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KNOWLEDGE ASSETS ABOUT CONSTRUCTION ENTERPRISE COLLECTED IN THE KNOWLEDGE MAP

ZASOBY WIEDZY O PRZEDSIĘBIORSTWIE BUDOWLANYM ZGROMADZONE W MAPIE WIEDZY

Abstract

A good level of knowledge is required in order to carry out construction processes in the correct way. The knowledge is acquired from publications, documents, legal regulations, standards, but mainly from construction projects carried out. This knowledge also resides in the employees' minds. The recording, storing and processing of knowledge for the purpose of drawing inferences about future projects may aid management processes to a considerable degree. The "Knowledge Map" can be used as a tool supporting decision making on the basis of the accumulated knowledge. The paper presents benefits which stem from the use of the proposed Knowledge Map in a building enterprise.

Keywords: construction business, Knowledge Map, knowledge management, process approach

Streszczenie

Do realizacji procesów budowlanych niezbędna jest odpowiednia wiedza, którą można pozyskać z publikacji, dokumentów, przepisów prawa, norm, a przede wszystkim z realizowanych przedsięwzięć budowlanych. Wiedza tkwi także w umysłach pracowników. Zapisanie, magazynowanie, a następnie przetwarzanie wiedzy w celu formułowania wniosków dotyczących przyszłych przedsięwzięć może w znacznym stopniu wspomóc procesy zarządzania. Narzędziem wspomagającym procesy podejmowania decyzji w oparciu o zasoby zgromadzonej wiedzy może być tzw. Mapa Wiedzy. W artykule autorzy przedstawiają korzyści wynikające ze stosowania zaproponowanej Mapy Wiedzy w przedsiębiorstwie.

Słowa kluczowe: budownictwo, Mapa Wiedzy, zarządzanie wiedzą, podejście procesowe

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1. Introduction

Numerous studies have indicated that knowledge is a vital resource, therefore investing in the skills of employees and inducing them to share knowledge brings tangible benefits. Knowledge acquisition is a lengthy process [2, 7, 8]. Thus one of the enterprise's primary tasks is to uncover, locate and store the knowledge resources it possesses in order to effectively exploit it. The skilful management of knowledge may bring tangible benefits in the form of increased productivity, higher quality of the services rendered and enhanced competitiveness of the enterprise [1, 3]. The tool for locating knowledge and aiding knowledge management is the so-called Knowledge Map [4, 6]. It is a deliberately designed means which enables communication between the ones who create knowledge and the ones who use it [6].

2. Problem description

According to statistical data, there are 235173 construction firms, employing in total 616420 persons, registered in Poland. Of this number, as many as 229899 firms (constituting 97.75% of all the construction enterprises) are small firms employing fewer than 19 persons while 3474 are medium sized firms employing from 20 to 49 persons. This group of small and medium sized firms constitutes the basis of the construction industry in Poland.

The firms contend with many difficulties. Due to limited investment expenditures in these firms they often lack management aiding tools [4]. The Polish construction industry suffers from high staffing fluctuation as a result of which the experience acquired during work in a given firm dwindles as its key employees leave the firm. The means not only the loss of experience, but also a loss of potential innovations. Consequently, great amounts of time and labour are spent reacquiring the knowledge needed for work at the particular workstations and for future construction projects.

The results of the surveys and analyses carried out in small to medium sized construction firms in Poland indicate that these firms lack management aiding tools [5]. It has also been discovered that only a few of these firms have quality, environment and work safety management systems implemented. The authors of this paper propose an IT-based Knowledge Map model as a tool for aiding management in the enterprise. The principal assumption underlying the model was the combination of the Knowledge Map concept with the process approach to management.

3. The structure of the Knowledge Map

The knowledge was classified according to the following observations:
• Each enterprise is a system situated in a certain environment,
• The environment affects the activity of the enterprise.

As a result of the operation of the system, production, auxiliary and management processes are being carried out. For this purpose appropriate tangible resources (e.g. people, physical means and work objects) and intangible resources (e.g. trademarks, inventions and patents) are needed. The knowledge necessary to carry out processes is contained in documents. As

the processes are being conducted, records of their course, constituting evidence of enterprise management decisions taken, are made. For evaluation of the processes, employees, the cooperating firms and the projects being carried out are essential for the proper functioning and development of the enterprise. The results of such evaluations are taken into account when making development decisions concerning the introduction of innovations and the initiation of organizational changes. The stream of such changes amounts to new knowledge in the enterprise. The areas of knowledge identified were included in the Knowledge Map.

