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# MANAGEMENT RESOURCES SYSTEM IN THE CONSTRUCTION COMPANY

***Abstract***

*The paper presents the key elements of resource management in the construction company. In the construction industry, as in other professions, the performance of which may become hazardous events, and independent functions entrusted to experienced workers, rich in quiet knowledge. It is important that this knowledge skillfully extract and disseminate.*

*The paper focuses on Business Intelligence systems, advanced planning and scheduling (ASP), methods of corporate performance management (CPM), balanced score card (BSC).*

## INTRODUCTION

Knowledge management depends on internal factors (within the organization) and external factors (business partners, customers, business environment). The main constraint to the development of appropriate knowledge management is close link to specific units of knowledge organization, while for the rest of the organization's this knowledge is not available. This phenomenon in management is called "viscosity of knowledge". The role of properly functioning system of knowledge management is to eliminate this type of phenomena. Barriers of the development of knowledge in enterprise is related to the viscosity of knowledge due to the natural reluctance to share knowledge and its limited absorption by people who are looking for this knowledge. Model elements of knowledge management in a construction company in relation to particular specialties such as construction, installation, power supply can be: knowledge management strategies and its transfer to the outside and the inside, organizational forms, information management and its archiving, workflow management, organizational culture, technological tools that improve and facilitate the transfer of knowledge. In any organization this model may look different, taking into account the specificity of its action. It can be freely expanded and refines.

## 1. KNOWLEDGE MANAGEMENT IN THE CONSTRUCTION COMPANY

An important aspect of knowledge management is to implement the model. The best results are achieved when the model is introduced in parallel in all processes of knowledge management, running at the same real time. Management includes classic features consisting of planning, organizing, conduction, management and control, including the creation of knowledge, its codification and transfer [1].

Transforming the quiet knowledge must be done taking into account the objectives of the organization as a whole and its individual knowledge of the employee and other staff.

In the process of knowledge management in the modern construction organization operating under varying external conditions the use of organic model is very effective. Organic structure means a flat structure, non-formal and decentralized of organization that significantly reduces the decision-making process.

In contrast to the bureaucratic model, the organic model is characterized by a bottom-up procedure of action, high level of employees' competence, flexibly defined areas of activity of each employee depending on the specific purpose, responsibility of the staff for effects, a small number of formal rules and a small degree of centralization of power.

Another model of modern organization is process organization in which business processes rather than rigid procedures are based on the selection of participants of the project, members of interdisciplinary teams, broad-minded and broad responsibility. The principles of operation of such an organization adapts to the situation.

In the investment activity related to the construction process not every process is already done according to the rules. The main reasons are changes to the designer violation of the regime of performance on time. In this case, the decision-maker, who is such a construction manager or other person responsible for the work is faced with the decision to make the replacement [2].

Decision-maker who has the suitable knowledge is able to decide to choose the replacement solution, provided this decision does not go beyond its competence and does not require confirmation or verification by a qualified designer. With the progress of life, the development of technology the structures of the organization become more flexible and focus on continuous adaptation of subordinate goals. Following departure from the rules of strict specialization, a complex hierarchy, formalization of the centralization of power. Depending on the needs and goals of the organization knowledge management can be focused on the man (silent knowledge , the so-called personnel strategy) or the technology knowledge (explicit knowledge, the so-called codification strategy). Information and knowledge are disjoint concepts, but in practice they often occur together. Therefore, models and knowledge management are all elements that enrich it, and may be useful in the decision making process. The purpose of management of knowledge, information, data, is to add value, ie the difference between the available resources and the resources before processing. Starting from the eighties management support systems related to information and knowledge have evolved from sub-group work through management processes, documents, information, creating corporate portals, reaching the current level of advancement in knowledge management. The development of these systems in the increasing operation on the data packet and the information resulted from the development of information technology and information of changes in the activities of business organizations and companies [3].

