Ambient Intelligence and Knowledge Management: Perspectives from the Czech Reality

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Abstract: - Although Knowledge Management remains a very popular concept there exist problems associated with its implementation. These problems are identified at all knowledge strata. One of them is also Management of Knowledge level, to which Ambient Intelligence related technologies belong. In reaction to the problems described herein, the Faculty of Informatics and Management at the University of Hradec Králové developed a KM implementation methodology. It provides a set of phased ground rules. Further development is underway to elaborate the method by integrating project management, benchmarking exercises, critical success factors, dashboard tools, and various technological instruments. This paper describes briefly the situation of knowledge management and ambient intelligence in the Czech Republic; provides an insight into the long-term effort in this field, which is based on an overview of the basic features of the methodology (KM-Be.At-It) in addition to the strides underway to ameliorate research in this area.

Key-Words: - Knowledge Management, Ambient Intelligence, Czech Republic, Knowledge levels, Methodology, KM-Be.At-It, Knowledge Intensity, Cross-Cultural Management

1 Introduction

Organisations aspire to improve their competitiveness and performance through implementation of progressive managerial approaches and advanced technologies. We find Knowledge Management (KM) and the Ambient Intelligence (AmI) concept among them. KM signifies a knowledge-based and knowledge-orientated management of an organisation, regardless of the main objective or type of the latter. It also involves the creation of an organisational environment and the achievement of the organisation's objectives based on the alignment of knowledge and organisational processes through knowledge resources and appropriate methods, techniques and tools [9]. While KM is an already established concept, AmI is relatively new envisioning the information society of the future. AmI is primarily based on the integration of information and communication technologies (ICT) into the environment through ubiquitous or pervasive computing. In doing so, it becomes transparent as to the technologies with which the user interacts; with the number of applications or how the applications are related. In some instances, the individual might not be even aware that technology or applications are involved at all [21]. AmI promotes pervasive, distributed technology; not intrusive and is omnipresent [23]. According to van Houten [27], AmI refers to future digital environments that are sensitive and responsive to people. Buxton [11] ventures as far as to suggest that ubiquitous computing is invisible within the workplace environment. Examples of the applications are associated with a range of fascinating possibilities. As cited by Gadzheva [20] AmI is identifiable in many fields such as building automation, telemedicine, interpersonal communication, retail, health care [18], and everyday home-life [5].

However, successful implementation of both KM and AmI in the Czech lands is rare. In the following paragraphs the authors discuss the challenging condition of these disciplines from a Czech perspective. In response, two solutions are investigated: the introduction of a methodology of KM introduction, which can serve as a starting point for AmI implementation, and research strategies related to organisational Knowledge Intensity with respect to AmI deployment.

2 The Current State: Czech Knowledge Levels

Generally, there are four knowledge levels [10]. The supranational and national levels precede the organisational level. The Management of Knowledge (MoK) is last and subsequent to the organisational level. Each differs from the other in many degrees. An increase in the resolution of any of the above permits further levels to be identified as independents. Exemplars of this refinement are particular economic sectors such as, tourism, engineering, telecommunications, and education, or clusters that possess different knowledge needs, utilisable tools, techniques, and procedures in comparison to particular organisations. The newly discovered strata are often uncovered between the national and the organisational layers proving that the demarcation between levels is often ambiguous.

2.1 Strategic documents

The supranational level operates using the Knowledge Economy (KE) and Knowledge Society (KS) concepts but absent of tangible knowledge. Likewise, one examines the benefits attributed to the Ambient Economy wherein detailed processes relative to monitoring and information extraction are considered [5]. This level is characterised by two predominant forces: supranational corporations and institutions such as the World Bank, OECD, and others. Equally, three approaches propel a shift of the scientific and societal paradigm: systems, knowledge, and environmental approaches. Within a Czech context, this level manifests through the issuance of numerous strategic documents. From the KM perspective one mentions the widely known "Lisbon Strategy" and the consequent Europe 2020. The ISTAG report [17] can be compared to the Lisbon strategy, since it envisions the development for the first decade of the 21st century. Some equivalent to the Europe 2020 in the AmI area is not yet generally accepted. ISTAG report itself depicts the future of the information society and in this way delineates research directions in the AmI area. In addition, the report promotes a holistic approach wherein the ultimate end-user is included. Equally, several European research projects [14] reflect these areas.

