CHAPTER 7

PARTICIPATIVE PROBLEM SOLVING

*Everything can become art, everything
can be studied scientifically.*

1. Introduction
In our educational institutions and in our culture in general, there is a split between art and science. It is believed that these two ways of working and thinking, the *artistic* attitude and the *scientific* attitude are two very different worlds, they are like oil and water. Although the link between art and science has historically been very close, exemplified by Leonardo da Vinci, the ideal that Leonardo represents is really not agreed upon by the art and science communities. It is the opinion of the author of this book that this distinction between and separation of art and science is artificial and increasingly anachronistic. Fortunately things are changing; new fields arise from the synthesis of other fields. For instance, scientists are relaying more and more on visual communication, and artists are working increasingly with computers. There is a common place to transfer information, ideas and knowledge. Visual problems are ultimately the same across disciplines. For example, Computer Graphics is a new field made up of art and science.

Another interesting field that demands knowledge and experience from art and science, as well as other disciplines, is Modern Design. The book of Nelson and Stolterman (2003) is a *coherent meta-theoretical and holistic approach to a design theory* applicable to any context. This book is valuable and useful: Full of many conceptual and practical ideas; given an integrated picture of central theories and concepts about design. In addition, it brings together qualitative and creative issues from Art and Architecture with quantitative and scientific approaches of Operational Research and Engineering. The authors do this by founding their concepts and analyses on the epistemological foundations of Systems Thinking.

Another valuable contribution related to management and problem solving is the book edited by Boland and Collopy (2004). The main premise of this book is that: *Managers should act not only as intelligence gatherers and decision makers, but also as creative designers.* Though decision and design are inextricably linked in management action, managers and scholars have too long emphasized the decision aspect of management over the design aspect. The main message of Boland and Collopy is that managing is not only decision making but also designing. This book is a collection of papers exploring the "design attitude" as opposite to the "decision attitude", that draws on examples of managing in architecture, art, and design. Their book is a critique of the predominant management education that focuses on training students to make choices among the alternatives presented to them, rather than training them to design new alternatives. In a series of brilliant and wide-ranging essays from a multitude of disciplines, the authors develop a theory of the design attitude that contrasts with the more traditionally accepted and practiced decision attitude. Their innovative view of management promises to provide a way into some of the most pressing issues facing organizational leaders, researchers and educators today. They have designed a thought-provoking volume that portrays management not as a science of rational problem solving but, instead as the art of generating visions and roads for achieving these visions. This collection of papers inspires, enlights, intrigues, challenges, and teaches readers about designing organisations and problem solving approaches.

In addition, in Chapter 1 we have already mentioned the work of Ackoff (1978, 1981) that argues of the need of approaching problematic situations as both artistic and scientific tasks, this is the *design or creative approach*, where you seek to change the

nature, and the environment of the problem to remove the problem, it dissolves the problem; it *idealizes* rather than satisfies or optimizes because its objective is to change the system involved or its environment in such a way as to bring it closer to an ultimately desired state, one in which the problem cannot or does not arise; it is innovative oriented and it makes use of creative and participative approaches aspiring dissolution in the containing whole. In the design approach the facilitator is both the artist and scientist supporting a group to deal with a mess through a problem solving process.

The main purpose of this chapter is to reflect, elaborate and document about how the concept of *"the art and science of problem solving"* can be used in the real world to deal with important problematic situations in Society. Here, the facilitator is both the artist and scientist supporting a group work. As a scientist, he will be using when needed scientific approaches, experimentation, simulation and mathematical modelling in the problem solving process. As an artist, he will metaphorically speaking be like a painter who combines colours and shapes (the participants in the process) to create an art work (the problem solving process). Or, the facilitator is the director of a theatre performing a piece of art.

Art and Science are both historically and culturally laden concepts. They are human-made constructions that evolve and change in history. Modern concepts of Art and Science will be shortly discussed in Sections 2 and 3, respectively. Thereafter, Section 4 will elaborate on the differences between Art and Science while Section 5 discusses their similarities. Next, our discussions will be more concrete by presenting a real-life case study: The design of a decision support system for the planning of oral examinations in high schools in Denmark; where different approaches will be used, this will be the subject of Section 6. Another case-study related to strategy development in a small firm will be presented in Section 7. In section 8, other case studies will be presented and finally in the last section, Section 9, the conclusions are depicted.

2. What is Art?
The answer to this question is conditioned by the fact that a definition of art has changed due to cultural and historical reasons. The boundaries of art have experienced a radical change over the last century. Previously, art was created in historically validated media and presented in a limited set of contexts for a limited set of objectives, such as search of beauty, religious glorification, or the depiction of persons and places. However, this century has produced new ways of experimentation, breaking and testing of boundaries. Artists have introduced new media, new contexts, new materials and new purposes. The art institutions have assimilated much of this experimentation, some of them depicted in the following list:
- Abstract painting (Pablo Picasso),
- Ready-mades (Marcel Duchamp),
- Interventions in non-art settings (Superflex),
- Performance art (Tracey Emin),
- Use of industrial materials, products and processes (Andy Warhol),
- Conceptual art (Joseph Beuys),
- Land art (Robert Smithson),
- Interactive art (Olafur Eliasson),
- Public art (Diego Rivera), and

- Video art (Peter Land).

This expansion in art activities causes a difficulty in achieving consensus on "definitions" of art. The following very general definition can be easily accepted:
Making art may be depicted as the process of responding to perceptions, feelings, ideas, dreams, and other experiences by creating innovative works of art through the skillful, thoughtful, and imaginative application of tools and techniques to various media and materials. The "objects" of art result of the encounters between artists and their intentions, their interventions, their concepts and attitudes, their cultural and social realities, and the materials or media in which they choose to work.