The feature that distinguishes the modern approach to the management of knowledge is an active use of hidden knowledge. This is particularly important in the construction process in which the tacit knowledge associated with experience plays an important role. In the construction industry, as in other professions, the performance of which may become hazardous events, individual functions are entrusted to experienced workers, rich in quiet knowledge. It is important to skillfully extract this knowledge and disseminate them. This task is especially difficult because besides properly prepared management procedures, it is necessary to break the psychological barrier occurring among employees, associated with deep-rooted culture of competition, and often precarious existence of employees in the organization of business, especially in times of economic crisis. Implementation of the system requires building relationships based on trust, reciprocity and high awareness of employees, and finally, properly prepared infrastructure. An example might be the relationship between workers in large construction companies manufacturing or regulations when employees have similar knowledge and skills, specialization is a small group of people, or in teams engaged in

the design, when similarly educated workers with similar qualifications do their work using the same IT tools - systems, CAD, CAM, CAE . Managing tacit knowledge, its dissemination in the future to avoid the same mistakes, such knowledge is useful in the preparation and implementation of new employees with less experience and qualifications. The rapid economic development, especially technology, requires individualized activities and expertise in carrying out the various activities and processes. This makes proper management of tacit knowledge an essential element of management in the company. Entering these improvements give tangible benefits to the company , increasing the efficiency of the design, documentation, project management, manufacturing, project execution is conducive to improving communication within the team and team self-education. In a natural way leaders lead teams of workers or their activities are of an advisory nature without leadership, formed the so-called competence centers, connecting people involved in the same or similar research area in the company. This is especially important and useful in companies with dispersed structures or with a wide range of customers or clients. In this way, a knowledge management system for risk assessment for the event or situation is created.

Presented aspects of the management of knowledge, including knowledge of the risks, are dynamic and open at the same time, allowing rapid response to ever-changing processes. At the same time, this approach can lead to creative chaos and instability, to which modern managers increasingly need to get used to it. Creative destruction in actions of the company has become the norm characterized by the conditions in which businesses operate today. The knowledge management system of the risk in the organization consists of people-knowledge staff, the knowledge available within the organization and tools that allow you to properly manage knowledge. Risk Knowledge Management Systems (RKMS) focus on storing, maintaining, securing, spreading and development of knowledge. Among the knowledge management systems there are: document management systems, enterprise portals, e-learning tools, data warehouses, ERP systems. Among the new systems there can be distinguished: business intelligence, planning and scheduling technology ASP (advanced planning and scheduling), methods to assess operational performance management CPM [4] (corporate performance management), balanced scorecard (BSC).

The effect of knowledge management is evaluated by measuring the knowledge (Fig.1.) using direct methods DIC ( direct intellectual capital methods ), methods based on the market value of the company MCM (market capitalization methods ), methods based on the ratio of return on assets ROA (return of assets methods ), method scorecards SC. Taking into account the company assets related to human intellect makes it a classic financial statements, in particular the balance sheet, on the basis of which it is estimated the value of the organization, different from the value that shapes the market. It is sufficient to make modifications to an existing model without destroying the existing system. Knowledge management process model consists of several interrelated sub-processes: searching, locating, acquiring knowledge, sharing it and its dissemination and development.

