Mapping Knowledge and Intellectual Capital in Academic Environments: A Focus Group Study

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Abstract

This paper argues that knowledge mapping may provide a fruitful avenue for intellectual capital management in academic environments such as university departments. However, while some research has been conducted on knowledge mapping and intellectual capital management in the public sector, the university has so far not been directly considered for this type of management. The paper initially reviews the functions and techniques of knowledge mapping and assesses these in the light of academic demands. Secondly, the result of a focus group study is presented, where academic leaders were asked to reflect of the uses of knowledge mapping at their departments and institutes. Finally a number of suggestions are made as to the rationale and conduct of knowledge mapping in academe.

Keywords: Knowledge mapping, academic, intellectual capital management, focus group, research management

Introduction

Across sectors, knowledge intensive organizations increasingly face similar conditions with a strong connection between the individual organisation's ability to mobilize, apply and disseminate knowledge resources on the one hand, and their competitiveness and survival on the other. Particularly, we can observe how intellectual capital management and knowledge management plays a progressively more important role within the public sector (Wiig, 2002; Cinca et al., 2003). The academic department or institute is among those (often public) environments facing rapid change as a result of new demands for commercialisation of knowledge, a need for a more efficient utilization of human resources due to cut-backs in basic funding, as well as the introduction of new accountability measures from government (Gibbons et al., 1994; Ziman, 2000; Jacob, 2003). These changes sometimes result in new ways of working, for instance an increase in the prevalence of university-industry cooperation, projectification and increased dependence on external funding, teamwork and a concomitant need for inter-team learning. Furthermore, the raising prevalence of temporary academic labour, often at the expense of tenured staff, necessitates new efficient forms of intangible asset management, knowledge transfer and professional socialization.

Under the label of intellectual capital management (ICM) and knowledge management (KM) we find a set of managerial activities aimed at identifying and valuing the knowledge assets of the organization, leveraging these asset through knowledge sharing, and creating new knowledge (Easterby-Smith and Lyles, 2003; Holsapple, 2003). Many of the processes for measuring intangible assets and managing knowledge originally developed for private firms, have been found to be useful for supporting the university (Jacob and Hellström, 2000). Some of these include (a) offering competent and effective service, (b) preparing for, building and leveraging public and private

intellectual capital, and (c) helping the public understanding of the needs and direction of public activities, programs, and projects (also see Wiig, 2002).

In the private sector, the need for increased transparency and reduction of complexity has often been catered to by the use of knowledge mapping tools. Knowledge mapping is a multifaceted approach for creating structure out of an overabundance of potentially useful information. It is a method for coordinating, simplifying, highlighting and navigating in complex knowledge contexts (Wexler, 2001). Universities are typical instances of such complex knowledge contexts. For instance Boyer (1990) classically argued that the work of the universities centers on four intellectual activities: *discovery*, *teaching*, *application* and *integration*, where discovery and teaching are traditional activities, while application refers to the development of new processes and products, and integration has to do with societal involvement, e.g. popularisation, or cooperative engagement such as university-industry relations. Management of knowledge and intellectual capital is relevant for the traditional activities of discovery and teaching, but the increasing emphasis on application and integration calls for new forms of academic management of intellectual capital and knowledge.

This paper argues that knowledge mapping may provide a fruitful solution to the problem of how to manage and coordinate the increasingly complex environments of academic departments, institutes and national laboratories. A framework for 'academic knowledge mapping' may provide a possible answer to the challenge of how to locate new forms of useful knowledge in the academic organization, including new directions for training employees, stimulating and facilitating knowledge sharing, and establishing useful links with external stakeholders and funders (Hunt, 2003). We will develop this argument by first reviewing a number of functions and applications of knowledge mapping. We will then present the results of a focus group study with academic leaders on the possible application of knowledge mapping in university departments or research institute settings. Finally, we will present

and discuss a number of possible inroads for constructing knowledge mapping in academic environments.