Modern artists use unorthodox materials, tools, techniques and ideas inspired by the worlds of science, technology, humanities, economics, psychology, sociology, anthropology, etc. Some are present in non-art contexts, such as factories, laboratories, trade shows, the Internet, schools, and the street. Social interventions are manifold. The process of creating art is filled up of problems related to design and decision-making. The design attitude is related to the creative and innovative process in problem solving, while the decision attitude is related to the scientific approach to problem solving. In this sense, science can support art both providing materials and the media, and rational approaches to problem solving.

3. What is Science?
Researchers and philosophers on science suggest several defining elements. This set of core ideas, *the scientific approach*, includes the following:
- An essay to understand how and why phenomena occur,
- Focus on the real (natural, social, human) world,
- Focus on empirical information,
- Seeking objectivity,
- Use of a rational or logical approach,
- Knowledge codify into laws and principles, and
- The continuous testing and refinement of hypotheses...

The crucial assumptions of the scientific approach are that the observed world is essentially orderly, and objectivity can be achieved through self-discipline and the reliance on methods such as the calibration of instruments, repeatability and multi-observed verification. There are of course variations in emphasis. That is, empiricists focus primarily on the role of observations, while rationalists emphasizes on the logical processes of theory construction and derivation. Some enhance induction built from observation; others focus on deduction drawn from theory.

Critical scientists see science as a modern delusion, challenging mainly the possibility of objectivity, noting the decisive influences of gender, social position, culture and history. Critical science is focusing in issues such as the interactions of the observer and the observed phenomena; the role of socially constructed frameworks at all stages; and the social forces and meta-narratives that form the questions and paradigms used in the research process.

Several researchers have contributed to the critique of science. One describes the way dominant paradigms shape the questions that get acceptance and support. Another critiques assumptions of scientific rationality, remarking that nature gives different

answers when approached differently. Others analyze the metaphoric language of science, its authoritative voice, and its unacknowledged patriarchal under life.

In social sciences and the humanities, this kind of critique predominates. Scientists and technological innovators, however, believe in the ability to discover universal truths and assert that reform can overcome those places where scientific process falls short of its aspirations to universality and objectivity. As validity, it is usually referred to the accomplishments of the rational approach in building robust theoretical structures, and in predicting and controlling the material, organic and social world.

4. Art vs. Science: Differences

Box 1 depicts the main differences between art making and science making. Einstein (1934) has stated that the artist and the scientist each substitute a self-created world for the experiential one, with the purpose of transcendence. The main difference is that the artist is guide by an "artistic attitude" while the scientist is guided by a "scientific attitude". These attitudes are characterized in Box 1.

Artists are reflective and intuitive persons; materializing and visualising subjective experiences; and breaking the boundaries and traditions. Scientists are logical and rational persons; formulating verbally objective theories and principles; and seeking to improve and optimize. Scientists in their work are usually problem solvers, which are selecting course of actions that is believed to yield the best possible outcome. Artists are usually problem dissolvers, which are changing the nature and the environment of the system where the problem is imbedded so as to remove the problem. These differences are not exclusive; this means that sometimes the artists will be working as scientists and vice versa, during their working process and problem solving process.

Differences:
Art   Science

- Aesthetic, reflective
- Emotion, intuition
- Idiosyncratic, personal
- Visual, sonic
- Evocative, subjective
- Radical change

- Know, understand
- Reason, logic
- Normative, principles
- Narrative, textual
- Explanatory, objective
- Improve, optimise

Box 1. Art vs. Science: Differences

5. Art vs. Science: Similarities

Box 2 describes the main similarities between art and science. Both value the careful observation of their environment to gather information through their senses. Creativity and innovation play a central role in both activities. To introduce change or improvement over the existing is of great concern to artists and scientists. Artists as well as scientists work with abstract symbols, representations for various realities and working tools. Even the language used by the two groups can be similar. Scientists working with mathematical models sometimes describe a particular good explanation or result as elegant or beautiful. The intellectual bridge of abstraction and aesthetic consideration is fundamental for both groups. Finally, both aspire to create works that have universal relevance.

These similarities provide many interest fields where art and science can support each other in their working processes. One of them is the interaction between creative and rational processes in real life problem solving. Another is artists been the facilitators of problem solving processes in scientific approaches. Modern artist are also inspired by new developments in science and technology, for instance the exhibitions of Olafur Eliasson (2004). Modern management scientists and researchers of problem solving approaches are also moving from the classical scientific approach towards a more artistic and design oriented attitude that is needed when innovation is needed in an organisation. In a modern world everything can become art, and everything can be study scientifically.

Art vs. Science: similarities

- Observation, experimentation, sensual
- Creativity
- Change, innovation, improvement
- Models, symbols, abstraction
- Universality

Box 2. Art vs. Science: Similarities

6. Case Study: Planning of High School Examinations in Denmark
This is a real-life logistic problem where a computer based support system has been developed and implemented. The system has been running at the Danish Ministry of Education since 1992.

Background
In Denmark, all planning of the official examinations at high school level is centralized at the Danish Ministry of Education. Denmark is the only country where such planning activities are centralised nationally. This cumbersome task had become increasingly difficult and time consuming due to educational reforms in 1998. In 1990, it was decided at the Ministry to develop a computer based decision support system to aid the ministerial planners in this planning process.

The Danish academic school system is divided into primary school (grade 1 through 9/10), high school (grade 10/11 through 12) and university/college, where primary school is the only compulsory school. High school, in the broad sense, has several channels; the academics as opposed to the technical or commercial high schools being the most attended ones. Approximately one half of all primary school graduates continue onto an academic high school.

The academic high school system has two major channels: The Gymnasium which is a 2 or 3 years package, 3 years being the most common, and higher preparatory school (HF), a two years package Through a system of merits, it is also possible to obtain an equivalent qualification through individual study-plans over several years (VUC). Denmark has 77 Gymnasiums, 25 HF-schools, 77 VUC-schools and 69 schools with both Gymnasium and HF curricula. This amounts to approximately 115,000 students and 12,000 teachers.

