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Knowledge: Overview of New Findings

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Abstract

The paper addresses knowledge; firstly, it provides a basic theoretical background of knowledge, and secondly, it overviews current research on knowledge management. The new findings deal with trust necessary for especially tacit knowledge management, serious games are revived as a tool for knowledge creation, and some noteworthy findings are included as well. This paper could serve managers in civil engineering industry as a matter for consideration.

Keywords

competency; knowledge; knowledge management; SECI model; serious games

Introduction

The problem of knowledge, knowledge management, their relation to other issues such as competencies or information management etc. is not new, however, the research in this field continues and constantly brings new findings, new information, and even new knowledge. This paper aims to focus on the main directions of current research and offer an instant information on the issues. Therefore, the goal of the paper is to provide reader with brief theoretical background, because this specific area of management requires to do so in order to unite terminology at least, and to provide reader with information on current findings. Thus this paper is organized as follows: the first section reads about the theoretical background, the second part overviews new research, and finally conclusions are discussed.

Methodology

This paper is based on review of literature and research papers published in renowned journals, so that it constitutes a brief manual for especially civil engineering managers (or academics as well), who are provided with both basic theory and current research. Scientific papers were acquired through Web of Sciences, SCOPUS and EBSCO databases on the basis of searching the keyword *knowledge* in their heading, subheading or keywords, then analyzed, and relevant articles were grouped together to form logical links.

Results

In this chapter, the results of the review are presented.

Basic theoretical background of knowledge

Knowledge management deals with data, information, but above all, knowledge. Yet these three terms are being confused, though the meaning is different. If talking about knowledge management, the three words should be defined first. An intuitive description is offered by Mládková [11, pp. 24-26]:

* data are objective and exist independently on human perception, can be evaluated in terms of money (how much does it cost to obtain the data), speed (time necessary to obtain the data), or capacity (how much data do we have for our disposal at given moment in time). Data about sales of a product remain only data, if we do not have the additional information about what influenced the sales. Data are the subject for information management, therefore the two terms (i.e. knowledge management and information management) are sometimes confused, see further;
* information are data with certain meaning for their user, thus are subjective. Data about sales become information when the user considers the data as important and knows how to use it. For someone else the data have no value, thus remain a data;
* knowledge is information plus human interpretation (sometimes equated as knowledge = information + x, where x = interaction of information with human brain), or information with context. The human interpretation entails knowledge and experience we already have, values and principles we worth, our mental models, emotions we feel, etc. Knowledge is immensely subjective, can be also a synonym for an activity, and is virtually impossible to store or capture by information technologies. This is the reason why knowledge management may overlap with other disciplines performed by companies, e.g. human resources management, leadership, talent management etc. Furthermore, knowledge can be divided into explicit and tacit knowledge: explicit knowledge can be formalized, written or drawn, can be stored, can be based on data or information, while tacit knowledge is explicit knowledge and any knowledge filtered through experience, skills, intuition, mental models etc. Tacit knowledge is anchored in routines, actions, systems, emotions, values. Tacit knowledge is, in a nutshell, the x from the above mentioned equation. So, tacit knowledge is unique for an individual and it is extremely hard to express and share it [11, p. 29].

Knowledge and competencies

Since competency is usually defined as a set of knowledge, attitudes and skills of a person, or as a set of knowledge, attitudes and skills demanded for a position in a company, knowledge may also be confused with competency. Competencies can be divided e.g. to technical and behavioral, while technical competencies are more professional competence usually acquired during university education and behavioral competencies are rather dealing with other qualities such as ability to establish and maintain relationships, negotiating skills, ability to solve problem situations or to take responsibility etc. [e.g. 3]. So, especially behavioral competencies can overlap or are sometimes used as a close synonym for tacit knowledge, though its original meaning distinguishes between knowledge as such and competency as such.

The SECI model

The model of knowledge creation, called the SECI model, in simplified version see figure 1, was developed and introduced by Nonaka and Takeuchi and enriched with *Ba* and knowledge assets by Nonaka, Toyama and Konno [13, pp. 5-16]. They see organizations not as information processing machines that solves problems by current stock of knowledge, but rather as a living organism that creates knowledge through action and interaction, by creating new problems and answering them.

