No-early-warnings procedure" elements were not rejected, because they indicate situations where the interviewee feels that he hasn't detected early warnings or that early warnings cannot be detected in the situation the question presents, or answers where the interviewee states that he has no experience of the matter in question. However, these elements are not numerous enough to be subjected to a more in-depth analysis.

The grouping of the answer elements is shown in table 6.6.1.

Table 6.6.1
The Type and Number of Answer Elements

	Basic interviews	Case interviews
Advance warning	439	421
No early warnings procured, difficult to detect	16	2
Observation procedures	85	-
Procedure	18	19
Total	558	432
No experience	57	

A total of 558 answer elements were extracted from the basic interview material, while the case interview material yielded 432 elements. In addition, the answers in the basic interviews showed that according to almost 60 answers, the interviewees had not experienced the situation being examined. Similarly, in the case interviews several interviewees replied that they had no knowledge of the matter the question was concerned with, or that they could not recollect the situation in detail.

The Case Material

The case interviews differed from the basic interviews, in that almost all of the interview questions concerned some problem that had surfaced in the case project in question. The number of open questions was relatively low and the project problem can therefore be seen as the starting point of the investigation.

The case material should be processed by case, using e.g. the Content of Case Study method presented by Patton [-90]; that is, by comparing the cases and analyzing the causes of the differences with the aid of the types of the case projects, as well as by comparing the results by case to the results of the basic interviews. However, this method cannot be used for two reasons:

a) The interviewee's recollections of the events may have become distorted as considerable time has passed since the project. The fairly large number of answers beginning with "I don't recall" indicates this

b) The requirement of anonymity limits the case-by-case processing of the material, especially the detailed scrutiny of problems and their causes.

The case project interview material is therefore processed in the same way as the material from the basic interviews.

The interview material shows that in none of the case projects were a systematic, broad risk analysis carried out before the initiation of the project. In case project 1, the major risks of the projects were recognized and a fair amount of work was dedicated to anticipating them. The project management of the owner of case project 1 was also the most experienced in the case projects examined, which is clearly apparent in both the interviews and the implementation of the project. Characteristic of the other three case projects was the limited project experience of the owner's personnel, which was reflected in various ways in the project events, detected early warnings and problems.

Combining the Materials

Interview materials were processed completely separately, even for the reason that the two interview periods took place some time apart from each other. In the earlier study by the researcher, the materials have been processed separately at first, and subsequently the possibility of combining them has been explored [Nikander - 98]. In the present study, however, the results yielded by the material are combined without further individual treatment.

Whether the materials are statistically from the same basic material was checked with the CHITEST of the Excel program by the Microsoft Corporation. This is a χ^2 test. The compatibility of the materials was checked for 1) the main groups of warnings, 2) the project problem phenomena, 3) the causes of the problems, 4) the early warnings/project problems, and 5) the project problems/causes of problems. For all of the checked percent distributions, the χ^2 values varied from 0,99980 to 1,00000. The χ^2 values of numerical material are very low [Nikander-98]. Numerically, the distributions of the materials cannot be assumed to come from statistically the same material, but there is no reason to suppose a difference between the distributions calculated percentually. The materials can probably be combined either on qualitative grounds or according to the percentual distributions [Nikander-98]. The combining will be carried out on the level of early warnings as well as on the level of "main groups of warnings/project problems" (table 7.2.1) and of "project problems/their causes" (table 7.2.2). This is done because other combinations would not yield relevant new information. The groups of early warnings have been combined qualitatively.

6.7 The Type Categorization of Early Warnings

The preliminary type categorization groups of early warnings in the table 4.1 formed the starting point of the analysis. To this literature summary table the researcher accepted a total of 91 examples of early warnings on the basis of the definition given in section 4.2. These were divided into 21 subgroups, which were arranged into 8 main groups.

Similarities

The interview answer element material concerning early warnings was examined for similarities in content, with the objective of finding early warning groups. The empirical observations, however, did not fit 100% to the preconstructed type categorization and therefore the interview material itself was allowed to steer the analysis in accordance with the principles of qualitative research.

Groups

The main groups stemming from the empirical research material are "gut feeling," "differences or deficiencies in the project culture," and "external source." "Gut feelings" are the most difficult signals to detect, identify and interpret. Usually they are inklings. The group "differences or deficiencies in the project culture"

consists of such issues as observations made during the first meeting, differences in the project terminologies, and lack of project experience. The group "external source" consists of outside hints and the like.

Many main groups in both materials also include some miscellaneous early warnings; these are “groups” that have included one or two elements, but are nevertheless relevant for the qualitative analysis due to their illustrative nature. These miscellaneous were gathered into a separate group, which was not taken into account when calculating the percentual distributions; neither has it been included in the further crosstabulate analysis. This exclusion was necessary, as the further analysis would otherwise have had to be conducted on the observation element level. The amount of these miscellaneous research elements is in the basic material 19 pcs and in the case materials 16 pcs.

The results of both interview materials are presented together in the results. A total of 91 early warnings were analyzed from literature, 420 from the basic material and 405 from the case material. There emerged 68 subgroups, plus those elements, which stated that no early warnings could be procured. These 68 subgroups of early warnings were further arranged into 11 main type groups (table 6.7.1).

Table 6.7.2 (appendix B) shows the early warning groups analyzed from the interview materials, a short description of these, and, as examples, quotes from the answers given by the interviewees.

The distributions of the elements from the respective research materials seem to differ from each other to some extent. To give the reader an understanding of these differences, the results are shown by research material in table 6.7.1. However, the basic and case materials can be combined as noted in the section “Combining the Materials.” The largest main group in all of the materials is “warnings expressed by personnel.” The next largest group varies by material to material (see table 6.7.1).

Table 6.7.1
The Distribution of the Elements into Main Type Groups of Early Warnings

Detected early warnings	**Literature %**	**Basic material %**	**Case-material %**
- Gut feeling		5.2	2.7
- Warnings expressed by personnel, project group	**40.6**	**28.6**	**22.7**
- The project manager (as a person), management, managerial style	10.9	1.7	8.6
- Project planning	8.8	6.2	**13.6**
- Project control	**18.7**	9.3	5.2
- Work on the project	5.5	**10.5**	**10.9**
- Communication	4.4	**10.7**	5.4
- Expressed by the parties (Owner, supplier, contractor)	6.6	**10.7**	9.6
- Documents, reporting (typical for projects)	4.4	**14.3**	**10.4**
- Differences or deficiencies in the project culture		5.2	9.9
- External source		2.4	1.2
Total, elements	91	420	405

Literature sources: [Neil -89], [Kezsbom et al. -89], [Obradovitch -90], [Kerzner -95], [Fleming -92], [Bent -82], [Cleland -94], [Kleim and Ludin -94], [Smith -83], [Harrison -93], [Lientz et al. -95] and [Zeitoun and Oberlender -93]

Some subgroups of the preliminary type categorization (see table 4.1 and table 4.2 in appendix A) contain observations only from the research literature, but not from the empirical material. These subgroups include "concealing difficulties" (which belongs to the main group "warning expressed by personnel") and "labour effectiveness" (the main group "project control"), (table 4.2, appendix A). The empirical material contained no observations conforming to the element "estimating schedule" in the subgroup "delay of the project" (the main group of "documents, reporting", see table 4.2), but did contain observations belonging to the elements "is slippage common" and "chronic delays" in the same group. In this part of the study, the latter were considered better placed in the document group, which is quite large. Similarly, the subgroup “ambiguous objectives” (the main group "project planning and objectives, table 4.2) could not be established as a separate subgroup, though the objectives of the project are referred to in other contexts.

In grouping the elements obtained from the empirical material, some problems were caused by the diversity of the elements. Possibly even more numerous subgroups and main groups could have been selected. The distribution of the elements by early warning groups does not necessarily show how commonly the different types of early warnings are detected in project work; rather, it may indicate the interviewees’ perceptions of how they have detected these in the situations presented by the questions. In the basic material, the early warning groups “expressed by the personnel,” “[with the aid of] documents,” and “expressed by the project parties” comprise about 50 percent of the answer elements. In the case material, the emphasis is somewhat different.

The distribution of the warnings by main groups seems to indicate the uniqueness of the case projects, which is due to the focus of the questions on problems. All of the special characteristics of the case projects cannot be discussed in this study because of the anonymity requirement; on occasion, interviews revealed rather sensitive information. A number of new warning subgroups can be detected due to the uniqueness of the case projects [Nikander -98]. Because of the narrowness of the material, it is hard to draw any generalized conclusions from the case material. Almost all of the warning subgroups that were present in the basic interview material can also be detected in the case material, though with a slightly different emphasis.

The uniqueness of the case projects is further accentuated when the distribution of the elements is examined on the level of warning subgroups in the cases. An interesting observation is that certain warnings can clearly be considered unique to a specific project; that particular type of early warning was not found in other projects.

In case 1, the largest main groups are “project planning” and “documents,” which together comprise about 40 percent of the total elements. It should be noted that in case 1 the number of detected elements is quite small, which gives a relatively major significance to an individual element.

In case 2, the largest main groups are “expressed by personnel,” “work on the project,” and “expressed by the project parties,” which together form about 60 percent of the total elements.

In case 3, the largest main groups are “project planning,” and “expressed by personnel,” together almost 45 percent of the elements.

In case 4, the largest main groups are “project planning” and “expressed by personnel,” together 40 percent of the elements.

A new feature is observed in the elements of the case material. The situations described by the interviewees and the interviewees’ observations interpreted as warnings show that about 40 percent of the elements have formed a problem of

some kind already at the moment of observation to the person who noticed them. They can be recognized as problems but cannot be categorized more specifically. The observation that a problem can, at the moment of detection, also be an early warning of future problems, is similar to the diversity of observations (set theory view) found in the literature, and can also point to a "warning-problem-cause" chain phenomenon.

Elements Belonging to Several Groups

Some elements can be interpreted as belonging to more than one group. For example, the element "*In the last price negotiation, one can get the feeling that the contractor is counting on additional bills*" can be categorized as a gut feeling, since it states that "…one can get the feeling…", but in addition, a non-verbal early warning could apparently embedded in the element. Similarly, in the element "*In examining the schedule, one gets the feeling that something is wrong*" is a gut feeling on the one hand, since it states that "…gets the feeling…" but on the other hand it could also linked to the early warning group of documents/level of schedules and the availability of these. Nevertheless, when analyzing the elements each element has been included in only one group, and the groups are therefore independent of one another.

The Recurrence of Early Warnings

The empirical material shows the differences in the recurrence of early warnings already observed in the material from the literature. The material includes observations that are clearly non-recurrent, such as early warnings detected in project plans, the bidding material or the contracts. Some early warnings may be single and non-recurrent, but can nevertheless be repeated or become a continuous state (such as the poor quality of reporting or a managerial style). In such a case, they are more serious and groups or chronological series can be formed of them. Project control planning deviations form clear chronological series.

6.8 The Role of People (Leadership)

Extremely varied definitions of the term "leadership" can be found in the literature [Cleland -94]. In this study, Project Leadership is understood in the sense as it is defined in Cleland [-94] and PMBOK [-95]; that is, as a part of project management. Leadership is the ability to make the other parties of the project understand and accept the objectives set for the project. It is the human factor that binds the project group together and motivates it to work toward the objectives [Cleland -94, p. 343].

The following groups of early warning types can be regarded as related to people (see table 6.7.1): "Warnings expressed by personnel;" "Project manager, managerial style;" "Work on the project" (at least in part); "Expressed by parties" (at least in part). The share of these groups of the total observations is 48 percent in the basic material and 50 percent in the case material. Of the early warning examples found in the literature survey 66 percent belong to these groups.

A person is the source of a warning in ca. 62 percent of the observations (table C.2.8). Yet all instances where an early warning was detected have involved the actions of a person at least in the background: (e.g. documents are designed by people). Again, it must be remembered that no early warnings related to natural events are reported, as no questions were asked regarding them. This may to some extent distort the relative distribution of the observations but it is scarcely likely that it would significantly diminish the importance of people as sources of early warnings.

About 42 percent of the observations from the literature include problems and causes of problems that are related to people. These include: “Project manager (PM),” “Management,” “Organization,” “Personnel,” and at least in part “Differences in project culture.” It can be observed from the empirical material that observation elements referring to the above-mentioned problem groups form 36 percent of the total in the basic material and 28 percent of the total in the case material (see table 7.1.1). It can be noted that most of the problem causes are directly traceable to people; the actions of people are in the background of all of the cause groups. The results are affected by the exclusion of problems caused by nature, which is due to the fact that no questions probed this subject.

All of the above perspectives show how strongly the early warning phenomenon is related to people and their behavior; therefore, early warnings may aid in personnel management. Taking up this aspect, however, would move the discussion into the area of general management and behavioral sciences, which are not covered in this study.

7. The ability of Early Warnings to Explain Problems and Their Causes

7.1. The Project Problem Phenomena and Their Causes

The important issue for the utilization of the results is to find out to which project problems, and their possible causes, the early warnings are related. The cross tabulation of the problems and their causes with the descriptive attributes is excluded from this study. Project literature furnishes ample information about the interrelatedness of the various project phases, parties, problems and the causes of these problems. In the material used in the present research, the dependencies between these factors can only be researched through early warnings; the material does not contain direct observations of the dependencies.

The study [Nikander -98] examined the material from the different interviews separately; in the current study, the results are presented either in parallel fashion or in a directly combined form. The combining is done by crosstabulating the percentage forms.

This chapter first discusses the problem phenomena and crosstabulates them with the early warning groups. Second, the problem causes analyzed from the material partly through inference are examined; these are crosstabulated with the problems. Finally, the chapter explores the kinds of "warning-problem-cause" chains that can be constructed on the basis of the research. These chains are augmented with the responses found in the material.

The analysis of project problems is conducted both on the level of main groups and on the level of subgroups. The analysis of the basic material reveals a couple of problem main groups that were not detected during the literature survey. As for the problem phenomena, some groups of problems are lacking from the case material. These differences may be caused by the different posing of questions in the materials.

Note

The results of the analysis of project problems are greatly affected by the posing of the interview questions, as a significant portion of the questions was directly concerned with project problems. For this reason, the results should not be used to determine how common various project problems are in projects; this is not one of the objectives of this study.

Warning and/or Problem Situation

Situations are detected in the case material which can be considered problems for the observer at the moment of detection, but which at the same time can be early warnings of some other potential problems. In some cases, the detected situation it self may be a cause of future problems, especially if nothing is done to correct the situation. Analysis revealed 177 elements admitting several interpretations were found (they composed 40 percent of the material). Of these, it is possible to distinguish 74 different situations which indicates an immediate problem and the observation of situation is simultaneously an early warning of another, future problem.

The fact that the phenomena and situations may have several interpretations is pertinent. Such a situation may at once be a problem, an observation of situation as

an early warning, and even a possible cause of a future problem. This is consistent with the chain formation found in the literature (see section 4.7 and 4.8).

7.1.1 Problem Phenomena

The analysis of the problem phenomena occurring in a project is based on the literature survey of problem phenomena and their causes conducted in the theoretical part of the study (section 4.6). However, this survey has not been allowed to limit the analysis; rather, when other problem phenomena and/or causes have been found in the material, they have been taken into account. The elements are analyzed for project problems element by element, not by the groups of early warnings.

In addition to the content of the early warning element, the context of the question answered by the interviewee influences the analysis of problem phenomena. In several of the questions/answers, the context of the question shows the problem with which the interviewee connects his answer. It became apparent that the problem phenomenon could not be analyzed without taking into account the context of each question. The question that the interview answer relates to describes the circumstances and environment of the situation; according to communication theories the warning (observation) should not be removed from these [Åberg -93] and [Wiio -89].

Groups of Problem Phenomena

The study [Nikander-98] analyzed 26 separate groups of project problems from the material (table 7.1.2, appendix D). The values listed in the column "Several problems" are the ones employed in further analysis. These groups are gathered into the 16 main problem groups presented in table 7.1.1.

Table 7.1.1
The Main Groups of Project Problems

Project problems, main groups	Litera ture %	Honko %	Basic material %	Case-material %
Schedule problem, delay, time	**11,8 %**	5,1 %	**19,0 %**	**9,5 %**
Cost-related problem	5,9 %	7,4 %	5,3 %	5,0 %
Delivery problem, performance	10,8 %	6,2 %	**8,8 %**	**24,8 %**
Project environment, consultant	4,9 %	7,0 %	1,7 %	2,9 %
Ambiguous objectives	10,8 %		1,9 %	
Owner with no CEO support	6,9 %		0,8 %	
Management problems, combined	**12,7 %**		**18,8 %**	**22,2 %**
Project manager as a person	6,9 %		3,5 %	3,3 %
Organization / Staff	**14,7 %**	5,8 %	2,1 %	0,6 %
Personnel problems in general	**21,6 %**		7,1 %	2,1 %
Project planning in general	8,8 %	**64,2 %**	5,7 %	
Monitoring and project control	4,9 %	1,6 %		
Communication	4,9 %		5,0 %	0,8 %
Engineering	2,9 %		**7,4 %**	**27,9 %**
Financial aspects			6,1 %	0,6 %
Differences in project cultures			4,3 %	0,2%.
Other problems		2,7 %		
Not defined			2,8 %	0,2 %
Total	102	257	720	517

Literature sources: [Kerzbom et al. -89], [Kerzner -95], [Obradovitch -90], [Lewis -93], [Lientz et al -95], [Harrison -93], [Cleland -94], [Broaddus -91], [Smith -83], [Jaselskis -88], [Honko et al. -82], (see section 4.6).

The table shows the groups of problem phenomena and the distribution of elements by main groups. In addition, the table includes the problem groups analyzed from the literature (see section 4.6), the groups used by Honko et al. [-82] (see section 4.6) and the research material. The literature survey produced 102 elements, 257 elements were found in Honko's material, 720 in the basic interview material, and 517 in the case interview material. The distributions of the observations in different materials vary greatly due to the different method of examination. In the basic material, the largest groups of observations are "schedule problems, delays, time", and "management problems." The second largest groups are "delivery problems, performance," and "engineering, technical problems". These four groups comprise about 54 percent of the observations. In the case material, the problems are concentrated in "delivery problems," "engineering, technical problems," "management problems", and "schedule problems", (total about 84 %). This is due mainly to the early warning analysis of project problems, which defined the questions. However, the distribution also depicts the attention that the interviewees have paid to various matters in their projects, since in the early warning analysis the diversity of project problem is much greater. The large size of Honko's group "project planning" is due to the fact that he has especially researched this aspect.

The Description of the Main Groups [Nikander-98]

The most commonly used indicators of project success or failure are 1) schedule and time problems, (i.e. how well the planned schedule of the project is followed); 2) cost problems, or whether the cost estimate of the project is exceeded, and 3) performance problems, (i.e., whether the planned functional, profit, and quality objectives of the project are met).

The following descriptions of the content of the main groups rely heavily on the literature survey:

1) The "project environment" group includes the problems caused by circumstances external to the project, the effect of the public sector on the project, project parties other than the client, such as the consultant, the supplier, the constructor and other interest groups.

2) The group "ambiguous objectives" includes those problems that form when the set objectives aren't equally clear for all the participants. These encompass situations where the scope of the project is ambiguous or is altered, or the emphasis of the implementation varies.

3) The most crucial party for the project's success is the owner of the project, or, as seen from the perspective of the other project parties, the client. Because of this, a separate group is assigned for all problems concerning the client.

4) "Management problems, combined": the group contains those problems that occur in both management and leadership.

5) "The project manager as a person": the group is comprised of the problems relating to choosing a project manager, the manager's competence or lack thereof, the manager's personal qualities etc. (Compared with table 4.4, the project manager, the management group, and the management—as an activity—are assigned separate groups).

6) "The organization/staff" group includes the problems in choosing personnel, problems caused by the organizational structure, as well as problems that are due to lack of resources or professional competence.

7) The group of "personnel problems in general" covers the problems in motivating the personnel, problems caused by unproductive attitudes of the

personnel, problems relating to the turnover rate of personnel, and problems that occur in teamwork.

8) The group “project planning in general” contains such problems as the inability to form a project plan, the planning of the project by an outsider, the plan is designed incorrectly or perfunctorily, the schedule contains errors, the cost estimate is insufficient etc.

9) “Monitoring and project control” is a problem group that is present as a problem in the literature as well as in Honko’s study, but is rare in actual project work.

10) The group “communication” includes all problems in the transfer of information.

11) The group “engineering” covers the problems in the technical engineering of the project.

12) The group “financial aspects” includes the financial problems of the project or of the companies participating in the project.

13) The group “differences in project cultures” comprises the problems that are caused by the different organizational cultures of the parties as relates to the implementation of projects, or the problems caused by the limited project experience of one of the parties.

14) "Other problems" is a group into which have been gathered problems that are mentioned in Honko’s study but not present elsewhere.

15) The group “not defined” refers to the answers where the problem indicated by the early warning element found during research cannot be defined on the basis of the available material.

7.1.2 Time available

The “time available” concept, borrowed from Ansoff’s theory, is defined as follows: “The amount of time available before the problem indicated by the warning reaches full impact on the project.” The response time available value presented by Ansoff (figure 3.4) was applied to the time available. Figure 5.1 (in section 5.7) clarifies the nature of the concept. The duration of the time available should include, among others, the following sub-periods: the decision time, the planning and negotiation time, the mobilization time of implementation and the rest of time for the implementation of response. These are shown in figure 7.1.

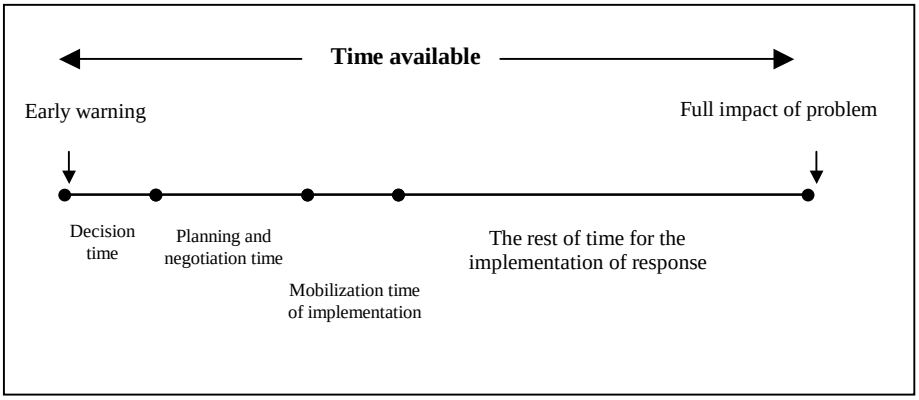


Figure 7.1 The sub-periods of time available

In examining the material it was noted that the time available is occasionally twofold. A) The time available can be evaluated according to how soon the problem indicated by the warning can be considered to affect the project, as expressed by Ansoff in his theory. B) Another aspect that can be considered an instance of the impact of the time available is whether the indicated matter requires immediate response, even though the time available itself could be regarded as temporally extensive (there is ample time). This is apparent mainly in the context of purchase negotiations [Nikander -98]. Errors and misjudgments made in these situations are very difficult to correct after the purchase contract has been made.

The time available could not be measured during the basic interviews; rather, the evaluation is done on the basis of the substance of the elements. The evaluation of the time available proved to be very difficult due to the limitations of the information provided by the basic interview material; a better evaluation would require more information about the background and about the circumstances in which the warning was detected.

The case material enabled a more specific analysis of the length of time available. The project history of the case projects is known, which made it possible to analyze the process of decision-making after the project was concluded. Similarly, the time that elapsed before responses were adopted for various problems is known, and it shows how much time was perceived to be available. (It should be noted that the decision-makers were not familiar with Ansoff's theory and the concept of time available).

Appendix E contains a summary of the problem situations that occurred in the case projects; more specifically, it discusses the nature of the impact of various types of problems on the project, the time available for responses, and the promptness with which responses were adopted. At least the following factors affect the assessment of the time available: how soon the problem begins to have full impact on the project, how much time is required for the planning of responses and for negotiations concerning those responses, and how much time is necessary for the responses to achieve their desired effect. The time available is also affected by the project situation (internal trends), the circumstances of the project environment (external trends) and the beliefs and assumptions of the interpreter.

The variation of time available was significant between projects and between different types of problems. When responses were adopted promptly after the first early warnings of the problem were detected, the time available can be considered to have been very limited. On the other hand, when the problem was a long-term, chronic one or the impact was felt throughout the project, the time available factor is very difficult to assess; in such cases the factor may also have varied. Responses may have been attempted several times, but when they have been ineffective the situation as persisted. In addition, there have been situations where no responses could be adopted or where strong measures have been seen as inappropriate.

7.1.3 The Causes of Problems

During the basic interviews, it was not possible to verify the exact perceptions that the interviewees had of the causes of problems. The results presented regarding the causes of those problems that were found in the material are mainly inferences made by the researcher, based on the full statement of the interviewee, the interview question, and the experience of the researcher. In other words, they are not solely the perceptions of the interviewees about the causes of problems. Therefore the results should be approached with caution, which is why they are shown in parentheses in table 7.1.3.

This problem was partly avoided in the case material; finding the causes of the problems indicated by the case material was significantly easier and more exact than in the basic interviews. The circumstances and situations of the case projects were familiar to the researcher, and the interviewees participated in investigating the causes of the problems. In this examination as well, the problem itself and the problem situation have the greatest influence on determining the possible cause. Hence, the number of elements whose causes could not be fully clarified (i.e. that had several causes) was much smaller in the case material than in the basic material.

On the basis of the CHITEST, however, it was noted that there is no statistical reason to assume that the percent distributions of the material stem from different types of data. This may also be caused by an unconscious tendency of the researcher to make the materials conform to the same standard. The CHITEST seems to indicate that the material from the basic interviews is of sufficient quality for it to be used in the comparisons.

The assessments revealed little information about linking an early warning directly to the cause of a problem. Despite the greater potential of the case material, a substantial level of uncertainty exists even in those analyses. To avoid erroneous conclusions, the causes must be crosstabulated only with the problem phenomena, not with e.g. early warnings.

The Distribution of the Causes

The causes of project failure found in the literature survey are shown in table 4.2, appendix A. The causes of problems found in the research material and in the literature survey, as well as those used by Honko et.al [-82], are shown in table 7.1.3.

Analysis yielded 373 observations in the literature survey (see section 4.7), 126 in Honko et.al [-82], 596 in the basic material, and 480 in the case material. As with the problems, the percent distributions of the causes are very different due to the different methods of examination. The analysis did not attempt to discern any subgroups. The largest group in the basic material is “several reasons" (30 percent of the cases), while the next largest groups of causes consist of “skills and abilities of persons involved” and “differences in project culture.” These three groups comprise about 58 percent of the cases. In the case material, the largest groups of problem causes are “differences in project culture” (37 percent), “managerial style” and “lack of resources.” These account for about 61 percent of the causes of problems.

The main groups used by Honko are “idea error,” “(project) planning error” and “implementation error.” The distribution of his observations among the respective groups is roughly one third (1/3). The idea errors of a project consist of the strategies and the search and development of investment ideas; the planning errors include defining, assessing and comparing investment options, and planning the funding; the implementation errors include the investment decision and the monitoring of investments. The tables show the similarities between the causes of failure and the causes of problems [Honko et.al -82].

Descriptions of the Causes of Problems [Nikander-98]

The causes of problems in the research material have descriptions very similar to those of the problem groups discussed in section 7.1.1.

The contents of the group "Project environment" match the contents of the problem group with the same name.

Table 7.1.3
Causes of Project Problems

Causes of problems	Litera ture	Honko	Basic material	Case-material
Project environment	7,2 %			
Ambiguous objective, mistakes in ideas	10,5 %	**27,8 %**		
Attitude-related			(5,4%)	8,1 %
Owner	8,0 %			
Management methodology	8,6 %		(9,4%)	**15,2 %**
Project manager as a person	7,5 %	12,7 %	(4,2%)	5,4 %
Differences in project cultures			(13,4%)	**36,7 %**
Organizational causes	6,4 %	2,4 %	(8,2%)	6,5 %
Personnel skill and talent	**18,8 %**	4,0 %	**(14,1%)**	4,4 %
Project planning	**20,6 %**	**34,9 %**		
Adjustment responses		6,3 %		
Monitoring and project control	5,4 %			
Communication	4,0 %			
Engineering	4,3 %	9,5 %		
Lack of resources			(8,7%)	9,6 %
Financial causes			(5,7%)	9,4 %
Several reasons, more than 3			**(29,9%)**	4,6 %
Other causes		2,4 %		
Cause not definable			(1%)	0,2 %
Total	373	126	596	480

The literature sources the same as for table 7.1.1 , (see table 4.4, section 4.7).

The contents of the group "Ambiguous objective, mistakes in ideas" match the contents of the problem group with the same name as well as cases of mistakes in ideas presented by Honko.

“Attitude-related” — the causes of problems in this group are comparable to those included in the problem group “personnel problems in general” — the group is a part of the problem. The attitudes include the motivation of the personnel, an unproductive or reluctant attitude, etc.

The contents of the group "Owner" match the contents of the problem group with the same name.

“Managerial methodology” — this group depicts a situation where the problems are caused by bad management and/or leadership activities, i.e., this group is analogous to the “management problems” problem group.

The cause group “The project manager as a person” contains the same items as the problem group “The project manager as a person” i.e., the manager’s professional competence, his managerial style etc.

The contents of the group "Differences in project culture" match the contents of the problem group with the same name.

The cause group “Organizational causes” refers to a situation where the cause of problems is a defective or otherwise inappropriate organizational structure.

The cause group “Personnel skill and talent” covers all deficiencies in professional skills and competence etc.

"Project planning" match the contents of the problem group with the same name.

With “adjustment responses” Honko refers to such changes made in the original plan by the project management that cause problems.The contents of the group "Monitoring and project control" match the contents of the problem group with the same name.

The contents of the group "Communication" match the contents of the problem group with the same name.

The contents of the group "Engineering" match the contents of the problem group with the same name.

The cause group “Lack of resources as a cause” contains the project problems caused by the lack of appropriate resources.

The contents of the group “Financial causes” match the contents of the problem group with the same name.

The cause group “Several causes, more than three causes” was formed because the analysis revealed a substantial number of observations that could be inferred to have more than three causes, as well as observations where the real cause of the problem could not be known on the basis of the available information. The group isn’t completely identical with the group “Cause not definable” or Honko`s "Other causes".

"Other causes" matches the group "Other problems" in Honko’s study.

