The Role of Ergonomics in Knowledge-Based Enterprises

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ABSTRACT

The purpose of the paper is to call attention to the importance of human factors in the activities of knowledge-based enterprises. The role of ergonomics in enterprise success is also presented. This is based on the thesis which states companies that consider their human capital as their most important asset are successful companies.
One may consider that in knowledge-based enterprises different ergonomic activities are important. Due to the form of industrial relations and organization, such elements are important: development and testing of integrated management systems according to ergonomic requirements, methods of personnel selection and consideration of stress in work conditions assessment criteria. Due to the form of cooperation in groups and human relations, such elements are important: problems of legal, economic and social responsibilities of team members and autonomy of the employees.

Keywords: Ergonomics, Knowledge-Based Enterprises

INTRODUCTION

The contemporary enterprise is based on knowledge and human participation in creation, flow and use of knowledge at each step of development. The key knowledge management processes are: locating, acquiring, developing, sharing knowledge, its distribution, use and retention.

The integral element of an organization is its workers. Without workers, no enterprise could function. This is even more important when one focuses on knowledge-based enterprises. The decisive role of workers determines success, development, and stability of the organization. Workers inside an organization are influenced by the structure, organization and culture of the enterprise. It is important to understand that the leadership and management style of the organization is also connected with people. Workers give an organization talent, intelligence, and training, first investing time and money on education. The specialized skills and training are especially important for knowledge work as in non-repetitive, non-routine work with high level of cognitive activity (compare with Wickramasinghe and Lubitz, 2007).

The concept of intelligent organizations penetrates deeply into the different levels of the organizational structure of the management system in the company, and its main idea is to give power to those who are closest to the action. As a result, employees understand and know what to do or improve in order to achieve the greatest effect, and errors rarely occur.

https://openaccess.cms-conferences.org/#/publications/book/978-1-4951-2103-6

In modern, flexible organizations that exist today, the space on its own initiative is far greater than ever. Control occurs only after completion of the project, which means each team member must understand what kind of initiatives are allowed and expected from team members.

KNOWLEDGE MANAGEMENT

Definition

In the beginning, knowledge management was defined as the process of capturing, distributing, and effectively using knowledge (Davenport 1994). A short time later, it was known as a discipline that promotes an integrated approach to identifying, capturing, evaluating, retrieving and sharing all of an enterprise's information assets. These assets may include databases, documents, policies, procedures, and previously un-captured expertise and experience in individual workers (Duhon, 1998).

Nowadays, knowledge management refers to a multi-disciplined approach to achieving organizational objectives by making the best use of knowledge. Knowledge management focuses on processes such as acquiring, creating and sharing knowledge and the cultural and technical foundations that support them (Liu and Parmelee 2013).

In comparing these definitions,, one may comment that they have the same base: capturing, creating and distributing and sharing knowledge. As a new element, one may recognize knowledge as an element of organizational culture.

Different kinds of knowledge is used in enterprises. Generally, one can divide the knowledge into three groups: explicit, implicit and tacit knowledge. It is quite popular to explain explicit knowledge as information or knowledge that is set out in tangible form. Implicit knowledge is information or knowledge that is not set out in tangible form but could be made explicit. Tacit knowledge is information or knowledge that one would have extreme difficulty operationally setting out in tangible form (compare Nonaka and Takeuchi, 1995 and Koenig, 2012).

Knowledge-Based Enterprise

For knowledge-based enterprises, strategy, structure, culture, technology and resources are important. Structure is also connected with flexibility, position in a network environment and virtual structures. Human resources are important. The main value of knowledge-based enterprises is intellectual capital connected with:

- human capital: people and their knowledge, skills, values, norms, attitudes, views, emotional intelligence
- structural capital: understood mainly as the organizational capital
- customer capital: created by customers, which reflects their potential value of purchase of products and services offered by the organization
- intellectual property, including: patents, licenses, copyrights, trademarks, secrets, projects (compare with Mikula et al, 2007)

Human capital is not limited only to management but also to other workers, resulting in shrinking of the difference between workers and management in such enterprises. Finally, we can add that the responsibility of regular workers is higher than in other organizations. Everyone looks for improvement in their work standing.

