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Securing Knowledge Assets in the Early Phase of Innovation

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Securing Knowledge Assets in the Early Phase of Innovation

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In the western culture the interest in knowledge dates back to the Greeks, e.g. to Alcmaeon, Empedocles and Democritus. Today knowledge has become a buzzword. The concept of the knowledge society is often used to underline the importance attributed to knowledge. The first signs of knowledge coming to occupy a major role in contemporary society emerged already in the 1980s. Researchers began to distinguish between knowledge-based and capital-dependent companies, such as Prahaled and Hamel (1990), Reich (1991), Drucker (1993), Florida and Kenny (1993), Boisot (1995, 1998), Starbuck (1992, 1993). In this period the concept of the knowledge worker was created, cf. Zuboff (1988).

The location of knowledge production has changed significantly over the past decades. Formerly knowledge production was generally related to research and educational institutions. Today, knowledge production is not confined to these institutions, but is also taking place in organisations, companies, etc. Knowledge formation is undergoing rapid change. Focus is shifting toward understanding knowledge formation as a practically oriented interactive process among people of different backgrounds and understandings of the area within which they work. Cross-disciplinary interaction is growing and moving toward the practical application of knowledge that is considered heterogeneous and user oriented, cf. Gibbons (1994).

Co-operation between Universities and Industry

Below we shall outline the practical experiment of coupling the knowledge of higher educational institutions with that of highly innovative Danish companies. The experiment ran for three years and was the joint project of the Confederation of Danish Industries and researchers from the Copenhagen University (Department of Psychology) and from the Copenhagen Business School (Department of Management, Politics and Philosophy). The experiment was financed by the mortgage-credit fund of the construction industry (Byggeriets Realkreditfond).

The working method was action research, and work was carried out in cross-disciplinary groups of seven-eight students at graduate level. Simultaneously

the companies worked with innovation groups of 8-15 members that had to solve a specific innovation assignment**.** The objectives of the companies were product innovation and the transformation of knowledge into economic value. The students did not directly participate in the processes, but gathered and processed knowledge related to the same area as the companies were involved in. However, as will become apparent, the students' approach to their tasks differed from that of the companies. The joint headline was management of knowledge processes creating innovation potential.

Thus, this experiment generated data on a new way of organising co-operation between universities and industry in relation to the management of knowledge in the early phases of innovation. However, more important is the way in which the students worked. This approach may be generalised to a model for how to secure knowledge assets in the early phases of innovation. The purpose of this chapter is to subject these two aspects to critical examination, and in the last part of the chapter we shall outline the resulting model.

The Early Innovative Phase (preject)

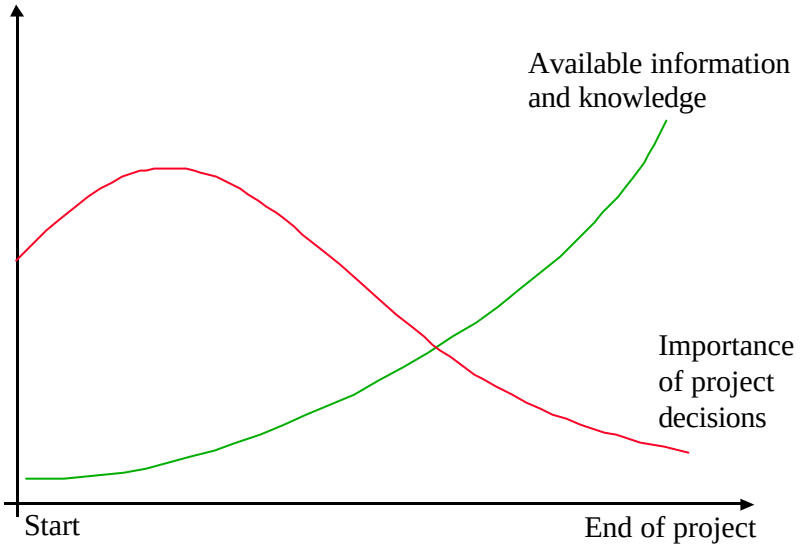
Innovation theory does not focus on processes prior to the development of innovations. If we take Schumpeter's theory (1934) on economic growth as our point of departure, the efforts following the creation of the innovation are assigned significant import. This viewpoint has strongly influenced the Danish understanding of innovation (see Herlau (1995) and Herlau and Tetzschner (1999), that is generally concerned with the sequence of events following the creation of an idea. Thus, in this period target, time and resource control - project management – should be considered as instrumental and rational management tools, cf. Kirkeby (1998) and Sjöstrand (1997). In the following, projects will be considered discrete events designed and planned by organisations (Kreiner 1992). Project work is not concerned with work routines, but with the desire to change a given situation.

If projects are carried out with a high degree of certainty as to their outcomes, it is by definition debatable whether they are really projects. However, projects

may also become turbulent to the extent that uncertainty implies that the projects must be terminated. If project management operates in a turbulent world where knowledge increasingly is part of the goal/result, the model comes under pressure, particularly in the first phase, which often takes the form of an investigation. This problem is outlined in Figure 1.

Figure 1

Project planning dilemma



Source: Mikkelsen & Riis (1998:23).

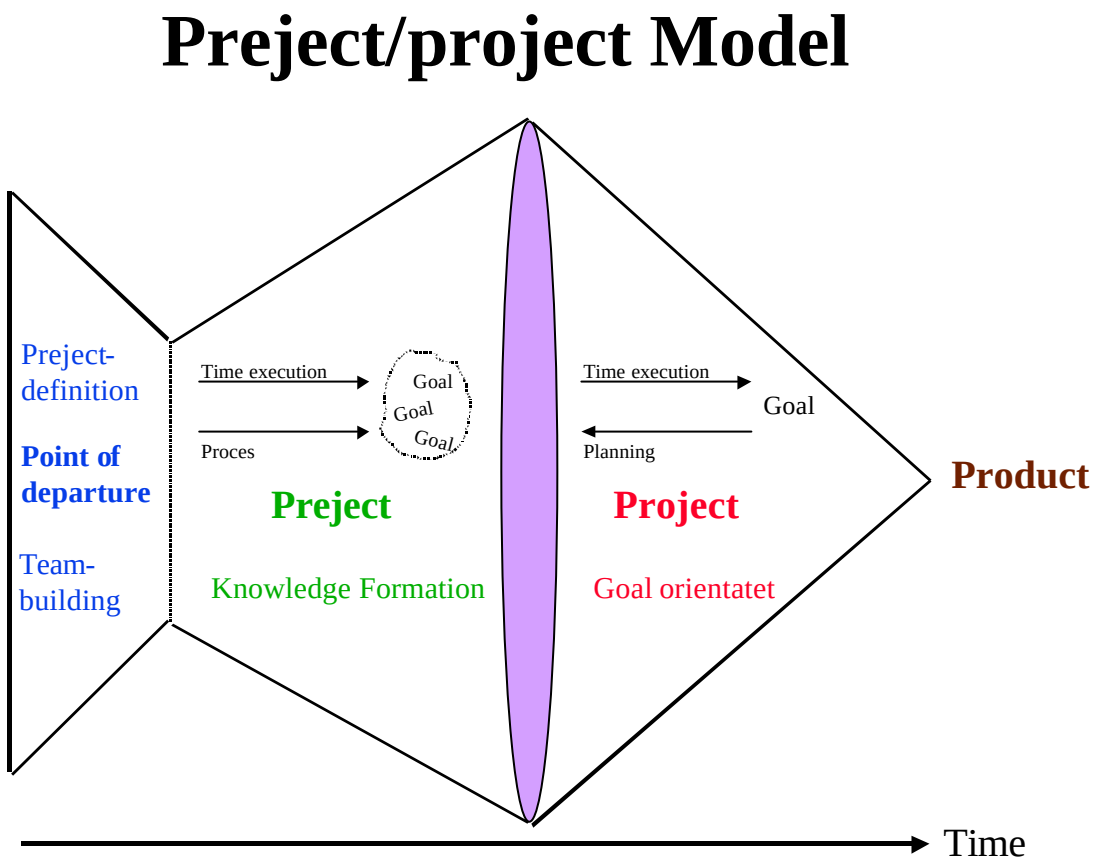
In the early stages of the project accessible knowledge and the outcome of the decisions based on this knowledge diverge.