Theoretical foundations

The functions of knowledge mapping

Knowledge maps and knowledge mapping has been said to be about facilitating efficient knowledge sharing between organizational members, and sometimes also with the outside world. Wexler (2001) has further suggested that knowledge maps must be problem-oriented; they have to address and attempt to solve a specific problem, and that problem orientation must be a central concern already early in the process of constructing a knowledge map. Problem orientation can take place in several different domains, for instance knowledge maps may be oriented toward identifying intellectual resources, socializing new members of an organizations, anticipating ne w opportunities, and stimulating learning and change (Wexler, 2001).

The objective of knowledge and intellectual capital management is to contribute to organizational development and competitive advantage by systematically managing (creating, finding and leveraging) the intellectual resources of the company. Knowledge mapping contributes to this overall objective by improving the organization's ability to navigate in a territory by using representations of the central intellectual environment (Eppler, 2003). In a similar way Duffy (2000) refers to knowledge maps as 'navigational systems that enable users to find the answers they seek'. As such the knowledge map is a key tool for representing the whole range of 'knowledge objects', across categories and locations, as well as the links between these objects. In other words a knowledge map is a constructed architectures of a knowledge domain. In this regard knowledge maps address at least two organisational needs with respect to knowledge: (1) increased transparency as to the location of

valuable knowledge in the organisation, thereby making knowledge more accessible, and (2) stronger support for development of a common context upon which employees can draw in the search for knowledge, as well as in creating new knowledge.

In a recent book entitled *Mapping Strategic Knowledge*, Huff and Jenkins (2002) similarly argue that knowledge mapping brings three key benefits to an organization: it connects and organizes strategic knowledge, it simplifies complex issues, for instance for decision makers, and it has the ability to represent knowledge on different levels of abstraction. In this last sense, knowledge mapping may be useful since "…mapping work is an especially strong vehicle for moving between theory and practice – a frequently desired but rarely achieved goal." (Huff and Jenkins, 2002: 2).

From an intellectual capital point of view it is now commonly understood that physical assets and access to capital value do not correctly reflect the ability of the organisation to create value now or in its future. A better understanding of this capacity would require an account of the organization's intangible assets, e.g. the knowledge and the routines needed for problem solving and for performing certain tasks in the organisation. Also reputation, network affiliation and organizational culture are instances of intangible assets and part of organisation's intellectual capital (e.g. Stewart, 1997). Following the intellectual capital perspective, one may argue that knowledge mapping should be focused on those intangible assets that can be used by the collective to create resources and opportunities for the organization, not least in terms of generating new intangible resources.

There are also a number of disadvantages associated with using knowledge maps. One obvious drawback for the organization is related to the possible damage caused by low-quality maps, e.g. in terms of time loss, misinterpretation of the content, or simply the reliance on outdated or incorrect information (Eppler, 2003). Another disadvantage lies in the increased risk of involuntary spill-over of knowledge to competitors.

Approaches to Knowledge Mapping

According to Soliman and Spooner (2000), the knowledge mapping process should start by deciding on the specific scope for and purpose of mapping knowledge, as well as the level of detail of the knowledge map. In creating graphic or other systematic representations of an organisation's knowledge assets a major challenge becomes the handling the dynamic aspect of the organisations' environment (Soliman and Spooner, 2000), as well as of the dynamic character of the knowledge base itself. Some knowledge loose value over time, other may be replaced with superior knowledge, and some knowledge may simply be forgotten. This calls for a dynamic and multi-functional approach to knowledge mapping. Wexler (2001) suggests a number of generic knowledge mapping approaches that may be combined to capture such dynamism. These include competence maps, e.g. lists or chart over available specialisms, concept maps, e.g. key concepts, strategy maps, e.g. goals of the organization or the group, causal maps, e.g. 'how-to' maps or project process descriptions, and cognitive maps, for instance maps over relevant fields of inquiry or work. Still, one of the most basic methods for mapping knowledge remains the organizational "yellow pages", the aim of which is to create transparency as to the location of knowledge in the organization by registering individual competencies in a database or similar. In other words it is a directory that enables individuals to identify the location of knowledge that they may need for specific purposes. Yellow pages often represent a mix of formal individual competencies in the form of competencies acquired from and certified by education and training on the one hand, and practice based knowledge acquired through problem solving activities in the organisation on the other. Some weaknesses of these systems lie in (a) the difficulty in verifying the quality or even existence of the knowledge that individuals claim they possesses, and (b) the maintenance, i.e. updating etc. of information in the system.