The students of the Gymnasium and HF are evaluated at the end of each school year. This evaluation includes oral and written examinations in certain courses. The planning of written examinations is much simpler since the days of examination are given before the start of the school year. This is necessary since all students answer the same examination questions and obviously they must do this at the same time. In what follows *examination* means oral examination. A *censor* is an eligible and ministerial appointed person - usually a high school teacher from another school – and an *examiner* is the person who conducts the examination – usually the teacher of the course.

An examination is carried out in the following way: A censor arrives at the school to observe the examination of each student conducted by the examiner for a fixed amount of time. After each student examination, the censor and the examiner agree on a grade for the student and then continue with the next student on the course, if any.

To encourage students to exhibit "good student behaviour", i.e. not miss classes, deliver term papers on time, etc., a bonus is granted in terms of a reduced number of examinations. Almost 95 percent of all students achieve this bonus. While a final year student could be examined in 7 subjects, "good students" will only have to attend 3 or 4 examinations. The decision of which 3 or 4 subjects the student is to be examined in is drawn in private for each student and is not revealed until the last school day.

Consequently, the student must prepare himself for all 7 subjects during the regular school year.

The examinations are gathered in a reserved 5 week period at the end of the school year from mid May to mid June. The Gymnasium only uses the last 3 weeks, except for final year students who also use the second week. First year HF-students use the last 4 weeks and VU-students and final year HF-students use all 5 weeks. Except for national holidays (which have a maximum of three whole days), the examination are placed Monday-Friday.

Previously, the examination planning was carried out by examination planners at the Ministry of Education using pencil and, especially eraser. Data was reported from each school on paper and sent by snail mail. In 1990, it was decided at the Ministry to develop an information system containing all relevant school data. The basic system is now an Oracle database with applications developed using Oracle tools and C-programming. Different systems are attached to the database, the examination system being the largest and most complex. A communication system handles the input of new data which is submitted from the schools to the ministry on floppy disks.

The problem and the approach
Summarizing, we can state that the task is to design and implement a computer based decision support system to plan and schedule the annual oral examinations for secondary education in the whole Denmark. For each student, it has to be decided:
- The number of oral examinations,
- The subjects to be examined on,
- The day, hour and room number for the examination,
- The examinator, and
- The censor.

In practice, there are two main interrelated factors that determine the process of the solution of the above mentioned problem. The *technical approach*, i.e. the suitability of the techniques, methods, software, procedures, and so on, included in the whole decision support system, and the suitability of the *social process* related to the problem solving process itself. In Hansen and Vidal (1995), the technical approach has been described. The second factor demands close interaction and collaboration between the group work, decision makers, experts, consultants and facilitators. In this section, we will primarily be focusing on the social processes though some aspect of the first factor will be shortly mentioned.

The planning problem described above is a complex and quite difficult combinatorial problem. It contains many decision variables; it has a variety of objectives and many feasible and satisfying solutions. We shall now elaborate on these observations.

Real life planning situations are usually complex. The examination planner has to comply with national laws and customs and must assist schools with their specific problems, making the examination period as smooth as possible. Obviously, a computer system should support him in this task, rather than introduce additional limitations.

The examination timetabling problem is well known for its mathematical difficulty (Eiselt and Laporte, 1987). This is also true for the assignment problems related to our planning problem. Since a student will normally take more than one examination, a school may have as many as 1500 student examinations. Each student examination is to be scheduled on a specific day, which produces very many decision variables. This assignment problem will contain more than 100 million binary decision variables if formulated as a traditional optimization problem.

Having multiple objectives is an ingrained feature of real life problems. These criteria involve a good spread of student examinations so as to provide good premises for each student, minimising the costs for the schools, the counties, and the Ministry, and sharing pedagogical benefits equally among the schools, subjects and geographical areas.

After experimenting with prototypes containing preliminary algorithms, it was concluded that finding feasible solutions did not present major difficulties. Finding satisfying solutions was more difficult but was still consider being attainable within reasonable amount of algorithm construction, system implementation effort and computational time. No demands for achieving optimal solutions were given whereas robustness and consistency were considered to be more important. This is in line with the following heuristic principle: *Managerial decisions might be improved more by making them more consistent from one time to another than by approaches seeking optimality to explicit cost models; especially for situations where intangibles must otherwise be estimated or assumed.*

These observations led to the conclusion that the final planning system should provide the examination planner with suitable information and optimising tools based in heuristic methods, which could be used interactively and that could be stopped at the users command yielding satisfying solutions.

To cope with the complexity of the problem at hand, it will be decomposed into four interrelated phases, each dealing with separate tasks and having well-defined goals following well-known heuristic principles (Silver et al, 1980). This decomposition approach follows to a certain extent the traditional approach (pencil and eraser) at the Ministry; this makes easier the final implementation process. This traditional approach was very time consuming for two planners with a lot of helpers.   These four phases are:
- Subject Draft,
- Examination Chain,
- Examination Scheduling, and
- Assignment of Censorships.

The work group and the stakeholders
The decision maker was the chief of the Examination Department at the Ministry. He is responsible that all the processes run smoothly. He played no major role in the development of the decision support system. He gave his full support to the work group.

The work group was composed of three planners from the Examination Department at the Ministry. There experiences from many years of work at the Department were

extremely useful while testing the different programmes solving each sub-problem. The leader of this group had a central position in the development of the decision support system because as a previous teacher in informatics, he had sufficient background to understand also the technical aspects of the problem and to contribute to its solution. He was not only the leader, but a user and a developer.

Stakeholders were of course the directors and teachers from the different schools that were involved in the discussions about the purpose of the new system, the first tests and the final implementation. The feedbacks from the stakeholders were important during the tuning of the whole system.

The facilitator was my previous student who had developed the technical approach in his MSc thesis; afterwards he was hired as a consultant for the Ministry. He was the facilitator of the whole development and implementation processes. As we will see below other experts were involved. He will seek for the collaboration of the users, the stakeholders, and the experts at the different stages of the development and implementation of the system.