7.2 Dependencies of Early Warnings — Problems — Causes

7.2.0 General

This section focuses on those results that are the most significant for the utilization of the research. Examples include: What kinds of early warnings refer to which project problems and vice versa? What kinds of early warnings can we expect (look for) when different kinds of problem situations are imminent in the project? Another cross tabulation is the tabulation of the dependencies between problems and their causes. The study [Nikander -98] discussed first both research materials separately (tables 7.2.3-7.2.4 in the appendix D), after which the compatibility of the materials was verified, and finally the results of the materials were combined. In this study employs the combined results. In addition, the case material is discussed in greater detail.

The cross tabulation of early warnings/project problems (table 7.2.1, on a separate page) can be read using either the early warnings or the project problems as a starting point. When the starting point is the early warning, the table shows which problem group the detected early warning belongs to, when it has first been classified into a warning main group. When the starting point is the problem, the table shows what kinds of early warnings should possibly be looked for when trying to procure additional information about whether to expect a problem. In the latter case, the phenomenon is closely connected with risk management. The crosstabulated examination of project problems and their causes (table 7.2.2) is very similar to the cross analysis described above. This part of analysis is here mainly to complement the picture of the early warning-problem-cause chain formation phenomenon. In the study, the causes of problems are crosstabulated only with project problems in order to understand the chain phenomenon.

7.2.1 Links between Early Warnings / Problems

Note

When examining the individual combinations in the table 7.2.1 and 7.2.2, it should be kept in mind that the number of observations (percent) represents the

number of early warnings the interviewees, in their opinion, have detected in the situations explored by the research questions, as interpreted by the researcher. They do not necessarily represent the actual occurrence of various situations in projects.

When looking for areas of emphasis, it should be remembered that the research has been conducted according to the principles of qualitative research, and even single observations are therefore considered significant.

Table

In the table 7.2.1, the material is grouped according to the number of squares that contain observations. Therefore, the first of the early warning groups in table 7.2.1 is the group “Expressed by personnel,” the second “Expressed by the project parties,” the third “Documents” and so on. Four of the problem groups have the same number of observations; hence, they may be considered of equal weight. These groups are “Schedule problems,” “Delivery problems,” “Engineering problems,” and “Management problems.” The fifth most common group is “Cost problems.” Values of over 2 percent are marked in bold text to facilitate the reading of the table.

Most Common Combimations

It would seem that the five most common early warning / project problem combinations are: 1) “Expressed by personnel / Management problems” (6.6 % of the observations); 2) “Expressed by personnel / Engineering problems” (4.16 %); 3) “Work on the project / Engineering problems” (3.52 %); 4) “Project planning / Delivery problems” (3.21 %); 5) “Expressed by personnel / Delivery problems” (3.2 %). These cover about 20 percent of the observations. The table contains a total of 1198 observations.

In the table, the figure below the percentage figure shows the number of interviewees that have pointed to the early warning that is a part of the combination in question. For example, the combination “Expressed by personnel - Schedule problems” has been reported by 16 interviewees.

20/80 Rules

Several areas of emphasis can be formed on the basis of the table: a) When adding together all of the combinations of over 1 percent, of which there are 33 (the total number of combinations is 208), it can be noted that their share of all possible combinations is 16 percent and they comprise 69 percent of the observations. This does not stray far from the 20/80 rule. b) A second area of emphasis is formed by the upper left corner of the table (the shaded area). The early warning groups in "box" are: “Expressed by personnel,” “Expressed by the project parties,” “Documents,” “Work on the project”, "Project planning”, "Communication", " Differences and deficiencies in project cultures", and " Project control and reporting". The problem groups in this "box" are “Schedule problems,” “Delivery problems,” “Management problems,” “Engineering problems,” “Cost problems,” and “Personnel problems.” This box contains 71 percent of the observations.

7.2.2 Links between Problems / Causes (Table 7.2.2)

As noted earlier, the assessment of the causes of the problems that emerge from the basic interview material is largely based on the interpretations made by the researcher, instead of on information received from the interviewees. In the case interviews, more exact information about the causes of problems was available, because the event history of the case projects was known. However, the CHITEST showed that there is no statistical basis for assuming that the percent distributions of the materials stem from different types of informative material. Therefore, even the assessments of problem causes from the basic material can apparently be considered fairly representative.

Table 7.2.1

The Materials Combined, Main Groups of Early Warnings / Project Problems

Project Problem Main Group									Project	Project				Project	Upper	
	Schedule	Delivery	Engineering	Manag.	Cost	Personnel	Project	Goal	manager	environ.	Organi-	Econ.	Comm.	plan.	manag.	Un-
Warning main group	problem	problem	problem	problem	problem	problem	culture	unclear	as pers.	consultant	zation			tot.	support	def.
Expressed by personnel	**2,39 % 16**	**3,20 % 19**	**4,16 % 24**	**6,60 % 28**	0,52 % 5	**2,57 % 17**	0,65 %	0,29 %	1,64 %	1,04 %	0,58 %	1,49 %	0,43 %	0,07 %	0,07 %	0,29 %
Expressed by the project parties	1,90 % 16	1,78 % 13	**2,52 % 20**	**2,86 % 18**	0,38 %	0,22 %	0,14 %	0,07 %	0,14 %		0,10 %	0,65 %		1,15 %	0,22 %	0,07 %
Documents	**2,67 % 20**	**2,15 % 15**	1,07 %	1,37 %	0,87 % 8	0,30 %		0,07 %	0,07 %	0,29 %	0,14 %		0,51 %	1,66 %		
Work on the project	**2,37 % 19**	0,94 %	**3,52 % 23**	1,51 %	0,27 %	0,70 %	0,10 %	0,14 %		0,18 %	0,10 %	0,14 %	0,60 %			
Project planning	0,97 %	**3,21 % 17**	1,60 %	0,79 %	1,73 % 10	0,10 %	0,14 %	0,14 %		0,34 %		0,18 %				0,07 %
Communication	0,46 %	1,18 %	0,60 %	**2,31 % 14**		0,27 %	0,22 %		0,07 %		0,14 %	0,43 %	1,30 %			0,07 %
Differences and deficiencies in project cultures	0,18 %	1,23 %	1,34 %	**2,73 % 20**	0,18 %		0,93 %		0,07 %	0,20 %	0,10 %				0,07 %	
Project control and reporting	**2,86 % 19**	1,41 %	0,84 %	0,56 %	0,65 %	0,36 %	0,07 %		0,07 %	0,14 %						
Gut feeling	0,49 %		0,61 %	0,86 %	0,14 %	0,14 %		0,07 %	0,18 %	0,07 %	0,14 %	0,07 %	0,14 %			0,58 %
Project manager, management	0,10 %	0,80 %	1,07 %	0,94 %	0,30 %	0,10 %		0,07 %	1,25 %	0,10 %						
External source	0,10 %	0,39 %	0,18 %		0,22 %							0,43 %		0,07 %		0,07 %

Total observations: 1198

Note: An individual percentage figure indicates how many times the combination has occurred in the material. It does not necessarily represent the significance of the combination for solving project problems or for the success of the project.

The figure below the percentage figure shows the number of interviewees that have pointed to the early warning that is a part of the combination in question.

Table

The material in table 7.2.2 is grouped according to the same principles as in table 7.2.1. This means that the order of project problems is slightly different. “Schedule problems” form the first group, “Delivery problems “ the second, and “Management problems” the third. Of the groups of problem causes, the first is “Managerial style as a cause,” the second “Differences in project culture as a cause,” and the third “Several causes, the cause cannot be exactly defined.” To facilitate reading, percent values greater than 2 percent have been set in bold. The material contains a total of 1465 observations.

20/80 Rules

The areas of emphasis in this table are formed by the same problem groups as in table 7.2.1, while the areas of emphasis for the problem causes are “Management as a cause,” “Project culture as a cause,” “Several causes,” “Organization as a cause,” and “Attitudes as cause.” These problems and their causes all influence one another. The box in the upper left corner of this table contains ca. 58 percent of the observations. There are 32 combinations of over 1 percent (the total number of combinations is 160) and they cover 71 percent of the percentual observations in the materials. Again, this is very close to the 20/80 rule. In this table as well, it should be remembered that the research has been conducted according to the principles of qualitative research, and even single observations are therefore considered significant

7.2.3 The Significance of the Combinations

The significance that combinations of observations have on project work varies greatly, depending on both the project and on the owner’s assessment of his business priorities. Some owners emphasize matters related to the schedule, because they need the investment to be ready for the sales season. Others may place the greatest value on keeping the costs low. Another factor that influences the significance of a combination is the perceived severity of the detected problem; i.e., the project’s sensitivity to the effects of problems in the particular combination. In addition, the significance that is placed on the combination may also depend on the position of the person who calls attention to the combination, i.e., the respect that other project participants have for that person influences the significance accorded to the combination. The final assessment of the combination’s significance is always made by the decision-maker (see figure 8.1).

For the above reasons it is usually very difficult to estimate the significance of combinations for investment projects. In analyzing the material, the same relative weight has been given to a detected early warning, the problems connected with it, and the causes of these problems. The number of combinations that has been analyzed from the interviews can be considered to some extent representative of the significance of those combinations in project work, because the interviewees have presented their views regarding the early warnings of project problems independently and without prompting: they have not had contact with each other, and the researcher has not offered examples of possible early warnings. In addition, the numbers of interviewees in table 7.2.1 can be considered to point to the same conclusion: it can be inferred that these interviewees have considered that particular early warning significant in the context of the problem in question. Nevertheless, the reservations noted in the beginning of section 7.2.1 should be kept in mind: the percentages are indicative rather than final and single observations, in accordance with the principles of qualitative research, can be considered significant. The topic is interesting enough to call for further research.

Table 7.2.2

The Materials Combined, Project Problems / Perceived Causes of Problems

The Main Group of Project Problems	The cause of the problem: Management	Differences in project culture	Several causes	Organi-zation	Attitude	Lack of resources	Economic causes	Personnel skills	Manager personality	Not defined
Schedule problem, time	1.68 %	**3.25 %**	**4.75 %**	1.06 %	0.88 %	1.43 %	0.76 %	1.09 %	0.06 %	
Delivery problem, performance	1.88 %	**4.15 %**	**2.02 %**	0.96 %	0.93 %	1.63 %	1.72 %	**1.97 %**	0.92 %	
Cost problem	0.65 %	1.78 %	0.81 %	0.20 %	0.26 %		1.18 %	0.52 %	0.34 %	
General management problems	**3.23 %**	**4.61 %**	**3.25 %**	1.85 %	**2.20 %**	1.53 %	1.06 %	1.10 %	0.14 %	
Engineering	**2.76 %**	**6.59 %**	1.35 %	**2.35 %**	1.29 %	**2.67 %**	0.76 %	0.57 %	0.08 %	
Total personnel problems	0.43 %	0.45 %	0.98 %	0.06 %	0.97 %	1.34 %	0.06 %	0.14 %		
Project manager personality	0.25 %	0.20 %		0.06 %	0.08 %	0.25 %	0.08 %		**2.19 %**	
Communication	0.86 %	0.46 %	0.77 %	1.09 %	0.29 %	0.23 %		0.12 %		
Economical factors	0.17 %	0.29 %	0.92 %	0.06 %	0.06 %	0.12 %	1.52 %			
Project environment, consultant	0.20 %	0.84 %	0.06 %			0.17 %	0.42 %	0.85 %		
Total project planning	0.23 %	0.35 %	0.40 %	0.52 %		0.06 %		1.15 %		
Differences in project culture	0.12 %	1.29 %	0.23 %	0.12 %	0.06 %			0.06 %		
Personnel group / Organization	0.12 %	0.42 %	0.35 %	0.26 %		0.12 %				
Unclear goals	0.12 %	0.29 %	0.40 %		0.12 %		0.06 %			
Upper management support, client	0.06 %		0.23 %	0.06 %			0.06 %			
Undefined	0.12 %	0.17 %	1.00 %		0.06 %			0.06 %		0.08 %

Total observations: 1465

Note:

An individual percentage figure indicates how many times the combination has occurred in the material. It does not necessarily represent the significance of the combination for solving project problems or for the success of the project.

7.3 Responses and Observation Procedures

General

A number of the interviewees in the basic interviews mentioned specific responses that they had adopted or considered advisable once they had detected a warning. These were not directly asked about in the interview. In the context of the case projects, this response area was mapped in some more detail. The material includes numerous mentions that can be called observation procedures; i.e., ways of detecting early warnings. This section focuses on these observation element groups. Literature, as well, seems to be an excellent source of information about possible responses.

Responses

The term "responses" covers those procedures that the interviewees have adopted, in order to minimize the impact of a detected problem, or whose adoption they have recommended. Responses thus strive to minimize the negative consequences that a problem could have for the final result of the project. Responses are not necessarily directed at, or successful in, removing the problem or its cause; this isn't always possible for the project management, as the causes of problems may lie in the project history, and/or the factors causing the problem may be outside the control of the project management. The interview materials contained very few observations of responses, as they were not specifically asked about during the interviews. In the case projects, the information provided by the interview material on project problems, their causes, and the responses to them has been augmented by other observation material.

Responses are a very important part of the utilization of warnings, since the mere detection and analysis of warnings does not in itself constitute actual project management and leadership. On the one hand, the reports of responses reflect caution (inexact information is not trusted), while on the other hand they show a desire for rapid responses that throw light on the situation, such as "increased monitoring" and "gathering additional information."

The need for constant observation of warnings was also noted. One of the most difficult issues in the utilization of warnings is to convince those persons who have neither detected warnings nor trust them that there is a need for responses. This is effectively illustrated in the books of both Betts [-82] and Herman [-96] regarding state and military intelligence. This seems to bee the filtering phenomenon.

Table 7.3.1 combines responses found in the material with project problems. From the case project interviews and the project problem analysis it is apparent that a great portion of the situations are such that project management is incapable of influencing them (cf. the studies by Bufaied [-87] and Lim [-87].) The problems are outside the decision-making power of the project management. Such problems include the client's financial problems, the client's project management style, and the client's manner of forming contracts. In such situations, especially the project management of the consultant and suppliers can usually only advise the client and adjust to the situation.

The question of whether all the responses are "orthodox" isn't addressed in this context. All of the ways of problem and risk handling presented in the literature emerge in the detailed analysis of the material. These include : *-Withdrawal (Denial/Retreating); - Smoothing (Suppression); -Forcing (Power or Dominance); - Compromise (Negotiation); -Collaboration (Integration)* [Kezsbom et al. -89, pp. 227..230] and [Kerzner -95].

Table 7.3.1
Responses That Can Be Adopted on the Basis of Signals

Problem	Response recommendation
1. Project environment	Problem external to the project
	Stakeholder Management [Cleland]
2. Objectives / scope	Devising a project plan
Technical performance	Methods of problem analysis
Delivery problems	Pre-screening of suppliers
	Pressure when problems arise
	Delivery monitoring (inspection visits)
	Revising the schedules (adjustment)
	Hiring outside experts
	Devising unambiguous contracts
Cost overruns	Methods of problem analysis
	Adjusting the budget
	Tight budget control
Schedule problems	Methods of problem analysis
	Adjusting the schedules
	Augmenting resources
	Negotiations with the concerned parties
	Pressure when problems arise
3. Client	Often a problem external to the project
	Stakeholder Management [Cleland]
	Client Perspective [Kleim and Ludin]
	Careful approach
4.Project Manager	Often a problem external to the project
5.Management	Literature sources; chapters of leadership
Management / Leadership problems	Hiring an outside expert
	Changing the organization of work
	Shadow organization, informal channels
Differences in project culture	Negotiations with the concerned parties
	Adjusting to the situation
6. Project group / organization	Literature sources; team management
Lack of resources	Procuring additional resources
	Adjusting the schedules for the situation
7. Personnel / motivation	Literature sources; chapters of leadership
8. Project Planning	Literature sources; devising a project plan
	Devising own plans
	Not accepting incomplete plans
9. Monitoring/ Control	Literature sources; project control
10. Communication	Literature sources; communication
11. Technical issues	

[Kerzner -95], [Harrison -93], [Nikander-98], [Lewis -93], [Kezsbom et al. -89], [Lientz et al. -95], [Whitten -95], [Cleland -94] [Nikander -98]

Observation procedures

Observation procedures are responses that strive to procure additional information about the situation. Table 7.3.2 combines the observation procedures found in the material with different problem situations observed in the material.

Quite a variety of this is presented in the interviews, ranging from regular project management methods to some new, promising ideas not discussed in the literature. The practicality of the observation procedures was not tested in this research. Often the observation procedures and responses have been merged and have become different parts of the same operation. These include project schedule management and information gathering. Some responses were noted that can be carried out beforehand and that attempt to explore the potential project problems or risks. These include:

- Preliminary inquiries / prequalification, such as a closer inspection of the references and checking credit information
- First impressions; the interviewees often considered this important when meeting a new project party
- "Test questions" posed in the first meeting; these can give an understanding of the project experience and abilities of the other project party
- Systematic audition of the drawings; this was one of the observation procedures not often mentioned in the literature
- Observing the contractor and supplier at the construction site: their manner of arriving and initiating work, or their so-called mobilization
- Another method considered important was setting, in the contract or otherwise, binding intermediate goals in the schedule in the form of milestones.

No new observation procedures of detecting warnings emerged from the case projects.

Table 7.3.2
Observation procedures

Project Problems	**Observation procedure**
Scheduling problems	Checking schedules in advance
	Additional information obtain while monitoring
Cost-related problems	Additional information obtain while monitoring
Financial problems	Preliminary research
	Hard to get information
	Hard to get information
	Additional information in prequalification
Delivery problems	Visiting the supplier
	Additional information obtain while monitoring
	Monitoring site mobilization

[Nikander -98]

7.4 Multiple Attribute Examinations

7.4.1 General

A number of multiple attribute examinations were carried out in the study Nikander [-98]. Rough "warning main group - project problem - problem causes" dependency networks were designed on the basis of both the basic material and the complete material. These networks show how varied the different dependencies appear to be, even though the examination only includes those combinations between which at least two percent of the observations are apparent. The study Nikander [-98] also examines the basic material in more detail regarding these

dependencies. The study notes that the dependency networks designed may tend to generalize the picture of the phenomenon excessively too much.

In the present study, the examination of multiple attributes is conducted with the complete material. The examination is somewhat more extensive than the one in the study Nikander [-98]; here the material is used to devise early warning - problem - cause - response dependency networks on a rough main group level. This network should still be considered information describing the nature of the phenomenon, but information given by this description still appears too sketchy for practical utilization.

Note: As noted in section 7.2.3, the combinations selected for figure 7.2 represent combinations that were most commonly referred to in the interviews; they do not necessarily indicate what combinations are the most significant for project work.

Attempts are made to extend the picture by conducting multivariate examinations on the subgroup level as well. Apparently, due to the variety of the material, the form of practical utilization should be very specific; possibly it should even be on the level of an individual warning. In this case, the broad scope of the material will be a problem: it will be difficult to manage manually, and aid should apparently be sought in the possibilities of information technology, [Nikander -98].

The relative scarcity of the material limits the quantitative examination of multiple attributes, hampering e.g. the understanding of how the descriptive attributes, especially the project phases and parties, affect the early warning - problem - cause combinations. Qualitatively the material can be analyzed in a limited manner for several attributes simultaneously. Nevertheless, such examinations have not been undertaken. The material could also be examined to determine how the views of the interviewees vary in relation to warnings and other investigated items. However, such an approach would quickly move the study to the field of psychology, which has been bypassed here.

7.4.2 The Warning - Problem - Cause "Network"

The combined "dependency network" (figure 7.2) of the materials is designed in accordance with the combined tables. The danger of "misleading" information, noted earlier, should be taken into account. Interpreting dependencies between problems and their causes so that an early warning - problem combination would always most likely be connected to the problem cause that is most often detected in the material may even in this combined material prove to be illusionary. The possibility of an illusionary connection will probably decrease when more of the possibilities shown in table 7.2.2 are accepted as potential causes.

Figure 7.2. (separate page), the early warning main group - problem - cause - response "network", shows the "dependencies" between those warning main groups - project problems - problem causes and the responses related to the problems that were present in at least two percent of the observations in the material. The group "several reasons (more than three)" is left out of the figure, since it is the largest cause group for almost all of the problems. The selected level represents a division that is even rougher than the 20/80 rule that was observed in the material.

The percent distribution of the observations (elements) was used as a basis for selecting combinations to the "network," although the number of elements for project problems does not represent exact information of the frequency of the project problems (see section 7.2.1). On the left in the figure are the warnings (the plain box), which are followed by the causes of problems (the box marked in bold), and the the project problems (the box with rounded corners). On the right are the

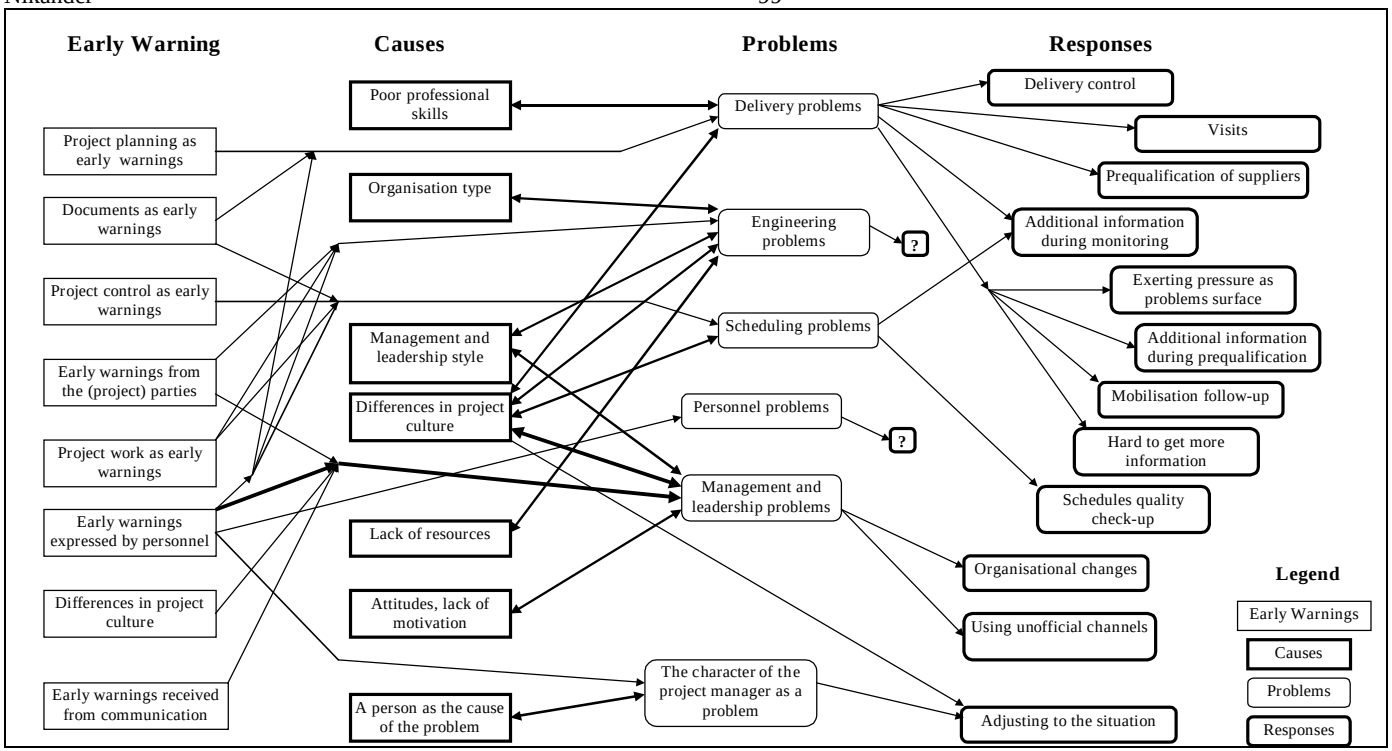


Figure 7.2 Warnings - Project Problems - Problem Causes - Responses Network; Combined Materials
A question mark indicates that the research material gives no information about the responses.

Note: As noted in section 7.2.3, the combinations selected for the figure represent combinations that were most commonly referred to in the interviews; they do not necessarily indicate what combinations are the most significant for project work.

responses (the box marked in bold with rounded corners) that, according to the observations, can be adopted to remove or decrease the impact of the problems and their causes.

The figure illustrates the variety of the early warning - problem - cause - response combinations. Even in this very limited form, the figure becomes somewhat difficult to read. The thickest arrows in the figure point out the "strongest" dependencies between the "warnings expressed by personnel" and "management problems" (6.38 %) as well as further dependencies "management problems" and their most common cause "differences in project culture" (4.61 %). The figure also shows that the warnings expressed by personnel often relate to several problems (six dependencies). In addition, the picture depicts the fact that the management and planning problems have numerous warnings. Similarly, differences in project culture are the cause of several problems. Several responses have been proposed to address delivery problems.

The research material includes no specific responses for "engineering problems" and "personnel problems." Because only responses found in the research material are included in the figure (i.e., it has not been supplemented with material from the research literature), it may give a one-sided view of the possible responses. For example, the schedule problems can certainly be reacted to in other ways than "additional information procured during monitoring" and "adjusting the schedule." Similarly, management problems have other responses than those presented in the figure. The selection of the dependencies has resulted in a very simplified picture that does not take into account all of the early warning groups or all the problems and their causes. As noted earlier, the figure significantly generalizes the results.

7.4.3 Multiple Attribute Examination on the Subgroup Level

A more detailed examination of the warning subgroups gives a slightly different view of the situation. This is apparent out in the figures 7.3 through 7.8 for different project problems. In the figures, the early warnings by main group and subgroup are on the left; represented by a tall parallelogram in the middle is the project problem that the figure is concerned with; on the right are the cause of project problems. The arrows depict the relation between the warning subgroups and the project problem causes as regards the project problem under consideration. The examination is qualitative, and therefore does not show the number of observations for every detail. The percental portions of the warning main groups, presented in table 7.4.1, are shown in a box beside the main group.

Figure 7.3 (separate page) illustrates the dependencies between the early warning groups and the problem causes as they relate to schedule problems. It should be remembered that the warnings should not be connected directly to the causes of project problems, but should always be presented in the context of the problem. The figure shows how the warnings expressed by personnel appear to be related to multifarious problem causes. The dependencies seem to be quite varied in other respects as well.

Figure 7.4 (separate page) examines the management problems. It demonstrates that a portion of the warnings expressed by personnel appear to be related to defined causes. "Attitudes" and "commitment to the project" as warnings are apparently related to the cause group "attitudes." When the lack of resources is a warning, the cause appears to also be the lack of resources.

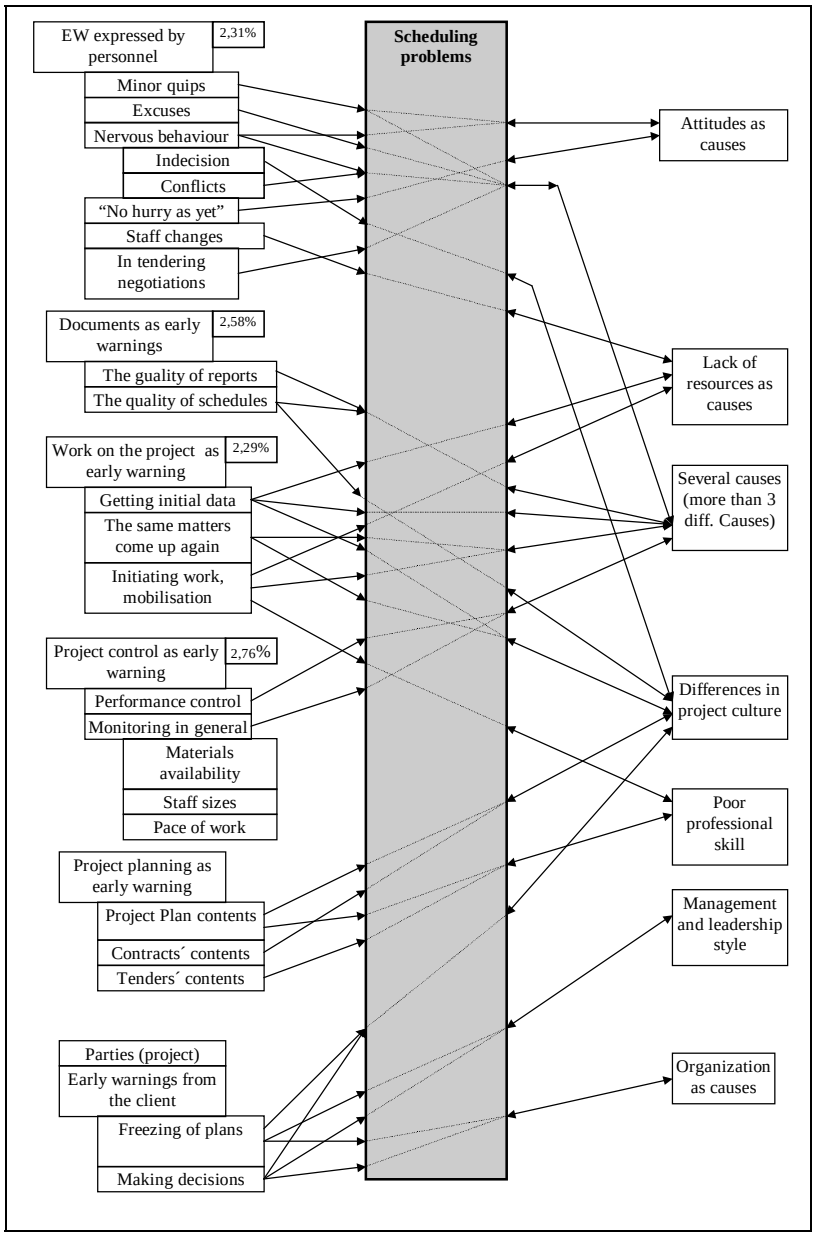


Figure 7.3 Warnings of Schedule Problems and Causes Related to Those Problems On the basis of observations

Other problem groups examined in this fashion are delivery problems, cost problems, engineering problems and personnel problems (see figures 7.5. through 7.8 in the appendix D). All of the problems appear to exhibit great variety as regards the causes of problems. Tables 7.2.3 and 7.2.4 depict in greater detail the relations between the early warning groups and project problem groups as percentages in both materials.