We will focus on the early stages of the project. Figure 2 illustrates the initiation and implementation of project work by way of an ideal model. Process and goal oriented work forms are outlined as respectively preject and project phase.

The preject concept outlines and contains a number of procedural activities, e.g. conflicts (Mintzberg 1983), demarcation of uncertain or lacking goals (Christensen & Kreiner 1991), planning paradigm problems with lacking interest in behavioural and cognitive aspects (Hall 1980; Morris & Hough 1987). These

activities are often considered “noises” in traditional project management literature.

Figure 2



Source: Herlau and Tetzschner (1999:216).

From Project to Temporary Organisation

The preject phase is often viewed on the basis of systems theory. The project is seen as a system formed by its combined components and coupled through their interdependency. The better the combination of components, the better the whole/project is, cf. Nathan 1991; Roman 1986. Packendorff (1995) rejects this view of project work as a tool and is advocating radical criticism. Instead, he assumes projects to be temporary organisations, cf. Figure 3. This assumption he shares with Weick (1979), who states that adapting the “alternative assump-

tions" involves studying organised action on the basis of the individual's conceptions rather than on the structural features of projects.

Figure 3. Research foci on Project management in different metaphors

Project metaphor / Research Focus	The project as a tool	The project as a temporary organisation
Development	Plan	Expectations
Implementation	Control	Action
Termination	Evaluation	Learning

Source: Packendorff (1995:328).

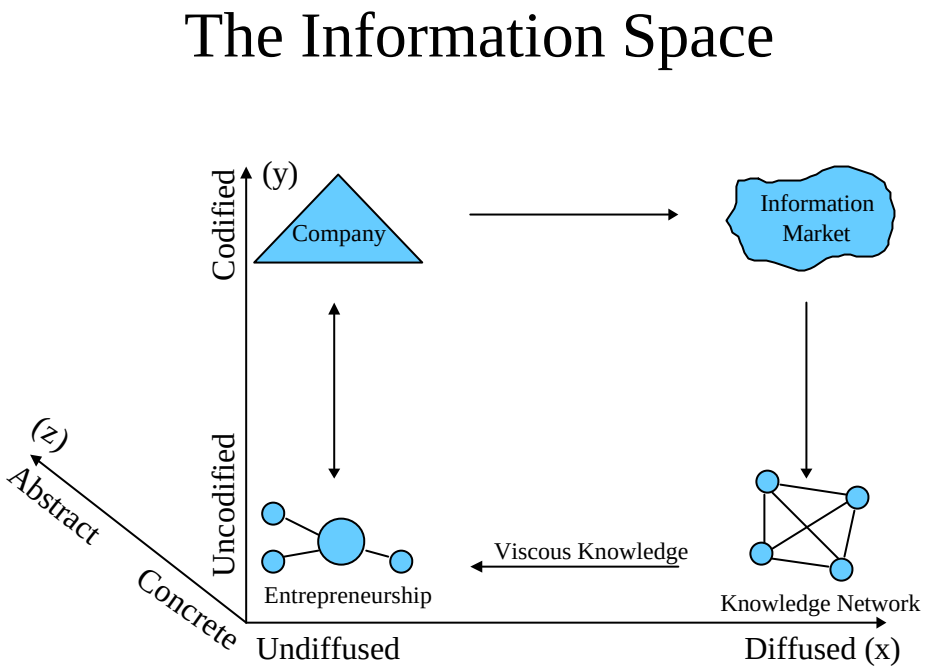
The above figure questions one of the fundamental elements of project theory - rationality. For many years James G. March has been one of the foremost challengers of the rationality paradigm. According to Hargreaves Heap (1989) Figure 3 can be viewed as a shift. Where instrumental rationality previously was thought to have high explanatory value, the growing use of knowledge shifts attention toward project management viewed from a procedural rationality perspective. In a world in which knowledge is increasingly applied in project work, the procedural rational perspective offers a more adequate explanatory model.

The Information Space

This challenge to the traditional rationality model can be formulated even more radically. Thus Boisot (1998, 1995) advances a theory, in recognition of the highly increased utilisation of knowledge, which rejects capital and work as the most important foundations for the economy. He focuses on data/physical factors. Thus, the information space is created, a three-dimensional model, which shows knowledge transformation as a flow between phases and conditions through which knowledge moves, see Figure 4 below.

Boisot takes the full consequence of the knowledge society's demand for more apt descriptions of transactions, which are increasingly based on transformation/transmission of knowledge.

Figure 4



Source: Herlau and Tetzschner (1999:265), adapted from Boisot (1995 and 1998).

The model is used as a comprehension framework:

- (Y): The scale on the codifying axis should have intervals based on the understanding of complexity (algorithmic complexity), i.e. the number of bits of information required to carry out a given data processing task.
- (Z): The abstraction axis reflects focus on structures both causal and descriptive, which lie behind data. Here, concepts rather than prospects are generated.
- (X): The diffusion axis represents communication (Boisot 1998:55). "Lower-level technical consideration will affect diffusibility and hence the availability of information within a given population. Higher-level social and cultural consideration will influence the absorption of informa-

tion within that population, and hence, the rate at which it is taken up and used".

Based on the information flow consideration in the model Boisot states: "When, then, is knowledge likely to flow readily and when is it likely to turn viscous? I argue that fluid knowledge is knowledge that is well codified and abstract: all extraneous data has been shed. Viscous knowledge, by contrast, is data rich, qualitative and ambiguous. It flows slowly, if at all. Think of the difference between transmitting a reference number and describing in detail a Rembrandt self-portrait, both on a long-distance telephone call". Boisot (1998:XIV).