Other experts were: One system's designer from a consulting firm and three programmers hired at the Ministry.

The facilitation process
In this case study the facilitator has two main tasks:
- First, to *design, develop and implement* a computerized decision support system in close cooperation with the users and other experts. As described above a satisfying system was developed by decomposing the complex problem in a series of interrelated optimization sub-problems each of them being solved using simple, fast, and reliable heuristic methods. Here the facilitator is working as a scientist using creative and rational approaches, mathematical modelling and algorithms to find satisfying solutions and using the scientific approach to manage the problem solving process.
- Secondly, *the facilitation of the group work* and the work of the experts in the development and implementation stages of the problem solving process. This was a long process, it started in 1991, the system was used for the first time in 1992, and it has being running every year since 1993. The task of the facilitator was to develop an efficient and innovative form of work, a common culture, a positive way of solving conflicts and a creative manner of finding new ideas. Here, the facilitator is working as an artist, he is instructing, directing, and coaching people to be participative, collaborative and creative in the problem solving process. He is like an instructor of a play in a theatre, supporting the different artists to perform their best and to create synergetic processes. Or, more metaphorically, he is like a painter were all the participants are his colours to be combined in shapes, shadows and forms to be able to create a master piece.

The technical approaches needed to deal with the above described complex situation are relatively easy to develop. Similar complex logistic problems have been previously solved using mathematical models and heuristics and special dedicated computerized systems.

The real complexity of the problematic situation in question is the *social complexity* related to the development and implementation of the system by the actors in a participative and collaborative way. The management of these social processes is a very complex task. Here the manager, that is the facilitator, is not only a rational and intelligent decision-maker, but also a creative and artistic designer. This managing attitude, managing as designing, is found in architecture, art, systems science and design professions.

Of course as with any practical project there have been conflicts, delays, and other problems related to negativity of some of the users or programmers leaving the Ministry; but in the spite of the facilitator's lack of practical experience, he and the leader of the working group believed that it could be done and were highly motivated to do the task. The system has now bee used for 14 years in practice. This has been a great success. For the Ministry, the examination system is the most prestigious system since the examinations have intensive attention from the schools, the public and the politicians; if things go wrong, from the press! Fortunately most people, including many students and teachers, are not aware of the existence of such a decision support system.

7. Strategy and Creativity: The case of Hermes (Månsson, 2001)

Hermes is a small privately owned company with 7 employees. It is a distributor of high tech products of hospital equipment and medico techniques to Danish hospitals. Over the years, the company has been relatively stable run by one managing director who has also been the owner. However, during the 1990's the company experienced some turbulence internally as well as and in a changing environment, creating substantial uncertainty and frustration amongst employees. In 1998, a new managing director took over the company which created a need for preparing a new business vision and strategy.

A historical presentation

Hermes was established in 1974 by the former director and his wife. The company was based on a vision to offer medico equipment to Danish hospitals. The director established a good knowledge both on the needed equipment and the network of doctors using the equipment by attending a fair number of medicine courses. Since it is the doctors at the hospitals that in large decided on which equipment to use, these contacts were invaluable to Hermes. Also the director spent much time on travelling in search for new products while his wife managed the financial aspects of the company.

Within the first couple of years, things went well for Hermes; people were hired and prospects were good, since more hospitals were built. In 1988, Hermes had 18 employees and a brand new office building. Later, the same year, it was decided to look for a new managing director. In relation to that, an assistant director was hired.

Four years later, the assistant director left the company. Unfortunately, with him went one of the company's largest sales products and around 25% of the turnover. This was possible, since the employees in Hermes worked more or less independently; contracts were based on individual contacts between Hermes employees and customers.

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Loosing around 25% of the turnover naturally created a critical situation for Hermes. In 1993, more employees were hired and some agencies were won. However, it soon became apparent that the lost market segment not could be regained. Hospitals were now closing and there were almost no prospects for building new hospitals which caused the market for medico equipment to stagnate.

In 1995, the balance sheets showed a negative result for the first time in the history of the company. The year after, it was decided to put down a managing group made up by three of the employees. The group then took over most of the leadership within the company, the managing director, however, still in the top position. Then in 1997, the director's son joined the company. He had been a member of the board for years and knew very well Hermes. Immediately, he was, in spite of lack of experience with the medico business and market, appointed as vice director of the company which caused the managing director to retire from his duties. Gradually, the vice director took over the responsibility of the company, and in 1998, he officially became the new managing director.

Almost instantly, the new director was aware that some products were not selling well. He realised that he had to cut down on some agencies – and eventually on the number of employees. These adjustments were implemented in the following years; Agencies with a low turnover were unwounded during 1999 and in 2000, a total of 11 employees were dismissed. Out of hands of the director, Hermes simultaneously lost some profitable agencies purchased by large competitors in the market, creating concern and a need for new business thinking.

In 2001, Hermes had 6 employees as well as the director. The managing group was dissolved. The organisational structure of the company was unchanged; each employee had his own area of competence and referred directly to the director. However, after the significant reduction of staff, it was evident that the company needed to reorganise in order to divide for example the administrative tasks between the remaining employees. The situation was rather uncertain, since no formal decision had been made concerning the work structure and tasks where problems were solved on a day to day basis more or less by the different employees feeling responsible for making things run.

The market situation has changed considerably compared to the situation 25 years ago. Today, chief doctors at Danish hospitals, being the primary customer group, have absolute power to decide on the products they want to use in their work. Companies in the medico-business are rather dependent upon good and close relations between their salesmen and these doctors. Furthermore, new competitors may be expected. The Internet opens up to global competition: most medico products are acceptable worldwide and can therefore easily be traded in this way.