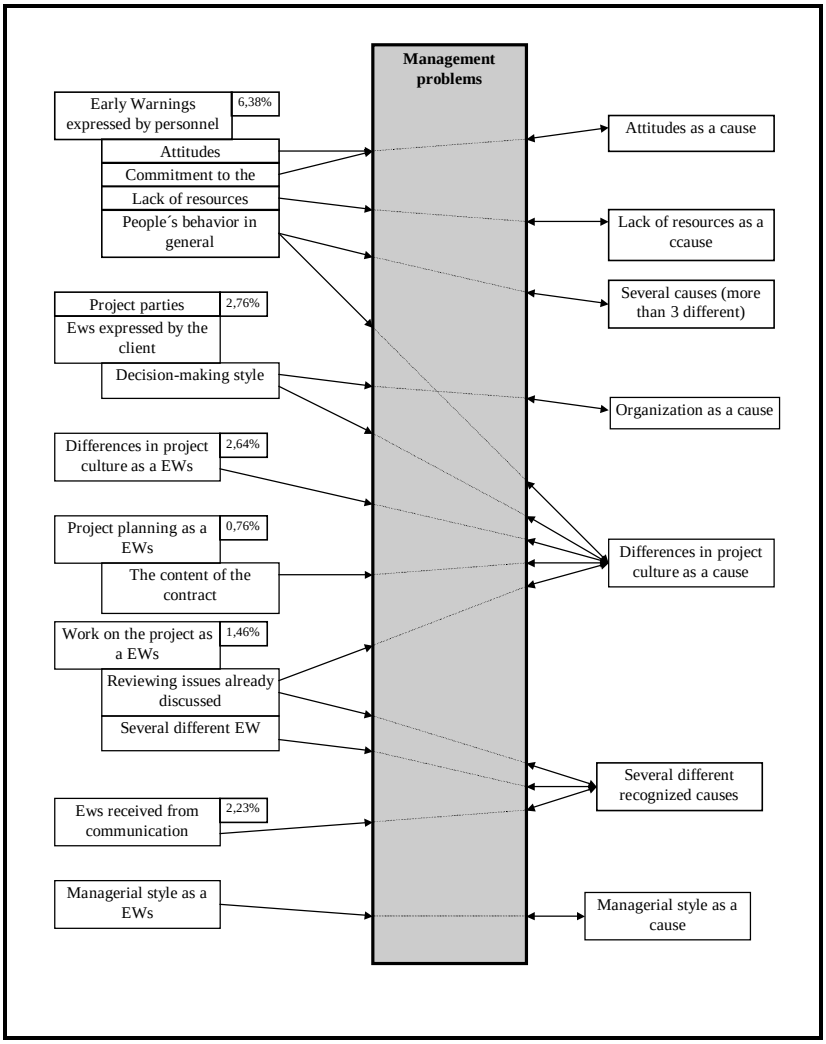


Figure 7.4 Warnings of Management Problems and Causes Related to Them
On the basis of observations

7.4.4 The Analysis of the Problem Situations in the Case Projects

The study Nikander [-98] analyzes problem situations in the case projects for each project and problem; the detailed results can be found in Nikander [-98]. In the results, similar problem situations have been grouped together, and the case projects have not been named because of anonymity requirements. Appendix E contains summary of problem situations. It can be noted that even in such a small sample, almost all types of problems have occurred.

The following types of projects occurred in the case projects: a) schedule problems in all of the projects, b) some form of delivery problems in all of the projects, c) one serious cost problem, and d) the client's insufficient experience of the particular project type in three projects. Additionally, in two of the projects it was noted already when launching the project that there will be significant project culture differences and disagreements between the project parties.

The most serious management problem was the project management managerial style of one of the owners. Moderately serious engineering problems can be said to have occurred in three cases. One project was plagued by problems that can be classified as organizational problems. Another project suffered from severe disagreements between personnel. Resource problems were evident in one project on several levels of engineering and management, while in two projects serious usage problems occurred during start-up. The problem charts in the next section give additional descriptions of the problem situations.

7.4.5 Problem Chains (Problem Networks)

Early warning - problem - cause - response networks could be formed for specific projects on the basis of the material from the case projects. The chain where the early warnings were most clearly detectable is presented in figure 7.9. Figures 7.10 and 7.11 show the networks for two other projects. In one of the projects no extensive chains could be detected as the project management effectively addressed each problem in its early stages. All of the networks demonstrate the varied ways in which the warnings, problems and causes are interconnected. In every figure on the left there are the warnings, in the middle are the project problems, and on right are the causes of problems. In figure 7.9 the causes of problem are above the first problem.

In the figure 7.9, a clear multistage problem chain formed. The lack of resources, though noted early in the project, was not addressed, and it caused other problems, which in turn had an impact on the entire project. No forceful responses were adopted in that project to stop the chain of problems from forming, and the problems continued to multiply and form chains all through the project.

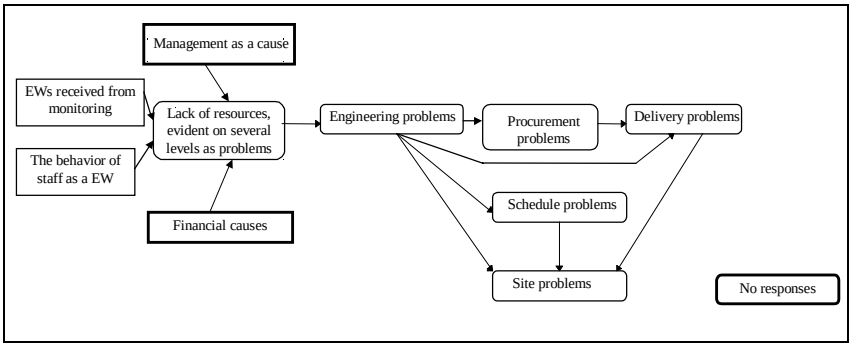


Figure 7.9 The Problem Chains of One of the Projects

Legend in figure 7.8 and 7.10

The project shown in figure 7.10 (separate page) contained numerous problems, but these problems were usually dealt with rapidly by either the project management or other experienced project personnel, and therefore no long chains of problems formed. The figure also illustrates the fact that a more or less effective response has been found for each problem. As can be seen in the figure, the same phenomenon, or an observation of it, can function as an early warning, a cause of a problem, a problem or even a response (the creation of a shadow organization, the decision making style of the client, lack of initial information, difference in corporate culture).

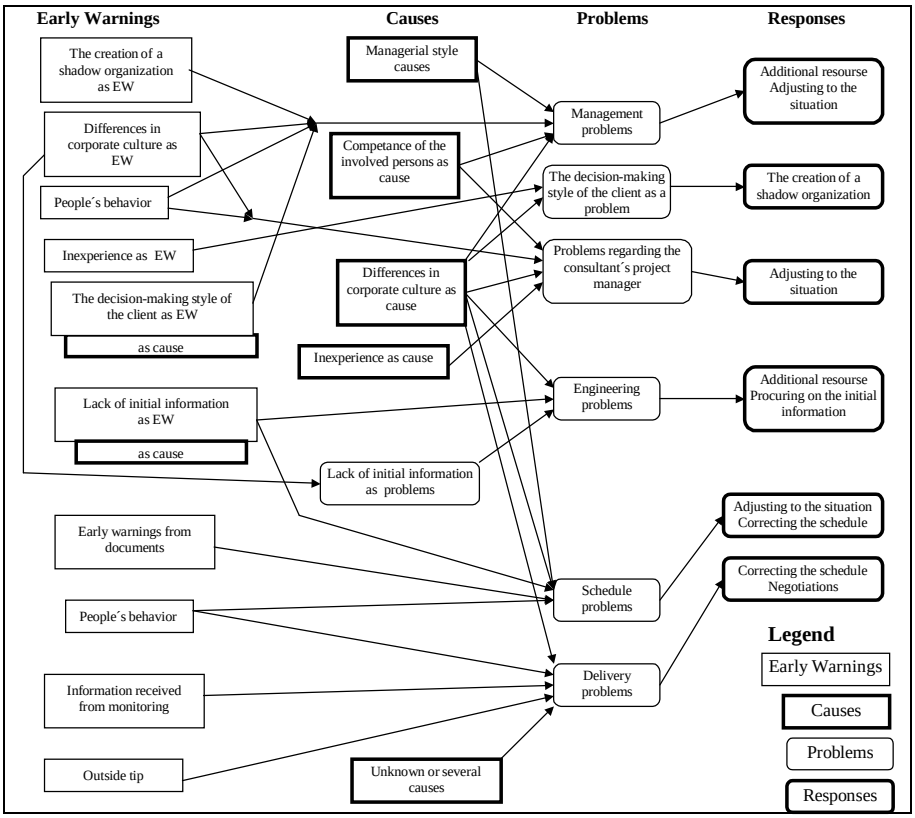


Figure 7.10 The Early Warning - Problem - Cause - Response Network for One Project

In the figure 7.11 (separate page), the basic cause of all of the project's problems appears on the basis of the interviews to have been the personality of the client's project manager. The manager could not admit to a lack of experience and had a highly authoritative managerial style. The final response was changing the schedule of the project. For the same reason, other problems occurred in the project, but these have not been added to the figure.

Conclusions from the Problem Charts

The problem charts demonstrate how different the case projects were and how widely the problems and the problem causes varied. Drawing a chart of the most successful project would not serve any purpose as even small problems were promptly eliminated. The most difficult project (figure 7.11) nearly became chaotic [Kiiras -2000] and came quite close to total failure. The complete history of all these projects entails situations very similar to those presented by Kiiras on project chaos. The case projects were not identically managed, nor was it likely that they could have been. On the basis of these four projects, there appears to exist a causal relationship between project management and the variety of the problems evident in the project. This phenomenon is similar to that presented by Bufaied [-87] in his

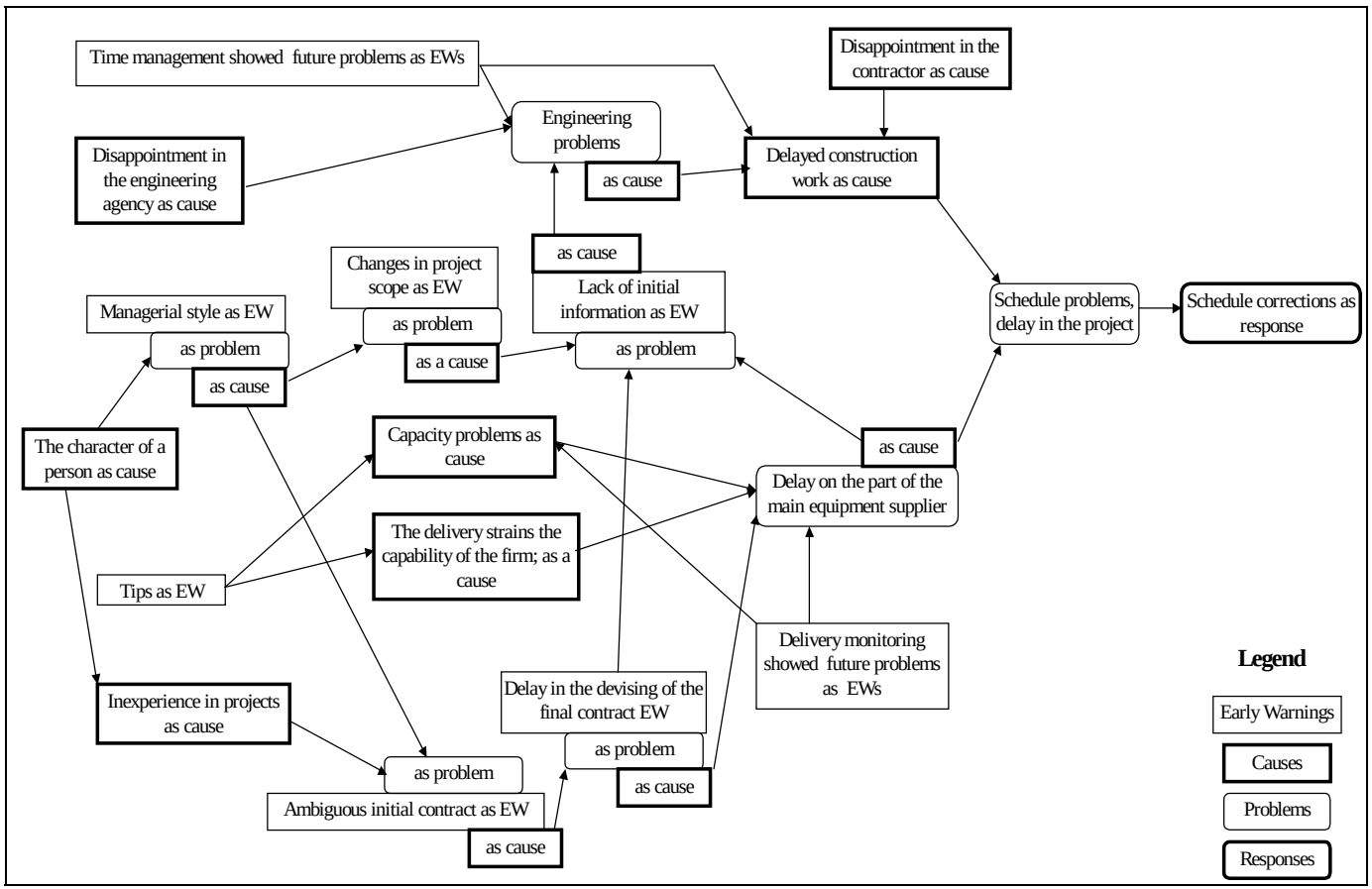


Figure 7.11 The Network of Project Problems, Early Warnings, and Problem Causes in One Project

study in the field of risk management. He shows that project management is the ultimate cause of all of project risks.
In the case projects researched in this study, management is present in the problem charts, though it is not necessarily the root cause of all problems. However, the event history of every case project shows that the project manager either influenced or could have influenced decisively the development of problems. His actions and behavior appear to be crucial.

7.5 The Relation of Early Warnings to Risk Management

7.5.0 General

On the basis of project literature, sections 4.8; 4.10.2 and 5.6 examine concisely the relation between the early warnings phenomenon and risk management. Risk management is discussed in section 2.5. Section 2.5.5 presents a study by Bufaid [-87] on risk chain formation (see Figure 2.5) and the Risk Mechanism Model by Niwa [-89] (see Figure 2.6). Figure 4.2 shows a concept developed in the present study: The Chain of Problem Causes, Problems, Early Warnings and Responses. Other factors that affect the analysis conducted here include: the definition of early warnings (section 4.2), the fact that it has been shown possible to detect early warnings in projects (section 6.7 and table 6.7.1), the fact that early warnings appear to be related to problems (section 7.2 and figure 7.2) and the concept of "time available" (section 7.1.2). In addition, section 7.4.5 discusses the problem chains and problem networks that were evident in the case projects.

Early warnings should, by virtue of their definition, inform their interpreter of future or incipient problems that may occur in the project. In section 2.5, it is noted that the concepts "problem" and "risk" can apparently be considered to be related to each other. The difference between them is mostly composed by the uncertainty of the materialization of risks, and by the association of risks with the future.

The case project material does not contain direct observations of risks and risk management, because a systematic, broad risk analysis was not carried out in any of the case projects prior to initiating the project. In one project the major risks of the projects were recognized and a fair amount of work was dedicated to anticipating them (section 6.4). The information collected in the present study of the dependencies between early warnings and risks is based on the relationships between early warnings and problems derived from the interview material and on the observed time available concept.

7.5.1 Dependencies of Early Warnings - Problems - Risk

Table 7.2.1 in section 7.2 shows in how varied ways early warnings and problems are connected to each other. The table presents the information both from the perspective of early warnings and from that of problems. The concept of "time available" (see figures 5.1 and 7.1) shows that at the moment of the detection of an early waning, problems are potential future problems. They could therefore be seen as risks. However, the study showed that early warnings do not give information about the likelihood of the problem (risk) to come true.

The early warnings detected in the study are rarely by themselves sources of information of a future problem. However, it is easier to see which problem may be concerned when other, previously acquired, information of the circumstances under which the early warning was detected is added to the analysis. This information can consist of e.g. the project circumstances at the time, indications about which project party the early warning is connected to, and the like.

Early warnings do not seem to impart a very clear picture of when the problem might become current (available time, figure 5.1). It appears the most that can be said solely on the basis of an early warning is that there is ample time or very little time, but no more exact evaluations are possible. Other information of the type mentioned above might clarify the issue; this could not, however, be studied as the available time factor could not be measured during the research.

Hence, the information provided by this study on the relationships between early warnings and problems can apparently be utilized in the risk qualification phase of risk management (see section 2.5). To improve one's understanding of projects, the information in table 7.2.1 can be employed in order to examine whether there might have existed an early warning of a problem that has already become current. This resembles the "hindsight bias" which Ashley [-89a] uses to criticize the entire Ansoff's theory.

Observation procedures, discussed in section 7.3, are responses that strive to procure additional information about the situation. The observation procedures are a separate group of responses, which can be utilized in reacting to the impending problem. They can be considered methods of risk assessment (risk identification) in risk management (see section 2.5). The practicality of the observation procedures was not tested in this research.

7.5.2 Problem (Risk) Mechanism of Project

Figure 7.9 can be developed into a presentation that conforms to Niwa's [-89] risk mechanism model (figure 7.12). The figure has been constructed on the basis of figure 4.3, and it shows the "causes of problems" (what Niwa calls risk factors) uppermost, the problems in progressive chains and the final result, the delay of the project. Early warnings have also been added to this figure; all of the case project problems were, according to the final report on the project, detectable as potential problems before they became current. At that time, in other words, they were only risks. The figure clearly illustrates how Niwa's risk mechanism model illuminates the nature of the problems encountered in this project.

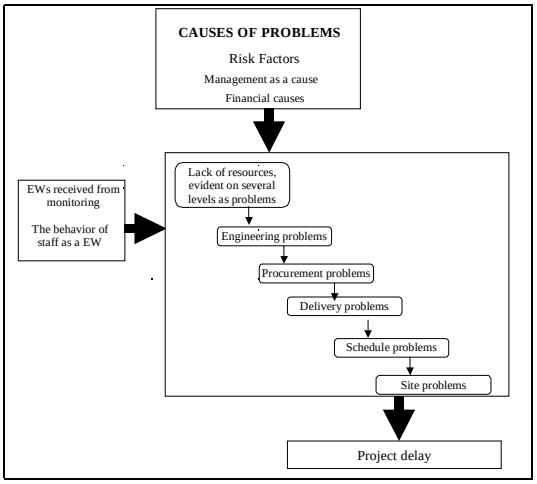


Figure 7.12
The Problem Mechanism Network of the Case Project fig 7.9
(according to Niwa, see fig. 4.3)

7.5.3 The Chain of Problem Causes, Problems, Early Warnings and Responses (figure 4.2)

Two separate problem networks can be analyzed from figure 7.10; these are shown in figures 7.13 and 7.14. Parallels to Niwa's [-89] risk mechanism model can be seen in both, even though the figures have not been drawn in the format of that

model. A schedule examination, shown in figure 4.2, has been attached to the figures; even though they have been drawn in a slightly different form than figure 4.2, it is possible to see the varying interpretation of observations and events that is carried out at different times and that is shown in that figure. In addition, figure 7.13 shows how the management operation carried out in the project, "the creation of a shadow organization," has been a sign to other project actors of the existence of management problems and has also caused new management problems. In contrast, figure 7.14 is a very clear-cut chain.

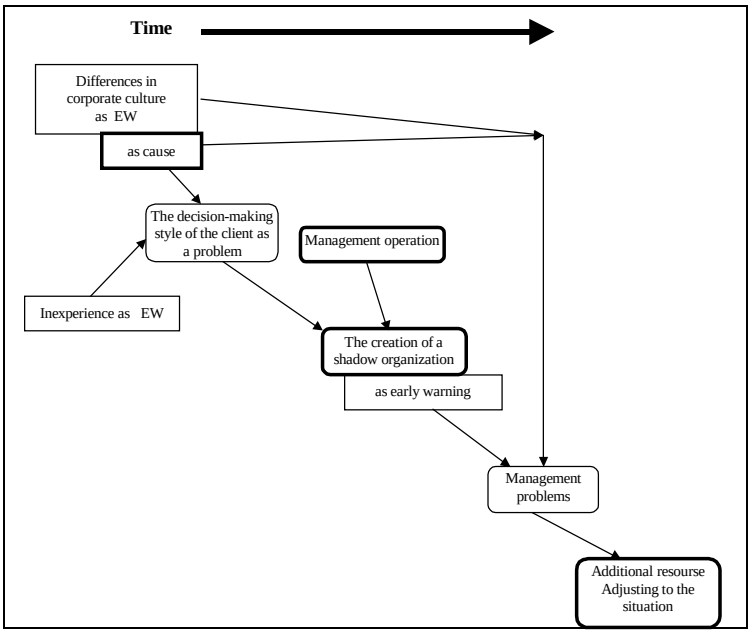


Figure 7.13 The first Networks of Problem Mechanism of the Case Project fig. 7.10

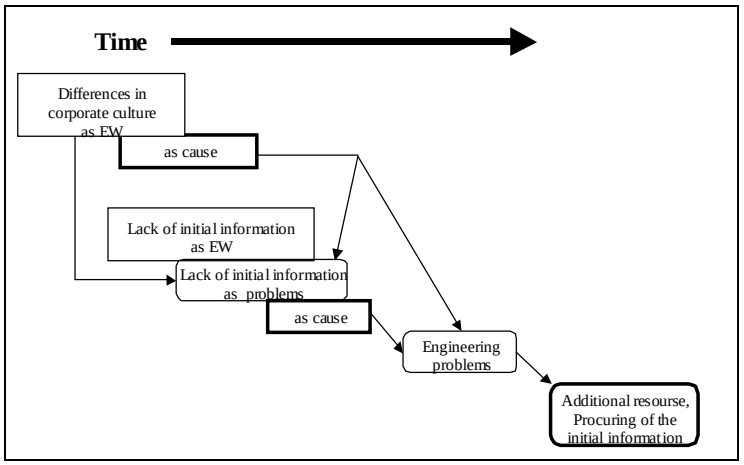


Figure 7.14 The second Networks of Problem Mechanism of the Case Project fig. 7.9

Figure 7.15 presents the project problem network of figure 7.11 in a simplified form. A resemblance to both the figure 4.2 and to the risk model by Bufaied [-89] (figure 2.5) can be seen. The root of the problem chain of the whole project is the managerial style of the project manager, which was apparently due to his personality. Problems developed partly as two separate chains, which share one dependency in the figure. Although several corrective measures were attempted during the project, only the one shown in the figure was successful. The partly unsuccessful measures included, among others, comprehensive negotiations with the equipment supplier for the drawing up of a final delivery contract. This need of negotiation in itself caused a delay in the fulfilling of contract. Similarly, the consultant's project management tried to

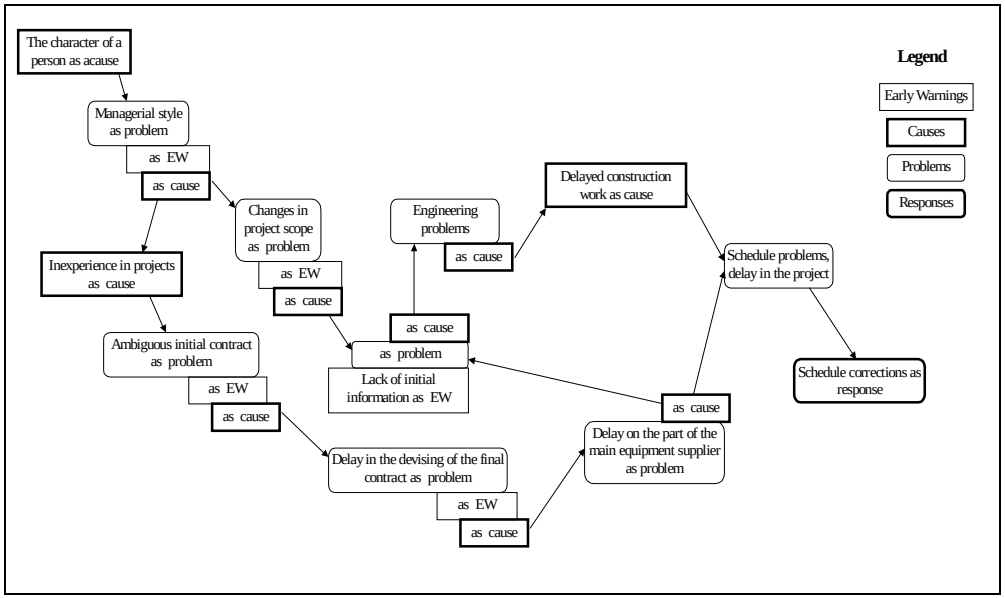


Figure 7.15 The Network of Problem Causes, Problems, Early Warnings and Responses of fig 7.11

find out the wishes of the client's project manager regarding the project manager, and to subsequently keep the scope firm. This, too, was partly unsuccessful as the client's project manager apparently was unaware of the importance of the matter to the project. The chain of problems proceeded inevitably and led to the redefining of the full project schedule and the delay of the project after several stages.

7.5.4 The Interconnectedness of the Concepts

How the early warnings phenomenon can apparently be included as a part of project risk management theories are clarified in figure 7.16, which illustrates the interconnectivity of the concepts of early warning, weak signal, time available, possible problem, cause of problem, risk factor, cause of risk, risk, issue, and response. An early warning gives information about a potential problem. The problem has a cause. The concept of time available expresses the possibility that a problem may not materialize or become current for some time. Therefore, it can be concluded that a potential future problem is a risk. The risk has the cause of risk (risk factor). To minimize the damage the problem causes for the project, responses are required to correct the situation.

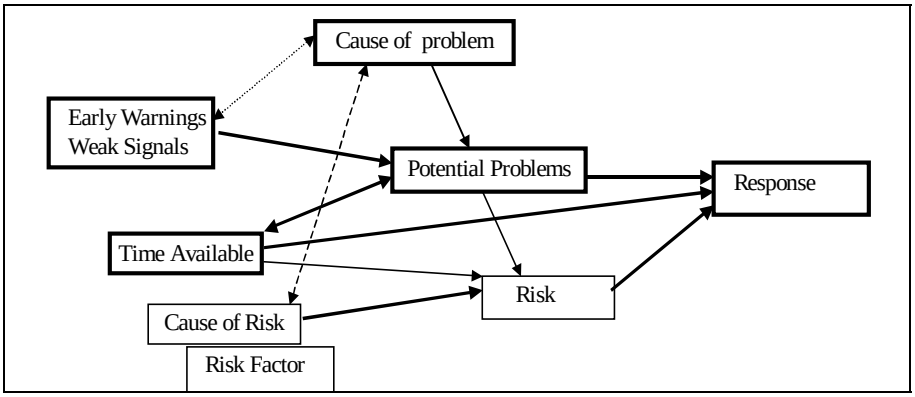


Figure 7.16 The Interconnectedness of the Concepts

7.6 The Reliability of the Results

The nature of the material, its weaknesses etc. were discussed in section 6.5, "The Applicability of the Material." It was noted that a serious threat is included in the material itself, in the selection of the elements. The interview elements are selected by a single person from the total interview material. This is a typical approach for the research method, but its reliability cannot be tested. The same weakness applies to the analysis; namely, it has been conducted by a single person, the researcher, which may lead to an unintentional skewing of the material. The results of the basic interviews were tested by giving the preliminary results of the analysis to three persons for assessment: MSc in Engineering Antti Jaskari from the JP Process Contracting Ltd.; MSc in Engineering Petri Vesanto from the JP-Terasto Ltd.; and MSc in Engineering Vesa Olsson from the Proha Group. The assessment of all of these persons was mainly positive. An attempt has been made to take the relevant remarks into account in devising the final results.

The material is made more representative partly by the fairly large number of interview elements. There are 439 elements in the basic interviews and 421 in the case interviews, forming a total of 860 elements. The χ^2 test (CHITEST) was used

to statistically assess the similarity of the basic and case interview results. The test showed that in the numerical form there is reason to assume that the materials differ; however, there is no reason to assume that they differ in the percentage form. The explanation for the similarity is either that the materials really represent samples from the same basic material, or the researcher has unintentionally endeavored to select similar elements when analyzing the material. The likelihood of the latter possibility is diminished by the large number of elements.

Combining the results from the different materials significantly improves the reliability of the results, though this may at the same time skew the results because of the individual characteristics of the case projects. One factor that may have distorted the results of the case projects is that the researcher has intensively participated in the schedule management of each case project. At the same time, this has unquestionably facilitated the analysis of project problems and especially the process of determining the causes of those problems. The results can probably be considered a fairly reliable description of the researched phenomenon in Finnish industrial investment projects.

8. Results

8.1 Examining the Results in the Light of the Objective of the Research

The objective of the research and the research questions were set in section 1.5. The answers to the research questions are presented by topic in the following sections. It seems to be possible to increase the amount of anticipation in the operative management of projects with the aid of the early warning phenomenon in the sectors of both project management and leadership. The phenomenon proves to be so broad and multifarious that a single study cannot complete the development of the utilization procedures. The research appears to fulfill its objective.

8.2 The Detectability of Early Warnings, (Question 1)

8.2.0 General

The first research question was: "Can information of the type of Ansoff's weak signals, referred to as 'early warnings' in this study, be found in project work?" This can be considered to have been answered in the positive, in part already in the literature survey. The examination of the literature also indicates that strategic and military intelligence, the research on international crises, and the research on corporate bankruptcies have shown that early warnings can be detected in these areas. Communications studies and future studies are also familiar with the phenomenon of weak signals. All of this demonstrates that Ansoff is not alone in his ideas. The significant difference between Ansoff and other writers is that Ansoff emphasizes the state of knowledge and the time available.

This study shows that phenomena conforming to Ansoff's theory of weak signals, i.e. early warnings, can apparently be detected in project work. The state of knowledge embedded in the early warnings observed in this study appears to vary in accordance with Ansoff's theory. The time available underscored by Ansoff also appears to exist, though the values it takes (time periods) could not be measured in this study.

The research material yielded 68 different early warning groups could be extracted from (table 6.7.2, appendix B). These were further grouped into eleven (11) actual early warning main groups (table 6.7.1). In addition, the material contains a number of "small groups" and "no early warning procured, difficult to detect" groups. The early warnings appear to be related to the observations of people and their work, i.e. to problems caused by people's work. Early warnings related to natural phenomena or similar factors were absent from the material, since they were not asked about in the interviews.

Early warnings, however, are not a "crystal ball" phenomenon. The future cannot communicate with the present, as the future does not yet exist. All of us (organizations, the interest groups of a project, other organizations, participants etc.) make our own future [Aula, 2000]; in other words, the effects of our present activities and decisions are only visible in the future (tomorrow, next week etc.). This human activity appears to give an excellent explanation of why early warnings are detectable. "Someone is always aware of impending (hidden) problems, nobody just wants to bring them out. Nobody seems to want to let the cat out of the bag" [an excerpt from an interview]. These observations can further explain the fact that

detectable early warnings can be connected with any one or several of the project parties, they can be detected in all of the project phases, and they can take extremely varied forms.