Nowadays, knowledge-based enterprises are supported by new technologies in communication, information collection, education and other systems. Different technologies (mostly IT) that support knowledge management are in use:

- document management,
- customer relationship management,

- project management,
- decision support systems,
- expert systems,
- artificial intelligence,
- data warehouse,
- intranets, extranets,
- e-business tools,
- work flow,
- web conferencing,
- e-learning tools,
- groupware.

Use and development of such technologies frequently creates a handicap in competition on the market.

ERGONOMICS AND ITS FIELD

The term “ergonomics” was first used in 1857 by Polish natural scientist Wojciech Jastrzębowski in an article of his. He composed the term from Greek έργον, meaning "work", and νόμος, meaning "law" (compare with the resumed and reproduced article, Jastrzębowski, 1997).

The International Ergonomics Association defines ergonomics and human factors as follows: Ergonomics (human factors) is the scientific discipline concerned with the understanding of interactions among humans and other elements of a system, and the profession that applies theory, principles, data and methods to design in order to optimize human well-being and overall system performance (International Ergonomics Association, 2013).

Ergonomics covers many disciplines connected with humans and their environments, including: physiology, psychology, anthropometry, biomechanics, kinesiology, mechanical engineering, industrial engineering, industrial design and information design. In complicated human/environmental systems, elements from different knowledge are joined and the term “macroergonomics” is used (compare Tytyk, 2001 and Brookhuis et al, 2005).

The International Ergonomics Association recognizes physical, cognitive, social, organizational and environmental factors in ergonomics. Physical ergonomics is concerned with human anatomical, anthropometric, physiological and biomechanical characteristics as they relate to physical activity. Cognitive ergonomics is concerned with mental processes, such as perception, memory, reasoning, and motor response as they affect interactions among humans and other elements of a system. Organizational ergonomics is concerned with the optimization of sociotechnical systems, including their organizational structures, policies and processes. Environmental ergonomics concentrates on the interaction between the user and physical environment, mainly characterized by temperature, humidity, heat radiation, noise, vibration, lighting and pressure (International Ergonomics Association, 2013 and Environmental Ergonomics, 2013).

ROLE OF ERGONOMICS IN KNOWLEDGE-BASED ENTERPRISES

Ergonomics during Enterprise Management Changes

Since the nineteenth century, one can see the evolution of the role of workers in an enterprise. In the nineteenth century and the first half of the twentieth century, people were the labor force in an enterprise. Similar to each other, they had few qualifications and little experience. Since the 1980s, “human resources” has become a popular term, expressing the idea of people as the most important resource in a company. Since the 1990s, the term “human capital” is more frequently used, thus defining a highly qualified, creative and largely independent labor force from employer specialists. In enterprises, one can see the trend to enable all employees to participate in the company's development based on their knowledge and experience. Additionally, the company takes care to improve the skills of workers through both the acquisition of knowledge outside the firm as well as the sharing of knowledge between colleagues.

Changing the approach of the role of the company, employees are often guided to their working conditions and application of ergonomic principles. Initially, ergonomics was used to increase the efficiency of production, where the fundamental importance constituted physical effort. Currently, a small amount of work stands comprises those which have a significant energy expense (compare Kawecka-Endler and Mrugalska, 2011).