The new director himself was in an awaiting position. He was a bit unsure of his role within the company. In reality, it was never his ambition to take over his parents' company and he felt more or less forced to do that when his parents wanted to retire. In a way, he took over the position in concern to his parents' life long work. However, he himself needed some directions for leadership and for formulating overall goals for

Hermes. He felt that he spent too much time on trying to make all employees happy and felt that a re-structuring of the organisation was needed.

Analysing the situation
In 2001, Hermes invited a facilitator, an MSc student, to come and take a look on the company. This facilitator was related with the director and was placed in Hermes for a period of 6 months. The purpose of the stay was to carry out a number of analyses that could support especially the director in his search for finding his standing point within the company and for starting out strategy related discussions that Hermes needed to take anyway.

However, the relation between the facilitator and the director put some constraints on the type of analyses that could be applied. It was for example concluded that a workshop for the whole company would be impossible to apply in the sense that most employees would be reluctant to be open-minded about the problems within the company when others were listening. The analyses, therefore, were carried out through a number of individual interviews with the facilitator and the single employees.

The overall purpose of the analyses was to identify issues and strategic points that could support the director (and indirectly Hermes) in finding his standing point. Analyses were carried out in a series of interviews with the employees, each interview lasting for about 1-2 hours. Dialogue between the facilitator and the director was however not timely constrained and often took longer time. Also the dialogue between the director and the facilitator was more frequent and less formalised however characterised by being completely confidential and based on trust.

It was decided to take a step-wise approach in applying methods and techniques in order to allow for a sound reflection process for the director and the employees in Hermes. Also, it was not possible to foresee to which extent the director and the employees would and could be willing to take part in the analyses. The facilitator, therefore, discussed with the director the imminent issues and it was decided to start by applying a metaphor analysis to understand the problematic situation and to be able to identify issues related to the organisation's culture.

Reading Hermes through metaphors
Generally, the idea behind using metaphors is to remove the fixed perception often put in descriptions of organisations. Using different metaphors and views on the organisation, new insights can create a varied range of possibilities for solving the problematic issues identified. Morgan (1997) presents a number of metaphors and a more detailed description of the approach.

Initially, employees and the director of Hermes were interviewed about their view on the organisation and the situation in Hermes. All interviews were performed individually with the facilitator. Afterwards, the facilitator identified a number of metaphors from the interviews. An overview of the identified metaphors and the interpretation they have provided in Hermes can be found in Table 1. The facilitator made up the readings based on the interviews. Later, they were put forward to each employee and the director and were slightly modified.

The machine metaphor	There is a wish amongst the employees and the director for an increased bureaucracy in terms of delegation of responsibilities, of competencies and formulating work procedures.
The culture metaphor	The culture of Hermes is undergoing huge changes. This is partly due to the new director and partly because of the restructuring where 11 out of 18 employees were dismissed.
The psychic prison metaphor	The employees and the director seem influenced by inner preconceived opinions about the structure of the organisation and the leadership of the company.
The organism metaphor	There has been a change in the surrounding environment due to several purchases from large competitors on the market. This causes Hermes to restructure and find new market grounds.
The brain metaphor	The market as such demands immense knowledge. The cutback in staff has resulted in a need for a certain degree of over capacity of functions and knowledge. There is a need for knowledge sharing and for securing existing knowledge inside the organisation.
The political metaphor	There could be a political game going on between the director and some of the employees as a consequence of the expert roles and external network connections they posses–being vital for Hermes' survival.

Table 1 Overview of metaphors describing different aspects of Hermes

After individual discussions with the director and the employees, the culture, organism, and brain metaphors were identified to be most descriptive of the situation. These metaphors were then further elaborated. Again the elaboration was presented for the employees and different problems were discussed and prioritised.

Reading the metaphors, most problems seemed to be related to the lack of communication and collaboration amongst the employees in Hermes as well as the lack of overall strategic discussion. The facilitator, therefore, developed a so-called storyline (Morgan, 1997) in which the most pressing problems, seen in the metaphors, are mixed with some recommendations on handling these. The problems are prioritised so it is only the most pressing issues that are addressed in this storyline. Figure 1 depicts the storyline. On top, the strategic issue and the communication and collaboration issues are placed. Below, are the recommendations on how to immediately handle the communication and collaboration issues and on handling the lack of a visible strategy.

There is a need for changing the attitude in the company before further strategic actions are taken. It is necessary to be able to communicate better and collaborate on achieving future goals

They have to be able to attend each others work functions in attempt to avoid bottlenecks. Business procedures and work tasks have to be seen as continuous learning processes

To match the changes in the surrounding environment, it is important that processes of change are taken into consideration in the future strategy
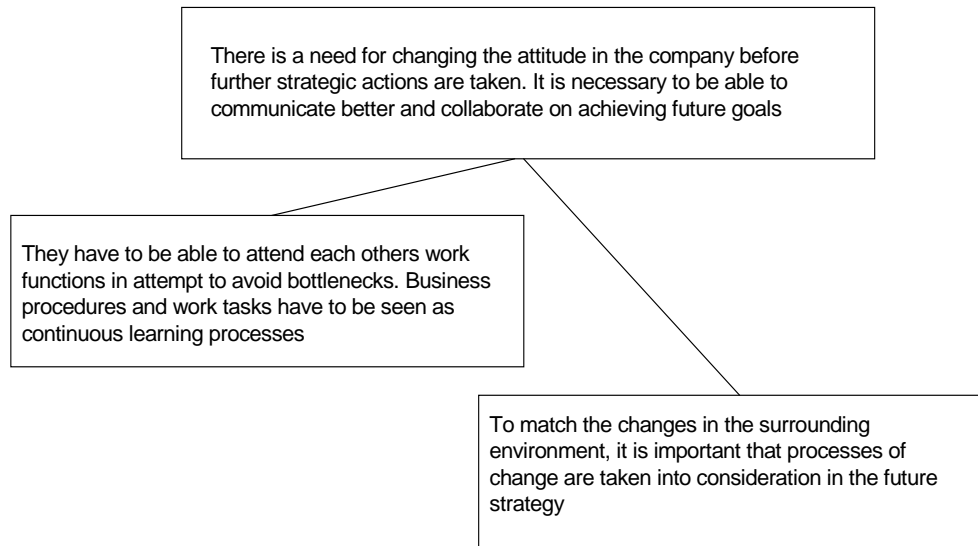
Figure 1 Storyline for Hermes, which depicts the most important problems and strategic perspectives

From the metaphor analysis, it was concluded that some problems were identified in association with the lack of clear strategic objectives. It was concluded that there were some things to do internally in Hermes – things that were independent on which external strategy Hermes would follow. However, since the director of Hermes was concerned with the situation and the various options he was presented for in terms of formulating the right strategy, it was decided to follow this path and apply another analysis on this part.