8.2.1 The Recurrence of Early Warnings

Some of the observations of early warnings appear to be one-time events that are not expected to recur. These are the instances that present the greatest difficult for determinining whether the observation was merely accidental or whether it really indicates a symptom of a relevant change (cf. Åberg's core questions of the detection of weak signals, section 3.1.4).

A separate group is formed by those, observationally individual, one-time early warnings that can often recur in the same or similar form or point to the same problem. When this is the case, groups or even time series can be formed of those early warnings. This should naturally be interpreted as a confirming of the urgency of the early warning.

Another group is formed by those early warnings that are "permanent" in their nature. The first observation of such an early warning seems to often be a kind of "eureka" experience. These early warnings include changes in people's behavior or the managerial style of the project manager.

Still another group is composed of the observations that form some kind of a time series. Plan deviation is the most explicit example of these. The most commonly used project control methods (e.g. time control, cost control) are based on detecting plan deviations and choosing responses on the basis of the information received from the deviations. When a plan deviation is detected, something has already happened; all plan deviations are the result of some problem or cause of a problem. When the plan deviations are minor, they often elicit no response, because nothing serious has yet happened. They should, however, be used as early warnings, as the plan has not been fully successful. The amplitude or the perceived seriousness of the deviation can apparently be seen as a quantity describing the state of knowledge of this type of early warning.

Utilization of plan deviations is further complicated by the possibly dismissive attitude of the project management toward minor plan deviations. This researcher has encountered such an attitude frequently; it has also been noticeable in the case projects used in this study. It seems that there is some degree of dependency between the success of the project and the willingness of project management to react to even minor problems and plan deviations. In the successful case projects, project management responded to even small deviations, and showed interest in deviations in general. In the least successful project, the project management practically forbade the reporting of fairly minor deviations to the client; the problems could only be reported once they were substantial and clearly jeopardized the completion of the project. The client, as well, showed indifference toward the utilization of plan deviations. However, no generalized conclusions can be drawn on the basis of only four case projects.

It can be stated that plan deviations are a group of early warnings, but not vice versa. Plan deviations are familiar to project management and they can always be clearly measured with the modern tools of project control. This study shows that there are a myriad of other, often qualitative, early warnings.

8.2.2 Filtering

Ansoff's [-84] filtering phenomenon and communication noise appear to form a significant part of the early warnings phenomenon. The empirical case project

material only yields a few indications of the existence of various filters. In some projects, the project management made very clear what kinds of information about the progress of the project was welcome, while in a couple of projects attempts (sometimes successful) were made to control what could be written in the monthly reports. In addition, decision-makers' indifference to warnings was clearly perceptible. On the other hand, one of the case projects could be considered an example of the opposite kind, since the project management showed interest in even the smallest problems and their early warnings.

Filters and noise seem to be effective in explaining why warnings are difficult to perceive under certain circumstances and why some people apparently have difficulty in detecting them. The power filter accounts of the behavior of the decision-maker. However, the empirical material is not broad enough to warrant conclusions, and the subject requires further research.

8.3 Describing the Character of the Phenomenon, (Question 2)

8.3.1 General

The second research question was: "Is it possible to design a description of the early warnings phenomenon and a typology of the early warnings?"

The present study creates an explanatory model of the early warnings phenomenon that clarifies its character; the model is presented in section 8.3.2 below. The phenomenon as a whole appears to be divided into two stages: a) detecting early warnings and accepting them as information, and b) decision-making, where the procured information is analyzed and the necessary responses are decided upon.

The communicative character of early warnings and their detection is also noted in the study. Early warnings appear to often fulfill several of the criteria set by communication theories for messages. The study further revealed that the mere detection of early warnings is not sufficient in itself: to produce a change in the progress of the project, some response has to be made to minimize the impact of the threat. It is interesting to note the various procedures of detecting early warnings used by several interviewees, which enhanced their opportunities to detect early warnings.

8.3.2 A Model Describing the Phenomenon

The character of the phenomenon is clarified in figure 8.1, "The Character of the Early Warnings Phenomenon and the Factors Affecting It." The figure was formed as a result of the interaction between the theoretical survey and the analytical phase of the empirical research. This interaction was strongly influenced by numerous conversations with various persons.

Figure 8.1 presents project events as a kind of process of occurrences. This is a time-bound current that is examined by the observer, or that "sends" a message to the observer. The figure illustrates the two-part character and the factors affecting the phenomenon. The phenomenon can be divided into two phases: 1) the communication phase and 2) the decision-making phase; however, it is difficult to completely separate these from each other

1) The communication phase can be divided into three parts: 1a) the detecting of the early warning; 1b) the interpretation of the early warning; and 1c) the acceptance of the early warning. An important factor in the communication phase, in addition to the actual message (observation), is the observer. He determines how the observation will be interpreted, because the message only reaches others in the interpretation of the observer.

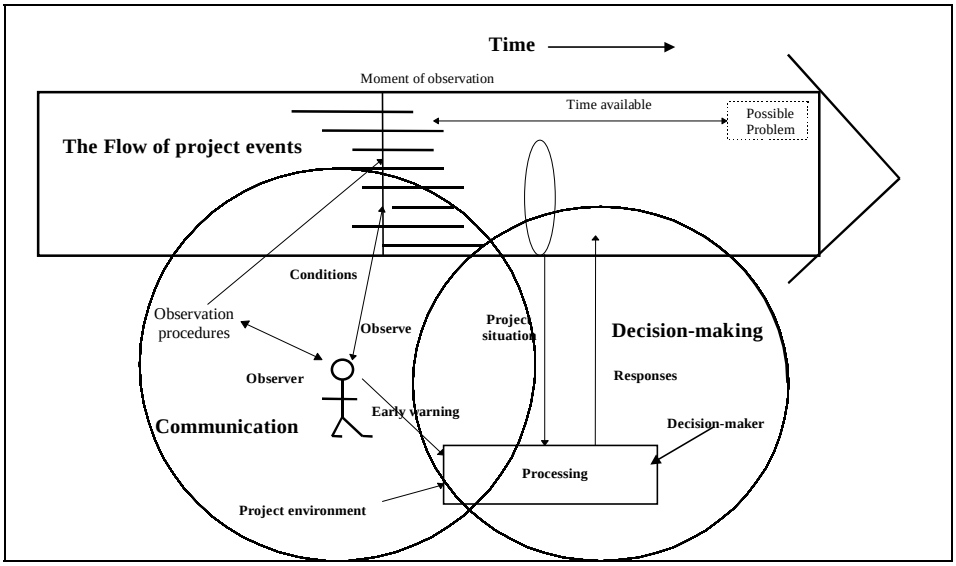


Figure 8.1 The Character of the Early Warnings Phenomenon and the Factors Affecting It

In stage 1a), detecting, the observer can utilize the type categorization developed in this study (table 6.7.2, appendix B). The descriptions and examples of early warnings presented may facilitate recognition of early warnings. Other descriptive typology of early warnings (appendix C) may also be helpful; these might include knowledge of early warnings that are typical to various project phases and the knowledge of their forms of manifestation.

In stage 1b), interpretation of early warnings, the dependencies between early warnings - project problems - problem causes presented in this study can be utilized. Interpretation may also be facilitated by knowing to which project party the type of early warning detected most often refers.

In stage 1c), acceptance, the observer acts according to the theories of communication: first, he either rejects the early warning or accepts it as meaningful to the project and to himself; second, once the observer accepts the early warning, he endeavors to interpret the impact of the observation, which moves him toward the decision-making phase. This is discussed further in section 9.2. The manner in which the early warning is processed can be explained both with the model of the "internal communication of the individual" (figure 3.9) and with facet theory. It should be kept in mind that the communication situation is always multi-stimulied. The stimuli are sets of thoughts. According to this view, the interpretation is influenced not only by the early warning itself, but also by the circumstances surrounding the detection, the project situation etc. This was manifest in the analysis of early warning elements.

2) In the decision-making phase, the relevant questions are: what is the significance of the early warning for the project, and what responses should be adopted on the basis of that early warning in this project situation at hand and in the prevailing project environment? The contents of this phase are described in more detail in figure 9.1, "A Model of Utilizing Early Warnings." The details of the decision-making phase, such as the relationship between the responses and the early warnings, could not be more comprehensively examined in this study due to the

small number of research elements concerning responses. A more extensive clarification requires further study.

Figure 8.1. also shows that the events at the moment of observation in the current of project events can no longer be influenced because of the time-bound nature of the current. Responses always influence future events. Project control is not a regressive cybernetic process where situations recur and their effects can be corrected. Project events do not repeat themselves during the same project.

8.3.3 **Categorizations,** The Second Part of Question 2

The second part of the second research question receives a positive answer: on the basis of this research a type categorization and a descriptive typology of early warnings can be created.

The type categorization consists of early warnings that have similar content; it can be said that these early warnings belong to the same type as far as is possible. The categorization is hierarchical: there are 11 main groups and 68 subgroups.

The descriptive typology which is parallel to the type categorization, is presented in appendix C. The appendix presents only the broad outlines of the crosstabulated examinations between the categorizations and the various attributes; they have been discussed in more detail in the licentiate's dissertation Nikander [-98].

The categorizations presented in this study may be useful in detecting and interpreting early warnings. When attempts are made to utilize early warnings in project control and management, the existence of early warnings does not seem to pose a problem; a more common problem is probably recognizing and interpreting the early warnings. The greatest problem, mentioned by several interviewees, appears to be to convince the decision-makers of the threat of incipient problems and that advance information is available of such problems. The problem of the credibility of early warnings is also present in military intelligence research and future studies. Investigations such as this one lend additional credibility to the whole phenomenon, thereby facilitating the work of the observer and interpreter of early warnings in providing clear input to the decision-makers.

8.4. The Relation between Early Warnings and Project Problems

Question 3

The third research question, "How do observable early warnings apply to different project problems?" also receives a positive answer — that is, a relationship between the two can be detected. For utilization of the results, exploration of the dependencies between the early warning groups and project problems can be regarded as the most important aspect of the study. Conversely, on the basis of only the basic interview material it was impossible to determine how early warnings refer to the actual causes of project problems, the results regarding this issue are not based on information received from the interviews. However, in the case interviews the unearthing of the causes of problems was quite successful, although the study fell short of understanding the direct relationship of the early warnings and problem causes. Because of this uncertainty, the causes of problems are only connected to the project problems. Due to the narrowness of the material, some dependencies may have escaped notice in this sector as well.

The project problems and their causes appear to be characterized by dependency on people's actions similar to early warnings. This is quite natural, as project work is completely composed of human actions. Only the project environment may be

influenced by natural phenomena, but even in these cases the environment itself is chosen by man, and he could relocate the project if he wished to do so.

Problems caused by natural phenomena, illnesses, sudden accidents or other similar factors did not emerge from the material. This may be at least partly due to the fact that questions relating to such issues were not asked during the interviews. In the literature, these issues are often classified under the heading "unexpected incidents" (Immediate Danger Signs as in Weschke [-94]). Naturally, it is possible to be prepared for such incidents through risk management. The material also demonstrates that early warnings can refer both to problems within the project that can be influenced by project management as well as to problems outside the project, over which the project management has no power.

8.5 Chains Formed by Problems and Causes (Question 4)

The fought research question was "Can observations of early warnings, project problems, and the causes of problems be chained together and networked, and can their character vary depending on the point and time of observation?" receives a positive answer. On the basis of the empirical material, the study develops a general and approximate dependency network between various early warning main groups, project problem groups, problem causes, and responses. On the level of a specific case project, it is possible to devise long and branching early warning - problem - cause - response problem chains and dependency networks. The same phenomenon was apparent in the theoretical survey, especially as concerns the studies of project risk management.

The general dependency network developed in this study may, however, excessively generalize the results; this is evident when devising dependency networks by project problem. For practical utilization, the database should be very specific; possibly the database should be designed on the level of early warning and project problem subgroups. In such a case, the size of the database may be a problem as it will be difficult to handle manually; help should be available from information technology database applications.

Responses and Observation Procedures

To supplement the narrow sample of responses and observation procedures in the research material, response recommendations found in the literature can be used (tables 7.3.1 and 7.3.2).

On the Similarities between Problems and Causes (Set Theory View)

Multiple interpretations of the observed items, already apparent in the theory part, is noted in the research material. Interpretation of the observed event or phenomenon may change depending on point and time of observation. The observation (signal) made of the event can be considered an early warning, but event can also be regarded as a project problem at the time of observation; furthermore, event can also be interpreted as the cause of a current or future problem.

Both the material from the literature and the research material indicate that A) observations made of phenomena or phenomena, that can be observed in projects, are either interpretable as "pure" early warnings of a problem, or express an existing problem, or are interpretable as causes of problems, but that are difficult to interpret in more than one way at the same time. B) When comparing the tables 4.4 (Project Problems and Their Causes Combined from Project Management Literature) and 4.1 (Symptoms of Project Problems on the Basis of Literature), significant similarities are detected. The same characteristics can also be found in the research material. This and the chain formation phenomenon indicate that a certain observed phenomenon or observation made of phenomenon can be interpreted in various

ways depending on the project circumstances in the different phases of project work at the time of observation. C) It is fairly clear, that even other types of items that can be interpreted to belong to two different groups could occur. However, the responses are a completely separate group. This can be presented in accordance with set theory in the figure 8.2.

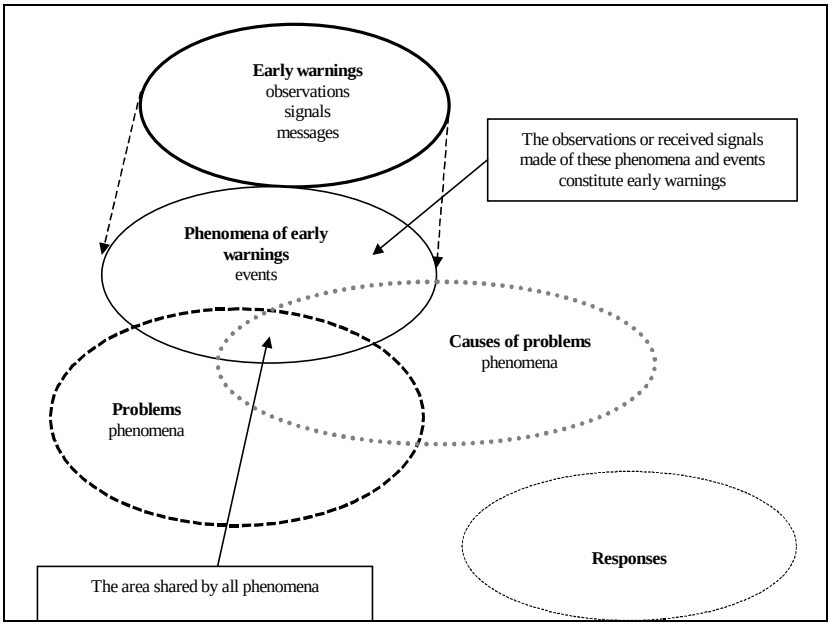


Figure 8.2 The Sets of Early Warnings, Problems, Causes and Responses

9. Discussions

9.1 Utilization possibilities

A number of utilization models for weak signals can be found in research literature; Ansoff presents the Weak Signals Strategic Issue Management (WSSIMS) model in the area of strategic planning and management. Several other writers have also presented SIMS models that differ from the Ansoff model mostly in the details. The field of communication studies has its own weak signal utilization model [Åberg -89a]. The observations of the procedures of detecting early warnings made in this study and the views presented by several interviewees on the phenomenon also show that early signals can apparently be utilized as a tool in project management.

In his book Åberg [-89a] discusses external and internal scanning which belong to the communicative functions of a company. The core questions raised by Åberg, also applicable to project work, are:

"- is the observed change symptom of a greater, relevant change, or is it only random variation?"

"-How can weak signals be detected as quickly as possible, so that the greatest available time will be available for the responses" [Åberg -89a].

None of the models presented in the literature appears to be directly applicable to project work; they are usually too cumbersome. Alternatively, an attempt can be made to apply various problem analysis models [Lewis -93]. The basic principles of the models presented in the literature are suitable to project work, but the applied method should be very flexible, rapid and simple.

The development of the Decision Support model (figure 9.1) presented in this study has been heavily influenced by the Ansoff model [Ansoff -84]; further, the development of the model has been influenced by the model of "External and internal scanning as a continuous event", presented by Åberg [-89a] as well as by the "Structural model of social action in an action group" [Heiskala -90]. Another factor that has influenced the creation of the Decision Support model is the interaction between theory and the analytical phase of empirical research, which has also influenced the design of figure 8.1. In addition, discussions with the experts mentioned in section 7.6 have helped to form the model.

The fundamental model for the utilization of early warnings presented in section 9.2 should be understood as a mental approach. As there has been no opportunity to test the functioning of the model during the present research, the future development and testing of this model depends on follow-up studies. All components of the categorizations designed in this study can possibly be employed in the utilization; the cross tabulations and early warning - project problem - problem cause - response dependency networks devised in this study can also be helpful.

The theories of project risk management are apparently not acquainted with the concept of weak signals/early warnings, although project risk management literature does mention the concept of "risk symptoms." The idea of utilizing phenomena of the early warning type seems to be very poorly represented in the literature on project risk theories. As already noted in the section on literature, the literature survey revealed factors which connect the early warnings phenomenon to project

risk management. These include: the observed connection between early warnings and project problems, the observed similarities between risks and project problems, the equation of potential problems with risks, the similarities noted between early warnings, project problems and problem causes, the changes in the interpretation of these factors depending on the perspective of observation, the formation of chains of these factors, which is also applicable to risks, the fact that the result attribute "problem" used in this study matches the concept of "risk categories", the similarities observed between causes of project problems and the risk factor (these concepts can be considered nearly synonymous).

The above-mentioned factors can be detected in the material of the empirical study, which strengthens the possibility, already present in the preliminary examination, that utilization of the early warning phenomenon can be integrated into project risk management. The perspective of project risk management could not be very thoroughly examined due to the limited resources of this research.

9.2 A Decision Support Model Based on Early Warnings

As figure 8.1 shows, the model is divided into two main parts: A) The communicative part, where the early warnings are recognized and the fact that they give information is accepted. This part includes the stages 1…4 in figure 9.1. B) The decision-making part, which contains stages 4…7. It should be noted that stage 4 can be considered to belong to both main parts.

9.2.1 The Procedures of Decision-Making in the Model

The utilization of early warnings in decision-making has two procedures: 1) early warnings and 2) problems or risks.

1) In the early warning procedure, the main question to be answered is: a) what problem (risk) does the detected early warning refer to? 2) In a problem- or risk-oriented perspective, the following questions should be answered: b) can early warnings implying the materialization of a particular risk be detected? and c) what kinds of responses (observation procedures) can be used to procure additional information of the threat of materialization of a particular problem (risk)?

It should be noted that, theoretically, each observer of signals interprets them in his own way — in other words, he has his particular way of seeing the situation and interprets it according to his own "facets." Nevertheless, only one decision regarding the responses can be made for the project as a whole. This is the responsibility of the actual decision-maker — project manager, the decision-maker of the owner, etc. That person can, naturally, take into account the views of other project participants. In figure 9.1, this "multiple interpretations" situation is illustrated by several overlapping frames around the process stages; these are marked "Different viewpoints" in the lower right-hand corner.

Two stages of assessing the future are included in early warning utilization. First, the severity, likelihood of materialization and time available of the potential problem (risk) should be analyzed (assessed, anticipated) on the basis of the available information and the view (experience, beliefs) of the evaluator. This is equivalent to risk management that includes consideration of the information provided by early warnings. Second, the decision-maker should evaluate the impact of the planned responses on the project, and the reactions, and responses of the various project parties and/or outsiders in the situation at hand. As mentioned earlier, the model presented here can be a tool for anticipating the future aspects of project problems.

9.2.2 The Early Warnings Procedure

In an early warning oriented approach, shown in figure 9.1, the first (1) stage is detecting an early warning; this is always done by a person and the early warning is detected in the stream of project events (figure 8.1). Ansoff gives the observer the important advice that detecting an early warning requires great sensitivity of the observer to listen to his environment "with an ear to the ground." The attributes describing the early warnings phenomenon, developed in this study, can be helpful to the observer during monitoring; these give hints about the types of early warnings that should be looked for, when and where. Juran [-95], as well, notes how important people are as sensors, and how it is true in all cases that a person compares the real (observed) event to his expectations (standard) and recognizes a deviation. As noted in section 8.3, "Describing the Character of the Phenomenon," communications theories seem to successfully explain the observation process.

In the second (2) stage of figure 9.1, the observer accepts his observation (message) and begins to interpret it, i.e., either considers it an early warning or rejects it as insignificant. This stage clearly shows the definition of a facet: *"a facet is composed of associations. An association is a piece of knowledge or an assumption, which is linked to an attitude. Associations are activated in the processing of a particular stimulus*." [Åberg -93]. The greatest problem is probably deciding whether the information in question is really significant or merely an arbitrary "event." Here the categories of early warnings devised in this study, with their descriptions and examples of what warnings may be like, can be utilized.

In the third (3) stage, the observer tries to determine the state of knowledge of the early warning, i.e. the significance to the project of the information it provides. The scale of assessment does not need to be absolute or valid in all cases, as long as it is definable in the situation in question. To help in this assessment, the observer can use either the scale presented in this study (though it has been noted to be quite inexact and vague) or the scale presented by Ansoff. The received information should be recorded even if it appears irrelevant or too scant, since more information on the same subject may surface in the future.

In the fourth (4) stage the observer strives to identify the problem (risk) that has emerged, as well as its possible causes (risk factors, causes of risk). This assessment is influenced not only by all the information provided by the warning (categorizations) but also by at least the project situation (internal trends), the circumstances of the project environment (external trends) and the beliefs and assumptions of the interpreter. The possible utilization of various project risk management methods (risk analysis etc.) is relevant in this stage at the latest. Another tool that can be used is a database of the type developed in this study concerning the relation between early warnings and project problems (risks) (table 7.2.1) and information on the dependencies between project problems and their causes (risk factors) (table 7.2.2). This is illustrated in a simplified form in figure 7.2, "Warnings - Project Problems - Problem Causes - Responses Network."

The time available (5) is explored along with recognizing the risks. The question to be answered is: How much time is available for the responses required by the problem (risk)? In other words, how urgent is the situation? This, too, is strongly influenced by the project situation (internal trends) and by the project environment (external trends) as well as by the interpreter. The classification presented by Ansoff in figure 3.5 can be used as a scale: delayable, postponable, urgent.

Probably the greatest difficulty in stages (4) and (5) is to convince the decision-maker of the existence of a problem, its impact on the project, and the necessity of

responses. This can be called a credibility problem; it emerged in the interviews conducted for this study and is equally apparent in studies on military intelligence, international security and international risks. Studies such as the present one about early warnings in project work may ameliorate this credibility problem.

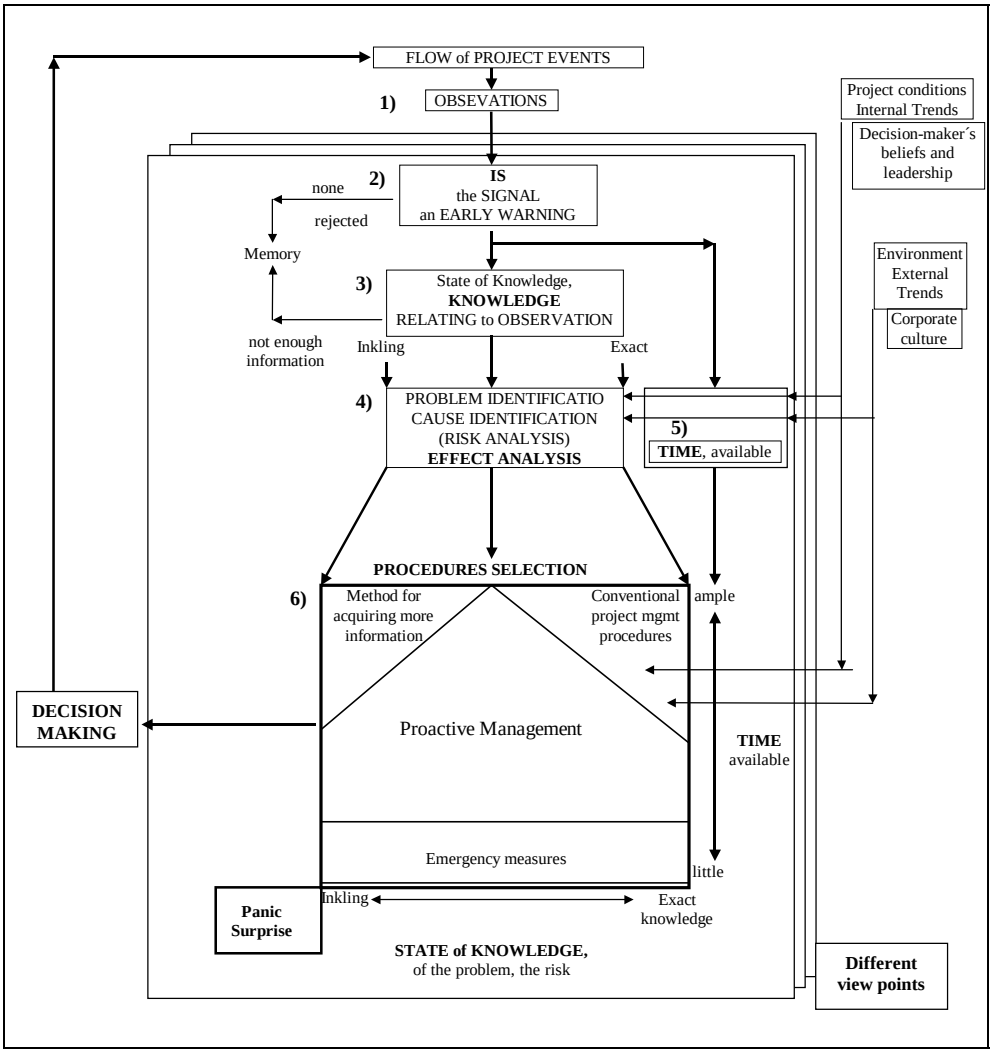


Figure 9.1 The Decision Support Model of Early Warnings
The model is indebted to Ansoff [-84a], Åberg [-89a], and Heiskala [-90].

Finally (6) it is necessary to endeavor to decide which responses the observed situation calls for. This is illustrated in the matrix in the lower part of figure 9.1, where the aids of decision-making are, a) the available information about the problem (risk) and its impact on the project and b) the urgency of responses (available time). At least the following additional factors influence the choice of responses: c) internal trends, d) external trends, e) the assumptions of the decision-

maker and his position in the project, f) the policies and corporate culture of his firm, and d) the effects that the response is hoped or estimated to have on the project. It should also be noted that a significant portion of the problems (risks) may be outside the influence of the decision-maker; this is evident in the analysis of the material.

No acquired preliminary information should be completely disregarded: even insignificant information should be stored in such a way that it can be compared with both older information and information available in the future. This is difficult to accomplish manually, but is possible with the help of database applications; this subject is further explored in section 9.3.

The situations in the extreme points of the decision-making matrix are the following:

a) If there is ample time, but the available information is weak (an inkling), observation procedures that give more information can be selected as sufficient (table 7.3.2). This covers the upper left corner of the matrix.

b) When there is ample time and the information about the problem (risk) is exact, normal project management methods can be used. See the upper right corner of the matrix.

c) If there is little time and the precision level of the information lies anywhere between an inkling and exact information, various “emergency responses” must be adopted. See the lower part of the matrix.

d) When the problem is “outside” the matrix, i.e., when there is no preliminary information of the risk and therefore it comes as a surprise, some kind of a “panic situation” will probably emerge when the risk becomes concrete.

e) In the middle of the matrix, proactive management style leadership may be considered applicable. This study is unable to develop the idea any further.

9.2.3 Problem Procedure

In a problem-oriented situation, which can be considered an application of the early warnings phenomenon suitable for the project planning phases, a useful approach could be constituted by the following stages of figure 9.1: Recognizing problems (risks) (4), Evaluating the urgency of the situation (5), If there is no immediate threat, procedures of monitoring early warnings will be selected. When early warnings are detected, early warning oriented action is returned to.

The significant addition that the model makes to the project risk management methods presented in the literature is that it allows the use of highly inexact information (inklings, weak signals) and makes possible the planning and implementation of responses in as early a stage as possible, as soon as information available about the situation appears sufficient.

9.2.4 Difficulties

The utilization of early warnings is made more difficult by the multifariousness and great scope of the phenomenon. There are a myriad of early warnings, they emerge in numerous forms, can be detected in various different situations and interpreted in several ways. In addition, several other factors influence the assessment of the severity of a detected risk; moreover, according to communications theories, receiving, accepting and interpreting observations (messages) fully depends on the receiver — someone who may find it hard to manage the copious early warnings. Furthermore, the associations of the observer crucially influence his acceptance and interpretation of an early warning.

Before the decisions required by the situation can be made, another person — the decision-maker — often enters the picture. The observer is now faced with the additional problem (mentioned above) of getting the decision-maker to believe in the existence of a risk, its severity, and the fact that responses are necessary. This same difficulty is noted in research conducted in the areas of strategic (military) intelligence service and future studies. A number of interviewees also remarked about this difficulty in the interviews conducted for this study. Additionally, the assertions made by Heiskanen [-88] in his book about believing in the results of intelligence work should be kept in mind.

Since the early warnings of the type detected in this study cannot be measured with instruments currently in use, detecting an early warning always depends on a person, and often on no more than one person,. In addition, the final interpretation of early warnings, as well as the task of decision-making, is the responsibility of a single person, and the result depends wholly on him. Information technology may, however, be of use in the interpretation and recognition of risks; the Knowledge-Based Risk Management model presented by Niwa [-89] appears especially promising (see section 9.3 for more information). Such an application may offer the decision-maker other alternatives in addition to the one that occurred to him first. Herein lies a danger, however, if the recommendations made by the application are followed slavishly. It should always be kept in mind that while an application may recommend and suggest, the final decision must lie with a human.

9.3 The Early Warning Phenomenon as a Part of Project Risk Management

The model developed in section 9.2 has very clear characteristics of project risk management. The stages 1…5 of figure 9.1 (making an observation, accepting the observation as an early warning, determining the state of knowledge and the time available, identifying the problem and its cause) can be regarded as at least a part of the first stage of work, risk assessment/risk identification of project risk management (section 2.5). In this stage (as pointed out earlier) the early warning categorizations can be utilized.