In spite of these difficulties, an important functionality of the knowledge map still is to enable the user to browse 'knowledge holdings' both inside and outside of the organizational boundaries (Duffy, 2000). Such maps must be able to structure knowledge to coincide with the way that people in the organization think about knowledge, how they prefer to retrieve it, and they must be able to differentiate functionally between tacit and explicit forms of knowledge (Duffy, 2000).

A way of increasing the sensitivity of knowledge mapping is to pay attention to the different forms of relevant knowledge on a higher level of abstraction. For instance Stewart's (1997) three forms of knowledge or intellectual capital: "human capital", "structural knowledge" and "customer capital" may be of guidance here. A complete map should include both explicit and tacit knowledge within all three categories. Heng (2001) presents a study of a small manufacturing firm's process of intellectual capital mapping based on the ISO 9001 quality framework. Heng argues that through its documentation procedure, the ISO 9001 quality management system is able to provide an account of the knowledge of the company, including a substantial part of its 'critical knowledge', i.e. knowledge that is of "vital importance to the viability and survival of the company" (Heng, 2001: 55). ISO 9001 elements listed by Heng that would be viable for mapping knowledge in the academy would be aspects of 'management responsibility', i.e. performance objectives, vision and mission, 'contract reviews', i.e. project portfolio, and project capability, 'document and data control', that is a database of available academic texts and manuscripts, and finally 'servicing', i.e. the networks of 'customers' or partners of an institution.

Several authors in Huff and Jenkins' (2002) compilation of articles on the subject point out that there are very few methods for helping the organization decide what are good maps for guiding it into the future. One of their reflections is that criteria for constructing future oriented maps must not be too closely tied to frameworks that emphasize the existing intellectual resources of the organization, such

as for instance is done in the resource-based view of the firm, since this would risk hampering renewal and creative growth. In other words, there is a risk that knowledge mapping increases the path dependency of actions, including the utilization of intellectual resources, by favouring reuse of existing knowledge at the expense of developing new solutions and insights. This reflection is certainly relevant for academe, where generation new, original knowledge is a core value (Ziman, 2000).

Despres and Chauvel (1999) point out in relation to mapping that "individuals and organizations function within information environments of their own making" (p. 115). This implies that the ways that knowledge is generated, sought out and used, are building blocks for a 'tacit' knowledge map, which can be reconstructed in an active knowledge mapping activity. However, this also has implications for how the functionality of a knowledge map should be seen, for instance, Despres and Chauvel (1999) state that the monitoring of an external environment X may limit the attention to environment Y and Z. Consequently the knowledge map must build in a definitive amount of divergence as well as convergence of focus: i.e. an ability to maintain attention to other areas than those that are currently focused on, as well as enable a specific focus on certain sub-fields. They put knowledge mapping in the area of business intelligence, scanning and ultimately self-perception of the organization. This function of the knowledge map, to not only make knowledge easier to access and exploit, but also to provide the organization with an identity or a 'place on the map', is taken up by several authors. Seeman and Cohen (1997) for instance suggest a move from the knowledge map to the 'knowledge atlas', where the 'map' metaphor suggest a picture of an area or structure and an aid to the user to find their way around, and the 'atlas' is a more global picture of all the relations that an organization is involved in, and all the resources on which it draws. Where the knowledge map answers questions of *who* has *what* knowledge and *where*, the atlas also addresses the questions of *when* in the process certain knowledge is needed, *how* activities and knowledge are related and *why* certain

knowledge based activities are taking place. In this paper we assume that the knowledge atlas can be seen as a functional improvement on the current forms of knowledge mapping, and does not really present us with a generically different form.