Organizations creates knowledge based on interactions of explicit and tacit knowledge. Socialization means sharing tacit knowledge with someone else, is the oldest and most natural way of learning, is time and space specific and tacit knowledge can be acquired only by spending time together and experiencing. Frequently socialization uses different methods than verbalizing the information, such as non-verbal language (body language) or examples or actions. Externalization means converting tacit knowledge into explicit so that the information can spread or be stored, but a successful conversion of tacit knowledge into explicit knowledge is hard and dependent on the abilities of people. Combination means processing of explicit knowledge and creating new explicit knowledge, typically by collecting information and putting them into new context or by breaking down a complex information into operationalized parts, ready to use and easier to understand. Internalization means creating tacit knowledge from explicit, learning by doing. Internalization concerns individuals who take action and practice and so embody new knowledge. Internalized tacit knowledge can then be shared with others through socialization and so start the process of creating knowledge over and over again, in a spiral that grows and resembles a snowball [13, pp. 8-10].

However, we should stop and think for a while. Do managers who promote knowledge management underestimate tacit knowledge sharing by socialization, if they consider coffee breaks a sign of employees´ laziness? Or are they right arguing with costs of employees´ time? Further in the text, the issue of trust is mentioned as well. How does trust develop? Can interaction with colleagues contribute to cultivation of trust?

Information needs a context to become knowledge. Knowledge needs a shared context, because knowledge is created rather through mutual interactions of people or people with environment than by individuals alone. Nonaka, Toyama and Konno [13, p. 14] offer a new concept of context, Ba: *“a shared context in which knowledge is shared, created and utilized. In knowledge creation, generation and regeneration of* ba *is the key, as* ba *provides the energy, quality and place to perform the individual conversions and to move along the knowledge spiral. (…) Ba is a place where information is interpreted to become knowledge.”* They add that close physical interaction, i.e. sharing time and space, is important for sharing context and common language but still is open for participants to come and go and so influence the environment. For illustration, the authors offer an example of Seven-Eleven Japan, where local employees are encouraged to talk to customers to build relationships and after some two years of experience they are given the responsibility to order items for a given store, because they can predict what their customers would buy and why. Besides, managers of Seven-Eleven meet every week. *Ba* is developed.

Knowledge assets are *“the inputs, outputs and moderating factors of the knowledge-creating process. For example, trust amongst organisational members is created as an output of the knowledge-creating process, and at the same time it moderates how* ba *functions as a platform for the knowledge-creating process.”* [13, p. 20]. Knowledge assets can be skills and know-how acquired during experience at work and this gives the company its competitive advantage, or it can be symbols, brand equity or design, or manuals and documentation, or actions and practices, organizational culture and routines. All these assets build the foundations for knowledge-creating process. *“Using its existing knowledge assets, an organization creates new knowledge through the SECI process that takes place in* ba*.”* [13, p. 22]. Sometimes it is useful not to focus on knowledge the company has, but on the knowledge it lacks. Successful experience should not be the only model of future problem-solving situations, otherwise the organization becomes rigid. Though learning is advisable, creating new knowledge is better.

Figure 1: The SECI model, simplified (source: Nonaka, Toyama, Konno, 2000, 9)

Knowledge management and information management

Knowledge management is sometimes used as synonym for information management; however, these two disciplines either overlap or differ, but never are the same. Information management is based on information technologies and focuses on proper usage of information technologies. Dogan et al. thus defines information management as follows: *“Organize, manage and use information to promote efficiency and improved performance”* [7, p. 396]. Furthermore, Dogan et al. highlight four fundamental findings that clearly distinguish knowledge and information management: 1. relying on information management does no good, or can perhaps also lead to bad ends; 2. it is necessary to bear in mind that knowledge management deals with knowledge, i.e. what do people know, thus deals with people, with their knowledge, while information management addresses above all technology; 3. information management should be employed as a necessary prerequisite for knowledge management; 4. knowledge management should create management of knowledge as an ongoing process of learning centered on human aspect.

Knowledge management entails information technologies and nowadays becomes reliant on them, but no information technology possesses tacit knowledge, therefore knowledge management should primarily focus on human resources management, organizational culture, finance, and the human side of knowledge [8, p. 68].