In a dynamic world transformation takes place between the two forms of knowledge. Over time, part of the viscous knowledge is transformed, but it takes time and processing. Often, the process is embedded in learning processes not used at universities. Boisot uses the term viscous knowledge to present a form of knowledge that does not receive too much attention. This condition of knowledge is situated in the lower right corner of Figure 4. Here knowledge possesses the most entropy as opposed to the upper left corner, which has the highest degree of clarity, but little entropy. Davenport and Prusak (1998) use the terms viscous and velocity knowledge. The terms represent a more figurative understanding than actual definitions.

Diffusable knowledge is assumed to be located in the upper half with the highest potential in the upper left corner. This knowledge is easily diffused and can be communicated through various media, e.g. books, newspapers, patents, graphs and the Internet. This knowledge could also be rendered as explicitly expressed knowledge, which can be copied and shared with others. This kind of knowledge is appreciated and often attributed high value in society. Processing data forms it, reducing complexity through goal oriented exclusion and complexity reducing codifying and abstraction processes. These elements can also be found in the goal oriented project management model, which often forms the basis for this kind of knowledge representation. The knowledge in the lower part of the figure is often created through arbitrary processes where complexity is toned down via absorption and impacting. A significant portion of tacit

knowledge is often created during this process. As the word viscous implies this knowledge is not easily transformed or communicated. Schön (1987) and Johannison (1992) discuss action learning as a pedagogical model based on this knowledge production - pedagogy as opposed to classical literary learning. The above could also be compared to the Dreyfus & Dreyfus learning model (1986). They add practical expert knowledge elements, which can also be found within the viscous knowledge concept. The above forms part of a framework for the project to be described.

Industry (preject)

The purpose of the project is to investigate the factors, which pull or push innovation capabilities in companies. The project terminated in the spring of 2000. We chose to focus on product innovating businesses that could be described on the basis of classic innovation theory (Rogers 1983). An expansion of the project so as to include service innovations (Sundbo 1998) was not part of the project.

The method of investigation was proscriptive. The project was carried out as a clinical research project. The proscriptive method ideally requires presence/observation prior to the events taking place (Kirkeby 1998). Satisfying this requirement fully has proved difficult, but it was possible to begin the investigation process at a very early stage through co-operation with three large Danish companies that product innovate at a very high technical level. We have been able to follow products from what could be termed loose ideas over inventions and product maturing to innovations.

The project focused on the preject phase. As demonstrated in Figure 2, this part is marked by the exploratory phase of divergent knowledge. Projects of a goal oriented starting point, e.g. customer or market oriented starting points, were excluded.

In the early development stages, meetings were the work forms. The meetings were monitored by at least two external observers who followed and docu-

mented the process using video tape recordings and summaries. The group members were selected based on what the companies termed normal procedure. There were only minor (natural) adjustments in the groups. Even though the companies and the participants stated that a normal starting procedure was followed, some of the participants seemed unaccustomed with the starting situation.

Information from the participants assuring that this was normal starting procedure did not seem convincing based on our observations which match, e.g. Mikkelsen & Riis (1998) who state that this phase is often considered the socialisation phase. Spontaneous agreements are made, and important parts of the project are negotiated outside and between meetings. A substantial share of this activity takes place for the purpose of decoding signals from opinion makers - the management. Argyris & Schön (1996) term this "espoused theory". Apparently the starting phase aims to be in line with the ideal project management work form.

It is obvious that the group's frustration centres on the project management model. They "search" for data within the organisation's knowledge base and in the loosely linked networks. To a surprising degree, the participants look for knowledge within the organisation's own comprehension (theory-in-use). Relations with company management run in a U-shaped form as described by, e.g. Staudt (1997).

The first phase is characterised by extreme interest and little interference on the part of the management, the group is left to "itself". Gradually management demands tighten through formal and especially informal communication with the group. Proposed inventions are assessed on the basis of criteria that were not explicitly expressed at the beginning of the project. In the beginning the attitude was that the group should be given a free rein. In one of the observed companies innovations relevant for the market have materialised. This is also expected to happen in the two other companies. It is not surprising to see these companies innovate. As mentioned earlier they are all considered to have great innovating potential.

One surprising observation was that the groups seemed very uncertain when they tried to innovate on the basis of what is considered "normal best practice" or "theory-in-use". The "professional" product developers generally took as their point of departure the company's internal understanding of the problems. The search and learning process was very short, they left the turbulent phase as quickly as possible.

Students (preject)

Based on training, the students chose a different approach to gathering and processing information. Below the part of the project concerning the student group is described. The group was composed cross-disciplinary of students from institutions of higher education in the Copenhagen area. The students had all signed up for the course in project management and innovation offered jointly by the institutions (Læreanstalternes Fælles Projektleder- og Innovation-skursus, LFPI) that runs for two semesters. Teaching took place at Symbion (Copenhagen Science Park). The course is offered to graduate students. Several of the participants are working on their theses. Teaching is based on the assumption of projects as kinds of organisation, cf. Packendorff (1995). During classes projects are treated as "unusual" organisations, because organisations in general have been formed on the basis of an historical process - a continuous period of learning and adaptation, cf. Kreiner (1992).

Certain systems are characterised as systems with moderate feedback. They often appear to be stable. Unstable systems are often dynamic with a high degree of feedback. This appears where the system can be defined as a network of participants, a loosely linked network, cf. Christensen & Kreiner (1991). The instability increases when feedback is both positive and negative. Knowledge of organisations and systems with a high degree of instability, e.g. during the inventive phase has generally been obtained through retrospective observations. Often, the turbulent situations have been forgotten or expressed in a way that relates to other values; Tetlock (1985), cf. also "theory-in-use" and "espoused theory". The project structure will in general accept this characteristic provided that it can be co-ordinated with the project work system, i.e. the social system.

This may be the reason why it is so difficult to observe and describe innovation processes retrospectively.

The above has often been described in keeping with the scientific tradition dating back to Newton, cf. Gibbons (1994). Problems are mainly looked at in an academic context and communication is therefore directed towards a certain type of readers. Knowledge formed through the loosely bonded system can be described as knowledge formed in the context of application. Knowledge is formed through continuous discussion, not a fixed goal. Models such as the garbage can model, cf. Cohen et al. (1972); Cohen & March (1974); March & Olsen (1976) are designed for the interface between certain activities and a turbulent environment.

In order to facilitate the study and establish data during the preject phase, a didactic concept called KUBUS® was developed through action research, cf. Herlau (1995). The leadership principle of the model is based on a stochastic model of leadership roles, cf. Argyris & Schön (1996); Leavitt (1986); Adizes (1979); Gjerding & Lauridsen (1995) and leadership functions related to persons, Belbin (1994). The model appears as an "artificial" leadership culture. The model is tested in the preject phase. Control and leadership principles known from literature on project leadership are used in this phase, cf. Herlau (1995 and 1997); Critcley & Casey (1984); Prince (1970); Shalit (1983); Herlau & Tetzschner (1999).