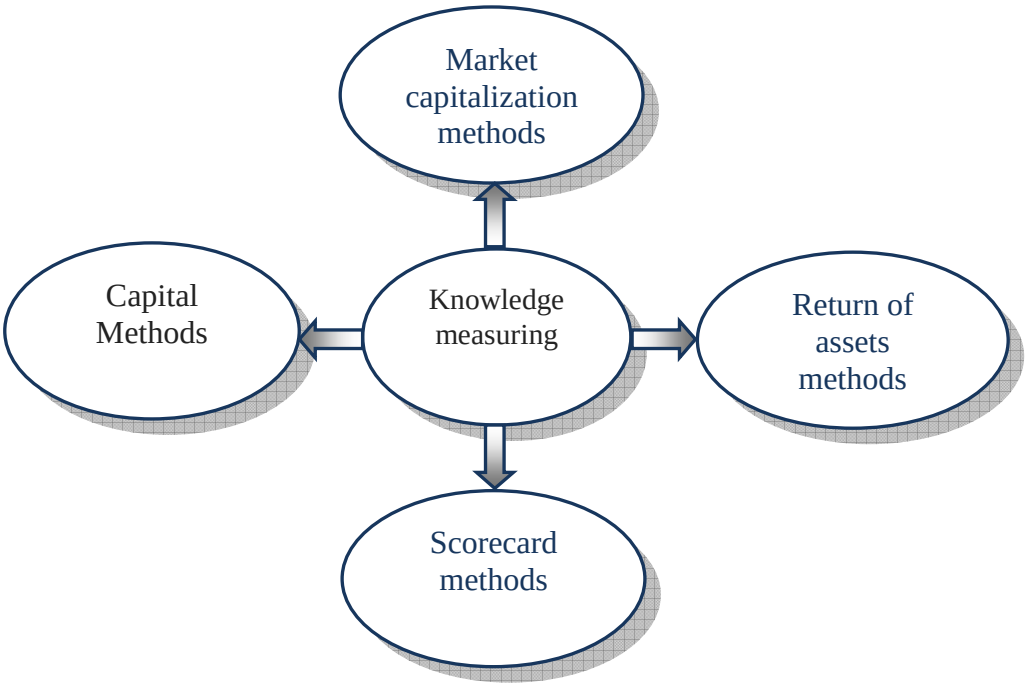


**Fig. 1.** Measuring the knowledge

## 2. THE PROCESS OF KNOWLEDGE MANAGEMENT

In view of the fact that knowledge is a good thing difficult to access, the organization should develop an appropriate strategy for acquiring knowledge. Knowledge management procedure may include the steps of obtaining, collecting, diagnosing knowledge because of its usefulness in a construction company, and stage of evaluation and validation. Acquiring knowledge is done in two ways: through the acquisition of knowledge directly using people and this knowledge is implicit and in the process of exploring the documents in hard copy and digital. The acquisition of knowledge can be done using the topics or skills map, contacts books, a matrix of competence. Knowledge discovery in databases is often called data mining. Knowledge discovery in databases requires data collection, data, integration, selection, transformation, intelligent processing, verification and presentation of knowledge. Knowledge of databases may be obtained using methods based on classical solutions: classification, clustering, use of artificial intelligence - the methods derived from the biological sciences, such as neural networks, mathematical methods and statistics, and hybrid methods which combine several methods. An example of intelligent knowledge discovery method can be fuzzy, temporal method, neural networks, evolutionary methods, methods derived from the study of language, as well as an incremental method, having the character of adaptive learning, methods of induction and abduction (case based reasoning ), in which reasoning and finding a solution is done by reference to the solutions to the problems of the past. In today's knowledge management systems data warehouses play an important role. A data warehouse is a technique for the collection, storage and data classification. It collects data from all systems in the organization. Before data warehouses there were used transaction processing OLTP (online transactional processing) and analytic OLAP (online analytical processing). OLAP technology is used in data warehouses. The data warehouse allows the use of information for strategic decisions, identify market trends. Among the databases in transaction systems it is distinguished by: the orientation on the subject, integration and changes over time. An important function of the data warehouse is the ability to aggregate data, the aggregation,

joining and calculating using mathematical functions. Very convenient function of warehouse in reaching the appropriate information is creating metadata, or data about: data, information about their location and structure. Among the data warehouse systems several categories architectural DW can be distinguished:

– a centralized DW, the whole process wholesaler takes place on a single server
– a decentralized DW - dispersed geographically dispersed technologically,
– the virtual DW.

In the virtual DW data in various source systems are made available to users through an intermediate layer (middleware). The advantage of this solution is no need for a data warehouse infrastructure, the database software and tools for transformation. In addition to the data warehouse there are developed: wholesalers of texts, documents, knowledge and markets data (information data superstore). The process of submitting data to the DW takes place in the following stages: extract data from sources, their transformation, loading the warehouse.