The structure of the Knowledge Map is shown in Fig. 1. Seven domains of knowledge are distinguished in the proposed map. Three components of knowledge are distinguished in each of the knowledge domains.
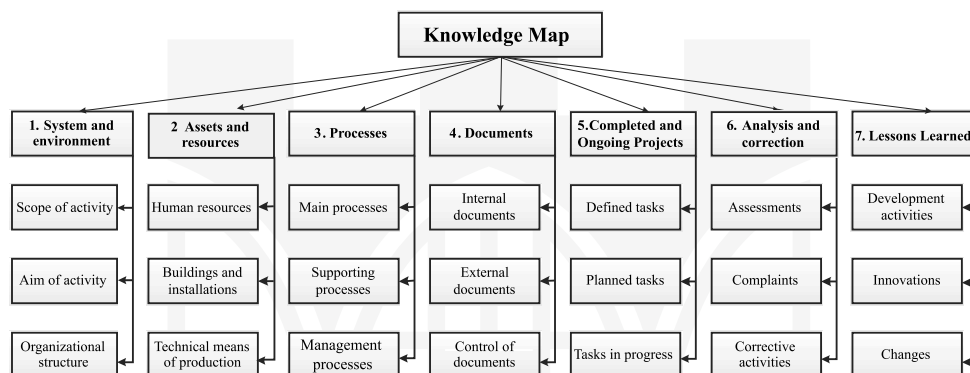

Fig. 1. Chart showing structure of Knowledge Map

4. Knowledge acquired from particular domains of Knowledge Map

The knowledge contained in the particular domains of the Knowledge Map can have a confidential or public character. Interested employees may access the particular knowledge domains after logging into the system, having previously obtained authorization from the firm's management. The information contained in the particular domains can be searched according to the adopted criteria and then printed in the form of reports.

4.1. System and Environment

The first domain entitled **System and Environment** contains information about the enterprise and its business environment, stored in three knowledge components.
• The first Knowledge Map component contains basic information about the enterprise, such as: the name of the firm, its legal entity, its telephone & address data, the number of its entry on the business activity register, the taxpayer identification number, the business activity identification number, the form of taxation, the type of accounting, the type of firm (a design, contractor or design-contractor firm), descriptive information on the scope of activity, the firm's operational and strategic objectives, the firm's main documents in the form of scans

or digital records (e.g. the firm's registration documents). The documents and information contained in the file make it easier to prepare bidding documents, contracts and other documents required for contacts with authorities, institutions and customers;

- The second Knowledge Map component stores content relating to the organizational structure of the enterprise, e.g. hierarchical dependencies between the particular organizational units of the firm;
- The third Knowledge map component contains information regarding organizations cooperating with the enterprise, such as: suppliers, subcontractors, the authorities, institutions and clients. In the case of suppliers and subcontractors, these entities can be evaluated on the basis of the history of cooperation with them to determine whether they should be considered for future contracts.

4.2. Assets and Resources

The **Assets and Resources** domain has been divided into: human resources, tangible resources and intangible resources.

- The **Human Resources** component contains detailed information on all the enterprise's employees, i.e. records, contact details, information on the position and responsibilities held, licenses and qualifications held, information on attended occupational health and safety training courses, medical check ups and the results of periodic employee appraisals. The information contained here is helpful in human management resource management with regard to the selection of employees for new tasks and their allocation within the enterprise, and in work safety management;
- The **Tangible Resources** component contains information on the machines and equipment which the enterprise has. Thanks to this, one can rationally manage the tangible resources and keep informed regarding the technical condition of equipment, condition survey dates and the availability of particular resources. On the basis of this information the user can create the firm's strategy with regard to tangible resources and make the right decisions concerning the purchase or sale of particular assets. Various schedules drawn up on the basis of the register of machines and equipment the company possesses are helpful when making decisions, seeking a new order or a logistical decision. In addition, the schedules contained in this domain, combined with the costs of maintaining the assets listed above, enable the user to estimate indirect costs used to calculate the estimated price of construction works through detailed methods;
- The **Intangible Resources** component has a similar structure. It contains information concerning software, licences, patents, etc. Information includes the name of the intangible item, its identifier (code), purchase date, purchase price, date of entry in the records, place of storing, present value and the name of the person responsible for it;
- For each of the **Assets and Resources** components, the program enables the collection and archiving of documents connected with it.

4.3. Processes

The set of processes contained in the **Processes** domain has been divided into three subsets: main processes, supporting processes and management processes. The set of main processes comprises processes relating to construction project preparation, design and implementation. The benefits for the KM user, connected with this domain are:

- This domain contains procedures for most of the main, supporting and management processes which occur in construction firms. Each of the procedures contains information about the operations and the sequence in which they are carried out, the starting documents created in the course of an operation or a process, the persons performing particular operations and being responsible for the whole process. It is also possible to record the execution time and cost of the operation;
- Standard process procedures are helpful in monitoring and assessing the processes being carried out with regard to their correctness, execution time and costs;
- In the case of an exchange of employees working at the workstations, the standard procedures facilitate their training and compliance with the new requirements in the enterprise;
- It is possible to filter the process base and carry out various analyses. For example, one can specify the responsibilities of the particular employees for the proper running of processes, find out which employees are overloaded or under loaded with work, determine the number of times the particular processes have been initiated and on this basis make a decision to outsource a process or allocate an additional employee to this process;
- The processes can be evaluated with regard to quality requirements, while the history of the evaluations can be produced for the particular processes.