This study offers no help for the charting of risks done in the project planning phase at the beginning of a project; the early warnings detected in the study refer to events and observations in the project itself, and the results can be used in charting risks during the project. Early warnings can give advance notice of arising risks. The stages 4 and 5 of the model can also be regarded as a part of the risk analysis/risk qualification stage; however, the contents of the stages of project risk management are broader than those of the stages made possible solely by information provided by the early warning phenomenon. Stage 6 of the model (Selecting responses) can be a part of the risk qualification and risk response development stage.

The early warning phenomenon does not, according to this study, give information about the factors that are closely connected to risk management, namely the probability of the materialization of risks, the impact of risks on the project or other information required and produced by the risk analysis stage. This information should be procured from other sources; it can then be included as additional dimensions in the decision-making matrix of the model shown in figure 9.1. It should be noted that the information provided by an early warning about the time available relating to a potential problem (risk) is not the same thing as the probability of the materialization of a risk. They do not substitute each other and are not opposite factors; rather, they supplement the total knowledge, and a separate

matrix should be formed of them. This information is not supplied by this study — rather, it requires further research.

Knowledge-Based Application Possibilities

As noted earlier, Niwa [-89] has developed a knowledge-based risk management model, and the information received about the early warning phenomenon in this study can possibly be inserted as a part of this model. The model presented by Niwa is mainly a tool of the risk identification stage.

The knowledge-based risk management model can be considered to contain two main parts: a) an interactive program and b) the structure of the database used by this program. The model is risk factor oriented. A risk situation can be examined in the model forward in time (forward reasoning), in which case it is determined which risks are possible when the risk factor in question becomes manifest. The situation can also be examined backward in time (backward reasoning); in this case the object is to determine which factors caused the current risk. A relevant issue for the user is that he can feed additional information to the program using suitable keywords, and/or the program may ask questions and offer keyword alternatives for the user.

The database of the model is based on a so-called work package idea, which can be considered an extended and improved application of WBS/OBS. The database is formed with the aid of multilevel matrices. The matrices combine the objects of work, which are equipment and buildings, activities (such as planning, purchases, installation), risks, and risk factors. The model is apparently concerned with activity management. The leadership side of the issue can possibly be connected to the model, but it does not form a very natural part of it.

The New Structure

Figure 9.2 illustrates one possibility of developing the model so that the early warnings phenomenon examined in this study could be utilized. The figure 9.2 shows figure 7.4 in Niwa, [-89, p.99], with the information provided by this study added in bold print. A database of early warnings must be added to the Standard Package Knowledge Base database. Associate Guidance has to be extended to contain the control included in the early warnings phenomenon. Two approaches are formed in the model: a) the original risk factor procedure and b) the new early warning procedure. This is in accordance with the model shown in figure 9.1. In addition, it probably is appropriate to store the information concerning the current project into a separate databank (Current Project Knowledge), from which it can later be transferred to the complete file. This makes the management of acute information more exact.

The original database can possibly be enlarged to include information about which early warnings can be connected to a particular work package or risk, and how the categorizations developed in this study is related to the work packages. This information, however, is not provided by this study but requires further research. Similarly, the way in which knowledge of early warnings could be used as keywords as presented by Niwa [-89] (according to him, the keywords included the idea of “indicators/hints”). The original model by Niwa does not appear to contain the stages risk analysis, risk response development and risk response control. These have been added to the figure, but this study gives no information on what they should contain and how they could be integrated in to the model of the program.

Another important point is that a program of this type constantly adds to its database; it has to be capable of “learning.” In collecting the database, care should

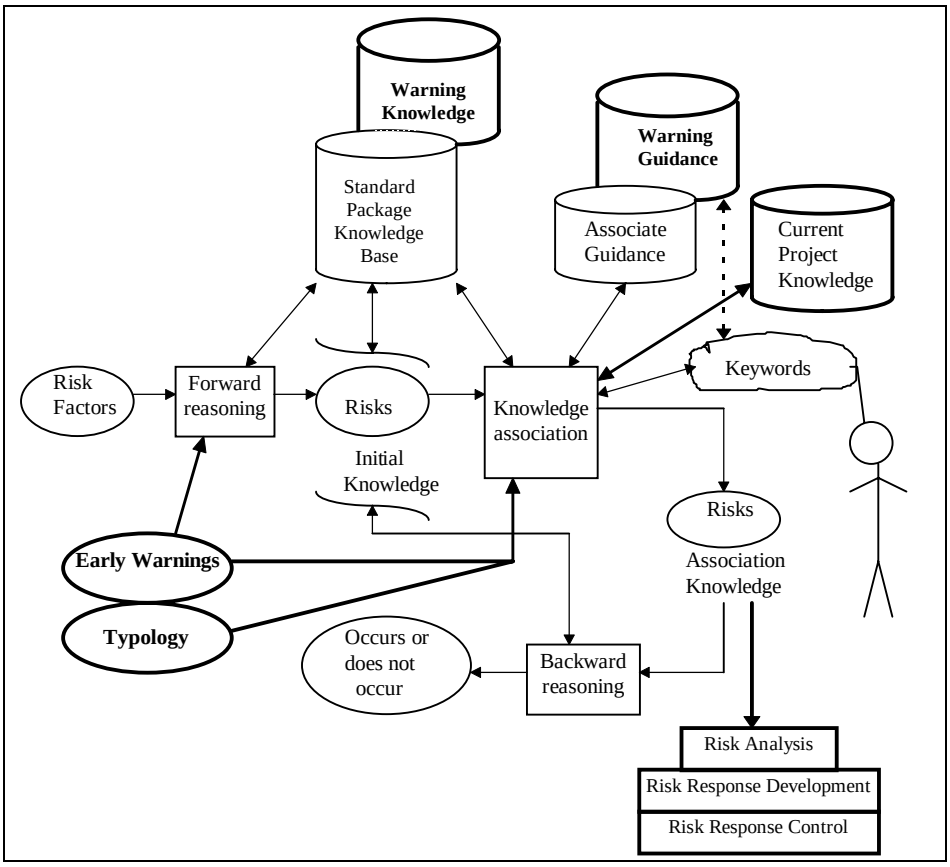


Figure 9.2 The Structure of the Human-Computer Interactive System for Project Risk Management.
The lines in bold show the additions of the present study to Niwa's [-89] model.

be taken to ascertain that it does not grow unduly large. Betts [-82] notes that "*A small but sufficient indicator list allows more rapid reaction than a complex list*" [Betts -82, p. 193]. He further states that the list of indicators of the U.S. European Army grew in the 1970s to nearly 500 different indicators. This was subsequently heavily trimmed, but about 100 indicators remained on the list [Betts -82].

9.4 Your and Your Organization's Abilities

Can the utilization of early warnings in risk management succeed in a micro-level environment - projects - when it seems to be problematic elsewhere? In their book, Davies and Gurr [-98] examine the 17 high-intensity wars and 70 low-intensity conflicts that raged in the world in 1997, determining how many people lost their lives in them and how vast a refugee problem they created. They also note the breadth of national and international research of early warnings of crises. Yet discussion about crisis management has surfaced in Europe only in recent years. Does this mean that leaders will wake up only when a catastrophe occurs in their own backyard?

None of the developed utilization models and database systems are of any use if the user is not attuned to detecting even weak (inexact) early warnings. There is no

other instrument besides people for detecting these kinds of signals; no technical instrument is available and probably cannot be easily developed. The study of communications shows that the ultimate receiver of all human messages is a person. This study, as well, shows the significance of people as sensors.

If you cannot detect and recognize early warnings, if you are not attuned to detecting them, if you are not prepared to listen to the field "with your ear to the ground," continuing this activity is futile. You must educate yourself, collect your own experiences, develop facets of your own to which you can then compare your observations. Project literature and other types of literature are full of self-improvement guides. The commercial market offers an "unlimited" number of courses and consultant services. It is therefore meaningless to try to present any new ideas for education on this point here.

As the old saying goes, "experience is the mother of wisdom." Studies based solely on books will not be sufficient in an area such as this, where individual insight is important; one must really gather personal experience and observations. The present researcher used the journal method from the literature for monitoring one of the case projects [Lientz et al. -95]. The literature recommends that one should keep a daily, private journal (or diary) of the project events and especially of one's own feelings and small observations. It emphasizes that the journal must really be private and even secret. In the experience of the present researcher, the journal aided in clarifying the events and problems of the project; therefore, it was at least a good research method.

It would be extremely important to get even the other project participants to realize the significance of early warnings; especially the decision-makers should believe in them. Here the project manager holds a key position: through his example, he can either strengthen or reject the anticipative management of a project. The present researcher experienced this very strongly in the context of the case projects: when the project management wasn't interested in anticipating problems, or even prohibited the presentation of forecasts and warnings, this activity naturally ceased. That particular project ended in a near-catastrophe. On the other hand, when the project manager in another project paid attention even to small hints and signs of problems, these could not grow and form networks. The project was the most successful of the case projects.

The literature and the commercial market are also full of all kinds of guides and services on organizational development; there are the most varied -isms, which come and go. A new -ism is hardly necessary. One of the reigning trends in organizational development has been to emphasize the openness, innovativeness and creativity of an organization. A certain amount of creative madness is undoubtedly good for the acceptance and utilization of the early warnings idea: one has to be prepared to accept stupid questions instead of trying to repress them. Aula [2000] discusses the "full-blooded" organization of the new era; this lies somewhere between the traditional stable box organization and a chaotic state. Could this idea be applied in projects?

10. Summary

10.1 The Successfulness of the Research Angle and Method

Qualitative research has provided an opportunity for understanding the early warnings phenomenon of under examination and has therefore been a successful method. Using semistructured interviews as a field method has given, even with fairly limited material, a basis for both qualitative and quantitative analysis.

The interviews do not necessarily bring out the actual events; instead, they may reflect the interviewees' opinions of the events. This is one of the weaknesses of the method. Another weakness is the fact that the research method depends so much on the researcher, whose interpretations may have colored the results. As for the case projects, the fairly long time that has elapsed since the projects were implemented can have diffused the interviewees' view of the events.

10.2 Assessing the Research

The research can be assessed on the basis of several factors. These include: 1) how well it has answered the research questions and fulfilled the goal set for it, 2) level of success of the type categorization of early warnings, 3) the information provided by the descriptive attributes (descriptive typology), 4) the link between early warnings and project problems and the devised models.

The theoretical part of the research approaches the topic from the perspective of several different theories from the detection of an early warning to the required responses. An analysis of the concepts related to the phenomenon is conducted in the theoretical part. In addition, that part explores the views of various other fields of study on the early warnings phenomenon; on the basis of these views it is concluded that Ansoff is not alone regarding the bases of his theory. The theoretical part further delves into Finnish communications theories and how these clarify the phase of detecting early warnings. A preliminary categorization is designed for early warnings and an investigation is conducted of the way in which the interpretation of the detected items can change their character from early warnings to causes of project problems. The observation is explained with a set theory model in the context of interpreting the results.

The empirical part of the study endeavors to examine the phenomenon through the use of descriptive methods for analyzing the activities in a project; this part of the research is directed toward explaining the phenomenon. Later in the study, the perspective is extended in a normative direction.

Due to the research method, the limited resources, the groundbreaking nature of this research, and the broad scope of the phenomenon, all of the research objectives set in the beginning of the research were not achieved; especially the development of the Decision Support model for the utilization of early warnings remains somewhat sketchy. The research gives a predominantly positive answer to all of the research questions. The second research question, concerning the state of knowledge of early warnings, could only be answered with a rather vague scale. The descriptive typology and the picture formed of the early warnings phenomenon by the

descriptive attributes can be considered fairly good. They clarify what can be observed, from whom information can be received, when information is received and where and in what form early warnings can be expected to be found.

The broad scope of the phenomenon complicates the unambiguous application of the results. The descriptive attributes, which form the main part of the typologies presented in this study, primarily describe the phenomenon. As noted earlier, it has not been possible to exactly measure either the state of knowledge and the information content of an early warning or time available for responses once a warning has been detected.

This research shows that the early warnings phenomenon can be described as having two phases: 1) the early warning has to be detected and accepted, as well as interpreted, and 2) decision has to be made as to what responses should be adopted. The research clearly indicates that the detection phase is a communicative phenomenon, effectively explained by the theories of communication. The study offers no tools for the decision-making phase; the research is too narrow to enable exact conclusions regarding the responses that should be adopted in various problem situations. The model developed in this study is more effective as a model explaining and organizing the phenomenon than as a decision-making model. The research indicates that the phenomenon can possibly be integrated into project risk management, though how this would be carried out in practice is not examined here.

The literature survey showed that there exist neither earlier systematic studies of the early warnings phenomenon nor broad studies of the Ansoff´s theory, while project literature includes only references to the phenomenon. No preliminary model of the early warnings phenomenon was therefore available prior to the empirical part of this research. This study can be considered successful as far as it organizes and explains the phenomenon being investigated; it adds to the understanding of the phenomenon and is a kind of a basic study exploring the nature of the phenomenon.

10.3 The Area of Applicability of the Results

The total results of the study, the model developed of the nature of the phenomenon, the categorizations, the Decision Support model and the leadership uses, can apparently be considered a new, additional project control and management method created for the field of project control. The information technology application of project risk management, described above, is an application of the presented Decision Support model. The addition to project management designed in this study does not refute anything previously developed (e.g. the sectors of project management discussed in PMBOK [-95]); rather, it strives to improve the project management´s opportunities to anticipate and forecast future events in a project.

The applicability areas of the research results can be examined both as separate results that answer the research questions and as a total, system result. The results that answer the research questions were examined earlier in this study; their areas of applicability will be discussed below question by question.

10.3.1 The General Area of Applicability

In general, the area of applicability of the results is at least somewhat restricted due to the research method, the limited amount of material, and the strong influence of the researcher. Weakness in the research method comes from the subjectivity of the interviewees as they give their views and opinions on a particular question. In other words, what they describe is not necessarily the actual “real-life” experiences they might have had. The aim of the interviews was to consider the answer remnants

in the sense described by Alasuutari [-93], which would mean that even individual answers would be reliable. The number of both interviewees and case projects is, with a view toward generalizations, small, although it is sufficient for qualitative research.

In qualitative research, the role of the researcher is very pronounced and gives him significant freedom in conducting the research. This, however, contains the weakness of the method, as the personal preferences and notions of the researcher can adversely affect the results. In the present study, an attempt was made to minimize this danger by submitting the preliminary research results to three persons for a kind of a panel assessment. The assessment of the research from each of these persons was positive.

The results can be considered valid for the research area, i.e. industrial investment projects in Finland. Some part of the results can probably be generalized even for other types of projects, though generalizing all the results for various projects would be risky. The results, with the possible exception of the leadership views, should not be applied outside project work.

10.3.2 The Applicability by Research Question

The first result — that early warnings occur in industrial investment projects — can be considered quite reliable. All of the interviewees had observed and experienced varying levels of phenomena that could be interpreted as early warnings. Even an interviewee in the basic interviews, who scoffed at the whole idea, admitted to experiencing an inkling-type early warning. The "existence" of early warnings can be generalized to apply to all project work. In addition, the positive answer concerns the state of knowledge and time available of early warnings. The answer is subject to certain reservations when the scales are very inexact (vague) and therefore almost solely the assessments of the researcher. Although the result is utilized in the form of the Decision Support model, it (as all inexact and vague information) should be regarded with caution. For these reasons this part of the results is difficult to generalize.

The description of the nature of the early warnings phenomenon can generally be considered applicable to project work when it organizes the phenomenon and adds to the understanding of it. Numerous interviewees recognized the early warnings phenomenon; hence, it can be considered fairly commonly known. The communicational character of the detection phase is obvious and therefore fully generalizable; the same can be stated about the project risk management character of the early warnings phenomenon.

The type categorization of the main groups of early warnings developed in this study has chiefly the same content as the summary of preliminary signals derived from on the basis of the literature. This lends authority to the generalization of these results as applied to investments projects and, with caution, to other project types as well. The information provided by the literature, too, usually concerns specifically investment projects rather than projects in general. It should be kept in mind that both categorizations are formed by the same person, which can lead to an unintentional error. Some of the early warning groups, such as "expressed by personnel," "managerial style," "communication" and "documents" may be common in all types of projects, and they can even be assumed to be applied in other areas of management as well. The attributes of the descriptive typology — state of knowledge, project parties, project phases and form of occurrence — are on such a rough level that they can, be applied to all project work if necessary.

The similarities between project problems and their causes was already noted in the literature surveys and the empirical part of the research strengthened this impression. The categorization of project problems and their causes are very similar to the ones analyzed from the literature; they can probably be used in other project types as well, although in that case the categorizations may not be fully compatible with the project type. Like the type categorization of early warnings, this categorization, as well, may be plagued by an unconscious error by the researcher.

It would be somewhat venturesome to generalize the results of the cross tabulations of "early warnings - project problems" and "problems - causes" in such a way that the percent figures show the frequency of early warnings in different situations. This is due to the fact that the number of results depends upon the number of questions. On the other hand, a qualitative generalization of the cross tabulations (i.e. this type of early warning refers to these types of problems) is possible in all types of projects, assuming that the said types of early warnings and problems can occur in the project in question.

Using early warnings in some form in project management and control proved to be surprisingly common, as understood from the basic interviews. Several participants in the basic interviews implied that they use early warnings in their daily work. In the case projects, however, utilization of early warnings was not observed. None of the interviewees had a systematic method, or the equivalent, for discovering early warnings, and neither was such a system discovered in the research on the case projects. The view that early warnings can be generally applied in project management is supported by the following considerations (among others): A) The early warnings phenomenon apparently has a risk management related character. B) The study of communications is familiar with early warnings. C) Project management literature contains references to the phenomenon [Lientz et al. -95] and [PMBOK -95]. The details of the form and model of utilization should be adjusted for each case.

10.3.3 Note

The information supplied by the occurrence distributions of the problems and their causes analyzed from the material should not be used for purposes other than those for which it has been used in this research. The distributions only show how many early warning elements the interviewees have, connected with various project problems according to the interpretation of the researcher. The results expressly do not show the frequency of certain types of problems in projects.

10.3.4 The Area of Applicability of the Entire Theory

When the results are examined as a whole, or as a new addition to the project management theories, the boundaries within which the theory is applicable should be defined. These boundaries are largely set by the applicability areas of these parts of the theory discussed above.

The rationality of decision-making is the second crucial factor of the theory. While forming the theory, it has been assumed that the actors (participants) in the project are rational in their actions. The premise is that in a project, rules that are mainly common to all participants are in effect in a project.

The common rules of projects include:

- National and international laws
- Contracts between firms
- The delivery conditions of international delivery agreements

- Cultural customs, both those specific to projects and those generally accepted
- The requirements of economy
- The objectives of the project
- Organizational “orders,” i.e. the rules of authority

No participant acts completely arbitrarily in accordance with his impulses, as can happen in governmental action in e.g. a dictatorship [Sivonen -98].

In practice, however, decisions made by the actors are not fully rational, since they do not possess all of the relevant information required for the decision. Therefore, they are forced to act based not only on definite knowledge but also on assumptions, experience and preferences. Decision-making is at least partly dependent on emotions. The model developed in this study endeavors to increase the rationality of decision-making.

It is relevant to note that a project must proceed toward its end result within the defined confines of technical, financial and resource availability considerations. A certain logic of events exists in a project; e.g. the designed schedule is based on this.

A significant difference between projects and international (or national) politics is that a project has no enemies (at least within the project) as is often considered to be the case in the anticipation of future events between nations. In a project, all parties strive to finish the project, even in the case that the project parties have divergent financial interests. No project party endeavors to injure another. The personal objectives of some actors (players), such as a wish to secure an employment or even pure lust for power, can affect the project both positively and negatively.

10.4 Increasing the Body of Knowledge

Ansoff introduced his theory of the existence of weak signals and their uses in the management of corporations in 1975; in the book published in 1984, he extended his ideas. Ansoff has shown no research results to support his theory. Several writers connect the early warnings conforming to the Ansoff theory with strategic management; at the same time, the idea itself is controversial [Mintzberg -94a]. Ansoff’s theory can be divided into partial theories, of which a crucial one is naturally the existence of signals. It is significant that the study of communication, as well as corporate bankruptcy studies and the fields of strategic security and military intelligence, recognize the existence of weak signals. The field of Finnish future studies, as well, has begun to research weak signals. Together these indicate that Ansoff’s theory receives some support. This study shows that it apparently is possible to detect early warnings in project work that fulfill the criteria formed by Ansoff’s theory for the existence of signals.

The testing of that part of Ansoff’s theory which asserts that the state of knowledge and the time available of the detected signals vary remains inexact in this study as regards the project environment. The study does seem to show that the early warnings detected in project work have varying information content; this is in accordance with Ansoff’s theory. No unambiguous scale can be defined for the measurement of this information content, and the scale remains very inexact. The situation is the same as regards the time available of early warnings: the time available seems to exist, but it cannot be measured on the basis of the research material.

The Weak Signals Strategic Issue Management system can be considered the other main part of the Ansoff's theory. The applicability of this system as such to project work is not examined in greater detail in the empirical part of the present

study, though it becomes evident in the context of the analysis of the research results and the development of the Decision Support model that Ansoff's WSSIM does not appear to be suited to project work without adjustment. One can say that the study appears to show that the basic part of the Ansoff theory is applicable to project work, although the theory in its broader form is not. This study extends the area of applicability of Ansoff's theory to project work.

This research shows that the existence of early warnings and their utilization in project work is already familiar to several project work professionals in a kind of unstructured, often almost unconscious, form. A similar observation can be made regarding project management literature. This study can be considered to have added a so-called previously known, but little researched, element to the theories of project management, which consists of project control with the aid of inexact information. The characteristics of this phenomenon are explained in the present study, which in turn adds to the knowledge basis of project management theories.

As noted in the literature survey, the project problems that early warnings help to forecast are risks (cf. the definition of a risk). The empirical part of the research uses the term project problem instead of the term risk. The character of project problems used in this study includes both the case where the problem has already become concrete and the case where the problem is only potential, i.e. exists as a threat (a risk). In this sense the early warnings phenomenon can be integrated into of the theories on project risk management. These theories are only vaguely familiar with early warnings (risk symptoms), although Niwa [-89] considers risk alarm a requirement in project risk management, and the phases of work of project risk management include identifying risks.

Nevertheless, the tools of risk identification do not seem to specifically include the identification of early warnings. With the help of the information technology application proposed in this study, the Decision Support model is integrated into project risk management as one of its methods; the study does not test the usefulness of this idea, and it therefore requires further research. Despite its limited character, this study fortifies the risk symptoms element of the theories on project risk management, which can possibly increase the predictability of the materialization of risks. This, however, requires further study, as does extending the idea so that it could become a part of a general risk management theory.

10.5 The Application and Use of the Results

As noted in the discussion regarding figure 8.1, the type categorization of early warnings appears useful in detecting and identifying early warnings. All of the results of this research can probably be used as tools for identifying and interpreting early warnings, both manually and as part of a possible database application.

The results along with the model describing the character of the phenomenon, make the early warnings phenomenon more organized and thereby assist in understanding it. The Decision Support model of the results can function as a tool for the anticipation of future development of project problems, thus helping the project management in project risk management. The model should be conceived of as a mental approach rather than as a strict model of action. The proposals made in this study as to how the results could be utilized as a part of a project risk management database application may form a starting point for e.g. a commercial computer program.

The results of this research do not by themselves offer the opportunity to build a decision making model or program which would allow direct conclusions about the various responses that might be taken when a risk emerges. The results should not

be used for assessing the frequency of project problems and/or their causes in projects.

The results can possibly be used as a basis for educational material and independent study. First of all, one should recognize the existence of early warnings, after which it is possible to begin to educate oneself in their utilization.

10.6 The Need for Further Research

If the early warnings phenomenon is to be effectively utilized in project control and leadership, further research is necessary to augment the area of applicability of the early warnings phenomenon. The necessary research would include studies that address the questions left open by the present study.

- Examining the weak signals present in preliminary phases of investment projects (brainstorming, prefeasibility, feasibility) may improve decision-making in those projects. This appears to be quite an extensive topic for research.
- The applications of the IFVR and the concept of epistemic value to project work.
- More information on the occurrence of early warnings, and additional elements for the database on early warnings - problems - problem causes - responses.
- The utilization possibilities in the leadership sector; this is a very broad area of research.
- The further development of the proposed knowledge-based project risk management model so that early warnings could be employed in it. The testing of such a model would be a crucial part of the work.
- Additional research is also required to enable the inference of responses in various problem situations (in different parts of the decision-making matrix), especially in chaotic project situations.
- A more detailed study of the relation between project risk management and early warnings, especially as regards the probability of risks. The ways in which the matrix in the Decision Support model (figure 9.1) could be extended to include the probability of the materialization of a risk as an added dimension, and the gathering of the basic database.

Terminology

Readers may wish to familiarize themselves with project terminology with the help of a number of books for example the [Kerzner-95]'s or [Lewis-93]'s book. A wide-ranging treatment of the subject, its terminology and its scope can also be found in [PMBOK - 95]. The following sources contain glossaries related to project work:

[Nordnet-85]
Nordnet, 1985, *Nordic Project Management terminology*, the five Nordic Project Management Societies, Oslo

[AACE]
American Association of Cost Engineering, *Cost Engineers` Notebook*, Project terminology,
Index AA-4.000, AA-4.002, AA-6.100.

[Selogie -85] liite VIII pp. 348...372
Selogie, Louis Allyn, 1985, *The Evolution And Development Of The Discipline Of Program/Project Management In The High Technology Environment (Research, Development, Military Regulations, Systems)*, Doctoral Thesis, University of California, Los Angeles.

[Lewis -93] pp. 431...435
Lewis, James P., 1993, *The Project Manager's Desk Reference*, Probus Publishing Comp. USA

Basic Interviews
The first thematic interview round in the study.

Case Interviews
The thematic interviews conducted in conjunction with researching the case projects.

Cause
The causes of problems in this study signify those factors or phenomena that are perceived to have led to the problem.

Early Warning
An early warning is an observation, a signal, a message or some other item that is or can be seen as an expression, an indication, a proof, or a sign of the existence of some future or incipient positive or negative issue. It is a signal, omen, or indication of future developments.

Element
An element is a research observation that the researcher has extracted from the case interviews. It is the core thought in the reply the interviewee has made to an interview question; especially something the interviewee has suggested as an early warning signal in response to a project situation or project problem presented in the question.

Form of Appearance
The source and manifestation of an early warning are not independent of each other, and in this study their possible combinations are called forms of appearance. Forms of appearance that are incompatible were eliminated during analysis. Incompatible combinations include e.g. document/action, document/non-verbal.

Forms of Occurrence
This term denotes the form in which we perceive early warning signals. It is closely related to the concept of "means and forms of communication" presented in [Wiio-89].

Fundamental reason
See Cause.

Interview (replies) element
See Element

Issue
Ansoff [-84] defines:
- *A strategic issue is a forthcoming development, either insider or outsider of the organiation, which is likely to have an important impact on the ability of the enterprice to meet its objective. An issue may be welcome: an opportunity to be grasped in the environment, or an internal strength which can be exploited to advantage. Or it can be unwelcome: an external threat, or an internal weakness which imperils continuing success, even survival of the enterprise.* [Ansoff, p. 337]
- *Issue outcome, result; a flowing, going or passing out* [Webster´s -92, p. 515]
- *"An Issue is a Potential problem, situation, or Factor that can negatively impact the project."* [Lientz et.al. -95, p. 136].

Method
Methods are procedures or techniques that can be used to assist the detection of early warnings.

Project management
A broad concept encompassing everything within the project activities according to the definition in [PMBOK -95]; [Artto-98].
PMBOK presents the following divisions of project management: Project Integration Management, Project Scope Management, Project Time Management, Project Cost Management, Project Quality Management, Project Human Resource Management, Project Communication Management, Project Risk Management and Project Procurement Management.

Project Control
Control = the management effort, either preplanned to achieve the desired result or adopted as a corrective measure prompted by the monitoring process. [AACE, p. AA-4.002 / 4 of 19]

Project problem
In this study, "project problems" signify phenomena that interfere with the completion of a project. They usually bring about immediate concerns for the project management.

Project Parties

Stakeholders partaking in the investment project.
- Client: The owner of the project, a company using the project after completion, the leadership and personnel of such a company.
- Consultant: An expert working in the project; a company with a direct business relationship with the client, usually as a planning agency, producer of project guidance services etc.
- Supplier: A company that plans, produces, and usually also installs, the equipment needed in the project.
- Contractor: A company carrying out tasks at the project realization site. The performance usually doesn't include production, though it does cover the delivery of different materials.

Project phases
The approximate period of project activity as described by the life span of the project in project theory.
These include:
a) Preliminary engineering phase, b) Engineering phase, c) Procurement phase d) Delivery phase, e) Site phase, and f) Start-up phase.
- In this study, the engineering phase covers both the preliminary engineering phase that takes place prior to the decision to carry out the project, and the engineering and designing done during the project itself. The bulk of the engineering phase is completed before commissions are made. Because the project phases overlap, engineering continues nearly to the completion of the project.
- The procurement phase is in this study considered to extend from the invitation of bids to the actual commission.
- The delivery phase covers the period from the ordering of the equipment to their delivery to the construction site.
- The site phase includes all work at the actual on construction site, even the start-up phase.

Project work
This term is used in the general meaning of "an undertaking carried out in the form of a project."

Response
Response denotes the tasks or activities decided upon due to the early warnings and/or the impending problem (risk).

Sign
"*mark or gesture which conveys an idea or meaning; plus and minus sign, he nodded as a sign of agreement."* [Webster´s -92, p. 925]

Source
The concept "source" is related to the concept of "sender" in mass communications. For the purposes of this study, however, "sender" was not seen as appropriate; the material includes several elements that have no conscious human sender in the way messages do. In addition, there are numerous elements in the material that can be considered to reflect observation or internal reasoning.
The term states the context in which an early warning is detected, and who or what introduces the warning.

The stages of early warnings in this study

Inkling denotes the stage where the signals are hardest to perceive, recognize, and interpret. "A gut feeling" is a good description of this stage. The credibility of the signals is very low. An anticipation can be experienced at any point in time. The threat the anticipation implies can manifest itself either quickly or over a longer period.

An Inexact Warning is easier to detect than a mere anticipation. It can even be recognized, but it usually presents itself very early in the project, when it is still impossible to know its results with any certainty.

A Clear Warning is more pronounced in all its characteristics than an inaccurate warning (though the border is blurry). They cannot be measured (given a numeric value), however, and therefore their credibility remains weak.

An Exact Warning is either measurable or otherwise easy to interpret and apparent to all parties; this gives it a high credibility.