The data from the data warehouse can be processed in the framework of multi-dimensional data analysis, data mining or reporting. The main type of data processing in the warehouse is analytical processing OLAP (discussed above). The results can be presented in the form of reports, for example, about trends, achievements and failures of marketing strategies. Data mining can function as an independent procedure or as a continuation of a data warehouse operations.

Basic techniques of data mining procedures include: discovery based on multi-level data generalization, classification, clustering, discovering similarities based on patterns, discovering patterns of tracks. The last step before the use of the discovered knowledge is its valuation and verification. The purpose of verification is to identify and correct incomplete or inconsistent knowledge. Knowledge can be verified automatically, or with the involvement of a domain expert. The methods of the testing include decision tables , use of meta knowledge, oriented graphs, K- trees, machine learning. Knowledge of the risks in the construction industry is a key element of the organization in the temporal environment, particularly in the context of globalization and increased competition. The risk, which is related to the legal relationship between the parties, and economic determinants of economic and socio - psychological occurring when doing business, must be identified and assessed, taking into account a wide range of criteria, taking into account the changing environment. Knowledge of the potential risk is subject to valuation by established procedures. This process can be described as valuing the knowledge of risks (risk knowledge validation ) [5].

Knowledge of risk is seen in the work as the intellectual capital of the organization, as well as expertise in the field of art, technology, and management, acting essential element of the knowledge base to determine the direction of management in the organization. Recognition of risk in the embodiment has not so far been the subject of research or theoretical analysis and provides an innovative approach of the problem. Knowledge of the risk varies its target method of usage in comparison for example with knowledge of the technology of a particular product. In the case of technology, this knowledge in subsequent stages of action of the organization is materialized into a product or service, eg, in the case of knowledge of risks conducted activities aim toward that analyzes the effect of identified risks - and therefore loss, delay in execution of works, the defective product, not materialized and have been in the virtual space. From a practical point of view, knowledge of the risk can be a part of a knowledge management system in an organization which is a part of the overall management of the company. Knowledge of the risk should be structured and managed with the help of tools and procedures to ensure the verification, update, correct collection and rapid access to knowledge by workers, policy makers and other persons authorized to do so. Intelligent decision support systems fulfill such a role. Efficient and effective use of

accumulated knowledge requires the following procedures to determine the suitability of this knowledge in the organization, to assess its quality and validity. Diagnosis, valuation and validation of knowledge are therefore essential activities in modern knowledge-based organizations. The term “diagnosis” is meant to establish the diagnosis of objective facts. Valuing is rating the steady-state with reference to a certain value system. Valuing, in contrast to the diagnosis, is a subjective, from the standpoint of a variety of purposes, the same knowledge can be evaluated differently. Some representatives of science treat a broad diagnosis, understanding this term alongside the findings of fact to evaluate. Diagnosis is therefore in the broader sense also in the evaluation stage. In this paper, the author operates a narrower definition of the diagnosis, not including evaluation. Validation of the re-verification of knowledge due to the passage of time or change in other factors that may affect the usefulness of this knowledge in the organization. Construction processes are usually accompanied by problems and complications associated with the execution of the work. A good manager is able to solve every problem that appears. Manager equipped with the right tools can predict and anticipate the course of events in a way that does not lead to a situation ending with loss, delay , there are additional costs associated with falsification of elements, etc. Diagnosis of knowledge about risk can assess the situation and appropriate adjustments even before the start of the project or in its early stages, protecting the contractor and the investor against loss. The need to subject knowledge permanent diagnosis, monitoring and verification of results comes from the enormous progress in technology, high inertia of construction as a sector of the economy to the application of new technologies, on the other hand - the characteristics of employees whose expertise does not always go hand in hand with high standards of work. The diagnosis requires a number of conditions. The diagnosis must be carried out in an appropriate temporal and spatial context, because only in this manner it could give a clear and true picture. The purpose of diagnosis is to assess the situation (valuation) and usage of applications to the future business activities. Implementation of diagnosis results from the evaluation of the target object that is not working correctly. Diagnosis is made on the basis of information that is quantitative or qualitative. When carrying out an automatic diagnosis, due to the use of knowledge diagnostic techniques can be divided into techniques simplified, techniques using the information databases available and the intelligent methods that use in addition to knowledge bases also learning the system modules, such as neural networks. With automation of prepared diagnostic two approaches are used. The first is a broad approach which generates a diagnostic limit, the second attempt is made to scan in more detail giving a more reliable diagnosis. Diagnostic procedures can be carried out according to the following phases: observation and recording of symptoms, analysis of the environment in which the event takes, comparing them with the assembled model, inference supported by expert knowledge, application of diagnosed effects in the virtual model of the construction process, generation of a diagnosis. Techniques used for the automatic diagnosis may use “shallow knowledge”, which is the minimum knowledge to diagnose or expertise deep. In systems of deep knowledge structural knowledge of the target components of the system, the relationships between these components and the fundamental transformations made in it are stored . It is an extension of the current procedural knowledge in heuristic systems based on shallow knowledge. Deep knowledge-based systems use multi-model systems. The quality of the knowledge base is critical to the value of the resulting diagnosis. The main problems associated with maintaining the quality of knowledge are inadequate, incomplete, inconsistent and uncertain. Inadequate knowledge means knowledge irrelevant from the point of view of the system. Knowledge that is fragmentary knowledge is called incomplete. The obstacle in creating valuable knowledge is knowledge inconsistent, in which a string of knowledge can be interrupted without leading to any useful conclusions. Knowledge of the system may be of uncertain, fuzzy. In order to determine the properties of