The field where these two concepts overlap is in transformation of data, or transformation of data into information and then into knowledge [9, p. 58]. The above mentioned model of conversion, the SECI model, addressed this in two of its four dimensions: in Externalization as the creation of explicit knowledge based on tacit knowledge, and in Internalization as the creation of tacit knowledge based on explicit knowledge. Combination, as the creation of new explicit knowledge based on existing explicit knowledge, can be added, too.

Application

Knowledge management influences organizational effectiveness especially through different knowledge management activities. If knowledge management is defined as a process that helps organizations discover, select and transfer information important for decision making, problem solving or strategic planning; and if organizational effectiveness is defined as how culture, leadership or processes affect the ability of an organization to meet its goals, then it is possible to claim that every organization should identify its own employment related factors that influence knowledge management processes that would lead to higher organizational effectiveness. Chidambaranathan and Swarooprani [6, p. 758] thought of this connection when researching employees of libraries in Qatar with the aim to identify the factors that affect knowledge management processes, because they considered turnover of employees together with large expatriate population as perhaps problematic for managing tacit knowledge. The core technical knowledge of a leaving employee is usually lost and knowledge management processes are currently failing to incorporate tacit knowledge as well, and this suddenly brings the problem of human resources management, because transferring individualized tacit knowledge ultimately depends solely on the willingness of the person and his or her ability to do so. He or she is motivated to share his/her knowledge only if he/she has a good reason, and how the authors state, this should not be a barrier in an economy that moves to knowledge economy. So they investigated demographic and job related factors they considered important for knowledge management activities (gender, age, education, nationality, position in hierarchy, job tenure, total years of experience, etc.), but they found no statistically significant factors. The only significant difference is in the type of institution, whether it is private or government institution. Chidambaranathan and Swarooprani [6, p. 762] see a main problem in problem solving techniques that are not captured and stored and available for all the workers in the organization – i.e. tacit knowledge is not managed well. This can be the fault of strictly hierarchical structure of government organizations with its specific culture and generally one-way flow of information (structured information from top to bottom, rarely free flow from bottom to up and vice versa). This conclusion is supported by a research of Un Jan and Contreras [19, p. 258] who developed a model for successful knowledge management system. This model, which is illustrated in a modified version in Figure 2, shows, in a nutshell, that knowledge management system must satisfy its users, so that only satisfied user continues to work with such a system, not only passively but also actively. User satisfaction is influenced by perceived usefulness of the system, by perceived output quality, and by perceived searchability (i.e. how easy or difficult it is to find an information, or in other words, whether the system can help individuals with retrieving the knowledge residing in the system). However, user satisfaction is influenced by the above mentioned factors only to some extent; to a greater extent by other two factors, which is organizational trust and extrinsic rewards. Extrinsic rewards mean generally monetary compensation, but some reward systems may prevent knowledge sharing among employees of an organization. Trust, or organizational trust, contributes to willingness of people within the organization to donate useful knowledge and to grip and use other people´s knowledge. This encompasses not only trust in the predictability and functionality of information technologies that causes willingness to use computers as support, but also trust in the sense of accepting certain degree of vulnerability based on positive expectations of behavior of others.

Figure 2: Success model for knowledge management systems (source: Un Jan & Contreras, 2016, 263)

However, the concept of organizational agility has risen in importance recently, too. Organizational agility means basically the ability of an organization to monitor the changing environment, respond to changes, quickly update knowledge, and still to achieve organizational strategic objectives [15, p. 2540]. Cegarra-Navarro, Soto-Acosta and Wensley [5, p. 1547] claim that effectiveness of a new knowledge an organization acquires may depend on the agility of an organization, which can take benefits from opportunities and avoid threats from the business environment.

Sources of knowledge

A study conducted by Castrogiovanni, Ribeiro-Soriano, Mas-Tur and Roig-Tierno [4, p. 1812] focused on sources of knowledge rather than sharing knowledge. Though the authors recognize the research that suggested knowledge creation is based on organization´s values and norms (e.g. Nonaka etc.), and that four knowledge sources were already identified: human resources, organizational management, technology adoption and business environment (authors cite Díaz, 2013), they needed to find out which source of knowledge is the most effective. They chose financial institutions as organizations with developed knowledge management system that recognize the importance of knowledge and are eager to consequently evaluate the financial contribution, or effectivity, respectively. Castrogiovanni et al. suggest organizations should devote and invest their resources to improvement of the following: firstly, reasoned knowledge, secondly, technology adoption, and thirdly, procedural knowledge. Reasoned knowledge is a *know-why*: people should possess three types of knowledge, which is know-what (description of situations), know-how (procedures and specification how to do something), and know-why (reason why to do something and drawing conclusions from situations). Technology adoption means not only reliable and up-to-date technology but apparently the use of social software and social networks and also by benchmarking or imitating the knowledge of competitors or business partners. Procedural knowledge was already mentioned (the *know-how*). Other factors either were not identified as effective or do not require concentrated attention or additional funds (criteria such as leadership style, strategic objectives communication, change in organizational culture, etc. Costs, or effectivity, of trust between organizational members was not assessed in terms of financial effectiveness, or investments, respectively).