Rich Picture
The idea of a Rich Picture is to make a graphical presentation, a cartoon-like representation, of the issues, different perceptions, people, places, concerns and processes seen by the employees in Hermes. Only imagination set the limit for the symbols that can be used. The picture is drawn to be able to analyse and improve understanding of a situation and for being able to choose the right actions for improvement of this situation. The picture can in no way be seen as a final statement but more as a reflection or immediate snapshot of the situation. Usually, the picture is drawn as part of an interview – in this case, it is drawn after the interviews by the facilitator only. In this particular case, the Rich Picture shall be seen as an overall picture of the situation in Hermes, – summing up some of the issues already outlined but focusing more on the relationships and variety in both internal and external issues.

Methodologically, it was the facilitator who created the picture using the notes from the interviews as a guide to finding relevant issues and processes. No specific rules were applied in the picture, and the symbols were selected by the facilitator. The Rich Picture can be seen in Figure 3.
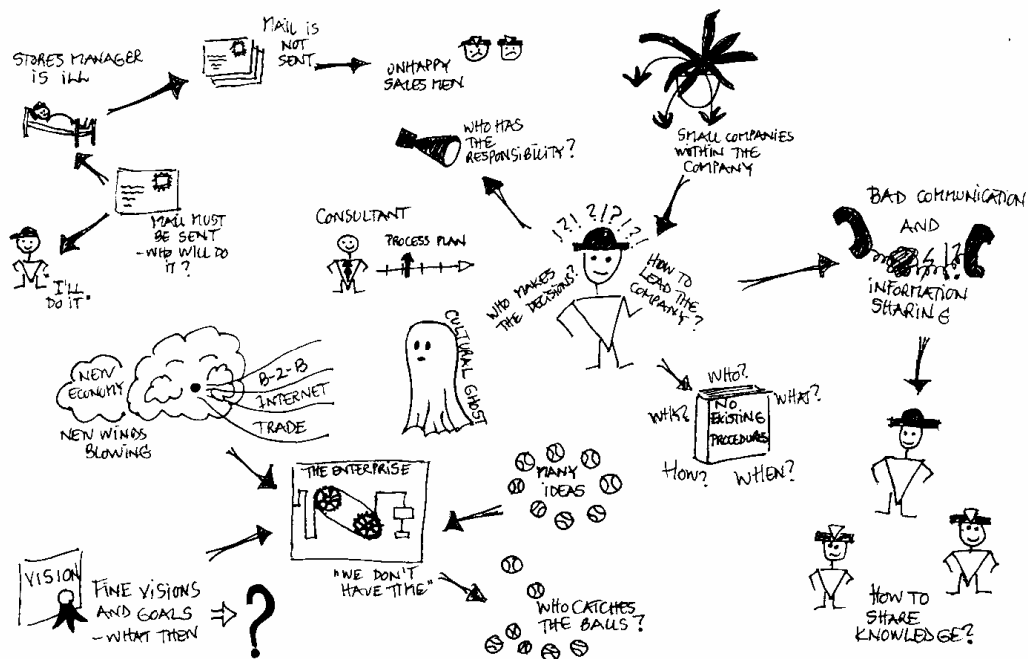
Figure 3 Rich Picture of the problematic situation in Hermes

Compared to the results of the metaphor analysis, the Rich Picture offers an easy overview of issues and relationships identified by the employees in Hermes. Also the significant problems seem to be more clearly visible. For example, the director's role within the company is centrally placed and with a number of relational linkages to other problems. Furthermore, the picture shows 'smaller' issues such as the mail which is not sent out. This issue may seem less important but for the employees, it was a major obstacle in their everyday.

Before the construction of the Rich Picture, the director had some problems picturing himself in Hermes, i.e., finding out his role in Hermes. This is clearly seen in the picture, and after this exercise, the director and the facilitator agreed on discussing various roles he could take on in the future.

The engagement in Hermes was ended with a number of recommendations given to the director as well as a general discussion in Hermes about the process. Both the director as well as the employees in Hermes was happy with the process. The director felt that he now understood much better the reasons for his confusion and could now see some alternative solutions for himself. The employees in Hermes was fond of the process; it had started an explicit and public discussion which before had been carried out "in the dark" without facing the problems and being active in solving these.

Clearly, the engagement had started a process in Hermes. Only time would now show if Hermes was able to go a step further in actively solving problems and developing the strategy for the future which seemed essential for the company.

8. Other Case Studies
The facilitation processes do not need to take so long time and not all problems have to be solved using mathematical models, computers and experts. The case studies shortly described below show real life problem solving were the facilitator was working as an educator, a scientist and an artist.

Community Facilitation (Whyte, 1996)
Noorvick is an arctic Eskimo community located somewhere in Alaska. The community is organised following the old traditions and some new ideas coming from the outside, the so-called developed world. The community has to deal with the authorities; located faraway in a big city, in what concerns development, planning and transfer of resources. Many problems, conflicts and disputes had not been suitable solved. The result was misunderstandings and poor cooperation. These two cultures, Eskimos and public servants, were not able to communicate to each other. Meanwhile lack of work, lack of education centres, poverty, and resignation was the actual situation of the community.

