

Making Knowledge Visible Through Intranet Knowledge Maps: Concepts, Elements, Cases

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Abstract

This paper seeks to establish the conceptual and empirical basis for an innovative instrument of corporate knowledge management: the knowledge map. It begins by briefly outlining the rationale for knowledge mapping, i.e., providing a common context to access expertise and experience in large companies. It then conceptualizes five types of knowledge maps that can be used in managing organizational knowledge. They are knowledge-sources, -assets, -structures, -applications, and -development maps. In order to illustrate these five types of maps, a series of examples will be presented (from a multimedia agency, a consulting group, a market research firm, and a medium-sized services company) and the advantages and disadvantages of the knowledge mapping technique for knowledge management will be discussed. The paper concludes with a series of quality criteria for knowledge maps and proposes a five step procedure to implement knowledge maps in a corporate intranet.

1. Introduction: the rationale for knowledge mapping

A major weakness of the domain knowledge management as it is discussed today in the business and research community is its apparent lack of genuinely new and effective instruments and methods to improve the way individuals, teams, and organizations create, share and apply knowledge (in the sense of know-how, know-what, know-who, and know-why that individuals use to solve problems; for this distinction see also [1]). In 1996, Davenport, Jarvenpaa, and Beers argued that knowledge work processes often lack adequate support by information technology tools. This analysis still holds true to a large degree today (see [2]). In contrast, this paper views knowledge management not only as a new perspective on information management problems, but as a field that can provide new ways of improving knowledge-intensive processes (such as market research, consulting, or product development) by going beyond the mere administration of electronic information and help

individuals make information actionable in new contexts, connect it with previous experiences, identify relevant experts, and enable organization-wide learning processes. Knowledge maps, as will be shown below, serve exactly this purpose.

Having said that this paper discusses a new, genuine type of knowledge management tool, one must admit that the terms knowledge map, knowledge cartography or knowledge landscape are relatively new labels for an idea that is rather old. This idea consists of representing our vital environment in a graphic way to improve our actions within this territory. The environment or territory in the context of knowledge management is not geographic, however, but intellectual. By constructing a visual knowledge architecture, it should become possible to examine the knowledge we depend upon on a global scale and from different perspectives. Thus, a knowledge map should assist an individual employee, a team or an organizational unit in understanding and using the knowledge available in an organizational setting. The intellectual environment that is mapped through this tool is mostly made up of referenced expertise, documented experiences, and extracted and formalized processes or procedures. It contains heuristic knowledge (know-how) in the form of people (experts), processes (e.g., complex workflows), and applications, rationales or experiences (know-why) in the form of lessons learned or project debriefings, and factual knowledge (know-what) in the form of documents or database entries which in turn can be linked to authors who can be asked for advice, assistance or a clarification of their documented findings.

While the basic idea behind a knowledge map – to construct a global architecture of a knowledge domain – might be quite old, the application context, i.e., the corporation, and the format, as an intranet hypertext clickable map, are quite new. The reasons why knowledge maps are now viewed as a necessary tool in a corporate context are mainly the scope of (global) expertise that resides within larger companies and the difficulty of accessing this expertise through informal communication.

Today, these problems can be effectively resolved with the help of knowledge maps. They not only make expertise accessible through visual interfaces, but also

provide a common framework or context to which the employees of a company can relate to in their search for (or contribution of) relevant knowledge. As Fahey and Prusak [3] stress in their analysis of common mistakes in knowledge management projects, a prime goal of any knowledge management initiative should be to create a common context for the employees. Knowledge maps provide this common context in an explicit common visual model.

The technology that enables this kind of tool are intranet-based software solutions such as Lotus Development's Raven, Autonomy's Knowledge Visualizer (this tool can be used to generate ad-hoc knowledge source maps, see www.autonomy.com), Microsoft's Visio or IBM's KnowledgeX. All of these software tools combine powerful visualization techniques with database functionalities. Yet, while the technological implementation of a knowledge map with the help of one of these tools (or with simpler means such as DHTML/JavaScript or XML) leads, as will be shown below, to useful knowledge artefacts, the process of creating a knowledge map is almost as important as the final product itself. We will see that the technological implementation is only half of the challenge of developing and using knowledge maps in organizational knowledge management. The other even more challenging task consists of gathering the right reference information and combining it in a framework that everybody can relate to. Thus, the mapping process itself can already provide a number of insights into the knowledge assets of a company and its problems in allocating knowledge effectively (a knowledge asset in this context is any explicitly qualified source of knowledge that provides potential benefits for the solution of problems relevant to a company's success). In our work with an intranet-based knowledge map for a market research company, for example, we conducted 35 interviews to gather the relevant knowledge we needed to create a knowledge map of the company's methodological skills. These interviews not only provided the necessary background information for the knowledge map, but also revealed a lot about the structural improvement areas of the company. Thus, Galloway is right in concluding the following about mapping (see [4], p. vii; for a similar conclusion see the mapping examples provided in [5] or the argumentation in [6]):