The KUBUS® Model

The traditional understanding of project management as a rational and instrumental system is taught mainly in terms of visiting teachers, textbooks and cases. This phase is described as the project phase in Figure 2. The phase termed the preject phase in the same figure is taught on the basis of the action-learning model. The model appears as an enquiry system, cf. Churchman (1971). It is an attempt of a normative system developed to work in the preject phase as a temporary organisation or as a system, which can support/strengthen absorption and implication. The model is known as KUBUS® and it is empiri-

cally and theoretically founded in Herlau (1995), Herlau & Tetzschner (1995, 1999). It consists of a set of tools, which like "rules" in traditional project management can guide the participants' work in groups. This educational practice, i.e. the model, has been tested over a number of years at the Copenhagen Business School, Westminster University, London, and Brookfield Business School, Belfast. It has also been tested in collaboration with the Danish Ministry of Education, cf. The Ministry of Education Report no1301 (1996). A national experiment has been initiated for testing the model on the educational system at various levels.

The KUBUS® model is in its basic form a management model. Project management tools can be viewed as organisation prototypes which, like probes, are sent down into the knowledge which is believed to be embedded in the groups of participants and the organisation that may span around this group, cf. Christensen & Kreiner (1991). According to Boisot (1998) this process runs to the left side in Figure 4. The KUBUS® tool spans around the participants who search downwards from the upper right corner in Figure 4.

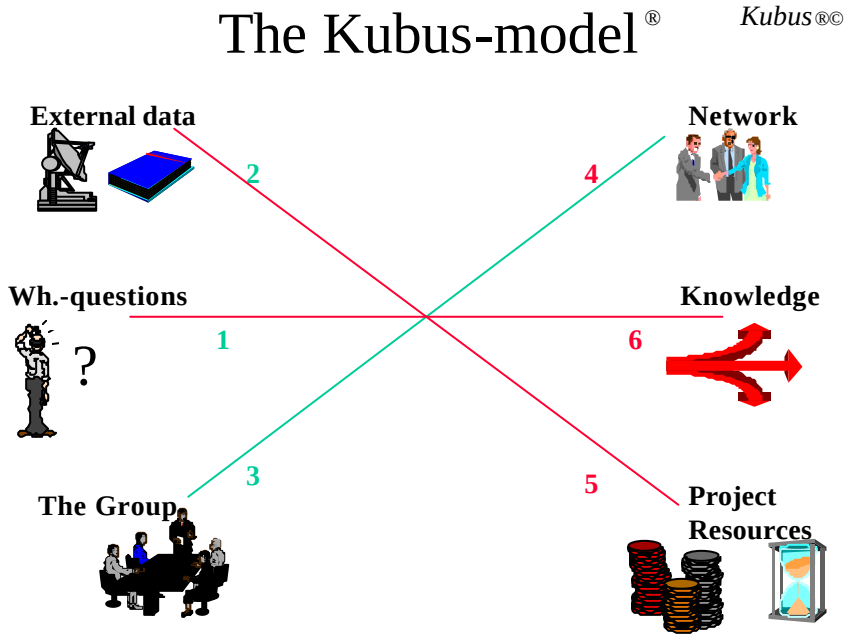
The activities described above have very different purposes and progress differently. Information is gathered and processed differently in the two situations. After an often turbulent and chaotic initial phase, the project management tool creates a goal. Then follows an instrumentally rational, convergent and target oriented process. The result is a completely defined and developed product and great order. Work is managed within the responsibilities of the project manager (alone) who generally is as difficult to describe as the contractor, Gaddis (1959). The terms chaos and order have become part of project management literature, which in the past years has used the chaos concept in relation to innovation and project management, e.g. Stacey (1996) and Peters (1987).

The KUBUS® model starts from a theme, which concerns the group. The highest degree of order exists at the beginning of work. It is in this context easy to pin point the beginning of the event contrary to traditional project management. This stands in contrast to the groups observed, where a very confusing process leads to a fumbling formation process with an opaque power base – as demon-

strated in the case material from the three companies. Differences between company and student processes should be found in the turbulent processes in the companies and the structured processes in the teaching situations. Using the KUBUS® model yielded high innovative outcome in one of the companies, however, this is based on an individual case. It should be noted though that the company in question sought lots of information outside its own organisation.
If we return to the explosive growth in and use of knowledge, cf. Nørretranders (1997); Boisot (1998, 1995) it is natural to assume that even the cutting edge companies, in this day and age, must face the fact that most information is formed outside and not inside the organisation. The organisations observed apparently have difficulties in adjusting previous experience, learning and practice to this fact.

Figure 5 illustrates the KUBUS® model. It basically consists of a number of rules that can help organise the group in the preject phase. The basic model consists of six areas of discussion.

Figure 5



Source: Herlau and Tetzschner (1999:273).

Management is practised as a service that the individual participants perform in rotation. Two complementary leadership roles are used. They are developed during the process through feedback from the members of the group. Thus, the group works within a transparent leadership structure (not just one leader). Darsø (1997), Herlau (1995, 1997), Herlau and Tetzschner (1995), Shalit (1983) and Guedalla et al. (1997) inspire the basic management model.

Management is sharply separated into two functions – a process-oriented and an outcome-oriented. All members of the group are actively exercising management based on their knowledge of the functions through which management manifests itself in the group work, and the members support the management functions by making themselves manageable through their actions. In practice, the participants are assigned management functions by rotation. In consequence, all participants take turns at working with exposing the management functions. As there are two management functions, two participants act as managers while the group is working.

In order to facilitate reference to the two management functions, they are referred to as red and green management, respectively. The following summarises the two management functions. **Red manager's function:** The primary function is to stick to the strategic goals, i.e., generating knowledge potential within the agreed work area. Furthermore to utilise the group's resources, especially its knowledge capital, and control that tasks are performed in accordance with the group's social codex. **Green manager's function:** The primary function is to maintain the original subject of the group work. Furthermore to ensure that all members participate equally in and understand discussions in the group about the subject and that the tasks distributed among the participants are formulated in the right way. And finally to ensure that the individual participant understands the task for which s/he is assuming responsibility and that all participants understand why the given task is of importance for the common understanding of the subject and why it will increase the knowledge potential.

During and in between meetings the red and the green manager collaborate closely in that they are both responsible for co-ordination activities between and

prior to the group meetings. During the meetings, red and green manager decides in turn according to the given management function and item on the agenda. Group members that have no red or green management function support the two managers based on the social codex adopted by the group. All group members will have or have had the role of red and green manager. By actively exerting the two management functions, each participant learns about the related problems. The participants will not passively wait for management; they will actively intervene and support the management function. They make themselves manageable. The responsibility for supporting the management function is expanded in that group members in or between the meeting seek to maintain and exert action based on the currently discussed and reflected attitude toward what they want, what concerns them, and which tasks they will commit themselves to undertake.

The two management roles are created based on the above fundamental functions, and the roles are developed/expanded during the entire process through feedback from group members after each meeting. Decisions on how to perform the duopoly management role are built into the social codex of the group. Through reflected participation the group is working toward the management roles that are currently constructed based on the participant's processing of their contents and functions. Thus, in the process the role becomes increasingly detached from the participants' personal management style and understanding of management.

This no-leader management, or as in this case two types of management (duopoly management), can be linked to several authors, and it is often considered the management function in organisations as a role (Drucker 1985), (Herlau 1995), (Shalit 1983).

