One Managerial Approach to Knowledge Representation: Developing a Knowledge Map

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Abstract—**Knowledge representation potential is understudied in such area as enhancing knowledge management processes. This work offers an overview of the existing approaches for mapping business knowledge. Furthermore it discusses the problems of knowledge maps created by managers and indicates their advantages and disadvantages. It was revealed that managers have shortage of competencies in information structuring and underestimate the role of ontology. That is a significant obstacle in the implementation of knowledge models. The paper supposes a systematic approach to the construction of knowledge map to overcome that issue a in a knowledge-intensive organization. It is taking into account specifics of Russian companies on one hand and low knowledge engineering expertise of managers on the other hand.**

I. INTRODUCTION

There is a limited amount of Knowledge Representation literature related to business. It deeply explores several distinct areas of management such as business process automation, digitalization, and decision support systems development. That stream of research is tied to the information theory and IT architecture of the company. However, KR potential is under-studied in such area as enhancing knowledge management processes. That stream of research invades cognitive psychology and human resource management. The present paper aims to bridge these fields of studies via literature synthesis and case study analysis. The focus of present work is knowledge map development as it is a starting point of knowledge management system implementation. One of the obstacles of business-knowledge map development is large variety of definitions and approaches to that subject. That is why it is necessary to establish common language not only inside the managerial body of literature but also across the domains. The family of ISO standards can be one of the possible common grounds for both management field and knowledge engineering field as the standards are aimed at broad number of business issues and are applicable to any kind of firm. According to the ISO 9001:2015 standard [1], knowledge is one of the main resources of the organization. Knowledge mapping allows to approach knowledge management systematically. Regular mapping, categorizing, and bench-marking of organizational knowledge can not only make it available for all employees, but also get greater value from the efforts to prioritize and focus in organizational learning.

At the moment, researchers focus on developing variety of software tools implementing the mapping procedure even for graphs with thousands of vertices [2], and displaying the business processes using a common notation [3]. However, it is often overlooked that a crucial role in the processing of available data into knowledge is played by the skills of the manager to summarize, interpret, and organize information. Lack of such skill effects negatively the quality of management decisions. Present paper suggests an approach which partially covers that gap.

II. EXISTING APPROACHES TO KNOWLEDGE MAPPING

Variety of knowledge-map related terms and approaches was studied in the previous work (Gavrilova, Alsufyef, Grinberg 2017). This section briefly presents evolution of the term and discusses the purposes of a knowledge map.

A. The evolution of the "knowledge map" term

Some top level terms in knowledge management have been already established and fixed in an above-mentioned standard. Knowledge of the company is defined in ISO standard as the combination of staff expertise, which is recorded and not recorded at the corporate tangible and intangible media.[1] Knowledge management is defined as a unified approach or a group of methods of knowledge creation, storage, protection and dissemination. However, the definition of term "knowledge map" is either vague and includes any type of knowledge representation (from Gantt charts to metaphors) or it is very narrow and supposes answer to one specific question only ("Where can I find a certain knowledge?")[4].

The term "knowledge map" appears in business literature in the end of XX century but authors do not clearly define it. Knowledge map denotes different types of charts, graphs, matrices and other graphic objects. In some studies it is defined as an analogue of the plan of the area that allows manager to figure out where and what knowledge can be found, while other authors denote by this term the totality of diagrams that present knowledge.

Among the trends of this area it is highlighted the desire of researchers to expand the study of applications of knowledge mapping in various business practices. In the processing of information (for example, in the context of Big Data) the use of mapping technique as clear and succinct presentation of data allows one to go to deeper levels of interpretation. Till now the scientific literature has not formed a uniform classification of knowledge representation techniques. As a result, practitioners work with the knowledge representation, not knowing which method to use in order to solve certain business problems.

In 2010s managerial literature converges to a common understanding of the "knowledge map" term. It has happened ten years after classical definitions were given by seminal authors. Today's common understanding is that the creation of knowledge map involves locating important knowledge of organization and representation that shows where to find that knowledge. Knowledge map points to the people, the documents, and databases. Knowledge Map is a navigation assistant for tacit and explicit knowledge that illustrates the knowledge flows in the organization [5]. Knowledge map describes the sources, flows, and limits of knowledge organization. Knowledge maps help to understand the relationship between knowledge stores and dynamics [6].

B. Purpose of a knowledge map

The company can group its learning experience in critical mass around certain strategic areas of knowledge [7]. Knowledge map can address a wide range of questions. Some most common a re listed below.

1) Identifying the knowledge necessary for the functioning of the business processes: The main goal of any knowledge map is identification of knowledge assets and their location. Availability of knowledge assets becomes one of the main issues for practitioners and regulatory organizations [8]

2) Spotting areas of potential competencies' development: It becomes possible to compare existing competencies of employees with those which are necessary to implement the strategy. That analysis yields a clear understanding of staff learning and development strategy.