„Mapping is merely an enabler – a means to a more important end. It is a vehicle for expressing and releasing the knowledge, creativity, and energy that lies within every group, regardless of its position or level within an organization.“

In this paper, we would like to give examples of various types of such knowledge enablers and describe the process we followed to produce them. We do so by first outlining

the five types of knowledge maps we have found useful in a corporate context. We then provide examples of such maps and assess their advantages and disadvantages (if used on a corporate intranet). Based on these insights we outline a five step procedure to generate a high-quality knowledge map.

2. The concept of a knowledge map

A knowledge map, as it is understood in this paper, generally consists of two parts: a ground layer which represents the context for the mapping, and the individual elements that are mapped within this context. The ground layer typically consists of the mutual context that all employees can understand and relate to. Such a context might be the visualized business model of a company (e.g., the lending business model of a bank), the actual product (e.g., a vehicle model in the case of a truck company), the competency areas of a company (as in the example of the multimedia company in section three), the value chain of a firm (as in the example of the market research group below), or a simple geographic map. The elements which are mapped onto such a shared context range from experts, project teams, or communities of practice to more explicit and codified forms of knowledge such as white papers or articles, patents, lessons learned (e.g., after action reviews or project debriefings), events (i.e., meeting protocols), databases or similar applications, such as expert systems or simulations. Knowledge maps group these elements to show their relationships, locations, and qualities. In this paper, we refer to knowledge maps as graphic directories of knowledge--sources (i.e., experts), -assets (i.e., core competencies), -structures (i.e., skill domains), -applications (i.e. specific contexts in which knowledge has to be applied, such as a process), or -development stages (phases of knowledge development or learning paths). We focus on these five types of maps as they answer the questions that came up most frequently in our action research with six companies over the course of two years. These questions were: how do I find relevant knowledge, how can I judge its quality, how can I make sense of its structure, and how do I go about applying or developing it myself?

A different, more abstract set of map categories is used by Huff in her anthology on the topic of mapping strategic thought. In her mapping typology she focuses on cognitive maps and distinguishes the following map types: text and language analysis maps, classification maps, network maps, conclusive maps, and schematic maps of cognitive structures [5].

Many definitions of knowledge maps that we have found in the descriptions of company projects or in academic papers are similar, but less specific. Vail, for

example, defines a knowledge map as follows (see [7], p. 10):

„A knowledge map is a visual display of captured information and relationships, which enables the efficient communication and learning of knowledge by observers with differing backgrounds at multiple levels of detail. The individual items of knowledge included in such a map can be text, stories, graphics, models, or numbers. [...] „Knowledge mapping is defined as the process of associating items of information or knowledge (preferably visually) in such a way that the mapping itself also creates additional knowledge.“

While this definition adequately describes the purpose of knowledge mapping, it does not distinguish the various types of knowledge maps that can be used in a corporate context. Below we provide such a distinction with the aforementioned five types of knowledge maps:

1. **Knowledge source maps:** They structure a population of company experts along relevant search criteria, such as their domains of expertise, proximity (for an example of such a knowledge map, without hypertext links behind the map however, see [8]), seniority, or regional distribution. Knowledge source maps answer questions such as “where can I find somebody who knows how to calculate a company valuation” or “do we have people who have run large e-commerce projects?”

2. **Knowledge asset maps:** This type of map visually qualifies the existing stock of knowledge of an individual, a team, a unit, or a whole organization. It provides a simplified, graphic ‘balance sheet’ of a company’s intellectual capital. Knowledge asset maps answer questions such as “how many SAP-consultants do we have, and how many SAP-projects have we completed?” or “how many of our software engineers have been with the company for more than five years?”