One day a stranger, an artist, arrived to the community. He was a young man, who just finished his education in communication, filmmaking and video techniques. He did not want to make military service and applied to do some social work somewhere in the poor world. He expected to be assigned to some Caribbean island, to one already going on project where he could use his artistic qualifications. The Eskimo community did not know about Tim's speciality and Tim did not know about the needs of the community. Tim was supposed to stay for two years.

In reality the artist knew nothing about Eskimo culture. Coming from a warm region, he had to adapt to cold, snow and ice. He started learning some Eskimo language. He was a fast learner and his natural open-mindness to something new helped a lot.

After this first period, that probably took a couple of months, the artist became an explorer. He formulated the following questions: How can I contribute in the best way with my qualifications to the development of this community? Can I?

After some talks with the leaders of the community and some of the authorities he was able to identify the central problem: The lack of a constructive and cooperative communication between these two cultures. What ought to be done? Both parts were willing to do their best, but they did not know what to do. The lack of trust to each other was deteriorating the situation.

After some incubation time, one night the artist woke up after a fantastic dream. In his dream the conflict was dissolved and a fantastic cooperation between the community and the authorities had begun. He knew exactly what to do. It was 3 o'clock in the morning. He went to his working table and started outlining his ideas. By 6 o'clock he went to bed again, but he could not sleep. He was anxious to meet the leaders of the community to discuss his proposal.

His proposal was: To use the art of filmmaking and the video technology to solve the communication problem. The wishes, problems and ideas of the community would be filmed and sended as videotape to the authorities. The authorities would look at the videos and start a dialogue process to achieve consensus about some proposals.

The leaders of the community were positive about the idea, they wanted to give it a trial but a central question was formulated: Who was going to make the videotapes? The leaders concluded: it had to be the artist; he had the expertise. He did not agree he did not like the idea that the community would be depending on his expertise. What would happen when he leaves the community? The other problem was the language, the films had to be made in the local language and thereafter professionally translated to English, and he was not able to do it in the local language.

Some persons from the community were selected; they formed the group who was going to learn about facilitation, the art of filmmaking and video technology. To select the persons was not an easy task, all the people wanted to learn the art of filmmaking! The artist elaborated a textbook and a series of lessons and workshops. His education program was following two principles: learning by doing and dialectical thinking. The students were very fast learners and highly motivated.

To make the story short, here is the final evaluation: The artist's ideas and actions were a complete success. His students learned to make films to communicate the needs and problems of the community. In his final report he wrote: *The villagers had established ownership of the technology and learned how to facilitate discussions with other villagers and with the authorities.* He was happy but a lot still has to be done. He resided in Noorvick for 11 years.

Career Planning (http://change.monster.com/articles/swot/)
One main activity in my job as a university teacher is the mentoring and facilitation of my student's visions for their future before starting their Master Theses. Creative tools can also be applied to career planning. This tool is a marketing analysis using the SWOT technique. As we have seen, SWOT analysis focuses on the internal and external environments, examining strengths and weaknesses in the internal environment and opportunities and threats in the external environment. We have seen in Chapter 2, the structure of a SWOT matrix.

To construct your own SWOT analysis is to set a course for your career planning, by examining your current situation. What are your strengths and weaknesses? How can you capitalize on your strengths and overcome your weaknesses? What are the external opportunities and threats in your chosen career field?

In a workshop for a group of students I ask them to reflect in a divergent process (brainstorming) about the following issues:

Strengths
Internal positive aspects that are under control and upon which you may capitalize during the planning process:
- Work experience,
- Education, including value-added features,
- Strong technical knowledge within your field,
- Specific transferable skills (e.g. communication, teamwork, leadership skills),
- Personal characteristics (e.g. strong work ethic, self-discipline, ability to work under pressure, creativity, optimism, or a high level of energy),
- Good contacts/successful networking, and

- Interaction with professional organizations.

Weaknesses
Internal negative aspects that are under your control and that you may plan to improve
- Lack of work experience,
- Low grades, wrong major,
- Lack of goals, lack of self-knowledge, lack of specific job knowledge,
- Weak technical knowledge,
- Weak skills (leadership, interpersonal, communication, teamwork),
- Weak job-hunting skills, and
- Negative personal characteristics (e.g. poor work ethic, lack of discipline, lack of motivation, indecisiveness, shyness, too emotional).

Opportunities
Positive external conditions that you do not control but of which you can plan to take advantage:
- Positive trends in your field that will create more jobs (e.g. growth, globalization, technological advances),
- Opportunities you could have in the field by enhancing your education,
- Field is particularly in need of your set of skills,
- Opportunities you could have through greater self-knowledge, more specific job goals,
- Opportunities for advancement in your field,
- Opportunities for professional development in your field,
- Career path you have chosen provides unique opportunities,
- Geography, and
- Strong network.

Threats
Negative external conditions that you do not control but the effect of which you may be able to lessen:
- Negative trends in your field that diminish jobs (downsizing, obsolescence),
- Competition from your cohort of college graduates,
- Competitors with superior skills, experience, knowledge,
- Competitors with better job-hunting skills than you,
- Competitors who went to schools with better reputations,
- Obstacles in your way (e.g. lack of the advanced education/training you need to take advantage of opportunities),
- Limited advancement in your field, advancement is cut-throat and competitive,
- Limited professional development in your field, so it's hard to stay marketable, and
- Companies are not hiring people with your major/degree.

To further refine the list of Strengths, Weaknesses, Opportunities, and Threats, it is advisable to use some creative and critical thinking. The students should explore their own self-perception of their strengths, but also put themselves inside a prospective

employer's head as he considers their strong points. Avoid false modesty, but also be brutally honest and realistic with yourself. Start out by simply making a list of words that describe you; chances do many of these characteristics comprise your strengths.