By introducing a management meeting tool that centres focus around the process, which is managed and carried through in a “management neutral” and transparent system, this model aims at rule control - procedural rationality. The group asks questions about what a person with this background and knowledge would try to add to the group in an open and transparent communication, cf.

Hargreaves Heap (1998). “Shared procedures” are the building blocks upon which procedural rationality rests. But based on such shared platforms of understanding, but the same procedures can lead to different solutions. Target rationality, which is prioritised in project management, cannot be achieved through procedural rationality.

Figure 2 illustrates that the transition between the preject and the project phases is unambiguous. The assumption is that during the transition, based on accumulated knowledge, a decision is made to begin a goal-oriented project. The accumulated knowledge, the viscous knowledge formed through rational knowledge processing, is predominantly tacit, cf. Polanyi (1996). It constitutes knowledge potential; it does not contain possibility, but rather a possibility potential. This knowledge potential is comparable to core competence, i.e. it is not defined specifically but rather as a human resource, cf. Penrose (1972).

Two Different Systems

These two approaches to knowledge accumulation, the preject work form and the project management approach, form and process knowledge based on two very different principles. The target rational model points toward the formation of knowledge through exclusion of information in that the convergent target orientation excludes information, and by doing so minimises complexity. The procedural model forms the background for information not easily contained. This knowledge potential, the mother of information (exformation), makes viscous knowledge valuable.

The concepts of information and exformation and their relations are introduced in Nørretranders (1991). Thus, there is a significant difference in the demand for record of information in the two systems. Where the project management form requires a target rational treatment of information by exclusion of information throughout the process, the preject process requires record to maintain the divergent information build-up that forms the base for the knowledge potential. When to stop the recording of information poses a classical problem - Church-Turing’s classical stop problem Bennet (1988) states that any process

that has not been run through before does not pass any information as to when the process should be terminated. This problem is "solved" in the real world in the project at hand. Among both students and company participants there is an implicit understanding of time and resources spent. The rational project understanding would, in the real world, take over and set limits. In the project this is reflected in the following way: when the knowledge potential is adequate, it triggers a goal-oriented activity.

Today, the computer is an indispensable tool in relation to the transmission and forming of information. It is considered as a tool in the process of creating information in the top left corner of Boisot's model. The same technology enables us to communicate through, e.g. the Internet, which puts the individual user into contact with the world using certain simple commands. Knowledge is diffused. Computers work by excluding information. The exformation system requires that all information obtained and the ways in which it came into existence is contained. Viscous knowledge is not easily contained or processed using a computer, cf. Boisot's example with the reference number and the painting.

The system observed in this project functions within a defined area of human activity - product innovation. The participants in the companies and the students share a lot of implicit knowledge in this area. Based on this assumption a computer program has been developed, the KUBUS® template, which records the process in the preject phase (see below). The program was designed on the basis of the teaching at the Department of Management, Innovation and Philosophy, and in co-operation between students and teachers. It is designed to record the process that is normally "thrown away". This is the reason why the meeting stage and management in the KUBUS® model have been highly coded.

During the project, the project groups in the companies have been observed, and simultaneously, the students have been working under the preject work form but with the same problems as the companies. The company project groups went through a turbulent problem/goal setting phase, which generally had as its point of departure knowledge available within the company. They quickly went to a goal oriented project phase. The students worked with the

same problems as the company groups. They moved from extreme order to a viscous knowledge potential. Knowledge potentials are generally retrieved and formed from information available outside the companies in question, but which the company groups apparently "overlooked". Arguably, the students, for obvious reasons, had to look for information outside the companies involved. However, the students' information search quickly became very wide and consequently the companies, as a source of information, would have a narrowing effect on the students. What is most puzzling is that the company groups, who were not as limited in their number of information sources as the students, only on a limited scale sought knowledge outside the company.

Apparently, the company groups and the students work within two very different areas of the same problem. This corresponds very well with Boisot's model. The groups gather and process information within two very different representations of information. Vis-à-vis Boisot's model, the students process and embed information, which they scan and treat during a divergent phase - available knowledge gathered on the "international information market". The company participants seem to be bound by previous experience, the company's implicit rules, and hence opt for an internal understanding - knowledge creation in agreement with inter-company rules that are not founded in the international information market.

The product life cycle becomes shorter and shorter. This becomes evident from Boisot's model in that there is less and less time to go through the embedding phase, absorption, and impacting in organisations which have an ever decreasing life span within technology. This problem is the focus of "The Innovation War" by Christoph-Friedrich von Braun (1997). Using this "lack" of time to embed knowledge concerning new markets, one can investigate the coupling between the innovating company and students working out of a university. During this project, the students demonstrated a higher degree of ability to process knowledge, which in Boisot's model translates into a downward movement on the model from the upper right corner.

One can advance the hypothesis that companies now generally master the project management tool so well that internal information, which the company possesses, is processed and transformed in-house at speeds which cannot be matched by efficient methods to gather and process new information. However, the companies risk suffering the "information death" in an information society.

Exformation and Information

Generally, the rational project management model is the implicit co-operation platform when university students and companies work together on projects, e.g. contract research. Since it is often the companies that have a leading edge in this co-operation their perception of reality forms the co-operation platform. Let us return to the use of the computer. As argued above, the company participants and the university participants work on this project with each their perception of the innovation problem. Information is gathered and processed differently in the two groups. The company participants worked with information that could easily be transmitted/communicated through computers. The university participants (the students) worked with what could be characterised as an exformation system.

Shannon and Weaver (1949) introduced the information concept as a solution to, and description of problems related to telecommunications. They invented a concept, which could be used to measure the performance and effectiveness of the telecommunications system. It must account for:

1. Insecurity and noise in transmitting signals, in the transmission channel, in the source and in the receiver.
2. The context in which the measurement and the communication takes place.
3. What we mean by order and disorder.

Thus, information has not been defined until we know what is meant by order. Information is defined when we know its context. We must be able to describe what macro- and micro conditions we are referring to. Information is linked to

concepts such as order and disorder, and at the same time to change and probability. Furthermore, it is impossible to know what information lies in a statement before we know what the receiver has been doing in his or her interpretation of the information. This often calls for a high degree of mutual knowledge as to the codified inferences used by the communicators - or a clear and logic information structure is required. "Charles Bennett argued in 1985 that the value of and meaning in a message (or technically speaking: complexity) could be found in the work done producing that message and not in the product. The value of meaning is measured by the work that the receiver may be spared for carrying out. The "information" thrown away in the process is of greater importance than the information resulting from the process"….. "Bennett's concept points to the e fact that complexity is something which requires time to be created. Time in which order is created. Time in which information is thrown away so there is less to control". Nørretranders (1991:112). That "information thrown away" or that information not yet accounted for may be called exformation. Again, in the words of Nørretranders (1991:131): "Exformation is the history of a statement, information is the product of history. Both are meaningless without each other - information without exformation is empty talk; exformation without information is not exformation, but only thrown away information".