Emphasizing process, Eppler (2003) has developed a five-step procedure for creating high-quality knowledge maps. The first step is to identify particular knowledge intensive processes, problems or issues, and to focus knowledge mapping on these areas. The second step is to recognise the relevant knowledge sources and assets underpinning the ability to perform in processes and problem-solving activities. The third step is a codification of these elements in a way that makes them accessible to the organization as a whole. The fourth step is focused at creating a user-friendly interface by integrating and codifying reference information into either a physical or a virtual interface which allows individual users to navigate and to find the needed knowledge (or the location of the knowledge). The last crucial step is to provide means and procedures for continuously updating the map and securing the map quality. Hunt (2003) suggests that knowledge in organisations with advantage can be measured by combining self-assessment and computer analysed testing. Central to these forms of self-assessment is the belief that the quality of peoples' performance relates not only to the quality of the knowledge they posses but also to the certainty with which they possess it (Hunt, 2003). Instead of just measuring whether people know something by, for instance, relying on the of the answer to a test or on previous assessments and credentials, the measure should also reflect the certainty with which people believe they know, particularly in practical situations (Hunt, 2003). The advantage of introducing this measure for knowledge mapping is that it captures the more subjective facets of knowledge, thereby increasing the ultimate value of the maps. It remains to be seen which ones of these approaches and functions that will be useful for academic knowledge mapping. In what

follows we will present a focus group study, or a 'discussion based survey' of demands and related

functions for knowledge mapping voiced by a group of academic leaders.

Method

Focus group sample

The present study was conducted as a focus group exercise where 27 senior academics participated

(professors, heads of department and research institute leaders) in charge of leading research in various

contexts. The group was meeting for a three-day discussion on academic management, to which the

participants had volunteered, and the present investigation took place in the beginning of these days.

Stratified purposeful sampling was employed ensuring that the group consisted of individuals

representative of a number of disciplinary affiliations and work profiles (Lyons, 2000). In addition the

age of the group ranged from 33 year to 65. The group consisted of 23 men (85%) and 4 women (15%),

whereof 12 were professors, 8 associate professors or senior researcher and 7 research managers at

either group, department or research institution level. The disciplinary distribution was as follows:

Natural science (4), technical science (4), medical science (6), agricultural and vet. science (1), social

science (6), and humanities (5). Out of the 27 participants, 17 came from traditional university

departments, 5 from independent research institutes partly supported through external contracts, and

finally 5 from 'clinical' research environments.

Procedure and analysis

The focus group discussion was intended to be *issue driven and theory based*, that is the group was

charged with finding examples of a theoretical construct (knowledge mapping) thereby elaborating and

examining it (cf. Lyons, 2000). In order to ensure this goal, the group was first introduced to some of

the basic concepts of knowledge management, intellectual capital management and knowledge mapping, their functions and possibilities. They were then posed with a discussion question: - What kind of knowledge mapping would be important in your organization, and how should it be carried out? The group was then subdivided into groups of five perople, with a spread of subjects and types of work tasks. These groups discussed the questions for one hour, and were then invited to a common focus group meeting around the questions, which was facilitated by one the authors. The focus group meeting was carried out in an open and discussion oriented manner, where most of the participants of the group contributed their personal experiences, opinions and views, as well as those of the subgroups. The focus group discussion was recorded and transcribed into a textual account encompassing the key experiences and views of the group. This document was then distributed to the group for comments and feedback.

Validity of the study

The focus group sample represents a fairly broad selection of disciplines and types of institutes/departments. The age distribution is fairly even, and the types of positions involved spread over a number of academic levels/tasks. The spread of disciplinary orientation and task orientation ensures that a diversity of variations have had the chance to occur, yet the common academic background facilitates a sharing of common experience (this is the *maximum variation criteria* elaborated by Lyons, 2000). One point of concern may be that the sample does not include any cross-national comparisons, but rather relates to one national context, i.e. Denmark. This may be compensated for by the fact that several of the included institutes are *de facto* international contexts in their own right, due to internationalist character of many of the disciplines. Still, one should probably be aware that the focus group might be more representative of a 'European university tradition' with a

stronger bias towards state funding and public service than many of its US counterparts. However, since the categories developed in the discussion did not pertain to any specific policy or cultural context, this may not present serious methodological concerns.

Finally, since the participants volunteered to take part in the study they most likely represented a group of individuals who nurture an interest in academic management. However, the purpose of this study was foremostly not to describe a representative cross-section of attitudes to academic management, but rather to bring out new and useful suggestions and experiences in the area of academic knowledge mapping. In this regard, the group represented a *theoretical sample* of individuals, i.e. of persons who had something to say about the topic at hand. This has been shown to be a positive point of departure for focus group discussions (Milward, 2000).