The impact of globalisation influences the national level. The noticeable increase in the flow of goods, services and also technologies; the migration of people, ideas, and wealth on an international basis are prevalent. In the Czech Republic, former privately or state owned corporations are now controlled by management councils with some located outside national borders. The lack of critical knowledge on an appropriate mix of personnel, technology, intellectual and physical assets may lead to the demise of indigenous commerce and may significantly influence both organisational and national culture. At the national level, KE and KS exhibit truly a Czech dimension that reflects the history, culture, economy, demographics, and politics unique to the Czech Republic. Government support for KM is articulated through a number of Czech ministerial publications that include for instance the Economic Growth Strategy. Institutions outside the public domain also exercise a pertinent role. A publication from the Association for Information Society entitled "Manifest of Knowledge Society" [25] summarises the current Czech situation and outlines the goals of a successful Czech nation in a global economy. Unfortunately, there are not similar strategic documents or activities related to AmI in the Czech Republic. The only unifying activity is the Ambient Intelligence Forum. All related activities are distributed among specialised workplaces at particular technical universities and are often camouflaged under different AmI-related concepts, such as, "Smart Workplaces" or "Intelligent Environments".

2.2 Knowledge management

Genuine KM is practiced at the organisational level. There are problems connected at the Czech organisational level. The transition to KE and KS emerges in parallel with other national priorities warranting change. Cultural aspects, including social and individual barriers, contribute significantly [7]. As KM lacks a globally accepted definition, it is perceived in different ways thus creating additional problems in communication and cooperation. The perceptions are often fostered by the misconception that KM consists largely of off-the-shelf software and/or hardware solutions. Although the latter may be necessary in the overall KM scheme as implementation or deployment tools, KM in both theory and practice concentrates far more on the human dimension. Lastly, case studies of successful KM implementation deal principally with larger concerns outside the Czech borders and concentrate on entities such as Chevron, British Airways or BP Amoco [1]. The majority of Czech companies are small and medium size enterprises. Therefore, the current models are hardly applicable to the Czech environment. These reasons compel the need for further research and model-development in order to address adequately the distinct Czech condition. Without the appropriate "Home-Made" tools, Czech organisations revert to services provided by consultancy companies that due to cost, often render KM out of financial reach. In other instances, foreign-developed methodologies are sought. In both cases, the organisation is confronted with methods and procedures created in different settings with different conditions irrespective of the cross-cultural

connotations. These methods do not reflect the needs and specificity of the Czech environment, lack sufficient detail and guidelines and are not available in the Czech language.

In the case of AmI, cultural aspects also play an important role. There are several basic AmI perspectives identified at the organisational level. For instance, the psychological perspective deals with individual barriers that prevent successful implementation of new technologies. It also focuses on development, conceptualisation, and the implementation of theories and models of user actions related to decisions to accept and adopt new technology (e.g. the technology acceptance model [16], or the decomposed theory of planned behaviour [26]), as well as challenges connected with the technology-human interface development. The social perspective investigates social factors that influence the possibilities of technology usage. These factors can be represented by the social barriers to a successful implementation of new technologies or by social "pressure" that potential receiver can perceive, i.e. the influence of social contexts [3].

2.3 Technological support

At the Management of Knowledge level (MoK) KM and AmI hold the tightest relationship. MoK is an established technological discipline that embodies the lowest but also the most basic level, in which attention to knowledge is exercised. In this vein, MoK focuses for instance on database data mining, expert knowledge acquisition, and other cognitive sciences. AmI related technologies, which support development of KM at the organisational level, can be also included at this level. One can find here, among others, RFID systems [6], Visual Thinking Agents [12], widespread Internet access, location-based services (LBS), or research in the fields of nanotechnology, biometrics, and cognitive science [20]. Methods, techniques, procedures and principles of research work within fields such as pedagogy, psychology and sociology are also part of this fundamental level.