3) Identifying areas of organizational knowledge that need additional development: Knowledge gaps remain invisible until knowledge map is developed. Creation a list of missing knowledge is a first step in bridging those gaps. After that an action plan should be developed. It includes several options besides employee development mentioned above. The gaps can be closed via knowledge acquisition from external sources: hunting necessary experts, inviting consulting company, employing external trainers, buying patents, databases and software, etc.

4) Regular evaluation of the current level of knowledge: Knowledge audit should be conducted at least once a year; it should be done more frequently in the knowledge intensive firms. Knowledge update and development should be paired with organizational forgetting[9]. Out-of-date knowledge causes significant problems in a knowledge intensive firm which works in a turbulent, frequently changing environment.

5) Knowledge commercialization: Knowledge map shows areas of strong expertise of the company. Knowledge intensive company sells products and knowledge. That is why it is important to inventory all knowledge and reveal those results of intellectual activity which can be commercialized in form of patents or services for external clients.

III. PROBLEM AREAS OF KNOWLEDGE MAPS DEVELOPED BY MANAGERS

Most scientific articles suggest that knowledge map is developed by an experienced professional. However, it is often not the case. We consider the situation when a knowledge map is developed by a company managers who usually lack knowledge audit experience and had taken none knowledge engineering courses. This section discusses of most common misconceptions related to the subject.

A. "We do not need an ontology"

Many managers misinterpret the term "ontology". Moreover, they highly underestimate the importance of business glossary as a basis for knowledge management processes. For instance, knowledge map which is a result of knowledge audit [4] can be developed in a company without any ontology. Despite the fact that half of the methods of a knowledge map building underline the importance of preliminary ontology development [10], managers tend to get around those acute angles. The reason for that is an absence of the relevant expertise. Knowledge engineering course is usually not included in the MBA or equivalent programs. Ontology or conceptualization of the specification [11] is a hierarchical domain model with solid mathematical and programming study. Without the ontology it is rather difficult to build any representation, especially if the number of elements on the lower level is broad as it is usually a case in big organizations.

B. "I know everything"

This mistake is a straightforward result of the previous one. Since manager can collect but cannot aggregate knowledge from employees and develop an ontology, he or she develops knowledge representation based on personal perception. Such map answers another question: "What does manager know about employees' knowledge". There are several positive aspects of such approach. Firstly, it allows a quick building of a knowledge representation without time-consuming knowledge elicitation from employees. Secondly, it stimulates knowledge structuring process at least of one manager. Still, it is not the representation of organizational knowledge, it reflects an individual point of view only.

C. "Any hierarchy can fit"

Another way out from the absence-of-ontology trap is taking one of the existing hierarchies; for instance, it can be competence list, business processes list or production cycle as a basis for the knowledge representation. This approach creates a solid basis for a well-structured knowledge representation. If a manager lacks synthesizing skills that can be a recommended
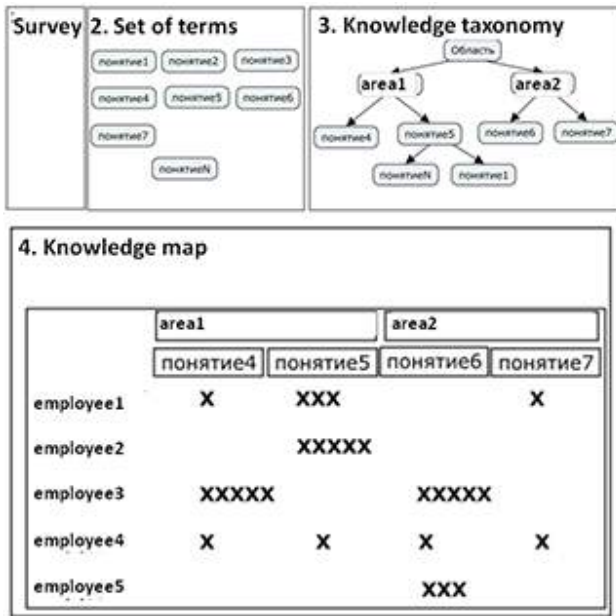
Figure 1. Proposed steps of knowledge map development

way of action. However, the result of such KR-development is questionable since every ontology has a very specific focus question and should be built around it. Thus, if one takes taxonomy developed for other purposes he or she most likely will get an irrelevant result. For instance, a manager develops a map of competencies instead of a knowledge map. It is related to knowledge but it is not the knowledge itself. Such map is misleading.

IV. THE PROPOSED APPROACH TO THE SPECIFIED PROBLEM

Present section suggests a sequence of steps towards proper knowledge representation developed. They are as follows: conducting a survey, which becomes a source of key concepts; developing taxonomy of those concepts; developing a visual representation of the taxonomy in a form of a knowledge map (see Figure 2 for details).