3. **Knowledge structure maps:** These maps outline the global architecture of a knowledge domain and how its parts relate to one another (for examples of this type of map, see [9] or [10]). This type of knowledge map assists the manager in comprehending and interpreting an expert domain. Typical questions that can be answered by such a map are “which are the skills needed to run a project, how do they relate to one another, and what are the available courses for every such skill?”

4. **Knowledge application maps:** These maps show which type of knowledge has to be applied at a certain process stage or in a specific business situation. Usually, these maps also provide pointers to locate that specific knowledge (documents, specialists, databases). Knowledge application maps answer questions of people who are involved in a knowledge-intensive process, such as auditing, consulting, research, or product development. They provide answers to questions such as “who do I talk

to if the market tests are inconclusive?” or “what are our experiences in moving from a prototype to mass-production?”

5. **Knowledge development maps:** These diagrams can be used to depict the necessary stages to develop a certain competence, either individually, as a team, or as an organizational entity. These maps can serve as visualized learning or development roadmaps which provide a common corporate vision for organizational learning. They answer questions such as “how do we achieve business excellence for our unit?” or “how can we prepare our unit (intellectually) for the entry into a new market?” We have also used this type of map to visualize the necessary steps to develop e-commerce competence (from mere web designing skills, to community development skills, to secure electronic contracting skills, to inter-business networking skills).

Besides these five types of maps, one can also imagine maps which combine some of the above types in one single map. Typically, a knowledge application map and a (partial) knowledge source map are combined into one single image. This way, one can not only show what knowledge is relevant at what project stage, but also how to locate that knowledge.

There are numerous visualization techniques that can be used to design such knowledge maps. They include, but are not limited to, the following methods (see Table 1).

Table 1: Mapping techniques for the knowledge map context

Simple Mapping Techniques	Complex Mapping Techniques
Mind mapping (T.Buzan)	Concept maps (Novak)
Clustering	Cause maps, see [5]
Matrices or portfolio diagrams	Concentric circles or Venn diagrams
Fishbone graphs	Metaphoric maps (e.g., a house, a balance, a compass, or a park)
Cartesian and polar co-ordinate systems	Process charts or flow charts
Pyramids	Spider web graphs
Hierarchic trees	Decision trees
Geographic maps	3D-environments (e.g., globes, landscapes)

The use of one of these techniques depends upon two factors: first, the requirements of the conceptual framework that provides the base layer for the knowledge

map (flow charts are feasible techniques for knowledge application maps, while concept maps are more apt for knowledge structure maps) and, second, the technological infrastructure and software that is available to implement a clickable map (there are numerous software packages that support hypertext mind-maps, concept maps or interactive flow charts, yet very few products that support more complex forms of knowledge maps such as metaphoric maps or 3D-environments).

In the following section we provide a number of examples of how these visualization techniques can be used to design knowledge maps of the five mentioned types.

3. Intranet knowledge map examples

The following series of knowledge maps is a result of our action research with six partner companies over the course of two years (1998-2000).

3.1. Knowledge source map

In principle, a knowledge map can be implemented on any technological platform that allows to combine visualization engines with hypertext capability (i.e., linking sensitive, visual zones to other data points) and database technology. Nevertheless, we have found the intranet the most accessible medium to host knowledge map applications. This is especially true since many intranet users are familiar with clickable maps or touch-sensitive visual zones from the Internet. Hence, the user-acceptance of a knowledge map in a browser interface is likely to be higher than in a proprietary application. The first example of an intranet-based knowledge map is taken from a multimedia company which mainly works in the development of web-sites, CD-ROMs, and stand-alone multimedia terminals. One of the company's problems is the adequate staffing of such projects with the right experts.

Thus, a knowledge map was designed to help project leaders and human resources professionals to assess the current state of experts available within the company at its three main locations (New York, Berlin, Basle).

The map divides the company's competence into five areas, namely graphic design, animation (i.e., shockwave programming), database design, project management, and technology know-how (i.e. server administration). The people within the company apply these skills to the aforementioned three areas of CD-ROM production, stand-alone systems, and web development (the concentric circles in the map below).

The partial view of the actual map below reveals that the most expertise resides in the company's headquarter in Berlin (color-coded accordingly), especially for the domain of web-site development. It also reveals that there are very few project management or animation specialists within the company. The map reflects the shift in activities away from CD-ROM production to web development where most experts in the map below apply their skills.