In this study the company participants process information in a complicated internal and culturally anchored pattern. Power and rules imply areas of action upon which consensus can be formed. Generally, this is a political process, and it is not easily decoded neither by the participants nor by outside observers, cf. Schein (1984), Mintzberg (1983). Organisations do not write down the history of this game, as it forms a too prominent part of the organisation's reality/history (tacit knowledge), Polanyi (1985).

The students worked in a special context - an "artificial corporate culture, KUBUS®" - built to enhance the transparency in the management's decision-making process. As work progresses, a thoroughly processed knowledge package within the given area is built up. However, the students do not have the

company's burdensome knowledge of what is rationally/politically possible in a "company" comprehension perspective.

The student group, composed across disciplines, builds knowledge in many different dimensions, and under the influence of the cross-disciplinary structure of the group. The "history" of how the students build knowledge through a divergent search and learning process, thus, becomes just as valuable as the information built. The students' work represents an exformation system built to generate a large potential of viscous knowledge.

Communication between the two systems: KUBUSÒ TEMPLATE

The problem relative to communicating information/exformation between students and companies is investigated through an Internet connection. The program, KUBUS® TEMPLATE, www.kubusnet.dk, (password needed), was designed to handle this communication. The students gather and process knowledge in templates designed in a way, which allows them to do a criss-cross search on topics and decision bases in the base. The transparent management model (procedural rationality) allows us to follow decision- and management search processes, which are also recorded. In order to demonstrate how KUBUS® template secures potential knowledge assets, we shall describe KUBUS® template in some detail.

The general structure of the template is a time axis on which all activities and filing are registered. The time axis is supplemented with a mind map (see below) giving a visual view of how information is coupled. It allows one to get a quick overview of critical paths and couplings of information. A map is like a "knowledge tree".

Using the base requires that one is familiar with the mind mapping technique, which is the best way of forming a general view of and registering and coupling information, cf. Buzan (1989). Mind maps provide overview of and knowledge

about dynamic group processes and the knowledge that the team creates. The technique is easy to learn and many school and educational institutions take for granted that students are familiar with it. In maintaining the mentioned processes, it also becomes possible later on to realise what the company did not know. The entire process is stored in the database. The company's employees/management is able to examine immediately or after some time how the decision- and knowledge basis has changed over time. In case the work does not immediately lead to an innovation, it can be resumed if new information appears. Another possibility is that the work yields no results but a different company breaks through within the same area. Here the base offers the opportunity of learning by analysing whether one could have achieved results and what obstructed this outcome.

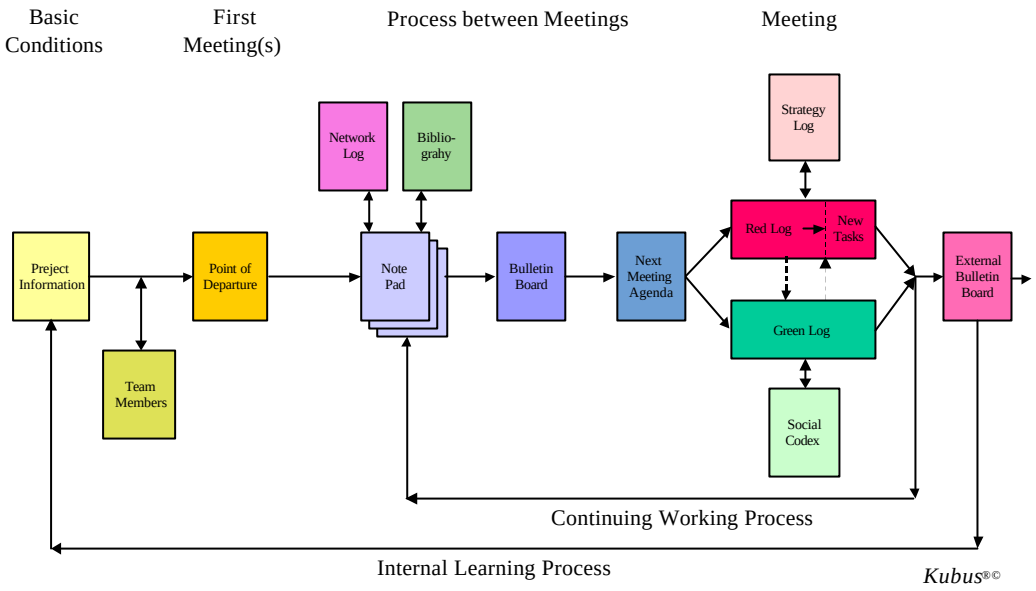
The underlying structure of the template is a series of "working papers" structuring the group's work in the preject phase. By structuring we mean that the papers are divided into fields for writing within. The writer is supervised in order to ensure that important tasks, reflections and communication are not omitted in the process. The work process in the base is emergent and all changes; their origin and consequences are registered. These might be strategy, focus, changes in management role, etc.

The template is structured as a database. The search system is a central function that can guide one around in all information. If one, for instance, wants to know why it was decided that a product should be red, one can search for the origin of this decision. At which meeting was the decision made, by whom, based on which contacts and amount, quality and processing of information (e.g. knowledge depth)?

Figure 5 illustrates the template graphically, and below we shall summarise the individual elements. The implicit assumption is that a company is applying the template.

Figure 5

The Kubus®Template Process



Source: Herlau and Tetzschner (1999:279).

Preject information is the first "working paper". It is structured so as to capture and sustain the opinions of the group and external actors (e.g. the company management) on the start-up of events. Stakeholders are indicated together with the temporal framework and resources for the preject, etc.

Here we encounter a difficult underlying problem. An event that constitutes the foundation for a course is reconstruct able from what is determined to be the final outcome. Traditional project management assumes decisions on project start-up to be made after the objective has been clarified and determined. Not until the event is terminated does one have an overview. The point of departure for the preject phase is the organisation's shared knowledge. Therefore, it is important to register the attitudes toward and understandings of the task that the employees "bring into" the space. Dynamic innovative companies have experiences and a "language" that couple the potentials of actors and organisation. Companies with no experience of this phase find it difficult to express themselves and construct a language related to this phase. Without a language it is difficult to act in concert. It is our experience that these companies often are

highly surprised at realising the great gap between what they believed the attitudes toward innovative collaboration to be and what they really are. The way in which the preject phase is formulated and created often leads to changes in internal relations, such as cultural changes. Here fundamental problems related to preparedness for the future are made explicit.

Team members. Identical information about the team members is registered, such as address, telephone, fax, e-mail. The base can be used internationally and to communicate among actors that are not meeting physically. In the latter case a short CV is included as well as information on special interests, qualifications, education, etc.

Point of departure is the first meeting in the group. Here, the space is determined within which the work can move around and be managed until the first strategic adjustment. The lower bound may be that the actors feel they are wasting their time and are unable to accept the working method, time limit, etc. The upper bound may be limited by level of ambition. Do we wish to implement the entire process or do we wish to work toward a concept that others can take over? Etc. "Service management" is determined and management roles are delegated. These are tested, discussed and adjusted via feedback. This process will be repeated throughout the entire course. It is recommended that green heads this meeting, which is often difficult to manage, and in general does not move beyond the domain of the green manager. The help of a large mind map drawn on a whiteboard or flipchart can manage the meeting. In certain periods red management is predominant in other periods green management will yield better results.