A. Conducting a survey

The main part of the mapping knowledge is conducting a survey among employees. The survey can be developed on the basis of the approved scientific papers [4][6][10] taking into account the specifics of the company. It considers existing business glossary of the firm and uses a database of a company employees. The list of questions should be fixed in the form of a questionnaire template. The result of mapping is creating a knowledge map in accordance with the preliminary established way of visualization. Knowledge map answers the question "Who owns what knowledge and where it is?". Thus, the survey ensures availability of knowledge to the extent necessary. The analysis of the survey results among professionals of one department allows us to develop a taxonomy of knowledge a department. The basis of taxonomy are the

answers to the questions of the survey. The purpose of these questions is to identify key knowledge areas that employees are willing to share and/or consider significant. Specified areas of expertise form the basis for building a hierarchical structure of knowledge functions, which not only lists the knowledge possessed by a Company, but also describes the relationship between these elements. This provides a basis to identify gaps in knowledge.

B. Developing a taxonomy

The taxonomy helps the user of knowledge by making it easier to find and use someone else's experience. Common taxonomies distinguish between explicit and implicit, General and specific, depending on context, personal and situational knowledge. Knowledge can also be characterized by type: descriptive ("know") and procedural ("know how"), causal ("know why"), knowledge about the terms ("know when") and attitudinal ("you know who" or "know who"). These categories allow managing knowledge at the process level. After type of desired knowledge representation is agreed upon, a manager can follow several steps to build a taxonomy as described in [12]. First, it is necessary to allocate of the basic concepts of the subject area. The set of basic concepts is based on employees ' responses to the above-described survey. Then it is identified the number of levels of the taxonomy and the preliminary distribution of concepts by levels. Further it is necessary to build relationships between concepts. Finally, the manager consults with various specialists to avoid contradictions and inaccuracies. It is done via the procedures of removal of synonymy and selection of commonly accepted meta-concepts. The last stage is iterative, after it one may need to return to the previous stages and reconsider relationships between concepts, or even redistribute them across levels.

C. Developing a knowledge map representation

Knowledge map representation is carried out based on the taxonomy of knowledge. Knowledge map can be realized as a table in MS Excell with some visual elements [13]. It is supposed to be available to each employee. Graphical elements denote two dimensions: the level of proficiency in a particular area and willingness to share. The level of proficiency in a particular area is determined subjectively. Further validation of this level can be done by a supervisor and/or on the basis of annual evaluation of personnel. It shall be entered in the appropriate cell at the intersection of the row "employee name" and column "knowledge". Name of knowledge domain is identical with that presented in the developed taxonomy. The levels of proficiency are displayed in the table as follows: 1 - beginner, 2 - basic, 3-qualified, 4 - professional, 5 - expert. For clarity, the level of proficiency can be displayed in the form of horizontal histograms using conditional formatting in MS Excell. Willingness to share defines the degree of readiness of an employee to share a particular knowledge. It is entered in the appropriate cell at the intersection of the row "employee name" and "Knowledge" column (same as above). It is denoted by colors as follows: a) green means "ready to

share knowledge", b) yellow stands for "may not always share knowledge", and c) red denotes absence of desire to share knowledge.

V. Conclusion

Knowledge map can be applied at two levels: operational and strategic. In the first case, the activities of knowledge management are aimed at understanding and disseminating their existing knowledge. The premise is that the Company has a broad knowledge and necessary to identify them. Thus, the core operating activities is the establishment of a mechanism for detection/mapping and dissemination of knowledge through the intranet. Following presentations of knowledge map can be developed at the operational level:1) Map knowledge necessary for business processes, 2) Map knowledge of the regions, 3) Map geographical location of the knowledge holders, 4) Visual search of knowledge and others. That can be done by mapping the developed knowledge map with other ontology or image. The choice will depend on the certain need of stakeholders. The strategic application of knowledge map is not only the cataloguing of existing knowledge, but also in comparison them with the knowledge necessary for the formulation and implementation of the strategy of the organization. In addition, the card can be used to compare the knowledge of the Company with knowledge of competitors (Zack 2009). The main issue identified in the present research is lack of specialized engineering knowledge in a managerial skill-set. The proposed solution to this problem is to involve an expert on knowledge engineering to build the taxonomy. Thus, knowledge representation in a form of a knowledge map is a convergence point for the strategic knowledge management and knowledge engineering.

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ОДИН УПРАВЛЕНЧЕСКИЙ ПОДХОД К ПРЕДСТАВЛЕНИЮ ЗНАНИЙ: РАЗРАБОТКА КАРТЫ ЗНАНИЙ

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Потенциал представления знаний недостаточно изучен в такой области, как совершенствование процессов управления знаниями. Эта работа предлагает обзор существующих подходов к отображению бизнес-знаний. Кроме того, обсуждаются проблемы карт знаний, созданных менеджерами, и указываются их преимущества и недостатки. Выявлено, что менеджеры испытывают дефицит компетенций в структурировании информации и недооценивают роль онтологии. Это является серьезным препятствием на пути внедрения моделей знаний. В статье предполагается системный подход к построению карты знаний для преодоления этой проблемы в наукоемкой организации. Она учитывает специфику российских компаний, с одной стороны, и низкий уровень компетенций менеджеров в области инженерии знаний, с другой стороны.