The technology behind this map is quite simple and consists of three elements: the actual knowledge map which is drawn in Microsoft Visio and linked to an Access database that holds the expert profiles (expert area, application area, location, phone number, etc.) and a CGI-script that provides a browser interface for the map. The experts update their profiles via a form which they can access through their browser. This form is directly linked to the Access database (which in turn is referenced in the Visio chart).

While this particular map is still in the testing phase, an identical application with the same architecture and map design has already been used for several months in a semiconductor company where it is also used to map specialized communities of practice.

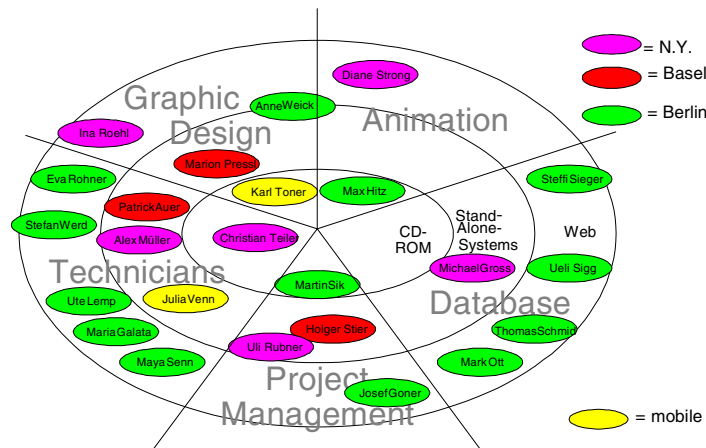


Figure 1 : A knowledge source map for a multimedia company (excerpt)

3.2. Knowledge asset map

Knowledge asset maps provide a visual balance sheet of a company’s capabilities. These capabilities can be represented in the form of a core competency tree or as a visual directory of individual or aggregated skills of the work force. For a depiction of a core competence tree see [11]. Based on such a map, a company can outline its capability profile bottom-up instead of top-down (as in a core competence tree). The following simple map provides an overview of a consulting team in terms of the competencies of its members. Large blocks represent expert knowledge on the particular topic, small blocks refers to basic knowledge in a particular domain. The domains in which these consultants work are IT (information technology), strategy, mergers and acquisitions (M&A), accounting and marketing.

The knowledge asset map illustrates various properties of the know-how constellation of the consulting staff. The map reveals, for example, that Andi Ehrler is a central asset for the company in terms of his skills (he is also the practice leader for accounting as the shaded block in that column indicates). He has substantial experience in all five sectors of the consulting activities. The map also

reveals that there is a general lack of specialized knowledge in the domain of mergers and acquisitions. Thus, it might be advantageous to drop this consulting service in the future. The map furthermore reveals training and personnel development needs. It shows clearly that Carl Brenner has not yet been able to gather an expert status in any of the five domains. The future staffing decisions need to take this fact into account.

Such a knowledge asset map can be valuable to plan the allocation of staff members or their training needs or assess the overall situation of a company’s intellectual assets. By clicking on a name, further information on the consultant is provided (such as e-mail, location, special interests, etc.). By clicking on a block, the map reveals the projects and courses that the consultant has completed in the particular field.

A similar version of this map has been implemented two years ago in a telecom consulting company. According to the head of operations, it has proved especially useful for the planning of training activities and for emergency cases where experts have to be identified quickly.

Consultants	IT	Strategy	M&A	Accounting	Marketing
Tinner, Jeff	■	■	■		
Borer, André		■			■
Brenner, Carl	■			■	
Deller, Max					■
Ehrler, Andi	■	■	■	■	■
Gross, Peter	■	■			■
...				■	■

Figure 2: A knowledge asset map of a consulting company (excerpt)

3.3 Knowledge structure map

As mentioned earlier, knowledge structure maps divide a skill domain into logical blocks. The map below shows that a web publisher requires three levels of know-how. First, basic editing knowledge is needed, which consists of layout and sequencing skills, as well as the content selection for an Internet site, plus an adequate vocabulary and writing style for its communication. Secondly, the publisher or editor requires knowledge on how to design the interactive environment for the pages he or she generated. Lastly, the web designer needs to know the relevant HTML or Java codes (Web programming languages) to make the site look attractive and implement adequate security measures.