Results of the study

The following account is drawn from the focus group discussion protocol. It is organized under the headings of (1) basic dimensions of academic knowledge mapping, (2) competence maps for academic inventory and communication, (3) external academic communication, (4) external academic communication, academic strategy, (5) concept and causal maps, and (6) general reflections.

Basic dimensions of academic knowledge mapping

Knowledge mapping activities in academe may serve different constituencies. They may be directed to serve the needs of people internal to the academic organization, or be oriented towards stakeholders outside. Furthermore, the maps may have an internal focus, trying to map resources of various kinds inside of the organizations, and they may have an external focus mapping resources outside of the

boundaries of the organization. Knowledge maps may also be an important part of creating research strategy, implementing strategy and developing routines.

Competence maps for academic inventory and communication

When knowledge mapping is directed at the organization itself, a central purpose is that of making clear what people can do, where they are and what they represent in the organization, for instance in terms of research and teaching competencies as well as interests. These inventories are central for supporting activities such as application preparations, ongoing projects in terms of problems solving and human resources, choosing dissemination options for projects, and selecting personnel for inclusion in applications. Examples of this type of mapping include competence mapping of various kinds, e.g. keeping a database or online catalogue with certain preset entry spaces, adding and updating information on the individual as well as on departmental homepages. The purpose of this is to make people visible to others at the department, but also to 'know one's own profile', that is, to keep a personal yet publicly visible record of one's own activities and achievements.

From an internal perspective it is also important to have an expert map of the organization to use when, for instance, a request from a stakeholder (e.g. a member of government or a funding body) is placed with regard to some specific piece of knowledge, a statement, comment etc. It may be so that a specific question is prone to return, and the department/institute must therefore have some kind of documentation of questions previously posed as well as answers given. The expert maps may also be related to internal demands for 'how to' knowledge in areas such as publishing as well as 'network knowledge' about publishers and editors. Annual reports and lists of publications may fill a proactive, self managerial role, rather than simply be a form of historical documentation, by inspiring people to achieve more and to push themselves to 'beat their own record' from year to year. Here it is important

to note that it is not only essential to make results visible, but also to determine what the person is working on at the moment. Furthermore, competence and knowledge maps are important in transition phases, for instance in a merger between units, or when a new department leader takes over.

External academic communication

Knowledge mapping aimed at the external world is most relevant when it comes to visualizing and presenting oneself as a unit or as an individual researcher. This can be likened to a form of marketing where the purpose is to attract positive attention, and in the extension some kind of pay-off,: new academic contacts, invitations or funder recognition. The departmental homepage is an obvious candidate for this type of communication. It can be used for external stakeholder 'promotion' purposes, as well as for orientation for interested actors in the field. It is important to use these websites to show what the organization has achieved, and what is going on at the moment. Future plans may also be a part of this presentation. The benefits of using maps in this way lie in the openness such 'billboards' provide vis-à-vis external stakeholder as well as the internal staff and a sense of common commitment. Knowledge maps *qua* external communication tools also become relevant in international projects, where on-line resources of project schedules, deliverables, guidelines and work plans are important forms of knowledge sharing.

Academic strategy

Knowledge mapping should also be central to the formulation of research strategies. It is important when developing a strategy of this kind, to know about the location and activities of personnel in terms of competencies, interests and future intentions, and to know about the relative position of the unit to the anticipated future. It is also important to know of ongoing projects, and what resources these

employ. The question here is about 'who does what and where'. It is important to know for instance about groups already acting on certain tasks, their compilation and duration. This picture should be made visible to the organization as part of the development of strategy, and new dimension may be entered in such as network activities, previous experiences etc., that are also of importance when considering strategy.

However, it is also important that a research leader lays out, at least schematically, the first directions towards the future. One way of going about this is to sketch out a preliminary view of where the organization ought to move, and then have its members come up and contribute 'their' piece, that is to place themselves within this framework according to their interests and competencies. Sensitivity must be exe rcised with regard to how different types of personnel are integrated into the strategic, or hypothetical knowledge map. Mapping may also be carried out in relation to an already existing strategy. Here it becomes especially important to focus on the gaps between what we have today, and where we want to go. One critical aspect of such mapping is the important role played by temporary personnel in some departments. Can they be counted as part of the vision (what the organization wants to achieve) or as part of what it has today? Are they part of the present resource base or a possible future resource base?

