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Knowledge Management in Superorganisms[1]

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Abstract: This paper deals with a general approach to knowledge management in companies and organizations. It strongly builds on insights concerning knowledge processing in superorganisms and reflects years of FAW experiences in applications. The paper in particular shows how (1) human resources, (2) issues of organization and (3) new IT systems interact in achieving a higher level of competence and competitiveness. In this context, dealing with non-explicit sources of knowledge is a major issue, too.

Keywords: human resources, IT systems, knowledge management, non-explicit knowledge, organizations, superorganisms
Category: H.3

1 Introduction

Globalisation and the spread of information and communication technology are making **knowledge management** a new challenge for companies. There is a saying in Germany that goes like this: "If company X really knew what company X knows, company X would be unbeatable." This applies especially in a world in which products, companies and employees are changing faster and faster. In reaction to this challenge, a lot of people are talking now about knowledge management, some of them in a somewhat “naive” administrative way, in which the topic is ultimately reduced to new software tools such as document management systems, GroupWare systems, etc.

The present text, which builds upon FAW's experience of more than a decade with the topic of knowledge management, takes a different perspective. Generally, it asks for common features in information processing in so-called superorganisms, be it animals, robots, swarms, insect states, humans, companies, organizations, humankind as a whole or GAIA, the biosphere of the earth. Essential issues deal with questions of knowledge representation, seen as frames of pattern transformation (see four-level

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architecture below), questions of learning and creativity and the priorization of scarce resources.

If this point of view is more focussed on companies and organizations, it sees knowledge as primarily bound to the people within these organizational “bodies”, their experience and the way they interact. Knowledge is hard to pin down, especially in its deeper dimensions, and certainly cannot be readily captured on computer systems. On the other hand, modern intranet and document systems in the area of flat knowledge offer great potential to simplify information access and exchange. Furthermore, there are humanised approaches to use these networks to improve employees ways to network among each other and to communication and to ask one another how to get at sources of information. FAW is pursuing this way of looking at knowledge management with a workgroup of small to medium-sized companies that belong to FAW's group of regional partners, and with several companies, that form the legal basis of FAW as a foundation in a series of projects, and also in projects with external partners. FAW, in this context, builds on its own **four-level architecture** of information and knowledge processing, which makes it possible to take a very general view of the topic and which clearly distinguishes among types of information that are more neural/holistic or more of a calculating/symbolic nature. This differentiation takes place on the level of individuals as well as, e.g., on the level of companies, **which are understood to be complex organisms,** too (cf. the remarks at the beginning of this introduction). The present text gives a short introduction to the topic. It treats FAW's four-level architecture and certain key elements of the approach in Section 1. In Section 2 it explains why companies -- even small to medium-sized companies -- should use knowledge management more. Section 3 describes the role of formalized knowledge administration and Section 4 looks at learning companies. The paper ends with a short summary and bibliography.

2 Placing the Topic in the Context of the Current Debate

Unlike many other approaches followed today, the present text deals with a view of the topic knowledge management that is oriented around **biological systems** and **biological evolution**. Such an approach views companies to be complex organisms oriented towards the goal of long-term survival while living in a biotope that is getting "hotter and hotter" under present conditions of economic globalisation. The approach takes a system-theoretical perspective on such complex organisms and is based on the following four points, which comprise the essentials of FAW's methodology of knowledge management:

- differentiating **four levels of information and knowledge processing** in such systems. This concerns primarily the interaction of "head" (symbolic processing mechanisms) with the "gut" (subsymbolic processing mechanisms), i.e. the interaction of control systems on the one hand and mechanisms of self-organisation on the other.
- identifying various **learning mechanisms** on the different levels of information and knowledge processing, considered.

- taking a certain view on **creativity and innovation** as an interplay of the mechanisms "Generation" and "Selection" of or between “solutions” on the various processing levels, and
- taking a certain perspective on the **interplay of hierarchy and distribution**, oriented around the organisation of and role that **consciousness** plays in human cognition. Results show that hierarchies should be used in such areas -- and only in such areas -- where important, but scarce resources have to be controlled intelligently and in a time-critical fashion.