Serious games

Though the idea of work-based simulation games or game-based learning is not new, it has been raised lately as a source for knowledge creation and also as a tool for knowledge sharing. Ahrens [1, p. 277] notes that interaction with a serious game generates procedural knowledge (i.e. *know-how*, see above). She advocates the resurrection of serious gaming as a great tool for gaining and shaping of especially tacit knowledge because the acquisition of systematic knowledge is of growing importance in a knowledge society. The knowledge that is acquired through such a game is considered to be of long-term duration for the occupational practice, of relevance of problem-oriented learning, and of applicability for the practice. Though serious games are not primarily developed as entertaining, they usually are. This is why people play games as voluntary, intrinsically motivating and engaging activity with the aim to succeed. In a game, where it is acceptable to make mistakes, people create knowledge from ambiguity, trial and error. Ahrens [1, p. 280] focused on harbor workers, described the specifics of the work and highlighted three factors that seemed to require training: usage of new technologies, high claims on safety, need of synchronization and teamwork; from this perspective her research is noteworthy for civil engineering as well. She suggested two specialized serious games, a Toolbox-meeting and High&Heavy. Toolbox-meeting is based on considering all parties involved especially considering safety issues, task sharing and responsibilities. The workers can take different point of view on process chain, communication in team, and a deeper understanding of the problem or the whole situation. High&Heavy facilitates the problem of planning transport of oversized cargo, which promotes understanding of complexity of problems, the need to make decisions under pressure (both time and group), prioritizing, etc. Ahrens concludes with notes on design of a game: it has to reflect the player´s current competences, it has to come out of the real working process to be easily transferrable and it should take advantage from its logically action-oriented nature.

Allal-Chérif and Makhlouf [2, p. 1539] described three case studies of utilization of serious games and how they contribute to improving knowledge management or knowledge creation, respectively, on the SECI model (see above). They chose financial sector (namely banks) because they perceive the knowledge it uses as standardized yet heterogeneous (here again these reasons can evoke building industry as well, or civil engineering). Banks use knowledge management to avoid risk, which can be very costly, for this purpose they especially focus on best practices and past experience. Social games in financial sector thus involve expert workers to share their knowledge, cultural knowledge, best behaviors experienced in the past, perhaps only once in a lifetime. These three case studies are called Starbank, SimuStar and Cash detectives. Starbank is a game developed by BNP Paribas, France, for new employees. The game is based on an employee´s avatar who must take the most effective winning strategy to satisfy all parties involved and this requires good economic knowledge and skills in financial techniques. Avatar can make mistakes and the reality does not experience financial loss, the player can play again. The design of the game also integrates new employees into the corporate culture. The game uses real cases from BNP history (externalization), avatar encourages them to use their knowledge (internalization), increasingly complex challenges pushes them into creation of new methods (combination), and competition and allowed collaboration with other players promote social networking (socialization). SimuStar was launched by Omega Performance, the USA, as a credit risk management game. Bankers must decide on loans, whether to provide it or not, and must take a critical attitude to client portfolio. Omega collected its 30 years´ experience (externalization) to help bankers apply the right knowledge, attain specific business competencies to reduce risk and to face the consequences of their decision (internalization), while interacting with other bankers and their managers (socialization), and leads to advancement by challenging extreme situations necessitating creativity (combination). Cash detectives is a part of a training plan for employees to be able to identify counterfeit banknotes, which was a problem for ICICI bank, India. ICICI collected information from experienced counter clerks (externalization), involves clerks in detection of counterfeit banknotes not only by improvement of their skills but also by motivation to do so and by awareness why it is important (internalization), challenges clerks with both growing volume and more sophisticated practices of counterfeiters and therefore clerks must conduct deeper examinations (combination), and provides agents who assist clerks by providing memory hints (socialization). Basically, Allal-Chérif and Makhlouf come to the same conclusion considering the design of a serious game as Ahrens; nevertheless, they stress out sophistication and continuous improvement of the game not only based on natural changes but also to keep the challenging spirit.