the knowledge of risks the valuation is carried out. An important feature of the evaluation, the recognition of something as beneficial, is its rationality, characterized by a few goals. Knowledge is an essential element of the system/software smart. The system must be equipped with the assessment criteria and standards, which allows for relativization of constructed value system. To organize the principles of the system it must be equipped with the procedures that are required in order. There are terms close in meaning to the concept of evaluation, ie, verification, evaluation, testing and certification. Verification of compliance is to determine the knowledge base developed from its assumptions. The assessment consists of determining the level of user's satisfaction with the system knowledge base. Testing is a validation of the system knowledge base. Certification is authorized operation of a knowledge base system. In the literature, one can meet two shots of validating knowledge. Recognition is based on a formalistic laws of logic, which are used in digital mapping: true and false . Recognition heuristic (pseudoformal) is a subjective assessment by expressing his satisfaction with the level of developed system by assigning a value in the range [ 0, 1 ], referring to the theory of fuzzy sets.

When valuing knowledge is formal, then you can determine whether a knowledge base satisfies a formal specification. In this case, the valuation is identified with the verification. When valuation of knowledge is based on pseudo formal grounds, for example by using fuzzy set theory, the valuation is identified with the concept of evaluation knowledge base. Verification is therefore an objective process of evaluation and assessment is the interpretive process of evaluation. Depending on the role of evaluation in process one can distinguish the concepts: ignoring, equivalent and dominant. The concept of ignoring excludes from the concept of valuation and replaces it with verification, evaluation or testing. In the concept of equivalent valuation is one way of estimating knowledge in the system, in addition to verifying or the evaluation. Dominant concept treats valuation as a key element in allowing the user to obtain the desired knowledge. This approach seems to be the most suitable for the realization of most construction processes. Certification in the building industry, which constitutes the final stage of verification is related to the placing on the market and supervision of construction and includes:

-technical approval or favorable technical assessment of the suitability of the construction product for an intended use, based on fulfillment of the essential requirements for building works, in which a construction product is used. The European Technical Approval is issued with additional requirements including the European Union. Providing technical approvals dealing with organizational units authorized to issue them under the Regulation of the Minister responsible for housing, spatial planning and housing. Technical Approval is granted for a construction product for which there is established the Polish product standards or the construction product for which the performance with respect to the basic requirements differ significantly from the properties specified in the Polish standard product. This applies to the products covered by the mandate given by the European Commission for the development of harmonized standards and guidelines for European technical approvals. Basis for granting technical approval is to evaluate the performance and life expectancy of the construction product properly identified, confirmed, depending on your needs, research, calculations, visual inspection of experts and other documents, using special provisions, including the technical - and construction of Polish Standards, - the declaration of conformity, which is a manufacturer's declaration stating on his sole responsibility that the construction product is in conformity with the Polish standard product or technical approval. For security reasons, use of building materials, taking into account the structural properties associated with the load capacity, as well as utility, aesthetic, fire protection shall be marking materials, which confirms the assessment of knowledge, which was the basis for their implementation, and which are easily identified on the product. These are:

