

Information systems for material flow management in construction processes

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Abstract. The article describes the options for the management of material flows in the construction process. Management and resource planning is one of the key factors influencing the effectiveness of construction project. It is very difficult to set these flows correctly. The current period offers several options and tools to do this. Information systems and their modules can be used just for the management of materials in the construction process.

1. Introduction

All resources are finite in financial terms, including materials. Their effective management, particular planning, is a must for sustainable construction. Material flow management is a challenging process and requires systematic approach. The human factor often fails to provide optimal use of material resources required in the construction process. Therefore numerous tools were developed in the digital time that offers a number of solutions. One of the available solutions is the use of information technology to support management of material flows. Information systems and modules facilitate efficient management of material utilization. This leads to optimal utilization of available resources in any form. The result is material saving and sustainable construction processes.

Information systems and especially Enterprise Resource Planning systems (ERP) are used in various fields. Construction is an area where innovative technologies are increasingly introduced. It includes not only process innovation by means of technology introduction in construction, such as new machinery and equipment, but also information and communication technology providing support for the management of the processes.

2. Information systems in construction

Construction field is characterized by fragmentation which exists both within individual phases as well as across project phases [1]. Participants from various organizations who are involved in a project phase or in different project phases are facing ineffectiveness and inefficiency in their coordination, collaboration and communication [2]. Powerful project management software has become a prerequisite to manage the projects more efficiently and effectively, and help the project managers in their decision-making [3]. The job is done easily, quickly and accurately thus constituting a competitive advantage. This may also be in the use of technologies for material flows management of construction production.

Progress of information and communication technologies (ICT) is undeniable in every field. Currently, the concept of IT (Information Technologies) covers both hardware and software which contains various essential software, application software and development resources [4]. There are all



information resources used in the creation and use of IS performance. Information and communication technologies are the methods, procedures and methods of collection, storage and processing, evaluation, selection, distribution and current receipt of the necessary information in the required format and quality [5]. Information and communication technologies (ICT) present a way that organizations can use to meet their needs related to everyday operations, which are supported by modern information systems. Alone information systems pose to the organization, in addition to supporting and management activities, they often help to differentiate from other enterprises.

In construction projects and companies various types of information systems (IS) exist, such as construction management or business software. They have been developed, applied, and widely used. The basic question is what an information system in the construction enterprise is and what features should include the effective material management. Information system represents a set of people, processes, technical and software tools providing collection, transfer, storage and processing of data for distribution and presentation of information [6]. Information systems are currently based on the use of information and communication technology. The opinions of information systems are different. In its narrowest perception IS is a hardware and software solution for processing of information for decision support and control [7].

In many construction enterprises ERP systems are used as a system designed for enterprise resource planning. Information Systems ERP represent the core of enterprise information systems and provide the greatest range of its functions and processes. ERP is a system that incorporates internal management information with the external management information that covers the sales, accounting and finance, manufacturing and customer care [8].

3. Information systems for material flow management

Construction projects are very complex in nature and integrate numerous resources. The material flows are generated between the principal contractor of the construction project and subcontractors that represent smaller companies also involved in realization of a construction project, and some of them responsible for materials supply. Management of materials flows is essential to provide their most effective use, the information systems are of great help in this regard.

ERP systems are based on a modular system where each module has a specific function (Figure 1). In Figure 1 the ERP system is made up of production, finance, human resources modules. This system is not sufficient for all needs; especially it does not address the issue of management of material flows.

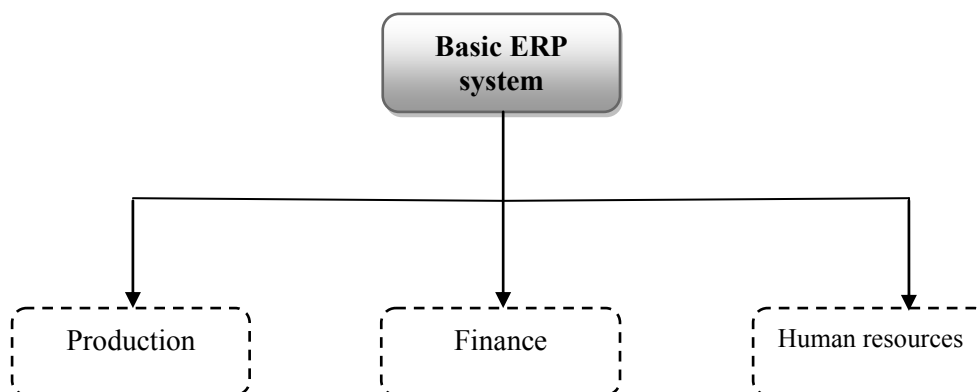


Figure 1. Basic ERP system and modules [6].

Supporting modules are important for planning and material flows management. It includes Customer Relationship Management (CRM), Supply Chain and Vendor Management (SCM), Human Resource (HR) modules and module for Finance and Accounting (Figure 2). Several sources report that the core ERP system creates only the production, finance and human resources [9]. The widespread perception of ERP also includes additional modules that extend

the functionality and potential uses. It is Business Intelligence (BI), Production, Engineering, Sales and so on.