A relationship between managers and MoK exists. Managers are not usually cognisant of the principles on which the products of MoK are shaped. This is not an unusual situation and is comparable to other work activities in which the operations behind the result are transparent to the user. The difference in this instance is that MoK products and services require a degree of awareness and intent. Managers may encounter difficulties understanding their purpose and practical utilisation.

2.4 Relationship among and between single levels

Together, the levels create one coherent system that possesses its own significant relationships. MoK in function with any knowledge-type represents the basis for all knowledge related activities. Subsequent products are applied at the organisational level. If this fundamental level does not operate properly, activities at higher levels will not be composite and complete. Despite its technological foundation, the MoK level neither supports a technological approach to KM nor does it stress its technological nature. It draws attention to the fact that modern technologies catalyse change. It is in this regard that the organisational level constitutes the basis of KE both at a national and supranational level.

3 KM-Be.At-It Methodology

KM-Be.At-It was developed to promote interest in KM and to offer Czech managers a viable option for KM implementation. This methodology can be also used as a framework for AmI technology deployment. The methodology consists of several phases. Each phase includes the main goal, purpose and content; required activities; basic prerequisites; completion criteria, key documents, and critical success factors. The phases are summarised as follows [8]:

Establishing the implementation/deployment team – the main objective of this phase is the "buy-in" from senior management and to ensure team's balanced view on all problems related to KM implementation.

Analysis of the status quo – the goal of this phase is to create an image of the current state of KM.

Knowledge strategy development – the development of the knowledge strategy supporting the business strategy moving forward. It identifies the particular knowledge activities sustaining both the business and KM goals and objectives. In parallel, the AmI ontology is determined as to the reuse and sharing of knowledge common amongst existing applications [28]. This analysis equally determines the nature of the new software agents required to facilitate successful KM. Recognising the competitive Czech environment in this era of intense globalisation, data mining as an AmI agent appeals to the small and medium-sized enterprises as a viable and necessary candidate. However, within the Czech context, the lack of a suitable infrastructure capable of supporting the required middleware and hardware may act as a barrier to ubiquitous computing [22].

KM implementation and deployment – In this phase activities differ based on the number and nature of tasks, the composition of the organisation, its culture, as well as the time and resource requirements. In addition, prioritisation influences the overall results. During this

phase, other activities crucial to the success of the project may be conducted. The methodology is general in nature. Potential users have to create their proper instance, in which s/he can emphasise the most desirable aspects of KM implementation, e.g. technological support including AmI technologies. KM survives by its on-going re-introduction and continuous re-evaluation.

4 Considerations of the Czech Reality

At the organisational level, organisations attempt to improve their performance and competitiveness by various approaches. Unfortunately, systematic KM is often not one of the selected ways of choice due to many reasons. A re-launch of the KM-Be.At-It methodology to a wider Czech audience includes an extensive array of best practices proposing successful KM deployment. The methodology also supports development at the MoK level, which deals with particular methods, tools, or technologies. AmI related technologies occur at this level, since they can support KM development and decrease the workload at a workplace in general. However, AmI contribution to this goal is intensively researched.

5 Future Work: Research Challenges

5.1 Knowledge intensity

While measuring the benefits of KM implementation or of intellectual capital development in organisations is quite common at the organisational level, overall organisational knowledge intensity quantification including both static (knowledge resources) and dynamic (knowledge processes) elements of KM is rare. Autio, Sapienza and Almeida [2] define knowledge intensity as the extent to which a firm depends on its knowledge as a source of competitive advantage. Davenport and Smith [15] assert that knowledge intensive companies will allocate more resources to knowledge management. However, the criteria enabling the classification of organisations based on knowledge intensity are not described precisely. Moreover, knowledge intensity may not be associated with KM programmes whatsoever. KM is only systemic and systematic to activities that are usually performed without explicit description. Every organisation owns knowledge resources and knowledge processes, but few recognise such consciously.