Noteworthy shards on knowledge

Ribeiro wittily defines managing tacit knowledge as *“managing who is going to work with whom, doing what and for how long”* [18, p. 342], because he sorts workers based on similarity (above all similar or comparable work experience) and assumes that the more similar workers the higher probability of knowledge sharing and actually using without attempting to make someone else (someone different) responsible for problems. If they are working strictly following the rules, it is a safe alibi to avoid responsibility for problems, but similar workers are more likely to be capable to apply the rules in more creative ways without compromising safety.

A study of authors from highly individualized societies (the USA and Israel) suggests that the ability of expressing negative emotions has a great impact on the knowledge creation process and contributes to better performance of project teams. Stephens and Carmeli [16] think that verbalizing doubts and challenging opinions and decisions of other team members contribute to starting of knowledge creation process, but only on condition that the relationships among the members are of high quality and that negative emotions would be expressed with respect and understood in the right way and will not endanger future collaboration.

Pee and Chua [17] found out that job autonomy influences the perceived value of knowledge, diversity of knowledge and intrinsic motivation, but does not significantly influence knowledge renewal. So the authors suggest to provide employees with more job autonomy wherever possible, or especially where task importance and consequently perceived value of knowledge cannot be enhanced.

A method for measuring the value of individual knowledge was developed by Massingham [10], where sets of knowledge accounts measure individuals´ tacit knowledge and aggregate them. However, this seems to be rather a competency model, or a tool for identifying the competency gap in the organization, respectively, so that managers can focus on recruiting staff with required tacit knowledge or competencies.

Nowacki and Bachnik [14] made an interesting point on knowledge management innovations: they found out that though only one fourth of the surveyed companies claimed to have launched knowledge management and pursue knowledge management practices, almost none focus on making continuous innovations of their knowledge management practices.

Assumptions about knowledge creation and sharing can be sometimes completely wrong. E.g. Mládková [12] proved that contrary to assumptions both women and men preferred internalization and externalization for knowledge sharing, while socialization of tacit knowledge was expected; and externalization is the most popular way of knowledge creation again for both women and men, and again contrary to expectations socialization was more popular for men as knowledge creation concerns. Mládková suggests this may be a result of western culture and western educational system that values and is reliant on explicit information, thus people than consider learning from explicit knowledge as correct, while they are not extensively trained in knowledge sharing, therefore do so naturally in tacit form.

Conclusion and discussion

The continuing research of knowledge has raised the question of trust, and other tried to identify different factors for facilitating knowledge sharing. Any of the above mentioned surveys succeeded to answer the question of motivation, why should someone be willing to share his or her tacit knowledge with the organization, or with colleagues in the organization, if it creates his or her competitive advantage? If the organization is aware that this is the key worker who possesses the know-how, how would they motivate him or her to share it? Would anyone be willingly losing his uniqueness? Trust can be only a part of the answer. Trust among employees can only promote exchange of knowledge but definitely not unique know-how. Or, perhaps, is one of the possible ways to make knowledge workers interested in sharing their knowledge to participate on development of the theoretical background for serious games? Furthermore, the question of support for tacit knowledge exchange was placed since there is a thin boundary between sharing tacit knowledge (and developing relationships and perhaps trust as well) and plain chatting, which cannot always be fully monitored by managers of organizations, therefore organizations may not always help create environment supporting knowledge exchange, though unwillingly, though otherwise promoting knowledge management in terms of explicit knowledge or information management. Also the care, love, trust and commitment that seem to be applied in Eastern cultures are questionable (i.e. not surveyed enough yet) in Western cultures. Therefore it can be suggested that the research continues with the aim to answer the question of motivation and to explore further ways of how can knowledge, namely tacit, be shared.

Limitations of this study are in the information resources available since it focuses on current research papers with the term knowledge management in its heading or subheading or keywords searchable through academic databases. If diverse new studies on knowledge management exist, they might be disguised under different headings.

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