For someone unfamiliar with the work form it may seem surprising that the participants are able to manage this process. Hersey and Blanchard (1975) find that this management form requires a certain degree of maturity among the participants. It is our experience that the actors in general possess this maturity if they understand the task and have discussed possible alternatives. This touches upon a very interesting aspect of the use of the concept. It is our experience that many of those participating in innovative groups are only pretending. They cre-

ate uncertainty in the group by trying to force the group to adopt an attitude toward proposals and ideas. They will discuss on the basis of undocumented internal assumptions. Unfortunately this brainstorming behaviour is in general accepted resulting in the other actors perceiving such participants as creative.

The function of the first meeting is to find out whether the group in gathering preject information has assessed realistically the companies and its own abilities to create usable innovations. If the behaviour described above gives and has given good results, the work process is satisfactory and there is no need for a method for generating knowledge potentials for systematically promoting innovation. It is far more critical, if the above behaviour is merely a method thought to yield results, that is, based on "supposedly this is how to do it". In most cases carrying the implicit expectation that others are free to elaborate on the "good" ideas.

Leavitt (1986) has described the situation we are in when having to teach actors systematically to produce innovation as a situation in which we must teach what we ourselves are unable to do. Many forget that brainstorming and similar techniques require strict management. In this context it would seem obvious to hire a consultant "who has the skills". However, it is often forgotten that the consultant assumes a management function which is not available among the company's own management potential. The management, incapable of this management form, and the employees expecting to be managed bracket the consultant's (financial) interests. If the issue is one of preparedness for the future, the bracket is lethal.

During the point of departure meeting the group must adapt to the basic idea of the Kubus work form. The group must generate communicated knowledge potentials of issues it knows nothing about. Creativity is to escape the cognitive cage, that is, what one tacitly thinks one knows. It is very difficult to conduct a conversation on something, which one does not know anything about, or to admit to others than one has deficient knowledge. Therefore, it is important to search for principles different from those one is familiar with. The process will only proceed when the management, the meeting itself, and the communicated

generation of knowledge are transparent. This might seem difficult. It is easier to rely upon the good ideas to pop up or on a consultant resolving the problem.

We must be ready to accept that some actors will leave the work here. The work form is contrary to their basic assumptions, meaning that they are unmanageable along the management principle based on the subject/subject relation. However, it should be emphasised that no underlying assumption about "he that is not with is against" must prevail. Not everybody is equally fit for or likes working under the uncertainty and complexity characterising the preject phase. That is ok. The daily operations require different valuable qualifications.

The meeting is conducted under the duopoly management that heads work in the six areas. The first meetings will primarily take place in arena three, the group. The point of departure meeting activates "working papers", that is, parts of the database that have not yet been described. The internal rules of the game are determined – meeting, work discipline, management role behaviour, strategy, next meeting, etc. This is written down in the minutes from the meetings produced by red and green managers.

Notepad. The most important element of the template is the actors' "working papers" which are used in between the meetings. Here work processes are secured, tasks are processes and solved, new paths are indicated, ideas are proposed and rejected. Here the first results of the work are registered. It is important that the group co-operates on and is disciplined in using notepads. Tasks delegated and instructed by red manager in view of strategy and resources must be documented in notepads in order for information to be relatable to minutes from meetings, network, archive, etc. It is important that the heading of the task is identical in the "working paper". Failing to do so corresponds to the company filing documents at random. Management gets feedback on the task. Notepads must end with a conclusion, an abstract.

Notepads are closely coupled to the **Network Log**, which keeps track of all common network contacts. In **External Data** the actors have access to a quite elaborate archive function.

Bulletin Board. This contains the agenda for the next meeting. Here we find new ideas, abandoned ideas, abstracts from notepads and information on the next meeting. Members that are or have been unable to participate in meetings will profit from reading this short page, which also enables external actors to follow up on the work and development. In case you want further details, your just click to the underlying notepad.

Reed and Green Log. Here the meetings and their outcomes are stored. We have earlier argued for the duopoly management in connection with point of departure. If this division is kept stringent, that is, the two-management role are developed and maintained consistently throughout the process, it is possible to communicate meeting activities to other actors and stakeholders. Only by being able to keep up with the depth of questions asked and the dialogue leading to non-knowledge, which is examined in the notepad, can the external actor understand and interpret the depth of the work, that is, how much work has been done to generate and process information. This perspective is especially important if international actors are included or have access to the template.

From communications between an English and a Danish group it became apparent, for instance, that though the two groups used the word "networking" to refer to the same work process, the Danish group acted much more aggressively and deeply than the English one. The cultural difference in the two countries as to what is acceptable within this form of contact is great. Along with the growing internationalisation we must expect in the future having to rely increasingly on the work of other actors and their processing of information.

Let us give an example. The template is used for communication between two groups of actors that collaborate on an innovation. Imagine that the Danish actors have produced a rotor based on a novel principle. It is an innovation. Also the marketing of the product has been innovative. Work with the fundamental development is registered in a template that contains all the knowledge about the new product. The Danish group now starts to collaborate with a group in England on marketing the product. The Danish group sends a prototype and

specifications in order for the British group to estimate the market for the new product.

Shortly after the Danish group receives e-mail from England: 3,000 pieces a year. Is this a qualified guess or valid information? In general we trust in the estimates of partners we have chosen to collaborate with, but this trust is undermined in a turbulent world where new products are continuously marketed at high speed and create new markets. Had the English group applied a template, that is the same system and innovation culture as the Danish group, it would have been quite clear whether the figure was a qualified guess or valid information.

If the meetings in England had been stringent with red and green management and the two templates had been coupled, the Danish group would have been able to "watch" the meetings in England. First of all, it would have known the team members and their point of departure. What were their ideas when they started on the task? How did they exhaust the various arenas? What did they not know? What new knowledge was included? How did they search for external data and network contacts? How deep was the knowledge, when they arrived at the figure 3,000 on the basis of accessible information? Perhaps the British would not have had to work for very long before the Danes realised that they had chosen the wrong partner, or that conditions in England represented unforeseen barriers. Or the English group might have revealed greater will, skills and creativity than demonstrated by the Danish group. Work could have been stopped earlier in the process if the desired minimum outcome could have been deduced from the accessible information. Time and resources could have been saved.

One objection could be that it is unrealistic for two groups of actors to co-operate so closely. On the other hand, merging information can save much time and resources. However, imagine that it had been two departments in a large company and the partner of co-operation was located in another part of the world, in a different culture and context. The alternative to the close co-operation in terms of using the same template is trust and assessment under

high uncertainty and to travel for meetings. However, with two different cultures operating in different contexts much of the information processing would have been based on estimated guesses. The example is also applicable to internal communication in a company or among departments.