State of Knowledge

A five-step scale of signals presented by Ansoff, which conveys the level of the information provided by the signal to the recipient. The degree of accuracy or inaccuracy of the information; the fuzziness of the information. The scales are presented on the chapter 3.1.2.

Time Available

According to Ansoff's definition, time available is the time that may be used for counter measures before the impending problem or risk reaches full impact on either the company or the project.

Weak Signals / Strong Signals

Ansoff gives the following definition of a strong signal [Ansoff -84a p. 22]:

Issues identified through environmental surveillance will differ in the amount of information they contain. Some issues will be sufficiently visible and concrete to permit the firm to compute their impact and to devise specific plans foe response. We shall call these ***strong Signal issues.***

or

contains exactly the information required for Strategic Planning. Enough is known to compute both the probable impact of the discontinuity and the profit impact of the response.

His definition of a weak signal is:

Other issues will contain ***Weak Signals****, imprecise early indications about impending impactful events.....*

or

all that is known (of them) is that some Threats and Opportunities will undoubtedly arise, but their shape and nature and source are not yet known.

Warning

Abbreviated form of the term "early warning".

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Appendix A

Table 4.2

Early Warnings (Symptoms) of Project Problems on the Basis of Project Literature

Total of the materials

Code is at the end of table

Warnings expressed by personnel, project group		
Interpersonal behavior		
- Unproductive gamesmanship, manipulation of others,.....	K4	
- The atmosphere is cold, strained unpleasant and forma	K11	
- What is the general mood and atmosphere in the project?	K12	p. 110
- ...every one is writing “protection” memos. Previously, everything was verbal....	K4	
- With customer - contractor relationship....	K4	
- Argumentative sessions at meeting	K9	p.144
- insubordination	K9	p.144
- excessive absenteeism	K9	p.144
- power struggles (faction)	K9	p.144
- spread of negative rumors	K9	p.144
- sabotage of other people´s work	K9	p.144
- Subtle sabotage, fear, disinterest, or footdragging	K8	p.405
- Activity-oriented	K8	p.405
- Confusion, conflict, ineffiency	K8	p.405
- Lethargy/unresponsiveness	K8	p.405
- Cliques, collusion, isolation of members	K8	p.405
Non-verbal information		
- Keeping alert to non-verbal clues can reveal much about the political environment....	K9	p.90
- The first signs of problems will not be in missed schedule and poor work. It will be seen in the members´ eyes, facial expressions, voice, and body language.	K12	p. 125
- People who talk in low voices and look down at the floor repeatedly are people who know something is in trouble.	K12	p.146
- The meeting provides an opportunity to revise, update, and add to the store of knowledge that the team possesses. This knowledge includes facts perceptions experience judgment and folklore.	K10	
	K8	p.372
Concealing difficulties		
- hidden feelings, conflicts avoidance at all costs	K4,	
	K8	p.405
- Some people will massage information to avoid alarming you when you should really feel alarmed. They may say something like, 'Yes, we are exceeding the budget. But that is only temporary as far as I can tell.'	K9	p.78
- People withhold information on a problem in the hope that the problem will go away	K10	
	K8	p.368
Attitudes and commitment to the project		
- Confusion and a loss of enthusiasm and motivation.	K3	
- It might signal a potential cost or schedule problem in the contract, regardless of trite contractor statements like "We're too busy getting the important job done..."	K6	
- The involved individuals may redirect their interest, energies, and commitment and, in extreme cases, search for alternative employment within or outside the company.	K3	
- Low commitment to project objective	K4	
	K8	p.405

- outright refusal to perform	K9	p.144
- Low level of involvement and enthusiasm	K8	p.405
- Image problems (credibility)	K8	p.405
- Lack of discussion about project	K12	p.186
- No discussion of task status	K12	p.186
- Interfacing and dependent project are attempting to become more independent	K12	p.186
	Honko	
Turnover rate of personnel		
- ..sign are attempts to jump ship and move to another project.	K12	p.146
- high turnover	K9	p.144
- Difficulty in betting resources for project	K12	p.186
- Project team members are resigned	K12	p.186
- Project team members are trying to leave project	K12	p.186
Professional competence of personnel		
- Poor quality of workmanship	K9	p.144
	Honko	
Personnel resources	Honko	
Project manager, management		
Project manager as a person		
...project manager takes only one perspective,.....they can focus on only one thing. The result is a project plagues with serious problems.	K9, K8	p.353
- The project manager maintains one-way contact with the team members, speaking but neglecting to listen.	K10 K8	p.353
- The project review meeting, which should maximize the two-way flow of information, turn out to be one-person shows, with the project manager talking.	K10 K8	p.353.
- Project manager seems to have problems	K12	p.186
Management		
- Uninvolved management	K8	p.405
- Management vacillation need for information on project	K12	p.186
- Difficulty and elapsed time in getting management review and approval of work and action	K12	p.186
Insufficient management resources	Honko	
Project planning and objectives		
Preliminary planning, errors made during the brainstorming phase	Honko	
Ambiguous objectives		
- Unclear project objectives and fluid commitment levels from key participant	K4, K8	p.353
- Undefined deliverables	K9	p.15
- Shifting goals and priorities	K10	
- Lack of clear milestone for project	K12	p.186
Project planning		
- Probably one of the earliest indicators of potential future cost and schedule problems is a given contractor being unable to get a Performance Measurement Baseline (PMB) in place, for whatever reason or excuse.	K6	
- Replaning	K6	
- Project objective and scope get cut back	K12 Honko	p.186

Observations in the bidding phase		
Project control		
Progress of the project, quality level		
... Monitoring of actual allocation against the plan can provide early warning of lack of manpower or lack of work.	K7	
- noticeable change in performance levels for the team and/or for individual team members always should be followed up. Such changes can be symptomatic of more serious problems, such as	K10	
- Quality problems	K8	p.405
- Frequent surprises	K8	p.405
	Honko	
Labour effectiveness		
- Poor working discipline	K7	
- Poor moral	K7	
....walk onto any project site anywhere.....	K8	p.462
- Low performance	K4	
	K8	p.353
- Low productivity	K9	p.144
Delay monitoring systems		
- Schedule variance (C/SCSC)	K6	
- Schedule slips	K8	p.405
- 15 % rule	K6	
Changes in the cost estimate		
- Management reserve (C/SCSC)	K6	
- Cost variance (C/SCSC)	K6	
- Budget slips	K8	p.405
- Contingency plans to the project surface	K12	p.186
	Honko	
Working on the project		
The character of the work initiation		
- False starts	K3	
	Honko	
Changes and disturbances in workflow		
- Number of disturbances and breaks	K1	
- High rates of change in part prompted by mistakes and errors.	K3	
Repetition of the same work		
- high rates of reworks.	K3	
- Duplication of effort	K9	p.15
Organization	Honko	
Communication		
- A lack communications means that the project is in a higher state of risk.	K12	p.146
- Poor communication skill	K9	p.15;
	K8	p.369
- ...increase in flow of paper works....	K4	
Expressed by the project parties		
Participation of the client		
- Perhaps one of the biggest signs of client interest in a project is the time and resources it allocates to the endeavour. ... through minimal contribution of time and resources, ...	K9	p.156
Support of the upper management, CEO		
- Favouriteism by senior management....	K9	p.142

- Uninvolved, disintegrated upper management.	K10	
- Lack of interest in project outside of the project team	K12	p.186
Contractor's problems in devising a schedule		
- Logistic ongelmien huono selvittäminen	K7	
- Ei ole tai huono alitoimittajien suunnitelma	K7	
Documents, reporting		
Quality of the reports		
- ...problem sign is vagueness in the status reports and information.	K12	p.146
Delay of the project		
- Is slippage common, while customer responsiveness is negligible	K2	
- Chronic delays or schedule slippages.	K3	
- Estimating schedule	text Honko	

[Neil -89,K1], [Kezsbom et.al. -89,K2], [Obradovitch -90,K3], [Kerzner -95 -95,K4], [Fleming -92,K6], [Bent -82, K7], [Cleland -94,K8], [Kleim and Ludin -94,K9], [Smith -83,K10], [Harrison -93,K11], [Lientz et.al.-95,K12], [Zeitoun and Oberlender -93], [Honko et.al. -82]

Table 4.3
Summary of the Causes of Project Failure Presented in the Literature

Objectives
- Objectives of the corporation unclear on lower levels of the organization
- Project objectives defined imprecisely
- Project objectives become blurred during the project
- Project objectives and project scope must be clearly defined
Personnel
- High turnover rate of project personnel
- Difficulties with the project group
- Commitment of the project team to the project
- Professional competence and abilities of personnel
Management
- Management failure
- Commitment of the project manager to the project
- Management resources
Upper management, CEO
- Lack of support from upper management / CEO
Client
- Difficulties with the client
- Level of participation of the client
Idea errors in the investment
Project plan
- Errors in the basic assumptions of the project plan
- Project plan poorly drawn, contains errors
- Errors in the cost estimate
- Resource plan sloppily drawn
Risk management
Technical details
Communication
Other
- Adjustment responses
- Difficulties with the basic organization
- Factors external to the company and the project

[Kezsbom et al. -89], [Lewis -93], [Kerzner-95], [Cleland -94], [Harrison -93], [Lientz et al. -95], [Morris, P. -94], [Jaselskis -88], [Lim -87], [Honko et al. -82]

Table 4.5 Project Problems and Their Causes Combined from the Literature

The indicators of project success / failure	references in sources		
A. Technical, Delivery, Performance (Qualitative)	12		
B. Cost related problems, overruns	6		
C. Schedules problems, delay, time	11		
Problems and causes	Tot.	problems	causes
1. Project environment, consultant	30	5	27
Project circumstances			
Government			
Other project parties			
Line organization			
2. Ambiguous Objectives / Scope	42	11	39
Project objectives			
Project scope			
Project focus			
3. Client with no CEO support	34	7	30
Matters dependent on the client			
Parent company			
Support of upper management			
4. Project Manager as a person	31	7	28
Choice of PM			
PM as a person			
Competence of PM			
5. Management / Leadership, combined	40	13	32
Leadership			
Management			
Details of the managerial style			
6. Organization / Staff	34	15	24
Staffing			
Defining resource needs			
Organization			
7. Personnel / Motivation, in general	90	22	70
Motivation of personnel			
Personnel problems			
Turnover rate of personnel			
Problems in teamwork			
8. Project Planning	79	9	77
Incompetent project planning			
Project planning carried out by an outside group			
Equivocal project planning			
Definition of tasks			
Difficulties in scheduling			
Cost estimates			
Details of project planning			
The nature of the project			
9. Monitoring / Control	23	5	20
Administration			
10. Communication	12	5	15
11. Engineering, Technical	18	3	16
total	462	102	373

[Kerzbom et al.], [Kerzner -95], [Obradovitch -90], [Lewis -93], [Lientz et al -95], [Harrison -93], [Cleland -94], [Broaddus -91], [Smith -83], [Jaselskis -88]

Appendix B

Table 6.3.2
The Questions in the Basic Interviews

QUESTION GROUP A

The views of the interviewee on project theory and project techniques
The objective of the questions is to confirm the professional knowledge of the interviewee on projects, to find out his specialty and to guide him toward the actual topic.
This part may take up to 15 minutes. The question series can be cut down or some questions may be eliminated.

1. Which activity areas do you think are the most important for the project's success? (Name e.g. five areas)
2. Can the significance and content of the different areas vary depending on the project party — client, consultant, supplier, and contractor? What is the significance of this to the success of the project?
3. Defining a project
4. Setting objectives
5. Project guidelines
6. Organization (Bureaucratic / Ad hoc)
   Classical models, other models
7. Cost control
8. Purchases
9. Monitoring of deliveries
10. Time control
11. Availability of resources
12. Quality of resources, opportunities for selection
13. Planning
    Project planning, Technical planning
14. The significance of monitoring:
    - 14a Planning
    - 14b Purchases
    - 14c Deliveries
    - 14d Construction work
    - 14e Installations
    - 14f Start-up
15. Construction site
    - 15a Management
    - 15b Time control
    - 15c Cost control
    - 15d Subcontractors

QUESTION GROUP B

The experiences of the interviewee

- This is the most important stage of the interview: to get the interviewees clarify their project experiences independently and freely, while leading him to "realize" the existence of weak signals or early warning signals.
- Try to mention situations to the interviewee where weak signals could occur, ask him to talk about the experiences he has had with signals or events/things that could be considered signals.

- This stage may take up to one hour.

1. What are the gravest factors causing failures in projects (name 5)?
2. What factors delay or cause difficulties in projects (give examples from projects)?
3. When are the delays or problems noticed?
4. Can you think of early warning signals (weak signals) that warn of problems? (Pick the examples from the answers of the interviewee.)
5. How have these types of weak signals been detected?
6. Are they detected early enough to allow for controlled responses, or do the responses have to be implemented in an "emergency"?
7. Discussion on a suitable old project based on memory. This is an important stage of looking for concrete events.
8. The kinds of methods the interviewee can think of to detect weak signals. Might there be some "trick" for this?

QUESTION GROUP C

Weak signals

Explain your theory, its basis, some background, if these haven't already been discussed. (This is not strictly necessary, notes Järvenpää).

The objective of this stage is to specify the experiences and views of the interviewee; especially the reviewing of sample projects may be important.

Has the interviewee noted these types of early signals, if they were not discussed in the previous stage?

Does the theory seem credible?

2.1. What types of signals come to mind?

THE RESEARCH FRAME / THEME AREAS questions

Have you experienced problems in the following types of situations; how do these give early warning signals; what kinds of signals?

PROJECT PARTIES / PROJECT PHASE

3. CLIENT

3.0 General experiences of problems caused by the client and the signals related to these

3.1 PLANNING PHASE

- Start-up phase
- Basic planning
- Detailed planning
- Lack of upper management (CEO) support for the project
- The level (or deficiencies) of the client's project experience and project culture
- How an erroneous focus or prioritization of the project is manifested
- How the client expresses his dissatisfaction with the consultant
- What indicates that the client's views are changing

3.2. DURING THE PROCUREMENT PHASE

- The decision-making problems of the client

3.3 DURING THE SITE PHASE

4. THE CONSULTANT

4.0 General discussion about the problems caused by the consultant and the signals related to these

4.1 IN THE PLANNING PHASE

- The first signs of resource problems
- A badly chosen project group

4.2 PROCUREMENT / DELIVERY PHASE
- Monitoring of deliveries not functioning
4.3 SITE PHASE
- Lax monitoring

5. SUPPLIER
5.0 General discussion about the problems caused by the supplier and the signals related to these
5.1 DETAILED PLANNING
5.2 PROCUREMENT PHASE
5.3 CONSTRUCTION
- Bankruptcy of the main equipment supplier
- How do you know that the delivery may be unsuccessful when first visiting the supplier?
- Supplier of complete equipment
- Manufacturer
- How can warning be received of a delay in the delivery of equipment?
5.4 TRANSPORTATION
- Can you receive an early warning from something that the transports are not going to succeed?
- Warning signals occurring during transports?

6. CONTRACTOR
General discussion about the problems caused by the contractor and the signals related to these
6.1 PROCUREMENT PHASE
- What indicates that the contractor is not proficient for the contract being made, or for the work?
- How is it evident when a contractor is not familiar with project thinking and project techniques?
6.2 DETAILED PLANNING
- Do you know examples of signals given by contractors in this area?
6.3 SITE PHASE
INSTALLATION WORK
- Problems of the contractor (too few workers, financial problems)
- What constitutes a weak signal of a delay on the part of the contractor?
- The scheduling problems of the contractor
- Too many activities
- The weak quality of the network
- Deficiencies in the initiation of monitoring
- The poor progress of productivity is an early warning signal
6.4 TEST USE and START-UP

7. COMMON / GENERAL PROBLEM AREAS
7.1 Cultural differences
- Differences in the project cultures of the project parties
7.2 Objectives
- The objectives of the project are not clear
- An objective or specification is ambiguous
7.3 Project management / managerial style
- How is the choice of an unsuitable project manager indicated?
- The project manager does not have sufficient decision-making authority
- How an erroneous/unsuitable managerial style manifest itself. Give examples.

- How does an erroneous managerial style affect the project? How do people react to it, give signals of it?

7.4 Organization

- Give examples that indicate an incorrect organizational form.

7.5 Personnel

- Discuss your experiences of how personnel problems manifest themselves; give examples.
- Unproductive attitudes toward the project

7.6 Project methods / control

- How is a poorly done WBS evident?
- How can you note that the schedule is faulty?
- What indicates an incorrect manner or order of devising schedules?
- The first warning signal of a cost overrun
- What suggests that project management should be tightened or increased? First signal?
- Is the report of the schedule manager sufficient in time control?
- The symptoms of unnecessary Fast Tracking
- A substantial amount of redoing tasks
- Numerous errors and mistakes

7.7 Communication

- Signs of communication problems

7.8 Changes

- When are changes disturbingly numerous; what indicates this?

7.9 External factors

- How actively should these factors be monitored?

Indirect factors

- The general economic situation
- Political changes
- The public opinion on e.g. environmental questions
- Changes in laws and administrative orders

Direct factors

The circumstances of a project, changes in the business environment; not taking this into account to redefine the project.

Table 6.3.3 Work / Project Experience of the Interviewees, Basic Material

Inter-viewee	Project party		Position in the project		Duties in the project		Current duties	Effect of line duties	Age group	Work exper. group	Years in projects group	Number of projects group large	small	others	Areas of projects varied	one-sided	dom.	intern.	Estimate of proj. exp. points	Attitude toward the theory
	primary	secondary	In working life primary	secondary	several	one		on proj. experience												
1	Consultant	Supplier	PM	Middle mgmt	X		Project	positive	4	4	3	5	5		X		X	X	5	5
2	Consultant	Client	PM	Middle mgmt	X		Project	only proj.	4	4	5	2	5		X		X	X	5	4
3	Supplier	Consultant	PM	Eng. duties	X		Project	only proj.	3	3	5	5	5		X		X	X	5	5
4	Consultant	Supplier	Eng. duties	Middle mgmt		X	Line/Proj.	substantial	1	1	3	?	?			X	X		2	3
5	Client		PMgmt	Firm mgmt	X		Line	substantial	5	5	1	1	3		X		X		3	2
6	Consultant		PM	Eng. duties		X	Project	no impact	2	2	2	3	5			X	X		1	1
7	Consultant		PMgmt	Firm mgmt		X	Line	substantial	3	2	2	3	?		X		X	X	3	1
8	Consultant	Supplier	PM	Middle mgmt	X		Line	positive	2	2	2	2	?		X			X	4	3
9	Consultant.		Eng. duties	Eng. duties		X	Line	no impact	2	3	3	4	4		X		X		2	3
10	Client		PM	Firm mgmt		X	Line	great	4	5	1	1	?	X		X	X		3	5
11	Consultant		PM	Eng. duties		X	Project	no impact	1	1	1	1	2			X	X		1	5
12	Client	Consultant	Eng. duties	Middle mgmt		X	Line	substantial	3	3	3	2	5			X	X	X	3	5
13	Supplier		PM.	Middle mgmt	X		Project	only proj.	2	2	4	?	?		X		X	X	5	5
14	Supplier		PM	Middle mgmt	X		Project	only proj.	3	3	4	3	3	X	X		X	X	5	5
15	Client.	Consultant	PM	Eng. duties	X		Project	only proj.	1	1	2	3	?		X		X	X	4	4
16	Client	Consultant	PM	Middle mgmt	X		Project	no impact	2	2	1	1	3			X	X	X	3	4
17	Client		PM	Middle mgmt	X		Line	substantial	5	5	2	1	1			X	X		3	5

Duties in projects		Duties in career life		Age group	Work exp. years	Work exp. classes	Work exp. years	Project Experience year class	Project Experience years	Nmber of projects Nmbr class	
PMgmt	Management of major projects	Firm mgmt	CEO	1	<= 40	1	<= 15	1	< 10	1	<= 2
	Project controller		Task leader	2	<= 45	2	<= 21	2	<= 12	2	3...4
			Group leader	3	<= 50	3	<=25	3	<= 17	3	5...7
PM.	PM			4	> 50	4	<= 30	4	<= 20	4	8...9
	Site mgr	Middle mgm	Production mgr	5	> 60	5	> 30	5	> 20	5	> 10
	Inst. mgr		Dept. head								
	Chief planner		Head of marketing								
Eng. duties	Project engineer	Eng. duties	Planning eng.								
	Project services		Dept. eng.								
	Planning eng.										

Attitude toward the theory: see table 8.5.4 , Eng. duties = engineering duties, PM = project manager, PMgmt = project management

Table 6.3.4 The Project Experience of the Interviewees in the Case Projects

Inter-viewee	Age	Work exp. class	Proj. yrs. class	Number of projects class		Operation areas of projects				Proj. party		Role in project In work life		Duties in project		Current duties	Effect of line dut. proj. size	Proj. size estimate points
				large	small	varied	unvar.	dom.	foreign	prim.	sec.	primary	second.	var.	unvar.			
21	3	2		2	4	X		X		Client		PMgmt	Firm mgmt	X		Line	large	4
22	2	2	1	1	1	X	x	X		Client		PM	Firm mgmt	X	x	Line	small	2
23	3	5	5	4	5		X	X		Client	Cons.	PMgmt	Mid. mgmt		X	Project	large	5
24	?	?	?	?	?		X	X		Suppl.		PM			X	Project		3
25	3	2	2	1	1		X	X	x	Suppl.		PM	Eng. dut.		X	Project	N/A	2
26	5	5	1	2	3		X	X		Cons.		PM	Firm mgmt		X	Line	large	5
27	4	4	1	1	2		X	X		Client		Eng. dut.	Mid. mgmt		X	Line	small	1
28	4			2	3	X		X	X	Cons.	Suppl.	PM		X		Project	large	5
29	2	1	1	1	2	X		X		Client		PM	Mid. mgmt	X		Line	large	2
30	3	2	3	3	5	x	X	X	x	Cons.	Contr.	PM	Firm mgmt	X		Project		5
31	2	2	2	2	3		X	X	x	Contr.	Cons.	PM	Eng. dut.		X	Project	subst.	5
32	3	3	1	1	1		X	X		Client		Firm mgmt	PMgmt		X	Line	subst.	1
33	2	2	3	1	?	X		X		Cons.		Mid. mgmt	PM	X		Line	subst.	2
34	1	1	2	1	3		X	X	x	Cons.		PM	Ins. teht.		X	Project		3
35	2	2	3	1	5		X	X		Contr.		PM		X		Project		4
36	4	5	2	1	4	X		X	x	Client		PM	Mid. mgmt	X		Line	large	4
37	4	4	2	1	5		X	X	X	Cons.	Client	PM	Firm mgmt	x	X	Project	subst.	3
38	5	5	2	2	3	X		X	x	Client		Firm mgmt	PMgmt	X		Line	large	4
39	4	4	3	5	5	X		X	X	Cons.	Suppl.	PM	Mid. mgmt	X		Project	posit.	5
40	3	3	2	2	4	X		X	X	Cons.		PM	Mid. mgmt	X		Project	large	5
41	3	3	5	5	5	X		X	X	Suppl.	Cons.	PM	Eng. dut.	X		Project		5
42	3	1	1	2	4		X	X	x	Suppl.		PM	Keskijoht	x	X	Project	large	3
43	5	5	5	2	3		X	x	x	Suppl.		PM		x	X	Project		4

44	1	1	1	2	5		X	x	x	Suppl.		Eng. dut.			X	Project		3
45	2	2	4	?	?	X		X	X	Suppl.		PM	Mid. mgmt	X		Project		5
46	3	3	1	1	5		X	x	x	Suppl.		Eng. dut.			X	Project		2
47	3	3	4	2	5	x	X	x	x	Suppl.		PM		X		Project		3
48	3	3	4	3	3	X		X	X	Suppl.		PM	Mid. mgmt	X		Project		5
49	2	2	2	1	3		X	X	x	Suppl.		Eng. dut.			X	Project		2
50	1	1	2	2	2		X		X	Suppl.		PM		X		Project		3
51	1	1	1	1	3	x	X	x	x	Cons.	Suppl.	Eng. dut.			X	Project		2
52	2	2	2	2	4		X	x	x	Cons.	Suppl.	Eng. dut.			X	Project		3

Table 6.3.5

The Interviewees in Alphabetical Order

	Last name	First name	Location
	Aho	Kalevi	Imatra
	Ahvenharju	Matti	Espoo
	Alakontiola	Erkki	Oulu
	Auru	Rainer	Kauhajoki
	Autio	Heikki	Helsinki
	Baarman	Göran	Billnäs
	Gustafsson	Christian	Helsinki
*	Haapala	Matti	Virojoki
	Hytönen	Olli	Nummela
	Hänninen	Seppo	Espoo
	Jores	Rauno	Anjalankoski
*	Juuri	Kalevi	Helsinki
	Kärkkäinen	Kyösti	Varkaus
	Käär	Jaakko	Espoo
	Laurila	Anna-Maija	Helsinki
	Leppänen	Lassi	Varkaus
	Levonen	Markku	Vantaa
	Lindström	Leif	Savonlinna
	Luomakangas	Jorma	Kouvola
	Malmivuori	Seppo	Espoo
	Markkanen	Ari	Varkaus
	Millner	Dan	Espoo
	Mänttäri	Eero	Espoo
	Nikkilä	Matti	Varkaus
	Nyysönen	Tapio	Varkaus
	Olakivi	Jorma	Varkaus
	Palmu	Kari	Varkaus
	Paltschik	Christer	Espoo
	Pulliainen	Seppo	Vantaa
*	Rickman	Harry	Helsinki
	Rintanen	Mikko	Espoo
	Salervo	Taneli	Espoo
	Sarkkinen	Reijo	Espoo
	Savukoski	Hannu	Espoo
	Suokas	Raimo	Porvoo
	Talsio	Martti	Vaasa
	Tiilikka	Matti	Seinäjoki
	Yrjölä	Kari	Espoo
	Vesanto	Petri	Vantaa
	Witting	Lars	Helsinki
	Anonymous	persons	5

‘) interviewed in both the basic and the case interviews

Table 6.7.2 Early Warning Groups Analyzed from the Material, Distribution of Elements into these, Brief Descriptions, Examples

Early warning Signal	Nmbr Basic	Nmbr Case	Per cent Basic	Per cent Case	Description	Quote from interview (Translated from Finnish)
Gut feeling	**22**	**11**	**5,2 %**	**2,7 %**	Gut feelings are the most difficult signals to detect, identify and interpret.	*- A suspicion may arise of being behind the schedule (H2)* *- Sometimes one has the gut feeling that it just won't work but can't really get a hold of it (H8)*
Personnel, project group	**120**	**92**	**28,6 %**	**22,7 %**		
Non-verbal information	22	6	5,2 %	1,5 %	Various non-verbal messages observed in negotiations are some of the most important reference signals in negotiations	*- Even when the demands were unrealistic, they promised to fulfill all of them (H16)* *-The contractor asks about things that are explained in the bid documents (H1)*
Personnel behavior	86	60	20,5 %	14,8 %	A large group of various behaviors	
Personnel behavior in general	13	17	3,1 %	4,2 %	The abnormal or inconsistent behavior of the contractor or supplier almost always signifies problems for the project	*- An atmosphere of "we're in no hurry yet" (H16)* *- If you propose a change to the contractor and his reaction is "that'll cost a lot" the conclusion is the same as before (this will crash) (H10)*
Mood, attitude	10	20	2,4 %	4,9 %	A dissatisfied atmosphere among the personnel	*- Mood tells you whether there are problems or not, can't be identified (H11)* *- Lowered morale, avoiding things, lowered (group) spirit (H4)*
Conflicts	15	15	3,6 %	3,7 %	Conflict situations	*- All sudden unusual events with the client can be signals (H8)*
Talk behind the back	8	1			Unnecessary criticism, rumoring	*-Problems are discussed behind one's back, no direct communication, lots of indirect expressions. (H3)*
Passing things back and forth	7	1			No progress in matters within the organization	*- Passing tasks around in the organization: not my business, somebody else's (H16)*
Speaking frankly	9	3			Lack of trust expressed very clearly	*- Sometimes people are frank and sometimes you just notice (H4)* *- Sometimes people will tell you or even ask you to your face (H6)*
Commitment	10	2	2,4 %		Weak commitment to the project is apparent in several ways.	*- Caustic opinions of experienced project personnel (H16)* *-Here's my work and me, I don't care for anything else. The client is a dunce, he doesn't know a thing, and won't learn either (H8)*
						- People don't care about things, indifference (H17)

Formation of cliques	4	1				*- Cliques of the managerial personnel, defining their territory (H15)*
Authority disputes	3					*- It's pretty common that people will go past you or disregard you, usually they go past you to others (H12)*
Making excuses	4				Typical for consultants, though not rare for contractors either	*-Delay, contrariness, holding things up, they're great at making excuses*
Lack of contact with the client		9			A phenomenon specific to a project	
Too inflexible planning		4			When noticed	
Lack of resources detected		13		3,2 %	When noticed	
Personnel turnover	7				A "phenomenon" especially prevalent with consultants	*- Putting new people on the job or proposing it (this could also mean a lack of resources) (H11)*
						- Especially if the client complains they often put new people on the job (H16)
Professional competence	9				The project and other skills of the personnel	
Project manager, management	**7**	**35**	**1,7 %**	**8,6 %**		
Project manager as a person	4	9			The personal qualities of the project manager	*- Hesitancy in the management, this shows up in exaggerated hurry and rush*
Managerial style	3	26		6,4 %		*- Assigning the planning to somebody and then just waiting*
Project planning	**26**	**55**	**6,2 %**	**13,6 %**		
Preliminary planning		16		4,0 %	The level and quality of preliminary plans	
Project plans	9				The deficiencies and inadequacies of the preliminary plans	*- If you know that the preliminary planning has been done badly, then you expect failure (H7)*
Bid material	9				The deficiencies and inadequacies in the bid material	*- Are the plans that we are provided with for our use or does the supplier give us some sort of copies from an earlier project (H11)* *- Scope has been too limited (H14)*
Contract	8	24		5,9 %	An incompetently drawn or ambiguous contract	*- The framing and contents of the contract, you can deduce a lot from those (H15)* *- That's apparent already in the contract and the definition of scope (H3)*
Bartered contract		7			A contract deliberately rigidly designed	
Design and contents of the budget		3			A poorly designed budget, with insufficient basis	
Preliminary material		5			Reference material	