Let us go into the four different levels in greater detail. On the lowest of them we see **signals**, each of them comprising a direct interaction of a physical-chemical nature with the environment, many of which are of a “**key-lock**” nature. On the one hand, signals induce direct effects, while on the other, so-called **features** are filtered out, based of them. Features are the input-information on the second level of information processing under consideration. Here, on the one hand, starts a functional transformation of such features, for example, into a motor response or actuation, perhaps in the form of trained (natural or artificial) **neural networks**. On the other hand, objects or **concepts** can be identified by **classifiers** on the basis of features. This leads to a conceptual or **symbolic level** of information processing, the third level, which includes a massive compression of information. At the same time it allows a much more rapid acceleration of the generation of new knowledge because of the powerful processing mechanisms available on this level. These include all kinds of symbol-processing, in particular those called "logical thinking" and the use of language: this is the classic domain of Artificial Intelligence (AI) as a scientific discipline. Beyond this there is a fourth level consisting of **theories** and **models**, on which one uses complex mathematical models or models from the natural sciences and instruments such as optimisation, statistics, decision theory, logic and numerical analysis to describe real-world cases and to make assertions and to draw conclusions from them.

In conjunction with the FAW approach, we realise that many companies perform as well as they do in some cases not because of, but rather despite, their control systems (Level 3). We realise that it is therefore important to maintain this **adaptability** and **ability to self-organise** (Level 2) on the companies' working level, and that one should not expect wonders from planning, especially when the role of planning is taken too narrowly. Instead, a great potential lies in the interaction of the various mechanisms and levels, described. Particularly, in **small to medium-sized companies**, but probably in all companies, aspects of **self-organisation** will continue to play an important, if not dominant, role, and to constitute a comparative advantage -- not even considering the advantage that such a modus of operation protects a company from espionage and copying much better than more formalised forms of use of knowledge.

The idea of **a company as an "organism"**, a feature typical of the FAW approach to the issue, is rounded off by **a stakeholder-oriented company philosophy**. Such as philosophy respects not only shareholder value, but also takes the other important actors more extensively into account such as employees, customers, suppliers and a company's local and regional environment.

3 Why Should Companies Practice Knowledge Management Today?

Today's change processes are very **dynamic**, in that new products and processes are appearing all the time, employees are coming and going more rapidly and stocks of new knowledge are accumulating always faster. Conditions change very quickly. Employees have to become and somehow remain competent in this rapidly changing world, to access the necessary know-how, to satisfy customer demands and to mobilise their own energies again and again. Whereas certain dimensions of knowledge about factual areas, the company's own history, along with knowledge of the strengths and weaknesses of its employees and partners was generated in former times under relatively constant conditions in virtue of the continuity among employees within so-called "communities of practice", today these things are altogether different. Today, having the relevant knowledge available is no longer as easy as it used to be. Today a company has to use technology and new organisational aids more than in earlier days to **mobilise its own energies** appropriately.

Mobilising a company's own energies takes various forms such as creating intranet structures, which are now taking on the role of a **(technical) nervous system** of one's own organisation; it takes the form of making, as a kind of so-called "flat knowledge" important standard documents available through databases and networks, of using software tools to co-ordinate or share information, and of using e-mail and similar services as the basis of a **strong internal networking**. It is also important to combine a corporate culture of the sensible documentation of content with the activation of a mentality of **"knowledge sharing".** But all this is still not enough. There are very essential stocks of knowledge hidden away somewhere in people that cannot be represented in a formalised manner. And there is very much important knowledge that perhaps could be articulated, but which can't be documented for cost reasons or should not be documented at all for other reasons, for instance, in order to **protect certain secrets**. And there is a lot that comes about in interaction as a spontaneous behavioural change that never becomes really manifest anywhere. The proper attitude towards these aspects which take place in one's "gut" rather than in the "head", and what employees and workgroups develop, taken as complex units, is also important.

We need the proper attitude towards the **potential dormant in interaction and self-organization**. We need a respect for knowledge that cannot be formalised, but is of a holistic nature. This is an important point. Money has to be invested here, and there are things to be learned here; this is an exceptionally difficult topic. Knowledge management is becoming increasingly important as an explicit topic for the orientation of successful companies; however it should not be allowed to exhaust itself in the illusion that one tries to formalise everything that is important. Often it is better instead to document, by means of e. g. yellow pages within an intranet, who can give information on which topic, who was once in a position to do what work with whom, etc. Another alternative to dedicated planning is **to organize an event** as an effective means of reaching a result by a specified time. Only by using and coupling such different approaches is it possible to encourage increased and focussed interaction of people in **a human-centred** way in distributed environments, in order to accomplish tasks with one another and to reach corporate objectives. Great new challenges lie

ahead in this area for companies and organisations that want to be successful. Only when this is realised, can certain **latent potentials be unlocked**, as will be described in the next section.