4.4. Documents

The **Documents** domain has been divided into three subsets. The first subset is comprised of internal documents produced in the enterprise, such as: documents relating to the construction investment process, stemming from the building code, work instructions, directives, reports, minutes from meetings, etc. The second subset comprises external documents stemming from the rules of law, such as acts, regulations and standards. The **Control of Documents** subset specifies the persons responsible for the preparation, verification, approval and storing of the particular documents. This domain plays a major role in construction enterprise management because:

- It is possible to create a single large set comprising specimens of all of the documents adopted in the enterprise, which considerably facilitate and speed up access to them by the authorized personnel. Thanks to document specimens it is easier to generate similar documents relating to different construction projects;
- Each document includes reference to the process with which it is connected. Moreover, each document is designated with an identifier in the form of a hyperlink to the other KM domains in which it occurs, a document name, a document type consistent with the adopted classification (internal or external), and a reference to the legal basis relating to the document;
- In the **External Documents** set one can save the current legal regulations and standards, either in the electronic form or as links to relevant web pages from which one can download the document currently binding in Poland. This considerably facilitates access to current acts, regulations and standards relating to the investment process in Poland;
- Management of the documents is made easier owing to pieces of information such as: the processes in which they occur, the current version of the document, since when it has been in force, who is preparing, verifying, approving and distributing the document, the number of copies made, which persons have inspected the document, the archiving place and period and the accessibility status (e.g. confidential);

- The information stored in the **Documents** block forms the firms electronically recorded archive and it can be easily processed and analyzed (this applies to all the documents or to selected groups of documents). Manual processing would take lots of time and energy and would entail additional costs for the firm.

4.5. Completed and Ongoing Projects

The **Completed and Ongoing Projects** module stores knowledge relating to the investment activity of the enterprise. The system user will find information on the completed, ongoing or planned construction projects here. The benefits from this domain for the KM user are:
- An archive of the enterprise activities. Each executed task is described in the following way: the task name, project owner, planned and actual time of project execution and the characterization of the project carried out with regard to the processes and documents involved including material and equipment needs as well as the necessary additional studies and expert analyses;
- The module comprises a set of ready-made models which can be used in the future when carrying out the same or similar projects;
- The module facilitates the preparation of future investment processes. Using the check-up questions included in the **Planned Tasks** block one can group processes for each construction project. As a result, a set of processes involved in the fulfilment of a given customer order is obtained. Besides the processes, the required documents and the responsibilities of the personnel taking part in the project are also automatically generated;
- Knowing the project commencement date and the model durations of similar tasks the user can easily draw up a schedule for the project and specify the predicted project execution time;
- Particular projects can be evaluated using the previously adopted evaluation criteria. The evaluations can form the basis for decision making concerning the execution of similar future construction projects.

4.6. Analysis and Correction

The **Analysis and Correction** domain includes the following components: assessments of suppliers, employees and processes, complaints and corrective activities. Suppliers, employees and processes are rated in terms of quality. For the KM user the benefits stemming from this domain are:
- Assessments made using the adopted rating methods and criteria enable the user to review the human resources, the processes being carried out, the suppliers and the subcontractors in terms of quality. The ratings and their changes over time can be the basis for drawing conclusions as to corrective and repair measures which should be adopted;
- Knowledge of filed complaints regarding construction services rendered reveals the weaknesses of the enterprise, its personnel and may also indicate the topics required for future training courses;
- The corrective measures taken as a consequence of complaints and ratings are the basis for introducing changes into the current procedures and for continuously improving the quality, effectiveness and construction firm management methods.

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4.8. Lessons Learned

The **Lessons Learned** domain comprises of a register of preventive measures, innovations and a component called **Changes** used to evaluate the knowledge acquired in a considered time interval.

- All achievements resulting from carrying out construction projects, individual and team experiences, ideas submitted by employees, improvement proposals, innovations and consequent changes are recorded;
- It is assumed that the innovations submitted and the preventive and corrective measures taken will prove that knowledge is created in the enterprise. Knowledge may also dwindle. It is assumed that the evidence of this will be the complaints filed. The knowledge gained in a given time interval is evaluated on the basis of the number of the above events and their weight coefficients;
- The estimated knowledge gain values are the evidence of development, stagnation or regression in the enterprise.

5. Conclusions

The Knowledge Map is based on the results of surveys and analyses carried out in small to medium sized construction firms in Poland and on the process approach to management recommended in the ISO quality management standards. When it is implemented in an enterprise, the Knowledge Map will store information concerning:

- The courses of all the processes in the enterprise and the documents connected with the processes, i.e. those required to initiate a process, created in the course of the process and after its completion;
- The resources which the enterprise has;

- Previously completed construction projects which may be used as models for carrying out the same or similar projects;
- Suppliers and subcontractors, and especially the results of their appraisals which will be useful when selecting suppliers and subcontractors for future projects;
- Employee appraisals indicating whether the employee is diligent, what value he/she represents for the enterprise and whether he/she should be rewarded.

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