- CE marking is a visual confirmation that the construction product has been reviewed for compliance with a harmonized standard or European technical approval or a national technical specification of a Member State of the European Union or the European Economic Area, which is recognized by the European Commission to be compatible with the basic requirements. When assessing compliance the following methods can be used: a) a preliminary examination of a representative sample of the product (type-examination) conducted by the manufacturer or a notified body, b) testing of samples taken at the factory to the manufacturer or a notified body in accordance with a prescribed test plan, c) a survey of samples taken at the factory, in the course of trade or on the construction site by the manufacturer or a notified body, d) testing by the manufacturer or a notified body samples from the batch which is ready to be sent or supplied to customers, e) internal (factory) production control, f) initial inspection of factory and factory production control by the notified body, g) surveillance, assessment and approval of factory production control by the notified body. Building character, which is a trademark, pointing to ensure an appropriate level of confidence. This means that the construction product marked with it is in conformity with the Polish standard of product or technical approval. Marking a product with a construction sign is permitted if the manufacturer established on Polish territory , has issued a conformity assessment and on his sole responsibility, the national declaration of conformity with the Polish Standard of product or technical approval. Conformity assessment shall cover the performance of a building , appropriate to its purpose, which affect the fulfillment of the basic requirements of a work.

## CONCLUSIONS

Implementation of construction projects carried out on the basis of the knowledge needed for proper performance - building facility. It concerns the physics and chemistry of materials, statics, dynamics of building structures with the interaction of subsoil structures , the physics of climate, the propagation of disturbances in the subsoil in connection with extortion paraseismic in which case the valuation is predominant. Verification or assessment while is held in the time of execution of the works, and compare it with the assumptions, such as the project to the developer, building codes and regulations. Considerations of usability, quality of work are set out in most building codes. Usually, the more stringent requirements, take into account the investor’s satisfaction, comfort of future user of object. It is obvious that the requirements higher than the average are subject to individual agreements between the contractor and investor. They may relate to the ranges associated with the serviceability limit state, the bending, scratching reinforced concrete structures, the amplitude of the vibration elements or structures under dynamic loads or quality finishes, interior design, land development. The testing process can be identified by checking the correct operation of the installation system ventilation, air conditioning, fire fighting knowledge base created from building regulations and guidelines of the investor.

## BIBLIOGRAPHY


1. Wierzbicki M., Czy e-learning, zarządzanie wiedzą, jakością i procesami to oddzielne wyspy, Microsoft S.A., 2004
2. Foster R., Kaplan S., Twórcza destrukcja, Galaktyka, Łódź 2003
3. Dobija D., Pomiar i sprawozdawczość kapitału intelektualnego przedsiębiorstwa, Wyd. WSPiZ, Warszawa 2003.
4. Todman Ch., Projektowanie hurtowni danych. Zarządzanie kontaktami z klientami (CRM), Wydawnictwa Naukowo-Techniczne, Warszawa 2003

5. Dutkiewicz M., Application of artificial neural networks to support decisions in project management, Transcomp – International Conference Computer Systems Aided Science, Industry And Transport, Zakopane 2009

# SYSTEM ZARZĄDZANIA ZASOBAMI W PRZEDSIĘBIORSTWIE BUDOWLANYM

***Streszczenie***

*W artykule przedstawiono najważniejsze elementy systemu zarządzania zasobami w przedsiębiorstwie budowlanym.*

*Zwrócono uwagę na systemy Business Intelligence, techniki planowania i harmonogramowania ASP, metody oceny sprawności operacyjnej zarządzania CPM, zrównoważoną kartę wyników BSC.*

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