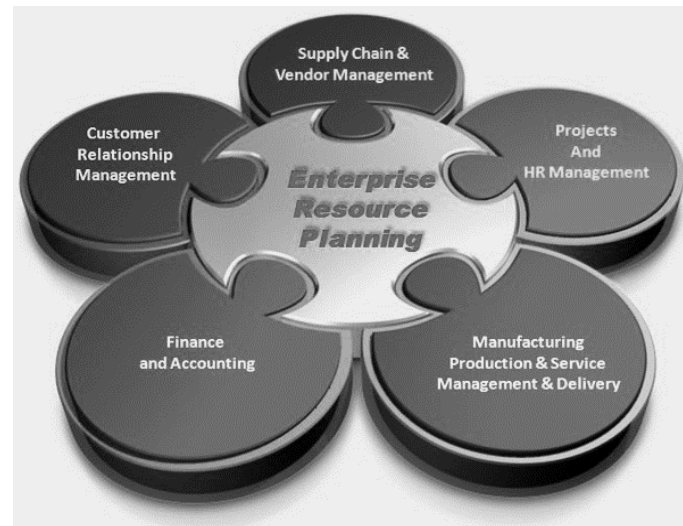


Figure 2. Extended ERP system and modules.

In terms of material flow management the most important modules are Supply Chain Management or Supply Chain and Vendor Management to management the entire supply chain.

4. Module SCM (Supply Chain Management)

The classic supply chain was essentially linear and consisted in the implementation of the basic bond:



Figure 3. The classic supply chain (material flow) [6].

In the Figure 3 the material flow direction is from the left to the right while the information flow and money (payments made for materials and services) are the opposites. Today's web-based businesses interconnect structures into more complex and more difficult ones to create mutually networked communities whose main common objective is to offer faster and cheaper desired and competitive product. It leads to exclusion (outsourcing) of a series of actions. Make use of the possibility of specialized companies, which have effective use of technology or know-how.

The supply chain today is no longer linear and covers more subjects. It can be defined as a combination of material, information and financial flows needed to ensure the development, manufacture, supply goods and services to customers - users. SCM is the management of this combined, complex flow. As SCM works well, ongoing transition from one phase to another chain is smooth. It does not include the production of unnecessary stock as well.

SCM is a set of tools and processes that optimize the management and maximum operational efficiency of all elements (cells) throughout the supply chain with respect to a customer. In case of construction it is a main contractor or investor [4]. SCM systems are a specific example of the interconnection of suppliers with subcontractors and investor, that is based on information and communication technologies. Through interconnection and exchange of information can be partners in the supply chain work to share information, plan and coordinate the overall process together in order to increase the responsiveness of the entire chain. The objective of SCM is mainly shortening

production and delivery cycles, increasing flexibility, better communication with partners involved in the chain, decrease inventory through production according to specific orders.

The basic functions of SCM solutions mainly include the following [10]:

- ensure reducing the time and cost of the material requirements,
- support planning activities,
- focus on increasing customer satisfaction (in construction it is investor or main contractor).

Management of logistics processes and the supplier relationship gradually developed, and has its history. Therefore, SCM cannot be associated only with the application of Internet technology. According to several authors five developmental stages (phases) can be distinguished in the development of SCM from the simplest forms to virtual networks [11]. The fourth level represents SCM extended supply chain in which the possibility for data exchange in the form of EDI (Electronic Data Interchange) or the internet there is an increase communication between businesses in order to reduce the time and cost of material realization. Process design and material realization gradually engages customer as well. The fifth step of SCM is a virtual network with flexible arrangement of the partners. Measure of the value that this arrangement provides is each partner in the network.

ERP systems are often supplied for a particular purpose. For the needs of the construction industry they are often modified. They often contain other specific modules to manage material and its optimum use. Setting these material flows effectively is often only possible combinations of a number of modules. Information systems containing both modules to manage material flows in construction will likely accrue [12].

Conclusion

Use of available resources is crucial to sustainability of the construction. Set these activities optimally is one of the basic conditions for successful and efficient construction project. One of these resources is also material. Setting material flows is a necessity for efficient use of materials in the construction process [13]. At the moment a number of tools exist to automate this process. These tools include the progressive tools increasingly used in construction. One option is to use information systems for material flow management in the construction process. Information systems are based on the use of ICT. ERP systems are at the core of information systems, which consist of individual modules. Information systems focused on the needs of businesses and construction are different from others. What is important is functionality management of material flows. These systems help to manage and configure the material flows.

This phenomenon is also confirmed by several studies. The use of information and communication technologies is increasing also in construction [14]. Their implementation expects a positive impact on the efficiency and coordination of construction management processes. Overall sustainability of construction and efficiency in the building process also affects the use of material resources. Therefore, one of the main functionalities of these technologies and systems is the management of material flows between the parties. This trend will likely continue. Pressure grows for effective use. Similarly, the pressure to implement information systems is increasing. This results in automated material flow management.

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