In the case of conceptual work, it has become essential to ensure the comfort (well-being) of workers. This should provide increased productivity of intellectual work. In the case of a knowledge-based enterprise, comfort (well-being) of workers itself seems to be insufficient. Innovativeness of companies cannot be based only on the use of workers’ learned knowledge. They must continually acquire new knowledge and often work in interdisciplinary teams, which by combining knowledge from different fields can create innovative solutions. At this stage, organizational ergonomic requirements and the use of modern technology are important. Among the new technologies, particularly important are those that support the flow, accumulation and acquisition of information, teamwork, contact with colleagues and clients, business operations (including alongside other players) and support for process-improvement professionals. A long-known aspect associated with the use of new technologies is to adapt the user interface to human capabilities and improving intuitiveness of systems. The phase of mobile device improvement began after the age of computer development. However, the role of ergonomics does not end at the interface. A greater challenge is to adapt and support multiple processes and equipment to the possibility of human perception. It is necessary to automate many processes and leave the human to make decisions based on highly processed information. A further step is the allocation of tasks between employees in the system, control of the flow of documents between employees involved in the process. In many situations, however, it is necessary to enable simultaneous work with data and documents in conjunction with distance work.

Personal Roles in Knowledge-Based Enterprise

Despite the fact that structures of knowledge-based enterprises are flattened, the roles of a team member are different. It is popular (compare Davenport and Prusak, 2000, Nonaka and Takeuchi, 1995, and Probst et al, 2000) to recognize three levels of management: operational, middle and executive. On the operational level, knowledge workers are mentioned as operators – specialists, knowledge process workers or knowledge transparent specialists. On the middle level, knowledge designers are mentioned as project managers or coordination specialists. On the executive level, we mention knowledge commanders or knowledge directors.

The aforementioned changes taking place in companies towards knowledge-based enterprises have an affect on many aspects of the work and influence on the assessment work conditions based on ergonomic criteria. Professionalism of staff and specialization based on high competence is planned to be replaced by knowledge sharing, versatility in the various roles and organizational functions, creativity and innovation resulting from it. On the other hand, the objectives in the form of the organization mission implementation, professional career and competition between employees will be replaced by harmonizing personal and professional life, diversity and choice of function, role and tasks in the organization, and cooperation in teams.

These tasks require an increase of mental workload (Butlewski, 2012). On one hand, the employee must constantly acquire new knowledge rather than be limited to standard activities on the basis of previously acquired skills. On the other hand, harmonizing personal and professional life may suggest the requirement of continuous activity (also in their free time) in solving problems related to work. Therefore, the problem of separating the private from occupational sphere appears. From an ergonomic point of view, the limitation of mental rest between periods of work occurs.

There are also positive elements in the aforementioned changes. Development of human personality is one of ergonomic requirements (compare with Roetting and Luczak, 2001). Finally, involvement of the workers can give proper answer to the influence of a particular factor. Because of the reasons in participatory ergonomics, a worker is an expert at his or her job (Theberge et al, 2002).

In this situation, the ergonomic requirements related to fulfillment of an employee's needs have specific meaning. This is due to the fact companies try to avoid staff needs. From needs oriented on professional success, determined by the level of the organizational hierarchy, salary and position in the professional environment, to needs oriented on continuous education, independence, comfortable working conditions, attractive tasks and projects, and building authority of knowledge. Seemingly, the situation is ideal from the point of view of ergonomic requirements, as it seeks to ensure comfortable working conditions and work satisfaction. The goal of improving working conditions as formerly done is associated with increased productivity, now called "improvement of company innovation". The employee is fully devoted to the performance of the tasks in the enterprise. Any activity not related to the work should fade into the background. It follows that only the employee can decide how to allocate their activity between work and personal life. The employee, however, must take into consideration the fact that someone else will be devoted to work to a larger extent and threaten that employee's position.

Another issue is the fact that it tends to occur in a situation in which people involved in the implementation of company projects are not their employees. The independence of these people largely results in them independently organizing their work.

New Technology in Knowledge-Based Enterprise

The enterprises that manage knowledge require direct communication between the employees and strong feedback between them. Equally important is good contact with environment, which allows fast transfer of information and knowledge. It should be supported with modern information technologies.