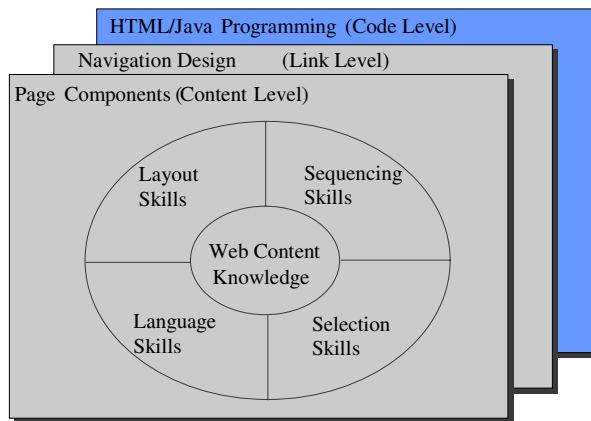


Figure 3: A knowledge structure map

Other examples of knowledge structure maps can be found in product development (where the various engineering, marketing, and management capabilities are mapped around a product or process), project management (where the various skills that are required to manage a project are mapped in a framework that shows which skills serve what purpose in the course of a project), or financial engineering (where the inter-relationship of insurance skills and banking skills are mapped out).

3.4 Knowledge application map

The knowledge application map is probably the most frequently used knowledge mapping format today. It outlines which knowledge is required at a certain process step, e.g., in the value chain of a company. In the example below, the value chain of market research company is divided into four processes: acquiring or generating data, transforming it into information by analyzing it, administrating and archiving this information, and

transforming it into knowledge by educating its clients about its findings.

In every process step, various IT-based tools and conceptual methods can be applied. If an employee is interested in one of these (approx. seventy) instruments, he can simply click at the name of a tool or method and a short description of the tool, its application context, functioning and contact person (as well as a rating of the tool or method by the corresponding specialist) will appear on the screen.

This is the actual map (with the exception of the terms translated into English) that is currently installed in the knowledge portal of the company's intranet. Underlined methods or tools are also sold as products to clients. Every term in the map is linked to an explication- and reference-page for the corresponding tool. This page consists of three columns. The first column outlines the tools title, the second column describes its application context, functioning, experts and their rating of the tool, the third column provides links to related tools or to relevant Internet sites.