Another possibility here is to move from seeing strategy as a problem of managerially 'closing the gap' between is and ought, and instead try to resolve the issue of how to bring maps depicting strategic challenges out into the organization. Ways of doing this may include report writing and summaries, Friday meetings, seminars, annual reports, grant writing and discussion, site visits to other places, etc., where the role of the knowledge maps is to capture and inform about these activities.

Concept and causal maps

Concept maps are important in order to map disciplinary boundaries and to share information and discuss departmental/subject orientation. These maps can be connected to reading lists for students and new members of staff, for purposes of education, and to facilitate a necessary background understanding of the subject in order for future knowledge sharing to be carried out. Competence maps may be transformed into concept maps, depicting the actual manifestation of the subject at a particular department, thus serving as a guideline to developing strategy. Casual maps may be developed, for instance together with administrators, which explicates how to work out applications, administrative processes, etc.

General reflections in the group

A more varied concept of competence, and thus also of achievement, is needed at academic departments. The abilities to publish well, to be 'a publisher' or to teach well, to be 'a teacher', do not capture the breadth of competencies at academic units. Also, in the future, academic environments will increasingly need more roles than these to perform well. Such roles could embody competencies like application writing, intra-organizational communication, trans-boundary networking, research management and funding, etc.

It is of outmost importance to map previous experiences among staff; that is competencies and knowledge acquired and employed before these persons were hired into their present organization. These accounts should be very specific; not just relate to educational background, but also, if possible, consist of a rich account of previous experiences and engagements.

It is necessary both to show <u>what</u> the unit does and <u>how well</u> it is doing it. What is the quality of what is done? In larger research organizations, this dimension is often difficult to capture if the

manager has no direct relation to individual people. The level of quality may be gleaned from looking at things like money, contracts, publications, and type of contacts with the outside world.

An important shortcoming of competence mapping lies in the inevitable reduction of information that is always done when a group of people are reduced to, say, a competence cluster, or even in the creation of an individual competence profile. Such a map may for instance give the impression that the group knows 'everything' in a particular area, but nothing outside of it. This can be a drawback in the use of competence maps, or knowledge maps more generally, by external stakeholders, who in effect assume that 'their' problem falls within the competence of the group, simply because it falls within area of the map.

Discussion and conclusions

Knowledge mapping in academe, while clearly in its infantry, has the potential to address a number of challenges that academic institutions are currently facing, e.g. new demands for commercialisation, efficient utilization and coordination of human resources, increased accountability and new team-based modes of knowledge production. More specifically, the present study shows that knowledge mapping has the potential to be of considerable value in academic environments, by providing useful representations of substantial scientific/disciplinary knowledge, as well as of 'support knowledge' (e.g. for application writing, budgeting, research methodology, project management, and staffing). Furthermore, the study suggests that such maps offer a range of advantages for the organisation in terms facilitating cooperation and contacts, as well as providing organizational legitimacy both internally and externally. The focus group study exemplified how, in general terms, systematic knowledge mapping in academic institutions may fill some of the following functions:

- Identify and enable disciplinary identity and work

- Provide access to 'support knowledge'

- Increase cooperation

- Enable strategic planning

- Enable empowerment

- Support and justify resource allocation

Specifically, the focus group identified the following areas for knowledge mapping, together with a number of subsumed applications or functions.

Insert table 1 here

The full variety of knowledge mapping techniques reviewed by Wexler (2001) and others has relevance for the type of areas and functions identified by the focus group, e.g. key concept maps, strategy maps, including goals of the organization or the group, causal maps, how-to' maps or project process descriptions, and stakeholder maps. However it is also clear that, as previously stated, the structure and application of such maps must take into account the particular way in which academic units work and create value. This comes out in the ways that academic employees think about knowledge, how they prefer to retrieve it, and the benefits assigned to the sharing of knowledge of various kinds. Furthermore, following Duffy (2000) we may also reflect that some of the types of knowledge referred to by the group may be tacitly understood among academics, yet would have to be explicated in

interaction with administrators who lack significant research experience (for instance – what is a good research project partner?). The opposite may hold true for issues pertaining to, for instance, administration of project finances, financial reporting etc: here tacit knowledge among administrators would probably have to be concretised through examples and how-to instructions in order to be readily utilized by researchers.