One of your greatest strengths can be loving the work you do. Learning to "follow your bliss" should be a critical component of managing your career. Some people know from an early age what kind of work will make them happy. For others, nailing down the self-knowledge that leads to career fulfilment comes from a process of exploring interests, skills, personality, learning style, and values.

In assessing your weaknesses, think about what prospective employers might consider to be the areas you could improve upon. Facing your frailties now can give you a huge head start in career planning.

As humans, we find it relatively difficult to identify the areas where we are weak. But this assessment helps to identify areas where we may need to improve. If you identify a skill that you know is in your chosen field, but you are weak in that skill area, you need to take steps to improve that skill. Past performance appraisals and even your grades and teacher comments from school provide valuable feedback.

Do not forget print resources, such as newspapers, periodicals, and trade publications. Check out job postings on the Internet to get a feel for the relative number of openings in your field. If you are a college student, check out your school's Career Services office for information on file on opportunities and threats in your field.

From this analysis, you will have a road map that shows you how to capitalize on your strengths and minimize or eliminate your weaknesses. You should then use this map to take advantage of opportunities and avoid or lessen threats.

After you have analyzed your strengths, weaknesses, threats, and opportunities, you should use that information to plan how to market yourself.

The marketing planning process entails a three-step process:
1. Determining goals,
2. Developing marketing strategies, and
3. Strategizing an action plan.

Goals - define your career objectives. What is your ideal job upon graduation (or the job you would like to transition to from your current job)? What are some other positions you could accept? What is your five-year career goal?

Marketing Strategies—a broad marketing strategy or "game plan" for attaining your objectives. What are the companies and organizations you are going to target to obtain your goals - your ideal job? How will you communicate with these firms? The strategies you identify should utilize all of the resources available to you, such as your personal network and a partnership with a mentor.

Action Plan - according to marketing principles, marketing strategies should be turned into specific action programs that answer a number of questions, including: What will be done? When will it be done? Who is responsible for doing it? Your key task here is

setting specific timetables and deadlines for getting the career and company information you identified in the marketing strategy step.

The elevator problem (Ackoff, 1978)
This is a classic case study in which the tenants of a large office building complained about the increasingly poor elevator service. A consulting firm specializing in elevator-related problems was employed to deal with the situation. It first established that average waiting time for elevators was too long. It then evaluated the possibilities of adding elevators, replacing existing elevators with faster ones, and introducing computer controls to improve utilization of elevators. For various reasons, none of these turned out to be satisfactory. The engineers declared the problem to be unsolvable.

When exposed to the problem, a young psychologist employed in the building's personnel department made a simple suggestion that dissolved the problem. Unlike the engineers who saw the service as too slow, he saw the problem as one deriving from the boredom of those waiting for an elevator. So he decided they should be given something to do. He suggested putting mirrors in the elevator lobbies to occupy those waiting by enabling them to look at themselves and others without appearing to do so. The mirrors were put up and complaints stopped. In fact, some of the previously complaining tenants congratulated management on improvement of the elevator service.

The Traffic Team Example (http://www.teambuildinginc.com/tps/020he1.htm)
In 1983, the management team of a large organization was struggling with a severe traffic problem on the road leading to their location. The road crossed four miles of protected wetlands, so it could not be widened without significant environmental impact. Each morning the traffic leading to the site was backing up the entire four-mile length of the road, adding an hour to commuting time. The resulting aggravation caused productivity to drop significantly.

Three years earlier the management team had hired traffic consultants to solve the problem. Their work focused on a future widening of the road and looked promising, but their attempts to devise short-term solutions failed miserably.

As a last resort, management decided to assemble a team of people from the company to address short-term solutions. The ten-person team was comprised of engineers, clerical personnel, line workers, and union representatives. This team met twice a week for a month, culminating in a series of recommendations that ultimately improved the traffic flow both into and out of the site.

The simplicity of the team's recommendations surprised management. For example, in one recommendation the team suggested that trucks making deliveries to the site be prohibited from doing so between the hours of 6:00 a.m. and 9:00 a.m. Since there were many deliveries to the site at this time, this recommendation immediately removed some of the slowest, most cumbersome traffic clogging the road. Additional recommendations were also made that similarly contributed to easing the problem. The result was almost instantaneous improvement in the traffic flow.

At the outset, management had doubted that this team could solve the problem. After all, experts had been studying it for three years. But in turning to their own people they found a solution, and in so doing, they tapped into the essence of team creativity. Innovation has no bounds, and when it is combined with a process of collaboration that multiplies its effect, it has great power.

> Assuming that the way experts or others formulate problems will lead to a solution is often wrong. Experts are only experts within the box that defines their expertise. But solutions to most problems that arise within the box are found outside of it. What is needed is out-of-the ordinary thinking, "crazy" ideas, without fear of the ridicule. Encouragement of "crazy" ideas ought to be the norm at organizational meetings.
> Ackoff and Rovin (2005)

9. Conclusions

Everything can de approached scientifically and everything can become art. Our main message is that in what concerns problem solving in complex situations, it is advisable to use both the scientific and the artistic attitudes. More satisfying results will be achieved, the risk of failures will be minimized, all the participants will be empowered, and everybody will learn from the experience, even the facilitator.

In the case of the planning problem, the Ministry could have ordered the decision support system from a firm instead of in-house development. But in such situation the consequences of failure were too serious and could easily become a political issue. In Denmark, there are too many bad experiences with implemented computerized decision support systems that were extremely expensive to develop and implement and that did not solve the problem, on the contrary caused more problematic situations.

In the case study related to the planning of the examinations the facilitator was educated as an engineer, but in the social process he was managing he was an artist although he was not aware of that. He used his intuition to solve conflicts, supervised the experts and used time to dialogue with the users. He was able to create a common language, a common culture and motivate all participants. He was managing by designing.

In the other case studies, the facilitators were both professional artists and scientists, being able to use these complementary approaches when it was needed.

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