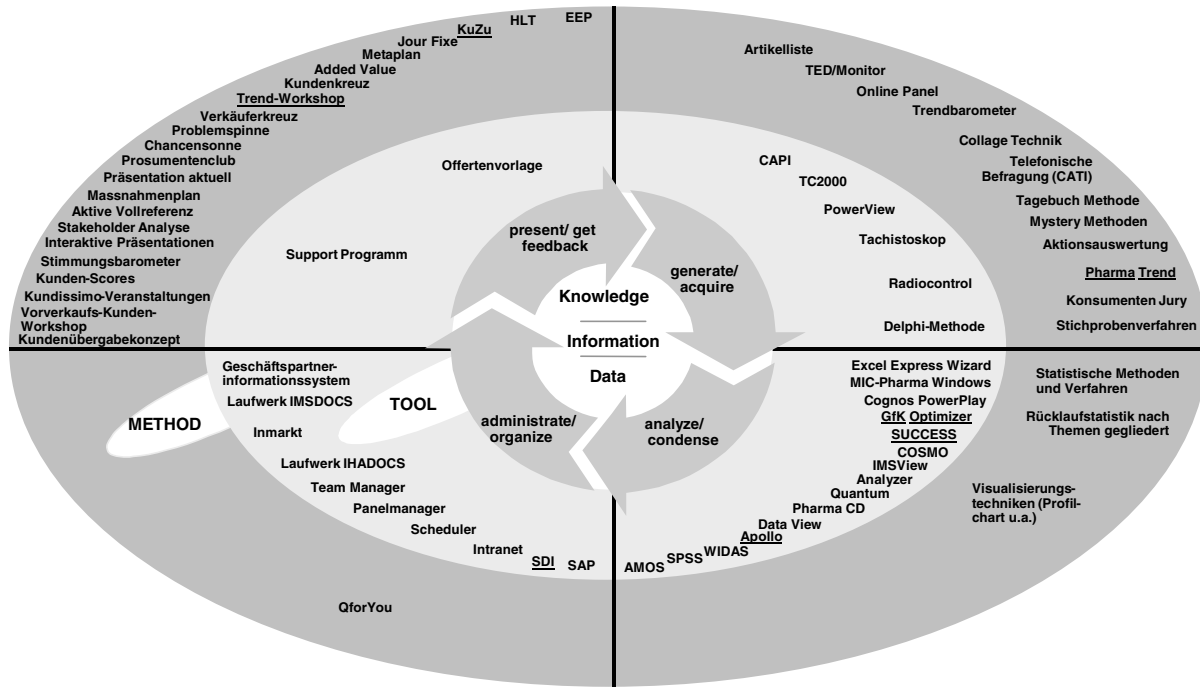


Figure 4: A knowledge application map of a market research company

3.5 Knowledge development map

The last type of knowledge map can be used to visualize the necessary steps to develop a certain type of competence. The relevant knowledge is mapped at various (sequential) levels. By clicking on a certain level of

knowledge, the map reveals further details and describes the necessary activities to acquire or develop that competence. The example on the next page is taken from an e-business context.

The map can be used to illustrate the necessary steps to develop competence in e-commerce passing through various stages from a mere web-presence that only provides on-line information, to more complex sites that offer community functionalities (e.g., forums, mailing lists, polls, etc.) or full scale e-business sites that include payment services. The map in its current form is not hypertext based yet. Hence, the mapped steps cannot be “zoomed in” on the corporate intranet.

3.6. Purposes of the maps

In summary, these examples illustrate that knowledge maps can serve the following five purposes:

1. They increase the visibility of knowledge sources and hence facilitate and accelerate the process of locating relevant expertise or experience.

2. They improve the evaluation of intellectual assets (and liabilities) in a corporation.
3. They assist employees in interpreting and evaluating knowledge domains.
4. They connect processes with knowledge sources (and thus go beyond the mere documentation of a process as found in most quality manuals).
5. They sketch the necessary steps for knowledge development in a certain area.

Having outlined the various functions of knowledge maps, we will now examine their possible disadvantages and advantages in more detail before outlining a five step procedure to implement a knowledge map.

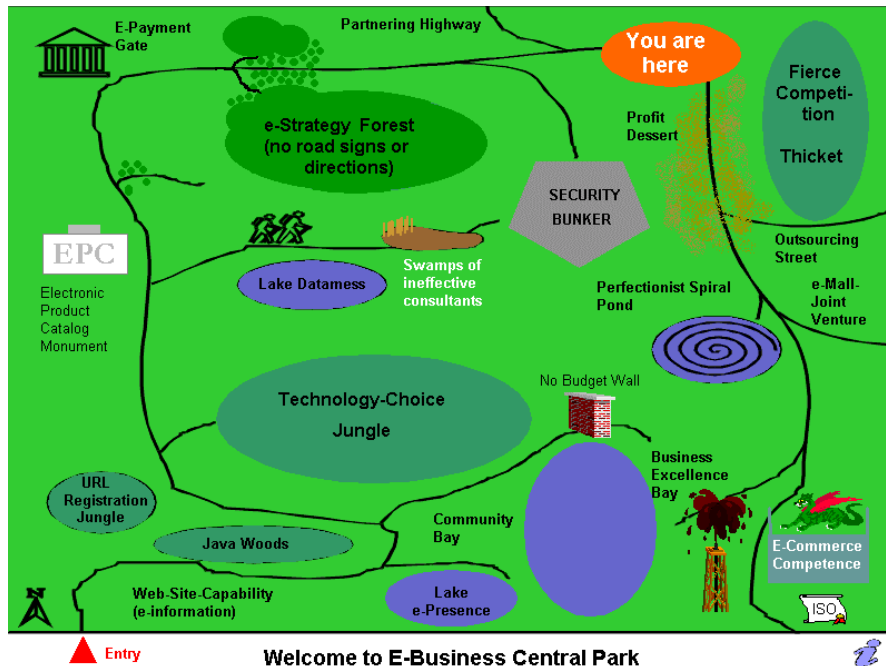


Figure 5: A knowledge development map for e-business competence

4. Evaluation of knowledge mapping: advantages and disadvantages

Knowledge maps are one possible way to improve the knowledge transfer and utilization in a company (other ways include yellow pages type expert directories, communities of practice, or knowledge fairs). Associated with this way are various advantages and disadvantages that one has to take into account in a knowledge mapping project.