4 The Management of Knowledge within the Framework of An Information and Knowledge Society / Virtual Companies

Globally, we are on the way to becoming a **knowledge society**. As we travel further along this road, knowledge is increasingly becoming a **major source of value generation**. In the virtual businesses which are developing, the proper handling of knowledge is continually becoming a more important factor in ensuring that a business holds together, that a **corporate memory** is created and that there is continuity. This also applies to a whole range of other business activities, such as the relationship with customers, quality assurance, working in collaboration with others, etc. Very different forms of knowledge will become more important. Attention has to be drawn here to knowledge about sources of information, knowledge of conceivable know-how input, knowledge about employees, business associates, customers and key account partners, and knowledge concerning production procedures and processes. Also to be included is knowledge about available information systems and technical components, e.g. actuators, which can be neurally or symbolically realised. Knowledge will have to be made available via databases and by the use of interconnected systems. **Interconnection** will be organised on the basis of **meta-knowledge systems** and a world-modelling that is operating in the background, and partly, too, by the use of mechanisms of **discourse management**.

When it comes to the concrete distribution of information and the retrieval of contents, **intelligent filters and brokers,** together with measures to ensure the quality of the knowledge in question, will become more and more important. From a business's point of view, knowledge of all on-going processes, production procedures, quality assurance measures, contract conditions, etc. is of central importance. At the same time, **on-line feedback from customers** will grow in importance, for example, making reference to the quality level of the firm's products actually being used. The processing of information (in the broadest sense) will continue to grow in importance and, therefore, also the use of networks, operating systems, middleware, database systems, meta-database systems, method banks, Geographical Information Systems (GIS), repositories, and so on. Uniting many of these aspects, knowledge concerning the whole infrastructure of information and communication (knowledge of the technical and information infrastructure) will become ever more important as an independently represented body of information. Being able to manage this constantly growing stock of information on knowledge infrastructure will be absolutely essential for organisations in the future.

In the course of the increased use of telecommunications and, in particular, with regard to the continuously increasing exploitation of the international cost differences concerning suppliers and employees, the **virtual company** will further gain in importance. Virtual companies will also allow the adoption of quite different forms of work organisation. Already today in the construction industry, working together through the

use of connected CAD systems at locations in various parts of the world is becoming a reality; this can be supported by modern GroupWare tools and the use of video conferencing facilities.

One of the guiding ideas here is **24-hour engineering design workdays**, alternating between different places around the globe. This will lead to a further enormous acceleration in product development times. Virtualisation and the use of modern telematics will make it possible to do many things faster and more efficiently than today. Travelling sales representatives are already frequently linked to their companies by cellular telephones and laptops, enabling them to finalise contractual agreements with customers on the spot. In dealings with customers, whole processing stages can be eliminated. A lot of interaction with the customer will be done via **multimedia technology as the channel of contact** which becomes the major interface to all information management and control systems of a company in the times of **e-commerce**.

Following this line of argumentation further, customers, especially the corporate ones (OEMs), as they communicate with the system, will take on inventory restocking responsibilities themselves. But not only such suppliers will be involved, but also employees will participate, as global sourcing gains importance; on many occasions the **virtual employee will be an independent entrepreneur**. In this context, many current company functions will be outsourced. Relationships with employees will, in part, be more temporary than today and mobile workplaces will play a central role. Just to remark in passing: in such virtual businesses the smaller degree of orientation to hierarchies and internal politics within the company will probably mean that the constantly necessary adjustments of organisational structures to market changes will become easier than today.

In this context, one essential company function will be **information management**, i.e. to make available the right information at the right time and in the right place for the right person. As already indicated above, this will, among other things, be a matter of ensuring the maintenance, technical support and integration of information processing systems among the company's employees and towards business partners, even over great distances and possibly even when frequent changes of personnel are involved. In this context, too, **contract management** will gain in significance, as will **online payment processing**. At the same time, the question of **data-security** will assume even more importance than it has already today since, in this process, company data will be more widely distributed and mastery of the subject of data-security - including **key management** - will be required. This also applies to dealings with suppliers and customers, as well as, for example, to the management of consortiums and projects for special tasks. In general terms, it will have to be ensured in these circumstances that a **corporate memory**, as a computer-supported system, is available and stays valid and powerful.

5 The Learning Organisation

For a variety of reasons, businesses all around the world, in addition to virtualisation, are on the way to **becoming learning organisations** and have to do so. This is linked with the fact that in the complex world of today, classical organisational structures, described primarily by sets of rules, which reflect the classical principles of organisation, are no longer able to react fast enough. For this reason, it is important to enrich and empower these rule-based systems with more informal relationships and structures such as can grow within a firm or outside it related to common interests, for example through intranets, and to make better use than before of the **intuitive or neural abilities of employees**. This also includes the possibility and necessity of employees being involved in **lifelong learning and training courses**, relevant content being in part laid down by the company, but also in part being chosen by the employee himself in his desire to improve. In the broadest sense, therefore, the aim of the learning organisation will be to make knowledge on all levels utilisable - as it is discussed in Part 1 in greater detail - and ensuring co-ordination among employees by specifying objectives and by making available to them all the guiding ideas of the company. In doing so, it should be ensured that an appropriate interaction between explicitness and more intuitive or neural or structural experience takes place. Providing the environment for these important future processes will involve many **logistic functions**, too.