A negative impact of this situation is the increase of work with display units. Fortunately, the development of new information and communication technologies increasingly takes ergonomic requirements into account. Using these technologies is often necessary because teamwork in a knowledge-based enterprise is not always available with direct communication. In many situations, the subject of the enterprise activity is connected using new technologies, different operating systems and applications.

Newer computer systems and applications enable faster transfer of information using more perception channels. An example from the past is the purpose of replacing the character-based interface with a graphical equivalent. As a result, bandwidth (the range of useful information visible to a user at a given time) and the speed of performing specific tasks was increased (compare Hankiewicz, 2012).

Information visualization concentrates on the use of computers or similar devices to explore large amounts of abstract data. Application of information visualization in computer systems involves selecting, transforming and representing abstract data in a form that facilitates human interaction for exploration and understanding. The next step is visualization with real-time perception and user response to enforce high mental work.

Knowledge visualization is a new field of research which focuses on the creation and transfer of knowledge by visualizations with and without the help of computers (Meyer 2013). Visual representations may be sketches, diagrams, images, objects, interactive visualizations, information visualization applications, and imaginary visualizations as in stories. It finally allows the transfer of insights, experiences, attitudes, values, expectations, perspectives, opinions and predictions. Knowledge visualization serves as a conceptual bridge to increase the speed and quality of knowledge transfer among and between individuals, groups or even whole organizations (Eppler and Burkard, 2004).

New Opportunities in Knowledge-Based Enterprises

In knowledge-based enterprises, skills of all company staff give the best result. Diversity of employees in respect of education and professional experience can even help in finding innovative solutions. Companies look for a broader group of talented people with special predispositions. Utilization of mental ability of handicapped people and young employees can also be useful. Sometimes they are able to see problems from a different perspective.

A completely different problem in the flow of knowledge is the language barrier. Automatic translation systems are still imperfect, often making foreign language knowledge an important skill of the company staff. It is especially important in global companies but also in other enterprises with staff from different countries. The staff may often work together as a team or prepare international projects. Further, a part of this organizational problem connected with communication language is choosing language for collection and retention of knowledge. For knowledge-based enterprises, this can be a fundamental decision and should be based on the language of the vast majority of used knowledge.

Key employees for a knowledge-oriented organization, which includes a company's managerial staff, especially those at the highest level, are those with unique knowledge and potential. Their value results from both the unique skills and relationships they usually have in other organizations and prestige among their professional environment. Their skills and contacts create core competencies of the company. Business contacts are often built in connection to private contacts, limiting the free time of that person.

Workers consume a lot of time learning how to do work. An employee, having gained specific knowledge on a particular subject, after some time, can play the role of a teacher to others. It is important that knowledge cannot be taught during lessons and through experience. Davenport and Prusak (Davenport and Prusak, 2000) claim that "knowledge works through rules of thumb: flexible guides to action that developed through trial and error and over long experience and observation. Rules of thumb are shortcuts to solutions to new problems that resemble problems previously solved by experienced workers. Those with knowledge see known patterns in new situations and can respond appropriately".

CONCLUSIONS

Knowledge orientation is changing the essence of enterprises, which collects potential competencies, information, and the opportunities created by the environment. The cores of enterprises are employees who create professional key competences of the company.

Analysis of ergonomic requirements fulfilment seems to be different in knowledge-based enterprises. Physical, cognitive, social, organizational and environmental ergonomic factors all are significant but because of mental processes, importance for a cognitive factor should be emphasized. In most cases, participation of employees (participatory ergonomics) in the assessment should affect more reliable results.

Dynamic changes in the world economy force enterprises to permanently improve their business processes and methods of functioning. Only enterprises that develop and implement effective methods of knowledge management can win in competition with others. Each enterprise has knowledge resources, but only these which recognize the human aspect are able to use them effectively and efficiently. Therefore, the ergonomic aspect of knowledge management is a key element of success in an enterprise. The processes that occur in enterprises are connected with participation, knowledge and competences of employees.