Knowledge Intensity is extensively recognised. In business environments, management quantifies the nature of the knowledge and comprehension an employee must possess to perform specific tasks competently within a level of ambiguity. Knowledge intensity consists of minimally four factors: the level and complexity of knowledge and understanding required to perform assignments; the level of expertise necessary for the competent handling of work-related volatility; the severity of consequences of potential work inaccuracy, and the swiftness of action. Today, an accepted approach or methodology does not exist that measures organisational knowledge intensity given a managerial perspective.

Firestone [19] considers the organisational information and knowledge infrastructure to consist of two models. The first represents the organisational and human components and their on-going interactions. The arrangement, communication and interactions are not determined by design, but emerge from the dynamics of the organisation and its activities. Thus, this model is natural. The second model represents a conceptually distinct integrated system that arises from the natural model, and can also be represented by AmI related technologies. According to Firestone, the second model poses the following characteristics:

- the components are computers, software, networks, electronic components, and the like,
- the components and basic interaction properties are determined by design, and
- the overall purpose is to support knowledge and knowledge management

The second model constitutes an artificial model that is developed by design. The resulting organisational knowledge-processing infrastructure is often a blend of the two. Since the organisation is a complex system, natural phenomenon continues to propagate unexpected and emergent behaviours [13]. The monitoring of organisational knowledge intensity assists managers in evaluating the interrelationship, the development and the nature of the two models and their coexistence.

5.2 The project

The authors propose a project to investigate how organisational knowledge intensity can be modelled, represented, monitored, technologically supported and used at the organisational level. The project targets to obtain answers to the many questions, however, the most important ones are:

- In what manner do particular factors such as cross-cultural management, AmI technologies, organisational processes, or knowledge technologies contribute to organisational knowledge intensity?
- In what way is organisational knowledge intensity perceived (described or modelled) and is the AmI concept considered?
- Which methods, techniques, and tools (including AmI) are useable for the organisational

knowledge intensity quantification and how to design and implement such within a managerial environment?

- In what fashion may the quantification of the knowledge intensity and AmI related technology deployment be able to contribute to the support of managerial decisions of higher quality at both a tactic and strategic level?

5.3 The research perspective

Knowledge hierarchy described above involves many scientific disciplines such as economics, international trade theory, management science, political science but also informatics, sociology and psychology. A current problem is that these disciplines analyse a single plane without deep consideration or linkage to other levels. The more one escalates in the hierarchy, the more evident are the problems related to economics or management whereas; in the opposite direction, research problems related to informatics or psychology appear. Indeed, a multidisciplinary direction for analyses is consistent with current AmI leanings to research [28]. Therefore, the application of a systems approach and systems thinking is necessary while studying organisational knowledge intensity within the knowledge hierarchy context. Knowledge intensive industries, cross-cultural management, Ambient Intelligence technologies, financial management, knowledge management, organisational culture, human resources, and knowledge intensive activities of specific organisations represent some of the facets considered. Throughout the proposed study, attention focuses on the possibilities of the further development of the organisational knowledge intensity, the performance of particular organisations in knowledge management activities and the general performance indicators.

5.4 The significance to practice

The benefits of the project include not only the methodology but amelioration to the existing body of knowledge. The theoretical results will enhance managerial familiarity of the relationship between knowledge management, organisational knowledge intensity, and Ambient Intelligence. Therefore, project output supports and facilitates managerial decision-making. Decisions in the area of knowledge management are strengthened by managers' knowledge and awareness of processes, technologies, resources, or departments which perform inadequately from a knowledge management perspective. Equipped with this information they are able to take efficient and more effective decisions on organisational resources allocation, technology implementation, finance budgeting, and other day-to-day tasks.

Conclusion

The relationship between AmI and KM is indeed close knit and offers unique challenges to the Czech management practitioner. Without a full appreciation of the synergy, management is unable to determine that AmI plays a significant role not only during the initial KM deployment but throughout its many cycles. In addition, AmI becomes a vital (and transparent) tool in the harvesting of many KM-benefits.

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