Green Log. The function of the green chairman basically includes: Stick to the subject, make sure that everybody understand and participate, and give instructions on delegated tasks. The role is created, developed and changed currently in the process. Shifts occur continuously when other actors in the group assume responsibility for this function. In order to best keep up with and capture all the processes and phases in the meeting, green manager uses the mind map technique during the meetings. Experience shows that green chairmen who master this technique are of great value to the work. The green minutes from the meetings are constructed along the principles of mind map. Here agreed symbols can be used, e.g. a lightening indicating blazing conflicts, a bulb giving light indicating a good idea, etc. Before the processed mind map is placed in the database in Green Log, elaborating comments are added. Here changes in codex are also registered, as well as feedback to actors and messages to the group. It should be emphasised that the green manager is not a consultant of creativity. The actors must supply the material. They are supported by the service rendered by the green manager in chairing the meeting. Groups that encounter process problems will in general find their problem here. They have ascribed traditional management responsibility to this function that is merely to constitute a supportive framework to ensure that the divergent process generated here is not merely uncontrolled brainstorming.

Red Log. The role of the red chairman of the meeting is to maintain the strategy, distribute tasks and check that they are performed. Much group work can go wrong because it leads nowhere. It all ends up in idle talk. Those that have been allocated tasks shirk the obligation either because they have not understood what it implies or have had the time to do it. It is the task of red manager to secure progress and cut through. If the actors after having worked within the domain of the green manager have not achieved any serious results the red manager must assume responsibility: "It is impossible for me to see how the

current information can be translated into tasks that will take us further in the process. It does not match the level that I find reasonable for this group" – back to green. Red manager's minutes from the meeting resemble traditional ones capturing decisions. Who does what and when?

Red function is traditional. Most members of the team easily understand the role but soon realise the dangerous underlying question that continuously pops up: "How does one manage when no objective exists to steer by?" The advice is to perform the role fairly wilfully. It is in the interest of everybody that knowledge is collected and processed, and being wilful is the best way of achieving this goal. Problems are discussed during feedback at the end of meetings. Actors that want to pursue specific goals must be given a free rein to do so within the agreed time and resources. In this context searching for consensus is of no use. Meandering actors are often those that enter into unknown possibilities. Here it is important that the two management functions collaborate. The attention of the one who strikes out a path for himself/herself is kept through good communication with the others.

The red minutes from meetings also stipulate the tasks delegated and to whom. Results are registered. Progress and paths that must be abandoned are also registered here. This also applies to shifts in strategy, allocation of new tasks, proposals for the next meeting and feedback to the group. This possibility is also open to the green management function. Managers are not always satisfied when assessing single-handed administrative tasks and the efforts of their work compared to the progress recorded.

External Bulletin Board is tied to the Red Log. Through the latter red communicates results and progress to stakeholders. **Strategy Log** accumulates and communicates the changes and ideas underlying the current strategy.

As a kind of postscript it should be emphasised that it is to some extent possible to deceive oneself or a manger but not two mangers in the KUBUS® concept. The distribution of obligations and who is carrying the load will soon appear from the managers' minutes from the meetings and in effect exclude a lot of

discussions. The actors carry the responsibility and they are to enter into a constructive regulating dialogue on management and quality of work during the process.

This ends the static description of the template. We have often mentioned learning, feedback, emergency, reflection, and change. Figure 5 illustrates the coupling between KUBUS® meetings and notepads. It is a system of positive and negative feedback. We have also argued that knowledge and couplings are created among actors, leading to new knowledge and new couplings.

The KUBUS® system is an operationalisation of a preject model; that is one of three models of working methods in the early phase of innovation.

Perspectives of the preject model

Following this rather lengthy description of a preject model we shall outline the perspectives of this line of thinking. Networking, project and preject stand for the three models of working methods in the early phases of innovation. The working methods are outlined in Table 1 below.

Though networking is a very familiar way of working for entrepreneurs, we have not mentioned networking before. Neither the companies nor the students used this management form. The model is a popular one for entrepreneurs, cf. for example Hills (1994), Johannisson (1992), Johannisson et al (1994). In general, the situation of entrepreneurs is characterised by uncertainty and/or lacking goals, which makes rational choice impossible, cf. Christensen and Kreiner (1991), Cohen et al. (1972), Cohen & March (1974), March & Olsen (1976). The weakness of this model is that the knowledge created inevitably is tacit knowledge.

Table 1. Three working methods in the early phase of innovation.

	Networking	Project	Preject
Structure	Loosely linked system	Planning paradigm	Clans and teams
Responsibility	Undefined, fluid	Delegated, formal	Personal, formal
Line of thinking.	Divergent	Convergent	Divergent
Leadership	Anarchy (not transparent)	Monopoly (transparent)	Duopoly (transparent)
Codes and rules	Loosely	Fixed	Fixed
Knowledge	Tacit (implicitly expressed)	Explicit	Explicit

As mentioned above the company project groups very quickly went to a goal-oriented phase, and worked in accordance with the project paradigm. What really happened in the early turbulent goal-setting phase was never recorded in the companies. This is probably due to the participants' knowledge of what is considered rational and political possible in the companies. However, most important is the fact that in effect many data and much possible information are treated as exformation.

The students worked according to the preject paradigm in Table 1 on the basis of the KUBUS® system. As mentioned above information on seemingly wrong tracks is not treated as exformation and thrown away, but is stored in the KUBUS® template. Knowledge sharing is made possible, and the KUBUS® template also functions as a means to secure the knowledge assets formed in the early phase of innovation. Hence, Figure 2 is the ideal model that may combine preject and project modes of working. This also involves perspectives in relation to co-operation between industry and universities.

The above is a description of a project, where a cross-disciplinary group of students worked together with participants from companies under a shared goal: to product innovate. Generally, the framework for such a co-operation is the rational project management model. The work form is exchange of explicitly expressed knowledge via meetings and reports. There is a growing criticism of the target oriented rational project management model.

This project aims at creating some form of hybrid investigation model. The practical work and the research in the companies take a more traditional approach. The company investigation is carried out prospectively. The students work within the same problem area as the companies. The rational target oriented management model does not form the basis for the students' work. Here, a rational model is sought; management and meeting forms are made transparent. This allows us to follow and communicate the knowledge built-up to the companies.

It is too early, based on the data presently at hand, to assess the outcome of the communication between students and companies. The process began rather late, and the development and run in of computer systems was time consuming. The need is for reflection, and learning how to work within an entirely different culture/framework of comprehension.

The company groups as well as the students have during the project made quality innovations, and the processes leading to these innovations have been closely monitored. It would be gratifying to end, by concluding that this is the future co-operation model for groups which culturally, within the knowledge area, and geographically are very different, but as the project progressed, a certain Hawthorne effect could not be ruled out (Perrow 1972).

With the experience built up relative to this type of investigation and the data recording/communication system, it will be possible to streamline student/company groups faster and on a larger scale. A longer period of time is needed before the results can be finally interpreted.

A preliminary hypothesis is: groups that are able to clarify what they among themselves do not know, based on a large knowledge potential, and a great amount of viscous knowledge, make innovations. Under these conditions, viscous knowledge forms a link between industry and universities, and the vicious knowledge may be stored in a KUBUS® template.

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