Project control	**39**	**21**	**9,3 %**	**5,2 %**		
Progress control	18	15	4,3 %	3,7 %	A classic progress control method based on the schedule	- *Schedule delays (H16)*
Monitoring	16	6	3,8 %	1,5 %	Classic methods of project work	
Monitoring, in general						- *(What makes your warning bells ring?) Little details that are promised to be ready in no time, but the next time you check nothing has been done, and nobody cares to intervene (H16)*
Availability of material					The contractor's or supplier's ability to acquire material	- *The contractor can't acquire the materials (H10)*
Quality of work					Pace and quality of work at the site	- *The final touches aren't put to the work, moving on quickly to the next phase (H16)*
Pace of work						- *Unusual sounds or the absence of the regular sounds at the work site tell you whether the work is going on as usual (H1)*
Budget corrections	5				Unfounded attempts to change the budget	- *When the prices are to be checked, someone begins to look after their own interests* - *Internal moment transfers (H13)*
Work on the project	**44**	**44**	**10,5 %**	**10,9 %**		
Work initiation	20	3	4,8 %	0,7 %	The efficiency of work initiation; sluggishness in this is often very revealing	- *The situation is often revealed in the kick-off meeting (H3)* - *Work initiation drags (H8)* - *If it looks like people are just small talking with you instead of showing results (H8)*
Mobilization					Mobilization at the site, slow initiation of work and/or poor turnout at the site	- *Looks from the sidelines, not officially, how the mobilization goes and how the situation develops in the beginning, interferes right away if something is going wrong (H3, H8, H13)*
Initial information / lack of it	17	29	4,0 %	7,2 %	Lack of the initial information of planning; the absence of this is typical for projects	- *The first serious signal is if the initial information isn't received (H12)* - *Initial information missing,, its absence anticipates (H15)*
Redoing the same things	7	2				- *If the same change is gone over again and again (H17)*
Organizational form		10		2,5 %		
Communication	**45**	**22**	**10,7 %**	**5,4 %**		
Communication	28	11	6,7 %	2,7 %		
General problems					Messages don't seem to reach the receiver	- *Misunderstanding others (H3)*

						- If the communications don't work, you'd better be prepared for trouble *The critical path moves to where the information is formed (H12)*
Tone of messages					The tone of messages and especially changes in it indicates that something has occurred	*- The clarity of the documents gives a vague indication (H9)*
Letters					Writing letters	*- People start writing memoranda and letters (H17)*
Conflicting information					Conflicting information	*- Diverging opinions when matters are presented to the client, on the part of the client (H2)*
Hints	17	11	4,0 %	2,7 %	Information about problems is often received in the form of hints	*- Hints and insinuations made by being dissatisfied with the schedule or with the scope of the work (H6)* *- Rumors going round about payments, hints from other suppliers* *- The grapevine often tells about a bankruptcy threat, hints, personal contacts, an (inexperienced) outsider has a hard time noticing this (H3)*
Expressed by the parties	**44**	**39**	**10,5 %**	**9,6 %**		
Typical for the client	40	39	9,5 %	9,6 %		
Decisions not received	15	17	3,6 %	4,2 %	Delays in decision-making, especially when caused by the client, is one of the most serious problem-causing factors in projects	*-The attitude of the client: whether they are determined or vacillating even in small things, that's a sign (decisions) (H1)* *- Lack of decision-making power, delays begin (H5)*
Withdrawal of trust	6	1			A third party notices the problem	*-Often about how the client and the supplier begin to make decisions without the consultant (H14)* *-The client begins to find out the consultant's opinions via the supplier and no longer goes through the consultant (H13)*
End users	5	10		2,5 %	Testing personnel recruited late in the project	*-The client doesn't have the personnel in the planning phase that takes over the project in the testing phase (H13)*
Freezing	4	4			The "decisions not received" group also means that the design principles cannot be "frozen"	*-Lots of new ideas are brought out in every single negotiation, the process frame can't be "frozen" (H1)*
Highest management, CEO	2				The highest management (or CEO) does not support the project.	
Additional information	3	1			A very typical sign for the bidding phase	*- People want more accounts of more options (support of management) (H16)*
Purchases	3	6			Related to purchases and procurement	*- The style of making purchases, whether planning and manufacturing go together or not (H6)*

Supplier / Contractor	4					
Advance billing	4				Endeavors to institute advance billing may appear as early as in the contract negotiations or later as a request to alter the billing method	- *Endeavoring to get advance billing (H3, H2)*
Documents, reporting	**60**	**42**	**14,3 %**	**10,4 %**		
Reporting	15	5	3,6 %		The quality and tone of the reports as well as delays in them are revealing factors	- *Vagueness of reporting (H15)* - *The longest (wordiest, explanatory) delivery monitoring report is often the poorest (H16)* - *Reports don't arrive on time (H16)*
Quality and reception of schedules	31	18	7,4 %	4,4 %		
Balanced character Logicality Receiving / Quality					The quality of schedules can be evaluated on the basis of their appearance: balance, readability	- *You have to be able to understand the important dependencies even if they aren't drawn out (H9)* - *If the contractor can't make a decent schedule, resource plan, site plan etc.. (H12)*
Technical plans	7	18		4,4 %	Changes of plans, especially when abundant, are warning signals	- *Deviations, noted at the end of the engineering phase, from the project requirements stated in the plans anticipate a possible delay (H15)* - *Requests for alterations that can't be avoided are an early signal of cost overruns. (H2)*
Incorrect revisions	3				The presence of old drawings at the site is a sign of problems in communication.	- *Incorrect document revisions (H11, H12)*
Ambiguous responsibilities	4	1			This situation indicates a problem in organization.	- *Ambiguity in the responsibility areas, people don't recognize them(H9)*
Differences and deficiencies in project culture	**22**	**39**	**5,2 %**	**9,6 %**		
First contact (with the client)	11	8			The observations made during the first meeting, and first impressions, are a good source of signals	-*Even the first meeting reveals inexperience of the project management, and one gets the feeling that there will be trouble (H15)*
					(according to interviewees)	- *The inexperience or ignorance of the client is apparent in that the client doesn't*

						know to make requests (for information, services, reports etc.)(H7)
First impression		4			Observations made during meetings with the client	*- If a helper comes to meet you, you can draw some conclusions from that (first meeting) (H16)*
Project terminology	7				Differences in the project terminologies used by the parties, or unfamiliarity with project terminology, indicate lack of experience with projects	*-About the firm management and its organization - I conduct an interview, check the quality of the technical personnel etc. (H14)* *-Often already in first discussions, logical differences in views, terminology (H8)* *-Whether a person is used to working in projects, knows his tasks, if not, the tasks may get mixed up (H16)*
Lack of experience	4	16		4,0 %	Lack of experience is apparent soon and in several ways	*-Uncertainty regarding technical matters indicates ignorance (manager) (H2)* *-Absence of an understanding of the whole, doesn't realize the significance of different parts (manager) (H2)*
American culture		11		2,7 %	A situation specific to a particular project	
External source	**10**	**5**	**2,4 %**	**1,2 %**	External sources; may give hints, or may contain definite numerical data	*- Not one bankruptcy comes as a surprise, there are clear signs: requesting payment in advance, giving discounts, changes in cash flow, hints from competitors (H13)* *- General signals: somebody is only sold to for cash payment, credit standing (H3)*
Total	**420**	**405**	**100,0 %**	**100,0 %**		
Miscellaneous groups	19	16				
No early warning signals procured Difficult to procure warning signals	15	2			Detecting early warnings difficult	*- The incompetence of the contractor isn't always obvious in advance (H2)* *- (The client's problems) Don't give early warnings, come up out of the blue. (H4)*
Total of all	454	423				

Appendix C

C. Understanding the Characteristics and Structure of Early Warnings

C.0 The Contents of the Chapter

This chapter presents the mainly descriptive typology of early warnings developed in the study Nikander [-98]. This categorization partly parallels and partly complements the type categorization of early warnings. First, the chapter defines the attributes used for this analysis. Second, these attributes are discussed one by one. Third, it examines the cross tabulations of the main groups of type categorization from the study Nikander [-98] and the attributes used in the present analysis. In addition, it discusses the differences and similarities between these categorizations.

C.1 The Attributes Used in the Analysis of Descriptive typologies of Early Warnings

The interview material was analyzed element by element for several attributes. The following factors were chosen as attributes that describe the phenomenon: 1) the exactitude of the information, i.e. the state of knowledge or the strength of the information; 2) the time available, 3) what project party the element refers to; 4) in which project phase the early warnings indicated by the element occur; 5) what forms of early warnings are detected.

These attributes were designed partly before the analysis on the basis of the question frame and partly during analysis on the basis of the feedback from the material. This chapter first examines the results attribute by attribute, and later progresses to various cross-tabulated examinations. In general, the phenomenon appears to be characterized by great scope and variety. The difficulty of interpreting early warnings without knowing the circumstances of detection was apparent in all stages of analysis. In this research, these circumstances are is to some extent represented by the context of the question answered by the interviewee regarding the element under consideration, but only roughly.

Again, it should be emphasized that the analysis was conducted by a single person, and the results are therefore to some extent subjective.

C.2 Attributes that Describe the Phenomenon

Regarding the descriptive attributes, the case material strengthens the impression given of the phenomenon by the basic material. Consequently, this material is not presented separately in this study. The material also shows that the case projects are to some degree unique in this regard as well.

C.2.1 The State of Knowledge of the Early Warnings (Magnitude, Level of Exactitude)

One of the research questions is to find out whether phenomena of the Ansoffian weak signals type occur in project work. All the interview elements were therefore evaluated on a scale of exactitude according to the information they provided, in a fashion similar to the classification of states of knowledge by Ansoff. The exactitude (state of knowledge, strength) of the early warnings was evaluated, on the Ansoff model, applying the four-stage division of states of knowledge shown in table C.2.1. The IFVR product

proposed by Kuusi [-99a] could not be employed here as the empirical research was conducted before Kuusi publicized his idea.
The stages of plan deviations mentioned in the table are not based on the research material. The theme of plans deviations as early warnings emerged very strongly in the interviews. These deviations are included in the main group "Project control and reporting," all the subgroups of which include plan deviations, but also contain non-measurable, qualitative warning signals. The states of knowledge of the plan deviations are based on the experience and assessments of the researcher. The state of knowledge could not be discussed during the interviews because the categories of states of knowledge had not yet been created.

Table C.2.1
The Exactitude of the Early Warnings (State of Knowledge)

An inkling	A gut feeling; the early warning hardest to detect, recognize and interpret; very inexact information. Very minor plan deviations. The conviction that some kinds of problems are impending.
An inexact warning.	Can be recognized and the source is detectable, but the information is very inexact. Plan deviations seen as minor. The characteristics of problems, the nature of impact, and the timing of impact are quite clear.
A clear warning	More manifest than the warnings in the previous category, but cannot be measured (assigned a number value). Clear plan deviations. Response identified: timing, action, budgets.
An exact warning	The signs can be measured; they can be assigned a number value. Major plan deviations. The profit impact and the consequences of responses are computable.
No warning procured	In addition to the above, situations were noted where no warning could be procured.

The table C.2.2 shows the distribution of the elements into the levels of exactitude (states of knowledge) presented earlier. The number of elements assigned to the inexact categories is clearly greater than the number of observed elements: basic interviews - 557 elements, case interviews - 556 elements (439 elements and 421 elements in table 6.6.1). The distribution of elements into different categories appears to closely resemble a normal distribution. However, this is shown to be probably an illusion, because the inexact and clear warnings include numerous warnings that can be interpreted in more than one way.

Table C.2.2
The Distribution of the Elements by the Level of Exactitude

	% Basic	**% Case**
Inklings	6.6	1.6
Inexact warnings	33.2	42.8
Clear warnings	46.5	52.8
Exact warnings	10.8	1.8
No warning procured	2.9	1.0
Total	557	556

The Vagueness of the Scale

In analyzing the elements, it was noted that the borders between the different states of knowledge are very subjective and vague. A notable number of elements could be regarded as belonging to two separate classes of state of knowledge. This does not necessarily mean that there would in reality exist seven states of knowledge instead of five; rather, it indicates that an element can be regarded as belonging to one or the other category, depending on the circumstances, even when examined by the same observer (researcher) [Nikander -98].

According to [Wiio -89] and [Åberg -93], this evaluation of the state of knowledge of the element depends, as does all other interpretation of messages, on the experience of the evaluator (receiver of the information) and on his tendency to adopt a certain attitude toward the object to be evaluated [Wiio -89]. The facet theory presented by [Åberg-93] gives an excellent explanation of how we interpret the early warnings we detect, how the observer and the interpreter link the early warning with each project situation, with the circumstances of detection etc.

C.2.2 The Project Parties and the Project Phase

The aim of the inquiry is to explore the scope of occurrence and the environment of the early warnings. The starting point is the question frame (table 6.3.1). The subject has been more closely examined in the study [Nikander-98].

The Project Parties

The analysis sought to find the project parties that the element could be considered to refer to, i.e., the project parties of which the element gave information. The results may be affected by the number and distribution of the questions. The distribution shows a great deal of evenness between various groups. The distribution by project parties is shown in table C.2.3. By looking at the table it can be observed that the estimate includes a fair number of answer elements that can be regarded as referring to more than one project party (the total number is significantly greater than the number of observed elements — 681 elements for the basic interviews and 414 for the case interviews). This indicates that there are multiple interpretations of warnings. Clients and consultants have common warnings, as do consultants, suppliers, and contractors, early warnings that concern suppliers and contractors tend to be especially similar [Nikander-98].

Table C.2.3
The Distribution of the Elements by Project Parties

Project Party	General	Client	Consultant	Supplier	Contractor	Total
	Warnings					
Basic interviews	18.8 %	17.9 %	21.7 %	22.6 %	18.9 %	681
Case interviews	3.4 %	34.1%	16.4 %	44.2 %	Incl.prev.	414

The Project Phase

This analysis looked for the project phase or phases during which early warnings can be detected. The results may be influenced by the number and distribution of the questions. In this distribution, some concentration on the groups “whole project” and “engineering phase” exists; the possible explanations for this are discussed in the analysis of the cross-tabulations. Table C.2.4 shows the distribution of the elements by project phase in the same manner as previously. There are 567 observations from the basic material and 421 from the case material.

Elements that can be linked to more than one category are present in this examination as well. Their share of the total is much smaller than the respective share in the examination of element distribution by project parties [Nikander -98].

Table C.2.4
The Distribution of Elements by Project Phase

	The whole project	Engineering phase	Procurement phase	Delivery phase	Site phase	No warnings	Total
Basic Interviews	27.5 %	26.1 %	16.0 %	15.7 %	14.6 %		567
Case Interviews	12.4 %	51.1 %	9.5 %	14.7 %	10.2 %	2.1 %	421

C.2.3 The Sources, Form of Manifestation, and Form of Occurrence of Early Warnings

With the aid of the attributes "source," "form of manifestation," and "form of occurrence," this study aims to determine what forms early warnings take and in what kinds of situations they can be detected. Categories of attributes were established during the analysis on the basis of the material. The material was analyzed separately for the sources and forms of manifestation of early warnings. These attributes are not independent of each other. On the basis of the analysis, the combinations that occur in practice were formed; these are in this study called forms of occurrence of early warnings. This study presents the results of the forms of occurrence in tabular form. The results have been discussed in greater detail in the study [Nikander -98].

Source

The attribute "source" is related to the communications concept "sender." In this study, however, the term "sender" is not used. This decision was based on the following reasons: a) the material includes numerous elements that are, according to the definition by [Åberg -93], messages without a conscious sender, and b) the material contains a considerable number of elements that can be considered to represent the act of making an observation or an internal inference. The attribute "source" indicates from whom the early warning is received or in what context the warning is detected. The potential sources of the elements analyzed from the material were used as a basis in determining the source of warnings [Nikander -98]. "A person," in different forms, has been the source in 62 percent of the observations, while "documents" are sources in 25 percent (see table C.2.5).

Table C.2.5
The Sources of Warnings

- a person;	an individual person
- a group;	a small group, a project group, a group of people
- a firm;	a business, an organization, a company
- a document;	a document, a drawing
- a situation,	an event, a situation at the site, a negotiation
- not definable	

The Form of Manifestation

This attribute indicates the form in which we detect early warnings. The attribute is close to the concept "means and forms of communication" presented by Wiio [-89]. Wiio [-89] first divides the means of communication into nonverbal communication and language. The studies of communication classify nonverbal communication in several different ways: such as 1) gesturing and pictorial representation; 2) representative communication, communication through a medium, message communication, time and distance communication and 3) auditory communication, signal language, motional communication and sensory communication [Wiio -89]. None of these classifications

describes well the early warning phenomenon examined during analysis in this study; therefore, a categorization somewhat divergent from that used in communications was selected for this study.

Table C.2.6
The Form of Manifestation of Warnings

- verbal	speech
- written	text, pictures (not only on paper)
- non-verbal	behavior, gestures etc.
- action	working
- no warnings manifest	

The potential forms of manifestation indicated by the elements analyzed from the material comprise the basis of the form of manifestation (see [Webb -87] and [Nikander -98]). The most common form of manifestation is action (34 percent), and the rarest is the non-verbal form. However, non-verbal form may not actually be rare; rather, it may indicate that the interviewees seldom detect them.

Form of Occurrence

The source and the form of manifestation of a warning are not mutually independent attributes. In this study their possible combinations are called the forms of occurrence of early warnings [Nikander -98]. The form of occurrence is in further analysis used as an attribute (in the cross-tabulations), even though the elements have been analyzed separately for both source and form of manifestation. Table C.2.7 shows the combinations that are possible in practice.

Table C.2.7
The Forms of Occurrence of Warnings

- A person / verbal
- A person / non-verbal
- A person / action
- A group / verbal
- A group / non-verbal
- A group / action
- A firm / written
- A firm / action
- A document / written
- A situation / action

Table C.2.8 shows the distribution by form of occurrence of the elements analyzed by the researcher, when all analyzed alternatives are taken into account. Clearly the most common form of occurrence evident in the interviews is the “document/written” form. Other common forms are a “person/verbal” and “firm/action.” This result reflects both the areas to which the interviewees have paid attention and the forms of occurrence in which warnings are easy to detect (document/written). There are 838 such detections in the basic interviews and 365 in the case interviews.

Table C.2.8
The Distribution of the Elements by Form of Occurrence

Form of	Person	Person	Person	Group	Group	Group	Firm	Firm	Doc.	Situation	Total
Occurrence	Verbal	Non-verbal	Action	Verbal	Non-verbal	Action	Written	ction	Written.	Action	
Basic	14.4 %	7.9 %	11.8 %	6.2 %	7.2 %	4.3 %	3.5 %	12.4 %	21.0 %	11.3 %	838
Case	7.7 %	3.8 %	9.0 %	3.3%	6.3 %	14.0 %	0.5 %	35.6 %	18.9 %	0.8 %	365

C.2.4 The Communicative Character of Early Warnings

All of the early warning elements included in the study are such that they provide new information for the person who detects them. By doing this they fulfill part (1) of the definition of information found in [Wiio -89]: “information decreases the uncertainty about a given issue and diminishes the possible choices.” Similarly, they include an element of surprise and novelty (see Wiio -89, part (3) of the definition of information). The elements contain messages as defined by [Åberg -93], observations as discussed by [Wiio -89], as well as combinations or units that people instinctively and naturally see in events, according to Wiio. Various types of non-verbal messages, as well as verbal and written messages, are detected quite clearly (see table C.2.8). The characteristic noted by Wiio, “*Information may be… the result of our own thought processes*” [Wiio -89] can also be observed among the elements; this characteristic includes e.g. "gut feelings" and “reading between the lines.”

In addition, the material appears to include so-called hidden information. It seems that people are not always capable or willing to verbalize their inklings and especially gut feelings; in some degree this may also apply to inexact early warnings. This possibly occurs in the categories “behavior of personnel,” “work on the project,” and “communication,” although it is difficult to analyze in detail. Naturally, the interviewees’ actual hidden information, which they have been unable or unwilling to express, cannot be explored.

[Åberg-93] emphasizes the multi-stimulied character of communication situations and encourages a holistic interpretation in accordance with his facet theory. This is well illustrated by the analysis of the elements: the element and the question with which it was related had to be processed together to better understand the information provided by the element.

As noted in the discussion on the sources and forms of manifestation of elements, early warnings may have a kind of sender, and the concept of a “form of manifestation” is close to the concept of “means and forms of communication” presented by [Wiio -89]. It can be concluded that the theories of communications effectively explain the nature of the detection of early warnings.

C.3 The Cross Tabulation of the Attributes that Describe the Phenomenon

General

The study by Nikander [-98] discusses extensively the cross tabulation of attributes that describe the early warning phenomenon. That study examines a) the state of knowledge (strength) of the main groups of early warnings; b) the linking of the main groups of the warnings to the various project parties and phases; c) the forms of manifestation of the main groups of warnings; d) the links between the project parties and the project phases; e) the strength of the state of knowledge for different project parties and phases; f) the forms of occurrence for different project parties and phases and g) the state of knowledge (strength) of the forms of occurrence. The study uses only two-dimensional cross

tabulations. In tabulations with more dimensions, the number of elements in a single observation square remains very low.

The State of Knowledge in the Main Groups, table C.3.1, appendix C
Naturally, the "gut feelings" are the most inexact, i.e. their state of knowledge belongs to the category of inklings; nevertheless, some border cases do occur. This seems that there can be overlap between them. Only the early warnings related to "project control and reporting" have an emphasis on exact information. The warnings in the groups "expressed by personnel" and "work on the project" focus slightly on inexact signs, although both groups include almost as many warnings that give clear information. An interesting detail is that the group "documents" also appears to provide inexact information.

Table C.3.1
Warning Signal Main Groups / State of Knowledge, Cross Tabulation
"X" expressed small groups, under 3 observations.

	The percent distribution of the answer elements State of knowledge				
Warning signal main group	Inklings	Inexact	Clear	Exact	No signal
Gut feeling	**4,6%**	1,0%			
Expressed by personnel	1,7%	**12,5%**	11.5%	1.2%	0.9%
Project manager, management		0,5%	0.9%		
Project planning		1,5%	2.7%	1.2%	X
Project control and reporting	X	1,7%	1.7%	**3.3%**	
Work on the project	X	**4,5%**	4.1%		
Communication		3,3%	4.6%	0,5 %	
Expressed by project parties		2,1%	5.7%	1.5%	X
Documents	X	2,9%	9.3%	1.7%	
Differences in project culture	X	1,9%	3.3%	X	
External source			1.2%	1.2%	
Total	7,4%	32,1%	44.9%	11.7%	

Warnings Typical for Project Parties and Phases by Subgroups,
tables C.3.3 and C.3.4, appendix C.
This information aids the utilization of warnings to direct his attention to the warnings considered most common by the interviewees; these warnings can apparently also be considered the most commonly occurring ones. No significant focus on a specific party or phase is apparent in any of the main groups of warnings. Evenness seems to be typical for the tables.

The Main Groups of Warnings / Project Parties / Project Phase, table C.3.2, appendix C

It seems that almost all of the main groups of warnings can be detected in each project party group and each project phase. This is true especially for the numerically largest early warning groups. No clear concentration on a project phase or party can be detected in any of the main groups of warnings. In addition, the table shows that the early warning group "expressed by project parties" (row) appears strongly in the "Client" column (5.2 %). This indicates that there may be a degree of overlap between these groups.

Table C.3.2
Warning Signal Main Groups / Project Parties / Project Phase, Cross Tabulation

	Project party					**Project phase**				
Warning signal main group	General	Client	Consul-tant	Suppl-ier	Contract-or	Whole project	Engin. phase	Procur. phase	Deliv. phase	Site phase
Gut feeling	1.4%		1.7%	1.4%	1.3%	3.3%		0.9%		
Expressed by personnel	7.1%	4.0%	5.2%	4.4%	4.1%	9.8%	6.3%	4.0%	1.7%	3.0%
Project manager, management		0.7%	0.6%			0.7%	0.5%			
Project planning	1.0%			1.7%	1.1%		1.2%	2.6%	1.2%	
Project control and reporting			2.1%	3.3%	2.4%		1.0%	2.6%	1.2%	3.1%
Work on the project	2.1%		1.8%	2.1%	2.0%	1.9%	2.8%			2.4%
Communication	2.4%	2.6%	1.8%	1.1%	1.0%	5.1%	1.9%	1.2%		
Expressed by project parties		**5.2%**	1.6%			1.6%	3.8%	3.0%	1.6%	
Documents	1.7%	1.1%	4.8%	4.8%	4.3%	3.0%	4.7%		5.2%	4.0%
Differences in project culture	1.3%			1.1%		1.2%	1.2%	2.3%		
External source				1,3%		0.9%			1.0%	
Difficult to detect				1.1%	1.1%		1.2%			1.0%
Total	18.6%	17.4%	21.6%	23.1%	19.3%	27.7%	24.8%	18.3%	14.5%	14.7%

Table C.3.3
The Distributions of the Warning Signals Giving Information of the Project Parties, the Numerical Distribution of the Elements, Basic Material, pcs

Early Warning / Signal Group		Project parties								
	Total number	General signals	Client	Client Cons.	Consul-tant	Cons. Suppl. Contr.	Contra-ctor	Suppl. Contr.	Contra-ctor	Calculated number
General Signals / Give Information of All Parties										
Communication, overall	29	**15**	6	2	2	3		1		15
Conflict situations	15	**10**	2	1	1	1				10
Gut feeling	27	**8**	1	2	2	5	1	1		8
Talk behind the back	8	**8**								8
Initial information / lack of it	17	**8**		2	3	1	3			8
Mood, attitude	10	**7**			3					7
Commitment to the project	10	**6**	1		1	1	1			6
Redoing the same tasks	7	**6**						1		6
Passing things around, avoiding responsibility	7	**5**		1	1					5
Information about the client										
Communication, overall	29	**15**	**6**	**2**	2	3		1		23
Typical for the client / Decisions not received	15		**15**							15
Hints	16	**2**	**4**	**6**			1	3		12
Speaking frankly	9	**2**		**7**						9
Professional competence of personnel	9	**4**	**3**				1	1		7
Typical for the client / Withdrawal of trust	6			**6**						6
First contact, first impressions	11	**4**	**2**				4	1		6
Project terminology	7	**4**	**2**					1		6
No early signals procured	16	**2**	**4**			5		2	1	6
Non-verbal information	22		**5**			7	1	6	3	5
Project plans	9	**2**	**3**				4			5

	Other signals typical for the client	19		**15**	**3**						18
	End users	5		**3**	**1**			1			4
	Freezings	4		**2**	**2**						4
	Highest management / CEO	4		**4**							4
	Further inquiries, additional information	3		**3**							3
	Purchases	3		**3**							3
Information about the consultant											
	Communication, overall	29	**15**	6	**2**	**2**	**3**		1		22
	Schedule, quality, receiving	31	**2**	1	**1**	**1**	**17**	4	2	3	21
	Gut feeling	27	**8**	1	**2**	**2**	**5**	1	1		17
	Initial information / lack of it	17	**8**		**2**	**3**	**1**	3			14
	Progress control	18	**4**	1	**1**	**1**	**6**	2	3		12
	Speaking frankly	9	**2**		**7**						9
	Initiating work (how it is done)	20	**1**			**6**	**1**	1	8	3	8
	No early warnings procured	16	**2**	4			**5**		2	1	7
	Personnel turnover	7				**6**		1			6
	Withdrawal of trust	6			**6**						6
Information about the Contractor / Supplier											
	Schedule, quality, receiving	31	**2**	1	1	1	**17**	**4**	**2**	**3**	28
	Non-verbal information	22		5			**7**	**1**	**6**	**3**	17
	Progress control	18	**4**	1	1	1	**6**	**2**	**3**		15
	Initiating work (how it is done)	20	**1**			6	**1**	**1**	**8**	**3**	14
	Control, in total	16				3	**2**	**5**	**4**	**2**	13
	No early warnings procured	16	**2**	4			**5**		**2**	**1**	10
	Bid material	9	**2**				**1**		**4**	**2**	9
	First contact, first impressions	11	**4**	2				**4**	**1**		9
	Supplier / Contractor / Advance billing	10				2		**2**	**2**	**4**	8
	External source	14	**1**	2	1			**4**	**2**		7
	Project plans	9	**2**	3				**4**			6

Table C.3.4
Warning Signals Typical for a Project Phase,
Numerical Distribution of the Elements, Basic Material

Early Warning Signal Group	Total number in material	Project phase: Engineering	Procurement	Delivery	Const. site	Whole project
Engineering phase						
Schedule, quality, receiving	31	**22**	7	22	21	3
Initial information / lack of it	17	**14**	6	9	5	5
Decisions not received	15	**13**	13	6	6	6
Progress control	18	**11**	6	10	12	3
Mood, attitude	10	**10**	8	7	7	7
Speaking frankly	9	**9**	2	2	8	2
Commitment	10	**9**	8	9	8	8
Procurement phase						
Non-verbal information	22	3	**18**	1	2	1
Decisions not received	15	13	**13**	6	6	6
First contact, first impressions	11	3	**10**	3	2	2
Delivery phase						
Schedule, quality, receiving	31	22	7	**22**	21	3
Reporting	15	7	6	**12**	6	6
Progress control	18	11	6	**10**	12	3
Commitment to the project	10	9	8	**9**	8	8
Site phase						
Schedule, quality, receiving	31	22	7	22	**21**	3
Initiating work (how it is done)	20	7	1	2	**13**	1
Control, in total	16	3	0	6	**9**	
All phases						
Communication, overall	29	4	4			**19**
Gut feeling	27					**16**
Conflict situations	15	2				**13**
Hints	16	2	1			**10**
Commitment to the project	10	1				**8**

The Main Groups of Warnings / Form of Occurrence, table C.3.5 , appendix C

The cross tabulation concerning the "main groups of early warnings/form of occurrence" is still under examination. The material appears to include some focus that is in accordance with the 20/80 rule on certain combinations of "main group of warnings / form of occurrence." Empty squares appear in the table only in small main groups. The largest combination group is "documents/written form" and the second largest is the "expressed by personnel/verbal".

The state of knowledge contained by different forms of occurrence apparently varies to some extent, though not very greatly. Relatively the most exact information seems to be provided by the combination "document/written form", and the most inexact by "people/non-verbal form" [Nikander -98]. There seems to be a strong relationship between early warning main group "Expressed by personnel" and form of occurrence groups "person /xxx" and "group/xxx". This is very natural because human being must be the sender of messages. The natural relationship is also between early warnings group "document" and form of occurrence group "document/written". In both situations there can be degree of overlap.

