Knowledge Management for Production

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INTRODUCTION

Knowledge is one of the key drivers of innovation and success in the modern, information-based society. Consequently, knowledge has to be "operated" and "managed," which causes particular challenges due to the intangible nature of knowledge: "… it is fluid as well as formally structured; it is intuitive and therefore hard to capture in words or understand completely in logical terms. Knowledge exists within people, part and parcel of human complexity and unpredictability. " (Davenport & Prusak, 1998, p. 5) Being held in minds, knowledge is not easily accessible and hence, not manageable in the usual sense. Nevertheless, knowledge management (KM) tries to establish appropriate processes of externalizing, internalizing, and applying the knowledge of people involved in a given environment. Within that context, the notion of *knowledge* has undergone various definition attempts and interpretations.

From an economic and corporate perspective, knowledge was viewed as a commodity, like other products, to be packaged, archived, retrieved as needed, and sent across networks. An example of this approach is the "Wissenstreppe" (knowledge staircase), proposed by Klaus North (2002). This model proposes eight steps, each of which is linked to an instruction on how to reach the next step. The lowest level [1] consists of symbols. Combining these with rule-based syntax creates *data* [2], and the addition of semantics produces *information* [3]; information enriched by connectivity leads to *knowledge* [4]. Knowledge combined with applicability results in *ability* [5], which in combination with *willing* can be converted to *behaviour* [6]. Effective behaviour leads to *competence* [7]. Competences leading to a unique selling proposition (USP) create *competitive advantage* [8].

Knowledge became increasingly a decisive factor in competitive gain (e.g., Bryant, 2006), leading to an expanding demand for KM. However, manifold problems caused the failure of several KM initiatives, and led to the rediscovery of earlier approaches, such as that of Michael Polanyi (1973, 1985). Casselman and Samson (2005) extended the two types of knowledge, *explicit knowledge* and *tacit knowing*. Explicit knowledge can be represented by signs (symbols, text, and images), and thus stored electronically. As such, it is quite similar, or even might be seen as synonymous, to "information." Tacit knowing is always tied to a subject, that is, to a mind, and therefore, cannot be stored in a technical system. Nonetheless, it is possible to initiate processes that lead to the generation, externalisation, internalisation, and thus, to the sharing of tacit knowing.

Information technology (IT) is the natural enabler of managing *explicit knowledge* since it supports to store and handle signs: electronic content of any kind is easy to extend, rework, comment, structure, and complemented by metadata. These basic features of any document-based information management are strengthened in combination with standard or tailor-made KM Systems (KMS), like the one described in this chapter to support knowledge processes.

BACKGROUND

Tacit knowing can be understood as knowledge that is required to perform a behaviour, such as riding a bicycle, for which explicit knowledge is not mandatory (Dreyfus, Dreyfus, & Athanasiou, 1988): Even a child can learn to ride a bike without explicitly knowing specific rules or being able to articulate rules or formulas for balance calculations underlying bicycle riding. Knowledge that can be transformed into a skill is strongly embedded in experience, for example, gained from practising or sensing. Something can be understood comprehensively; reasons and connections can be recognised. Nevertheless, tacit knowing comprises aspects that are difficult to codify, such as personal convictions, perspectives, and values (Nonaka & Takeuchi, 1995).

The difficulty, and often even incapability, of articulating knowledge is one challenge of KM. Another one comes from the fact that even if *explicit knowledge* is available, it does not necessarily translate to action. In contrast to tacit knowing, explicit knowledge can be acquired via rote learning, which, however, can fail in its application or in conversion to intelligent behaviour. Learning facts without

relevant experience, understanding, or insight, results in the opposite of *tacit knowing*: lazy knowing, that is, knowledge that lacks capability.

The core concern of organisational KM, however, is the concrete use derived from (transforming or applying) knowledge, and not only to collecting and storing facts in databases, which would promote lazy knowing primarily. Therefore, KM, in the manufacturing industry, should focus on supporting and improving production processes. There are four categories of software-systems that can be used within that context (in sequence of increasing appropriateness):

Content management systems (CMS) and enterprise content management (ECM) transform structurally and semantically predefined (forms) information (content) into a desired uniform appearance (corporate identity). They are easy to handle, and establish tree structures of knowledge items, potentially complemented by metainformation.

Document management systems (DMS) store all kind of documents in a well-structured or extendable fashion. The documents have attached metadata, and they are indexed for rapid finding by full-text search. DMS have features like check in, check out, authorisation concept, workflow, user roles, history, and versions.

Learning management systems (LMS) are designed for knowledge transfer, but mostly concentrate on *internalisation* (learning). Content is created and arranged by experts.

Groupware (GW) systems focus on supporting the communication and collaboration of people having a common task or goal. They feature common workplaces for storing, exchanging, and processing documents, writing comments, and managing tasks.

When dealing with the introduction of knowledge management into an established organization, various social, technical, and organisational challenges arise that have to be considered for success:

1. ***Social challenges*** generally arise from changes inevitably coming up with the introduction of KM and KM-systems within an organisation. Change always requires energy in order to adapt to new circumstances, and also raises fear of failing to cope with the change. Specific KM-related social challenges are the willingness to share knowledge, knowledge externalization (how to articulate?), knowledge input, and retrieval.
2. ***Technical challenges*** refer to the functionality needed, and to the integration of KM mechanisms into the existing system landscape (platforms) that, in our case, required a tailor made solution. The KM user interface should behave (look and feel) similarly to the existing systems in order to be easily handled and used. In particular, the corporate design has to be conserved. Even in the case of a tailor-made solution, however, it should be flexible, w.r.t., both the user interface and the database interfaces. Another challenge comes from the key function of KM support, namely the search, if it is to be supported semantically and ontologically.
3. ***Organisational challenges*** primarily address individual learning: learning and knowledge processes mostly run self-organised; learners are stamped with personal conviction, perspectives, and values, forming a complex cognitive structure (Maturana & Varela, 1988; von Foerster, 1985/1999). Thus, structural changes can be achieved by controlling measures, but not instrumented or determined, and, knowledge processes cannot be completely planned.

Another organisational challenge is **search,** which can only be as good as the data to be searched. Consequently, all employees should use the same words ("language") for describing problems or solutions so that at least a wording-directive is needed. Another point is to train the users how to search.

Enhancing the level of education and further training of employees needs **time**, **freedom,** and "**knowledge rooms**": knowledge processes cannot be controlled by the parameters of economic efficiency. People need not only time to *internalize information,* they need also time for unconscious processes of internal assimilation and its linking, for understanding new and unplanned experiences, and for unexpected knowledge processes coming up with different types of acting.

Users have to be "won" without destroying their *intrinsic motivation*. Brain scientists, like Spitzer (2005), think that we have a natural predisposition to learn with fun, which is often distressed by education in school (Quinn, 2007). This could be pushed back if external rewards raise the knowledge sharing, retrieving, and transmission to something special. Thus, KM should offer to integrate knowledge processes in a natural way into the working day, where working and learning melts together.

Users easily can be stressed by huge systems coming with a big bang. Therefore, it is necessary to introduce a critical solution in small and easy-to-handle parts and steps: from function to function, and from department to department. The best way is to start in the area with the highest psychological strain, and with lead users, possibly supporting them by rapid prototyping and workshops.

Last, but not least, all the efforts put into motivating and training people, establishing, filling, and maintaining a knowledge base, must have a sustainable effect: this requires continuous attention of users and feedback, and appropriate activities in case of necessary modifications. A KM system, for example, should always exhibit something new to the user in order to attract his/her attention and motivation.