Many of the functions of knowledge mapping brought forward by the participants of the study would appear to capture what can be called 'critical knowledge' for academic environments. This being so, many of the knowledge mapping functions presented by Heng's (2001) still seems to hold. Apart from Heng's suggestions, e.g. performance objectives, vision and mission, 'contract reviews' and project portfolios, project capability, 'document and data control', networks of 'customers' or partners, we are also able to suggest, broadly, strategic functions such as future development plans and staffing requirements, and concept maps for disciplinary boundary-work, socialization and learning.

As pointed out by Despres and Chauvel (1999), it can also be noted that the selection and concrete application of knowledge mapping should take into consideration the need for balancing focus and detail with breadth. The categorisation drawn from the participants' account could function as a way of narrowing down the focus of a single mapping application, while acknowledging the need for several interlinked mapping activities in academic environments. The categorisation may also function as a way of assigning responsibility for mapping activities, so that for instance a professor/chair may take up the challenge of creating a cognitive map of the unit, while a head of department may engage co-workers in creating a strategy map. A broad external focus such as that described under the heading of 'external academic communication' presumably concerns all co-workers, and activities subsumed here could function as a way of creating common identity as well as to stabilize and extend personal networks. This also relates to the notion of *empowerment* of the academic worker. The increase of

projectification and teamwork in academic research suggests the importance of individual decisions reflecting the interests and needs of the organisation as a whole. Knowledge mapping may serve as a coordinating mechanism for individual academics, thereby creating empowerment while still serving operational, collective ends. Such informal mechanism for coordination have increasingly been argued to play a role in academic settings, where the management of researchers to high degree is a matter of managing self-managed individuals towards a common goal (Ernø-Kjølhede et al., 2001).

Finally, we would like to refer back to a few important suggestions voiced by the group. Knowledge mapping may come to require an expansion of the notion of relevant competencies from that which has traditionally been the case in academe. For instance, as mapping is carried out, new areas of relevance apart from that of teaching and research will have to be acknowledged as carriers of intellectual capital. Most likely, careful and open-minded mapping will result in an increased emphasis on Boyer's (1990) *application* and *integration* aspects of academic activity. Related to this, the call for knowledge and competence maps, which integrate a richer professional history of employees, emphasizes continuity and experience as key, critical aspects of academic knowledge. These are no doubt important qualities of an academic worker, however, following Ziman (2000), we also have to acknowledge the primacy of creativity and conceptual renewal that ought to signify the research world. Mapping should thus strive to maintain dynamism while capturing structure. Lastly, it is important to heed the call made by the participants in this study, not to 'map blindly', in purely quantitative or descriptively simplistic terms, as well as to integrate a notion of quality into knowledge maps.

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Table 1: Knowledge mapping in academic environments

Categories	Functions and applications
Competence maps for academic inventory and communication	- External and internal connections - Project staffing and results dissemination - Application preparation - Stakeholder response, expert and query inventory - Network knowledge - Self-management: 'where was I and where am I' - Establishing continuity during leadership change - Stimulating and facilitating knowledge sharing
External academic communication	- Visualizing and presenting oneself as a unit or as an individual researcher - Stakeholder 'marketing' or promotion - Billboards create common commitment vis-à-vis external context - Coordination centers for geographically distributed projects
Academic strategy	- Locate personnel's activities, interests and intentions - Describe active projects and resource employment - Drawing a path into the future using knowledge about resources - Conducting critical analysis of existing strategy's relation to current knowledge - Staffing plans - Document and inform organization about transformational activities
Concept and causal maps	- Map disciplinary boundaries - Sharing research information and debate subject orientation - Student orientation - Socialization of new academic staff - Evaluation of competence profile in terms of subject orientation - Communication with administrators

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