Table C.3.5
Cross Tabulation of Early Warning Signal Main Groups / Forms of Occurrence, Basic Material

	Form of occurrence									
Warning signal main group	Person verbal	Person non-v,	Person Action	Group verbal	Group non-v.	Group Action	Firm Written	Firm Action	Docum. Written	Situat. Action
Gut feeling		**1,3%**			1.2%					1.0%
Expressed by personnel	**5.0%**	**3,8%**	**4,3%**	**2.9%**	**4.5%**	1.9%	0.6%	**3.7%**	1.0%	1.4%
Project manager, management		**0,6%**								
Project planning	0.8%								**2.7%**	
Project control and reporting									**3.0%**	**2.0%**
Work on the project								1.3%	**1.7%**	**2.6%**
Communication	**3.5%**			1.7%					1.5%	
Expressed by project parties	1.9%		**3.0%**					**3.3%**	1.2%	1.7%
Documents									**7.1%**	1.1%
Differences in project cultures	1.1%						0.7%	**1.3%**	**1.2%**	
External source	0.6%							**0.7%**		
Difficult to detect										

The Project Parties / Project Phases, table C.3.6 , appendix C
These elements are distributed quite naturally. Warnings that refer to all parties are most common during the whole project. Warnings that refer to the client and the consultant are mostly apparent during the engineering phase, when the other parties take little part in the activities. The warnings referring to the supplier occur mostly during the delivery and site phases, whereas those referring to the contractor are manifest during the site phase [Nikander-98].

Table C.3.6
Cross Tabulation of Project Parties / Project Phase

	Project phase				
	Whole	Engineer.	Procurem.	Delivery	Site
Project party	project	phase	phase	phase	phase
General	**11,0%**	2,2%	1,2%		
Client	3,6%	**7,6%**	4,5%		1,0%
Consultant	4,3%	**8,7%**	1,8%	4,6%	4,4%
Supplier	2,5%	3,6%	3,5%	**7,2%**	**6,2%**
Contractor	2,4%	3,1%	3,4%	3,6%	**7,5%**

Form of Occurrence / Project Party, table C.3.7 , appendix C
Information about the client is received from the activities of the company and from discussions between people. Information about the consultant comes from written documents, discussions, and the activities of the company. Information regarding the supplier is provided by discussions, written documents, and activities in different situations. The distribution of the early warnings regarding the contractor is very similar to that of the warnings regarding the supplier [Nikander-98].

Table C.3.7
Cross Tabulation of Project Party / Form of Occurrence of Warning Signal

	Form of occurrence									
	Person	Person	Person	Group	Group	Group	Firm	Firm	Docum.	Situation
Project party	verbal	non-v.	action	verbal	non-v.	action	written	action	written	action
All parties	2.6%	1.8%	2.0%	2.3%	3.1%	1.3%		1.0%	4.1%	2.4%
Client	**3.6%**	1.7%	2.5%	1.1%			1.0%	**3.3%**	2.8%	1.5%
Consultant	**2.7%**	1.7%	2.4%	1.4%	1.3%			**2.8%**	**5.7%**	2.1%
Supplier	**3.1%**	1.4%	2.5%					2.7%	**6.1%**	**3.0%**
Contractor	2.5%	1.3%	1.8%					1.8%	**5.3%**	**2.8%**
Total	14.5%	7.9%	11.3%	5.8%	6.0%	3.9%	3.2%	11.6%	24.1%	11.8%

Inklings and Project Experience
This research endeavored to find out whether the “sensitivity” of different persons to inkling-type early warnings (such as gut feelings) is in any way related to their project experience or to their attitude toward the early warnings phenomenon. This was measured through calculating a weighted average from the interviewees’ answers, so that

inklings were assigned a weight of 4, inexact signals a weight of 3, clear signals 2 and exact signals 1. If questions prompted the interviewee to respond that no early warning could be procured of the subject of the question, this answer was assigned a weight of -1.
It was noted that there seemed to be very little correlation between the averages and the attitudes or project experience of interviewees; no conclusions should be drawn on the basis of this weak correlation, especially as the material is so limited. The meager differences can apparently be explained by the fact that all interviewees clearly had project experience, compared to someone who has not been previously engaged in project work. All the interviewees can be considered to possess a certain level of expertise.

Appendix D

Table 7.1.2
The Distribution of the Elements by Project Problem Group, Basic Material

					Result of Analysis					
Project problem, main group **Problem, subgroup**	**Question group**		**Interviewee reports problem**		**One problem**		**Primary problem**		**Several problems**	
	elem.	**%**	elem.	**%**	elem.	**%**	elem.	**%**	elem.	**%**
General, open questions	42	.9%								
Schedule problem, delay, time	45	9.6%	53	10.3 %	46	18.1 %	70	15.3 %	137	19.0 %
Cost problem	28	5.9%	34	6.6 %	23	9.1 %	33	7.2 %	37	5.1 %
Delivery or performance problem					34	13.4 %	50	10.9 %	63	8.8 %
Project environment	117	24.8%	126	24.6 %	12	4.7 %	12	2.6 %	12	1.7 %
External factors	no answers									
Consultant's problems	46	9.8%	46	9.0 %	12		12		12	
Supplier's problems	27	5.7%	35	6.8 %						
Contractor's problems	44	9.3%	45	8.8 %						
Ambiguous objectives	13	2.8%							14	1.9 %
Client	57	12.1%	58	11.3 %						
Absence of the support of (upper) management					2	0.8 %	6	1.3 %	6	0.8 %
Management problems, in total	38	8.1%	64	12.5 %	9	3.5 %	79	17.3 %	135	18.8 %
Management, in general									79	
Difficulties in decision-making									12	
Lack of trust as a problem									28	
Cooperation problems									6	

Project manager as a person	14	3.0%	22	4.3 %	25	9.8 %	25	5.5 %	25	3.5 %
Organization / personnel group										
Erroneous organization	15	3.2%	15	2.9 %					15	
Personnel problems, in total	19	4.0%			24	9.4 %	42	9.2 %	51	7.1 %
Personnel problems, in general			20	3.9 %	18		19		22	
Resources					6		23		29	
Project planning, in total	25	5.3%			24	9.4 %	27	5.9 %	41	5.7 %
Project planning, in general			22	4.3 %	23		23		24	
Problems with purchases					1		4		10	
Communication	30	6.4%	31	6.0 %	12	4.7 %	30	6.6 %	36	5.0 %
Engineering			7	1.4 %	4	1.6 %	24	5.3 %	53	7.4 %
Financial issues			17	3.3 %	18	7.1 %	28	6.1 %	44	6.1 %
Differences in project culture as a problem	28	5.9%	31	6.0 %	8	3.1 %	31	6.8 %	31	4.3 %
Not definable			13	2.5 %	13	5.1 %			20	2.8 %
Total	471		513		254		457		720	

Table 7.2.3
Cross Tabulation of Early Warning Signals / Project Problem Main Groups, Basic Material

	Early warning signal, main group												
Project problem, main group	Gut feeling	Expressed by personnel	Project manager	Project planning	Project control	Work on the project	Commu-nication	Expressed by parties	Documents	Differences in proj. cult.	External source	Difficult to detect	total
Schedule problem, delay, time		**3.5%**		1.1%	**4.2%**	**3.6%**		**2.9%**	2.1%				19.0%
Cost problem					1.3%				1.1%		0.4%		5.1%
Delivery or performance problem		**2.9%**		1.4%		1.3%							8.8%
Project environment, consultant				0.3%					0.6%				1.7%
Ambiguous objectives		0.6%											1.9%
Client, absence of support of mgmt								0.4%					0.8%
Management problems, in general	0.7%	**5.8%**				1.4%	**3.9%**	2.6%	1.1%	1.3%		0.4%	18.8%
Project manager as a person		1.8%	0,7%										3.5%
Organization / personnel group		1.1%											2.1%
Personnel problems, in total		**4.6%**											7.1%
Project planning, in total									3.2%				5.7%
Communication							1.9%		1.0%				5.0%
Engineering		1.1%				1.8%		2.4%					7.4%
Financial issues		2.5%						1.3%			0.8%		6.1%
Differences in project culture as a problem		1.3%								1.8%			4.3%
Not definable	1.1%											0.6%	2.8%
Total	1.8 %	25.2 %	0.7 %	2.8 %	5.5 %	8.1 %	5.8 %	9.6 %	9.1 %	3.1 %	1.2 %	1.0 %	

Table 7.2.4
Cross Tabulation of Early Warning Signals / Project Problem Main Groups, Case Projects

	Warning signal main group													
Project problem main group	Gut feeling	Expressed by personnel	Proj. mgr mgmt	Project planning	Project control	Work on the project	Communi-cation	Expr. by parties	Docu-ments	Differ. proj.cult.	External source	No warning	Small groups	total
Schedule problem, delay, time	0.4%	1.2%		0.8%	1.3%	1.0%		0.8%	3.1%				0.6%	9.8%
Cost problem				2.5%										5.0%
Delivery or performance problem		3.3%	1.5%	4.8%	2.3%		1.7%	2.9%	3.5%	1.5%	0.8%	0.2%	1.5%	24.6%
Project environment, consultant		1.7%												2.9%
Ambiguous objectives														
Client, absence of mgmt support														
Management problems, in total	1.0%	6.9%	1.5%	1.0%		1.5%		2.9%	1.5%	4.0%			0.8%	22.1%
Project manager as a person		1.3%	1.7%											3.3%
Organization / personnel group						0.4%								0.8%
Personnel problems, in total														2.1%
Project planning, in total														
Communication							0.6%							0.8%
Engineering	0.8%	6.9%	1.9%	2.7%	1.3%	5.0%	1.2%	2.5%	1.9%	2.3%	0.2%		1.0%	27.7%
Financial issues		0.4%												0.6%
Differences in project cultures as a problem						0.2%								0.2%
Not definable												0.2%		0.2%
Total	2.3%	22.7%	7.9%	12.5%	5.4%	9.8%	4.6%	9.4%	11.2%	8.8%	1.2%	0.4%	3.8%	100.0%

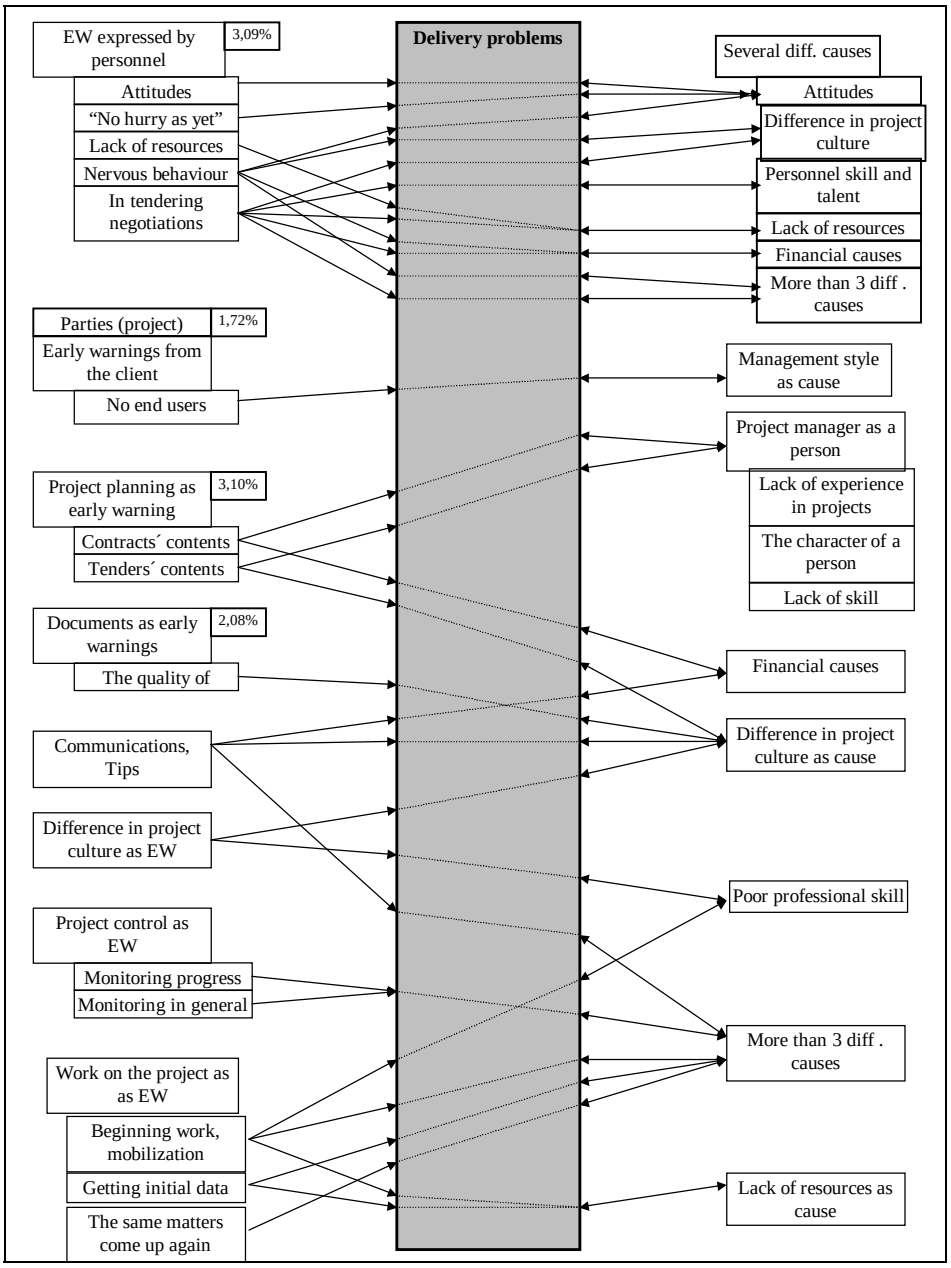

Figure 7.5 Warning Signals of Delivery Problems and Causes Related to Them

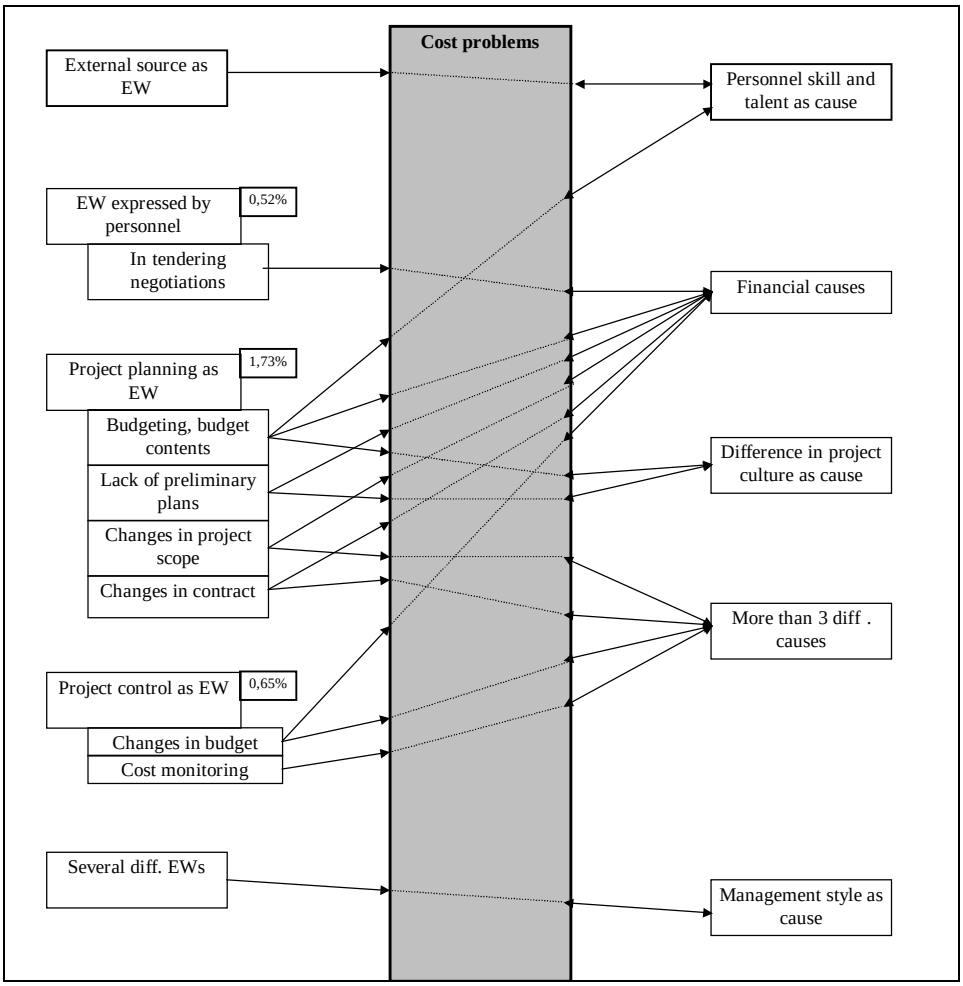

Figure 7.6 Warning Signals of Cost Problems and Causes Related to Them

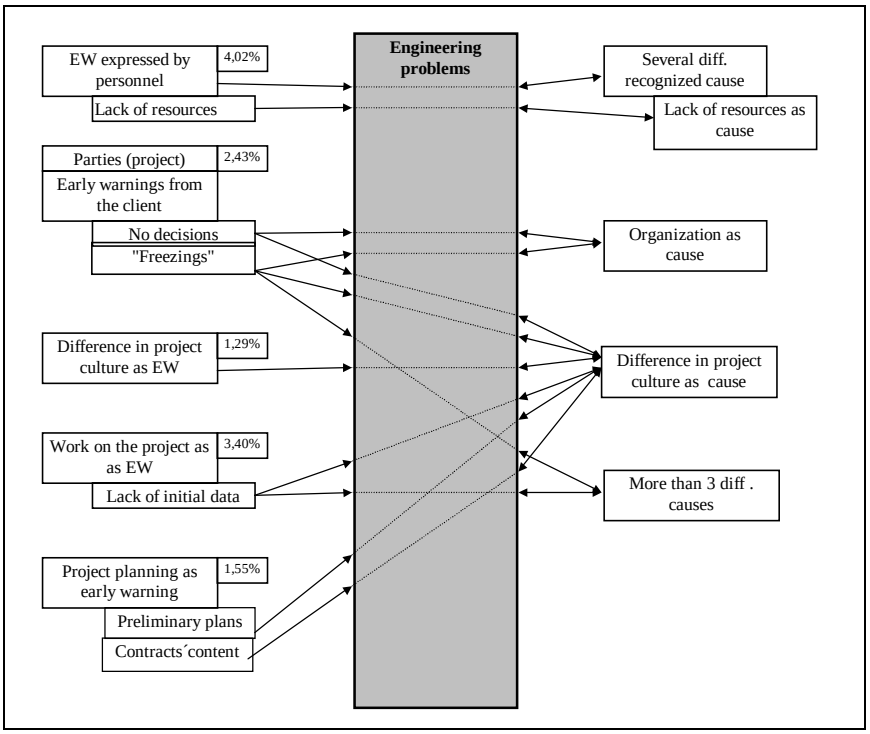

Figure 7.7 Warning Signals of Engineering Problems and Causes Related to Them

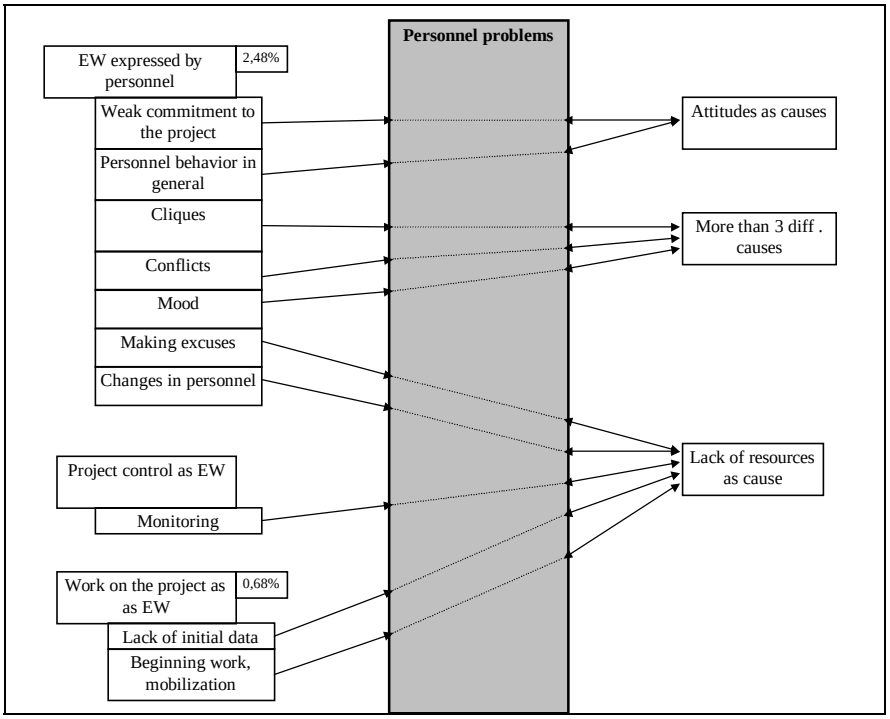

Figure 7.8 Warning Signals of Personnel Problems and Causes Related to Them

Table 7.4.1
Early Warning Signal Groups / Project Problem Groups, in More Detail, Basic Material

Early warning signal groups	Nmbr of elem.	Project problem groups: Sche-dule	Cost	Delivery	Manag-ement	Proj. mgr	Organ-ization	Pers-onnel	Proj. plann.	Comm-unication	Engin-eering	Fin-ancial	Proj. cult.
Expressed by personnel	125												
Non-verbal information	22	4		**13**				1				8	
Personnel behavior	83												
Personnel behavior in general	13	4		6	2							7	
Mood, attitude	10				4			4					
Conflict situations	15	2			4			3					
Talk behind backs	8				1			4					
Passing things back and forth	7	6			4			2					
Speaking frankly	9				7								
Commitment	10	2			6			7					
Formation of cliques	4				1			3					
Authority disputes	3				1								
Making excuses	4	2			1			2					
Personnel turnover	7	3			2			5				2	
Professional competence	9			2	3							1	
Miscellaneous warning signals	4	2			5			2					
Project planning													
Project plans	9			2									
Bid material	9			6									
Contract	8			2									
Project control and reporting	39												
Progress control	18	**17**											
Control, in total	16	13											
Budget corrections	5												
Work on the project	44												

	Initiating work (how it is done)	20	12			4						2		
	Initial information / lack of it	17	8			2						10		
	Redoing the same tasks	7	6			4						1		
Communication		45												
	Communication, in general	29				**18**					**13**			
	Hints	16				10					1			
Expressed by project parties		50												
	Typical for the client	40												
	Decisions not received	15	2			9						8		
	Withdrawal of trust	6				6								
	End users	5	4									4		
	Freezings	4	2			2						4		
	Absence of mgmt support	4												
	Further inquiries, add. info	3	2			1						1		
	Purchases	3												
	Supplier / Contractor	10	1											
Documents		63												
	Reporting	15	6											
	Schedule, quality, receiving	31	8							**21**				
	Technical plans	7	1											
	Incorrect revisions	3												
	Ambiguous responsibilities	4								1				
	Miscellaneous warning signals	3								1				
Differences and deficiencies in project culture		23												
	First contact, first impression	11												5
	Project terminology	7												6
	Lack of experience	4												1
	Miscellaneous warning signals	1												1

Appendix E

Analysis of the Problem Situations in the Case Projects

The study analyzes the problem situations in the case projects both by project and by problem; similar problem situations have been grouped together in the results. Due to anonymity requirements the case projects have not been named. A summary of the problem situations is presented below.

In addition, this appendix looks at the type of impact different problems have had on the project, the amount of time available for responses and the promptness with which responses have been undertaken. The problems may have affected the project either as fairly long-standing single impacts (e.g. for a few months) or as chronic problems throughout the project. The amount of time available had to be inferred afterwards on the basis of the manner in which responses were adopted in different problem situations.

Scheduling Problems

All of the projects contained scheduling problems, some serious and some easier to solve. There were a total of eight significant scheduling problems, though only one project was substantially delayed. Most of the scheduling problems seem to have been in areas that either suppliers or contractors could influence. The project management of the client could influence the improvement of the situation indirectly.

Schedule problems consisted mainly of one-time problems spanning a few weeks or few months, though they did include some problems with a more extended period of impact. Responses were usually embarked on promptly, even at the first signs of a problem. The actual time available varied greatly.

Time control reporting provided the warnings for the scheduling problems. In about half of the situations the situation came as more or less of a surprise to the project management. In the cases where the client's project management had the decision-making power and where the problems were detected sufficiently early, the response was to augment the project plans (make additional plans). The results were also successful. In the cases where the client's project management had no direct decision-making power (as was the case with all problems of the supplier and contractor) the client's project management was only able to negotiate and to try to put pressure on the party concerned. The scope and character of the responses was completely dependent on the decisions of the concerned party. As for the whole project, the client's project management was generally only able to make alterations in the schedule. The client also negotiated with those suppliers and contractors whose work would apparently be affected by the impending delay. Especially in cases where the impending delay was a surprise, very little could be done to avert that delay.

Delivery or Performance Problems

Delivery problems differ from scheduling problems in that they also include various types of technical problems. The scheduling problems of equipment suppliers and contractors could also be classified as delivery problems. Delivery problems were the second most common type of problem in the case projects; they were present in each project in some form. There were a total of four delivery problems of a more serious kind. The detection and character of delivery problems were very similar to those of scheduling problems.

Cost-Related Problems

There was only one serious cost-related problem. This problem had a chronic impact throughout the project it appeared in, and repeated efforts to find an appropriate response only succeeded close to the end of the project. The time available for responses is difficult to determine in this case as the problem had such a long-term impact.

Though other projects did not encounter cost-related problems on a similar scale, all of them were nevertheless faced with the need to cut costs, especially as the project was drawing to a close. In these cases, the impending cost overrun was discovered through cost management reports. The threat of a serious cost overrun was apparent in a very early stage to project experts who critically examined that project: the basis of the design of the cost estimate proved weak. The reason for this can be found in the inexperience of the client's project management; however, the client's project management was not able or willing to correct the matter.

Lack of Experience in Projects

In three projects it was noted that the client did not have sufficient experience in projects of the type in question. This became apparent immediately in the initiation phase of the project, or even earlier in the preliminary planning phase in the context of negotiations with the consultant. This problem type had a chronic impact throughout the project in all cases. Responses were adopted immediately, and the time available is therefore considered to have been very limited.

In two cases the client took measures to recruit reinforcements to his organization; these projects also attempted to provide training for the inexperienced personnel. Both cases contained organizational difficulties, but the project personnel endeavored to learn and to cooperate. The final results of both projects were excellent.

In one case, there was unwillingness to recognize the problems, and the later attempts to reinforce the organization were not very effective. The organization of this project proved complicated from the start and various conflicts arose. The consistently greatest problem was that the client's project management refused to admit their inexperience; all of this finally resulted in very poor results. It can be said that the client's staff had no project culture nor did they strive to create one during the project.

Differences in Project Cultures

In a few projects it was noted immediately during initiation that there would be substantial differences of opinion between the parties regarding project culture. The differences were apparent in the first negotiations and to some extent even in the preliminary planning phase. The impact of this problem type was felt chronically throughout the project in all projects. In one of the projects, management endeavored to minimize the impact of the differences with periodical training of the personnel and common negotiations. In the other projects the differences were between firms and nothing could be done about them. During the project the personnel tried to adjust to the situation and to understand the viewpoints of the other party.

Management Problems

Naturally, management problems were present in some form in all of the projects, though they were very mild in two of them. All projects that encountered this type of problem were affected by it throughout their duration, which makes it difficult to speak of time available for responses. The gravest problem was the managerial style of the client's project management in one of the projects; this was due to the personality of the manager in question. The people who were acquainted with the manager in advance apparently already knew the problem; others soon discovered it through e.g. the contents of the procurement contract and the way in which this contract was made. In another project, the client had decision-making problems that were experienced as rather difficult; this resulted from the decision-making culture of the particular company. Attempts were made to ameliorate the problem by forging personal contacts with the decision-makers, but the problem caused significant distress and anxiety to the management.

Engineering Problems

Three quite different cases can be considered to have encountered engineering problems of a more serious kind. These problems had a very short-term, one-time impact.

Time available is considered to have been short and responses were undertaken without delay. In one of the cases, a hint was received from another contractor, but the situation itself came as a surprise. In another case, the problem was completely unforeseen by the management. In a third case, engineering problems could be expected since the implementation of the project was consciously launched with very inadequate plans. As the problems were within the sphere of the supplier, the only measure that could be taken was to negotiate, which was immediately done by the project management. In the cases where the problems arose in areas that the project management could influence, additional engineering was immediately instituted or engineering resources were increased.

Organizational Problems

The first project was plagued throughout its duration by chronic difficulties that could be classified as organizational problems; they were mainly related to the authority of the project manager, who never received sufficient decision-making power, resulting in unusual managerial relations. Attempts were made to remove the problem through project guidelines, but this was unsuccessful. In the end the problem did not hamper the project, apparently because the project personnel was very experienced and found the correct working procedures independently. The project created a project culture particular to itself.

The second project encountered a very short-term, one-time organizational problem, which was corrected without delay. The time available was very brief.

Personnel Problems

Severe conflicts among the personnel occurred in only one of the projects. These problems were chronic in nature and affected the project for its whole duration. They can be considered to have arisen quite surprisingly and little could be done about them, which means that the time available cannot be precisely assessed. There was no willingness or opportunity to institute e.g. changes in personnel.

Resource Problems

One of the specific personnel problems is a resource problem, which had long-term adverse effects. Resource problems occurred in one project on several levels of engineering and management. Signs of these problems were quickly discovered in the early phases of the project. In some cases, responses were embarked upon promptly, while in others no visible responses were undertaken (though there may have been internal discussions of which the present researcher has no information). That the project management did not always respond forcefully is perhaps partly explained by the fact that the problem was in the area of subprojects. The problems caused a problem chain, which in turn caused a number of delivery problems (delays), though the most significant results were only apparent in a follow-up project.

Since prehistoric times, man's activities have included project-type undertakings. The emergence of Concurrent Engineering has made growing demands on project management. The classic project management methods are often slow: problems may already exist when those methods are applied. The research examines the background of Ansoff's theory, the way in which project theories treat project problems, the causes of problems, and possible early warnings.

The research shows that signals, messages that comply with communications theory can be found in the project environment. These signals are always to some degree inaccurate. The relationship between early warnings, project problems, and problem causes is investigated; the dependence network designed of these three factors plus the responses they require furnishes some of the most important data for further utilization. The study designs a fundamental model for the utilization of the early warnings phenomenon.

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