REFERENCES

Brookhuis, K., Hedge, A., Hendrick, H., Salas, E., and Stanton, N. (2005), "*Handbook of Human Factors and Ergonomics Models"*, Florida, CRC Press.

Butlewski, M., (2012), "*The influence of work on psycho-physical human condition"*, in: Life improvement at work Misztal Agnieszka. Butlewski Marcin (Ed.) Poznan, Wydaw. Politechniki Poznanskiej, pp. 33-35

Davenport, T. H., (1994), "*Saving IT's Soul: Human Centered Information Management"*, Harvard Business Review, March-April, 72 (2), pp. 119-131.

Davenport, T. H., Prusak, L., (2000), *"Working Knowledge: How Organizations Manage What They Know"*, Harvard Business School Press, Boston, USA.

Duhon, B. (1998), "*It's All in our Heads"*. Inform, September, 12 (8).

Environmental Ergonomics, (2013) Website: http://www.environmental-ergonomics.org/

Eppler, M. J., Burkard, R. A. (2004), "*Knowledge visualization - towards a new discipline and its fields of application"*, ICA Working Paper #2/2004, University of Lugano

Hankiewicz K., (2012), "*Ergonomic characteristic of software for enterprise management systems"*, in: Advances in social and organizational factors, Vink Peter (ed.), Boca Raton: CRC Press, pp. 279-287

International Ergonomics Association, (2013) Website: http://iea.cc/whats/index.html

Jastrzębowski, W. B., (1997), "*Rys ergonomii, czyli nauki o pracy*", Ergonomia, tom 20 nr 2, Wyd. PAN, Kraków.

Kawecka-Endler, A., Mrugalska, B., (2011), *Contemporary aspects in design of work*, in: Advances in human factors, ergonomics and safety in manufacturing and service industries Karwowski, Waldemar, Salvendy, Gavriel (Ed.). Boca Raton: Taylor and Francis Group, pp. 401-411

Koenig, M., (2012), "*What is KM? Knowledge Management Explained"* Website: http://www.kmworld.com/Articles/Editorial/What-Is-.../What-is-KM-Knowledge-Management-Explained-82405.aspx

Liu, S., Parmelee, M., (2013), "*Introduction to Knowledge Management"*, University of North Carolina at Chapel Hill Website: http://www.unc.edu/~sunnyliu/inls258/Introduction_to_Knowledge_Management.html

Meyer, R. (2013), "*Knowledge Visualization*" Website: http://www.medien.ifi.lmu.de/lehre/ws0809/hs/docs/meyer.pdf

Mikuła, B., Pietruszka-Otyl, A., Potocki, A., (2007), „*Podstawy zarządzania przedsiębiorstwami w gospodarce opartej na wiedzy"*, Difin, Warszawa.

Nonaka, I., Takeuchi, H. (1995), "*The knowledge creating company: How Japanese Companies Create the Dynamics of Innovation"*, New York: Oxford University Press.

Probst, G., Raub, S., Romhardt, K., (2000), "*Managing Knowledge: Building Blocks for Success"*, Wiley & Sons, Incorporated, John

Roetting, M., Luczak, H., (2001), Ergonomics as Integrating Constituent in Occupational Safety and Health—Past, Present, and Future, International Journal of Occupational Safety And Ergonomics 2001, Vol. 7, No. 4, pp. 507–526.

Theberge, N, Cole, D., Granzow, K., Frazer, M., Laing A., Wells, R., (2002) "*Negotiating Workplace Participation: An Analysis of a Participatory Ergonomics Program in an Industrial Setting*" Paper presented at meetings of Association of Canadian Ergonomists, Banff, Alberta, October 2002.

Tytyk, E., (2001), "*Projektowanie Ergonomiczne*", Wydawnictwo Naukowe PWN, Warszawa-Poznań.

Wickramasinghe, N., Lubitz, D. (2007), "*Knowledge-Based Enterprise: Theories and Fundamentals"*, IGI Global.