The utilisation of employees' know-how, referred to above, has often proven so central that today the primary consideration is often how to use this knowledge, in a suitable form, to boost the performance of a company. This usually means, as a rule, less hierarchical forms of organisation and structuring (heterarchies), more freedom and "empowerment" for employees and, for management, a heavy emphasis placed on the creation of conditions under which the capabilities of employees can best flourish. It is then a matter of the staff, for both separate individuals and within working groups, to find the best solutions for the benefit of the firm. In this context, a very important part is played by the right kind of interconnection of employees via appropriate infrastructures, such as intranets which might be seen, as already pointed out above, as the **nervous systems** of modern businesses, possibilities for self-organisation through agendas, ease of access to knowledge sources of all kinds and the possibility of enlarging the contents of such knowledge bases locally with data of personal interest or value. It is in the nature of things that employees who are independently active to such an extent **need a clear picture of the aims of the company on all levels**.

Ultimately, in conformity with the theory of **self-similar structures**, this development leads to the observation that such future learning organisations will be recursively made up of interacting sub-structures, which are similar in many respects to the whole **(self-similarity**). Of course, the whole structure must be strongly characterised by cohesion between the parts, by interaction and empowering and all parts must have a clear idea of the philosophy and overall aims of the company. Conceptually, a comparison can be made here with profit centres which, however, here are guided by clear target vectors, and the making available of a wide range of information, this within the clearly delineated framework of interaction which leads to the common attainment of overriding objectives and not to results that are in many ways sub-optimal. Principles

of **self-organisation** are decisive, as is the utilisation of **meta-knowledge**, both at the structural level, in the organisation of collaboration, and also for the individual employees. Once again, much of the orientation and clear setting out of aims on a detailed level, which was characteristic of the trend towards explicitness, is intentionally lost in this process. **Success factors** are, in part, **more hidden** and, in part, exist in employees' heads, partly in the forms of interaction that arise therefrom.

Continuous further training will also be a central feature of learning organisations. Where the training itself is concerned, this will mean the provision of learning environments in which lifelong learning can take place. Alone on the grounds of the cost, but also once more with an eye to making the most of one's own possibilities where competition with others is concerned, the essential training and learning processes will be **multimedia-based with their content designed accordingly**, and will **take place at the point of learning**, e.g. on company premises at times individual persons themselves choose. In order, as a business, to ensure that this is achieved with maximum success, businesses will establish links, in the form of **knowledge co-operation associations**, appropriate to the subject concerned, with varied business associates, partners in the supply chain and, of course, with the right kind of scientific partners in research centres and universities. This, too, will in turn be strongly furthered by the possibilities that networks offer. In this context, the **quality assurance function** within the firm itself will gain in importance both domestically and worldwide, thus requiring the development of abilities in the area of the **assessment and international certification** of the content of training courses and of qualifications.

6 Concluding Remarks / Summary

The present text has only been able to present fragmentary elements of knowledge management, as it is needed in today's world: it pertains primarily to personnel development, human resource management and organisation, and also has technical, database-related and formalised aspects. Here, the IT environment is strongly involved. It should be emphasised once again that paying attention to the human-centred aspects is extremely important. This is an aspect that FAW has spent a lot of work on, especially in conjunction with small to medium-sized companies in our region. That is a question of making it easier for employees to ask other employees for information; it means identifying and rewarding those persons who are especially helpful to others via knowledge-sharing; it can also mean protecting certain key people so that they are not too easily accessible to others. **Mission-critical knowledge** has to be protected adequately, which sometimes means **not making it explicit**. FAW thinks that it is also important to gather and make accessible information about situations in which something **did not work out right**. Finally, it should be emphasised again, that knowledge management has to be embedded into a context of organisation, personnel development and system technical infrastructure. In this context, in our work with small to medium-sized companies, we have dealt with and also produced documents on topical combinations such as knowledge management and personnel, knowledge management and conflict, knowledge management and crisis, knowledge management and mergers, etc. Knowledge management is really an interesting topic. Many small to medium-

sized companies are doing the right thing intuitively. They should not have primarily to think about buying software systems for that purpose; instead, companies need to use the new technical tools available within an appropriate organisation and accordingly skilled human resources to help them develop their present structures further and to link such structures together more effectively; along their full chain of value creation.

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