4.1. Advantages of knowledge maps

The general advantages of knowledge maps should have become apparent by now. First, they render corporate knowledge assets visible for all employees that have access to the Intranet. Thus, they provide a systematic context for the retrieval of reference information. Second, they can connect experts with each other or help novices or rookies identify experts quickly. As a consequence, knowledge maps can speed up the information seeking process and facilitate systematic knowledge development

since they connect insights with tasks and problems. Another central advantage of knowledge maps is their potential to make implicit knowledge explicit through the use of visual metaphors and symbols. For illustrations of this advantage see [12]. From a marketing point of view, knowledge maps can be used to emphasize and sell the competencies of a company to external groups (e.g., potential clients, potential employees, shareholders, analysts etc.).

In summary one can say that knowledge maps can help employees and clients remember, comprehend, and relate knowledge domains through the insightful visualization and aggregation of information about the company's experiences, skills, or intellectual resources in general. To clarify this advantage, which is a direct result of the visualization techniques used in knowledge mapping, we can rely on the following explanation by hypertext cartography expert Michael P. Peterson:

“Firstly, a diagram offers a synoptic, global representation of structure or a process and this contributes to the globality and the immediacy of understanding. Secondly, a diagram is an ideal tool for bridging between a conceptual interpretation and the practical expression of a certain reality. A diagram is a synthesis between these two apparently opposed types of representations – the symbolic and the iconic. Diagrams are not, generally, the direct image of a certain reality. It is the figural expression of an already elaborated conceptual structure, like any other symbolic system” (see [13], p. 34).

Although a knowledge map uses these two features of a diagram – global understanding and conceptual representation of reality – it is more than just a diagrammatic representation. A knowledge map is more than a simple diagram because it offers more dimensions and richer semantics than a diagram. Specifically it offers more elements that are relevant to solve a problem than a diagram, such as time, location, quality levels, relationships, and time aspects. Unlike a diagram it is not inert and finished, but interactive and expandable.

In addition knowledge maps make extensive use of metaphors (such as mountains, layers, routes, or buildings). Finally, a map also shows pathways and options and can relate to other maps (e.g., via embedded hypertext links).

A knowledge map is therefore more similar to a geographic map than a diagram. It answers the same basic four questions that a geographic map seeks to answer, namely:

1. Where am I, what is my context (environment)?
2. Where can I go, what are my options?
3. How do I get there quickly, and in the most direct way possible?
4. What does it take to get there; what are the required resources?

In consequence, a knowledge map provides systematic orientation in the intellectual territory of a company and helps to find directions, assess situations, or plan resources.

4.2. Disadvantages of knowledge maps

As geographic maps, which still many people find difficult to comprehend or use, a knowledge map also has certain disadvantages. The disadvantages associated with this method are summarized in table 2:

Table 2: Disadvantages of knowledge maps

Disadvantages for map users	Disadvantages for map designers
<ul style="list-style-type: none"> ● the potential harmful effects if the map is seen by illegitimate users (such as head hunters or competitors) ● the danger of misinterpretation ● the fixation or 'reification' of one frame of reference (i.e., the layout of the knowledge map) ● the danger of information overload if the map represents too many elements or dimensions of a knowledge area ● the danger of using an outdated map 	<ul style="list-style-type: none"> ● the commitment to one scheme of order and neglect of other perspectives ● the difficult depiction of dynamic processes ● the relatively high costs for production and updating ● the missing quantification of interdependencies ● the reduction of complex structures to graphic symbols ● the difficult and time-consuming task of ergonomic visualization

These numerous potential disadvantages have to be weighed against the benefits that result from establishing a knowledge map. In the following section, we propose an implementation process and accompanying quality criteria to avoid this extensive list of disadvantages.

5. Implementation and Quality Control

To construct and design a knowledge map that avoids the aforementioned disadvantages, the following five steps need to be sequentially completed:

1. Identify knowledge intensive processes, problems, or issues within the organization. The resulting map should focus on improving such knowledge intensive areas. This step typically involves a screening of a company's value chain or main processes and various interviews with key employees (involved in knowledge-intensive business activities).

2. Deduce the relevant knowledge sources, assets, or elements from the above process or problem. The question which needs be answered at this point is: „In order to manage the process or area well, what expertise and what experience is needed or helpful, and where and how can one access that knowledge?“

3. Codify these elements in a way that makes them more accessible to the organization as a whole. Build categories of expertise that are relevant to the process or area identified in step one. If the process is, for example, project management, possible categories might be experts on project planning, controlling, project documentation, or experts in IT-support for project management.

4. Integrate this codified reference information (i.e., the different types of project management specialists or resources) on expertise or documents into a visual interface that allows the user to navigate or search visually. Connect this navigation system to the process or working environment itself (integrate it into the workflow of the process or the homepage of an organizational unit). This step involves the actual design and implementation of the knowledge map. Here, a specific visualization technique has to be chosen that best fits the objective of the map. Knowledge application maps, for example, are usually best visualized with process flow maps or decision trees.

5. Provide means of updating the knowledge map. A knowledge map is only as good as the links it provides. If these links are outdated or obsolete, the map is useless. Therefore, a map needs to be continuously updated by the 'map maker' or the people who are represented in it. This step may involve designing an automatic workflow that regularly asks experts to update their position in a knowledge map.

These five steps provide a generic sequence of activities to establish a knowledge map. In all of these steps, one has to be aware of the quality of the final map. In our experience in implementing three such maps, the last step is often the most difficult and crucial one in order to assure the quality of a knowledge map. Hence, it makes

sense to define a set of quality criteria for the resulting map at the very beginning of the mapping process in order to prevent quality issues in step five. Vail distinguishes the following quality criteria for knowledge maps:

- participative: the mapping team creates the map interactively and involves as many employees as possible,
- shared: the map represents a truly shared model that all knowledge workers can relate to,
- synergistic: the experts all contribute their different expertise to the map, in order to generate one logical and comprehensive picture,
- systemic: the map's elements can be combined logically to an integrated whole,
- simple: the map can be overlooked at one glance,
- visual: the map uses a visual framework that is made up of iconic elements,
- information rich: the map is informative in the sense that it aggregates a great amount of noteworthy references that help in the problem solving process. See [7], p. 14.

These criteria already provide some guidance in gathering the elements and designing the framework for a knowledge map. When completed, we suggest that the map is again reviewed with the following quality criteria (in the sense of a concise checklist that can be further elaborated according to the company's standards and policies):

Table 3: Knowledge map quality criteria

Knowledge Map Quality Dimensions	Review Questions
1. Functional map quality	<ul style="list-style-type: none"> ● Does the map serve an explicit purpose for a specific target user group? ● Is there an implemented process to update and review the knowledge map periodically? ● Is there a feedback mechanism through which users can suggest improvements to the map?
2. Cognitive map quality	<ul style="list-style-type: none"> ● Can the map be grasped at one glance (not overloaded)? ● Does it offer various levels of detail? ● Does it allow to compare elements visually? ● Are all elements clearly discernible?
3. Technical map quality	<ul style="list-style-type: none"> ● Is the access time sufficient (no time lags)? ● Can the map be used with a browser-interface? ● Does the map appear legibly on various screen resolutions?

	<ul style="list-style-type: none"> ● Is the map securely protected against unauthorized access?
4. Aesthetic map quality	<ul style="list-style-type: none"> ● Is the map pleasing to the eye (adequate color and geometric form combinations)? ● Can the map's visual identity be kept when new elements are added (map scalability)?

If these criteria are met, an intranet knowledge map may well become one of the killer-applications of a corporate intranet since it provides a quick and comprehensive overview of a company's intellectual assets.

6. Conclusion

Knowledge maps provide a visual orientation for managers or specialists who wish to locate, evaluate or develop knowledge in an organizational context. They condense information about knowledge sources, assets, structures, applications, or development needs in an accessible way. As Wurman points out, the creative organization of such information can create new information and insights (see [14]). Each way that one organizes information can create new knowledge and understanding. This new understanding results from the organizational context that knowledge maps can provide. Nevertheless, knowledge maps have not yet lived up to their potential in the corporate world. Management literature on the topic has still only a few success stories to illustrate the potential of such maps, such as the Swiss pharmaceutical company Hoffmann-La Roche where a comprehensive knowledge map was used to improve the (knowledge-intensive) new drug approval process and hence improve the time-to-market of new products (for a depiction of this map see [15], p.172). However, with the rapid development of intranet technology and its potential to combine appealing visual interfaces with database applications, knowledge maps may soon prove to be a standard element in any company's knowledge management repertoire.

7. References

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