AN INTEGRATED SYSTEM
OF CONSCIOUS ENTERPRISE RESOURCE MANAGEMENT

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Abstract

Technical support and management over sales process in enterprise oriented on customer particular technical demands, require new approach in current economic environment. In the face of strong competition and tendency for costs reductions of offered technical solutions, especially with low materials value – the key task is reducing cost of technical support and sales service. It is possible by reduction of time spent by specialist working out typical, simple but time consuming the most popular queries from the customers. To this end, in existing enterprise proper project was undertaken aimed at developing a computer system integrating modules of technical knowledge data base of offered solutions as well sales and customer relationship management. The subject of the paper is the company information structure-oriented integrated system of conscious resource management. Prototype version of system was developed and is running, up to full operational stage of the system, information about exact worked solution are prohibited for publishing. Worked solution is unique on the market in the range of fixing systems what a reason to limit outgoing detailed information is. Achieved prototypes generates impressive output, with reduction of 70 [%] of time necessary to designs the same solutions with traditional tools. Quantity of mistakes on product list is almost gone, and quality of designed solutions also is significantly improved with very precise and detailed drawings. Initial results allow confirming that commence of this project it was right decision

Keywords: management, cost reduction, technical support, technical documentation, ERP, CRM, CAD

1. Introduction

An enterprise computing structure is, in most cases, formed by the following ERP (*Enterprise Resource Planning*) system modules: warehousing, resource management, delivery checking, production planning, supply, accounting, finance, human resources management (pays, personnel), sales, customer relationship management (applying to direct customers).

The aforementioned ERP modules allow the enterprise to work efficiently as far as material demand planning, production, warehousing receivership and logistics are concerned, but exclusively on the basis of past data. All the anomalies in form of unforeseen, massive single orders (which are desirable from the viewpoint of the business revenue) distort the elaborated forecasts and production planning. The broadening of the market range a company covers in forms of large investments has a result in the increasing number of possible inconvenient situations.

On the basis of experience, it can be stated that running a successful trade business in the conditions of possible inconvenient situations requires an additional support in the form of:

1. technological knowledge, for instance: selecting the right properties of certain elements (like, material, its strength), the documentation of those elements and systems like CAD in 2D or 3D, working out the material balance sheets, verifying the material availability, reserving the material for the planned delivery date, in case there is no date – stating the substitutes or the closest delivery day possible,

2. Customer Relationship Management (CRM): the identification of new customers (wholesalers, deliverers, general executives, investors, design groups) and customer quotation process.

The technological backup is, most of the time, based on individuals with proper engineering knowledge and specific knowledge of the products in use. Such a state brings about a situation

when the qualified personnel spend a long period of time on each occasion to work out typical re-applicable solutions generating little revenue. If the value of the solutions worked out is low, the technical service expensed may exceed as much as 20% of the profit, affects profitability and competition on the market in a negative way. All the solution modifications are connected with huge amounts of time spent on verifying the documentation and material balance sheets, which is why the possibility of executing more projects at a time is limited. Increasing the number of offers worked on may result in worse quality of the documentation generated and therefore, provoke calculation errors, which are unacceptable.

An investment-oriented trade business is a long-term process. Working out the solutions on the designing stage and the implementation of the project is divided in time by several months or even several years, which introduces a demand to implement a system monitoring the state of each project. The investment realization takes place after the design phase is over; the realization phase is a dynamic process involving many installation and trade companies connected with each other by different relationships, which have to be taken into account during the customer quotation phase and determine which companies are selected for the realization of the project (Fig.1).
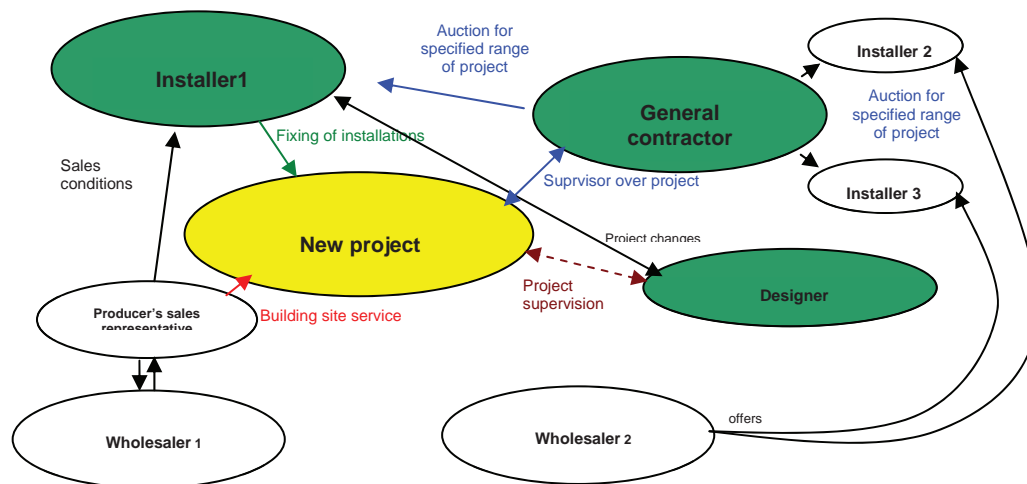

Fig. 1. The relation scheme of the companies involved in the realization of a common project

The technical support on the part of the coordinator of the project is available to all the companies involved (Fig. 1). Depending of the kind of the company, different documents essential to attest the technical solutions (from general installation schemes to technical documentation containing detailed account of the material strength) or the value of material during bidding and realization (from the overall investment value to a detailed material vs. element cost comparison) are required. The solutions worked out are similar as far as construction is concerned, and totally different when it comes to products used (for instance, the types of rails or clamping rings). It requires repeated similar installation schemes calculations and the selection of appropriate elements. The substitution of elements results in the need for changes at the figures, installation schemes and material balance sheets. It takes much time to prepare proper documentation; the calculating process itself is even ten times shorter.

The order realization process, from working it out technically, through customer quotation, order and sending off requires three phases, which, due to the lack of integral information environment, are realized by three independent modules:
1. engineering – working out technical solutions,
2. CRM – preparing offers for regular and new customers,
3. ERP – the procedures of ordering, sending off and packing the material.

The communication between the aforementioned modules is conducted entirely manually by means of a given system operator's work. That is connected with extra time required to re input

the output data of one module as input data of another; as a result of which errors connected with the human factor may occur.

The subject of the paper is the company information structure-oriented integrated system of conscious resource management. Selected problems related to the integrated system of enterprise resource management have been discussed in several references, e.g. see [1-7].

2. The resource management system solution

Product configuration systems adjust the final modular product of the technical system in agreement with customer's requirements and they are a part of sales configuration systems. In case of willingness to shorten the production cycle, to increase the number of components from outside deliverers and to make the delivery faster, the manual configuration of the product and parameter verification make the delivery time longer. In case of the configuration systems working properly, the error costs generated by configuration systems do not exceed 1% in relation to the revenue.

It is assumed that the autoimmunisation of the product configuration process has been known since 1980 and it is a subject to development. The earlier solutions failed because of difficulties connected with the management of the knowledge on implemented program procedure.

The principle of configuration systems makes use of the knowledge on management along with the user's requirements on the particular product components (Fig. 2) while the proper technical requirements are met.
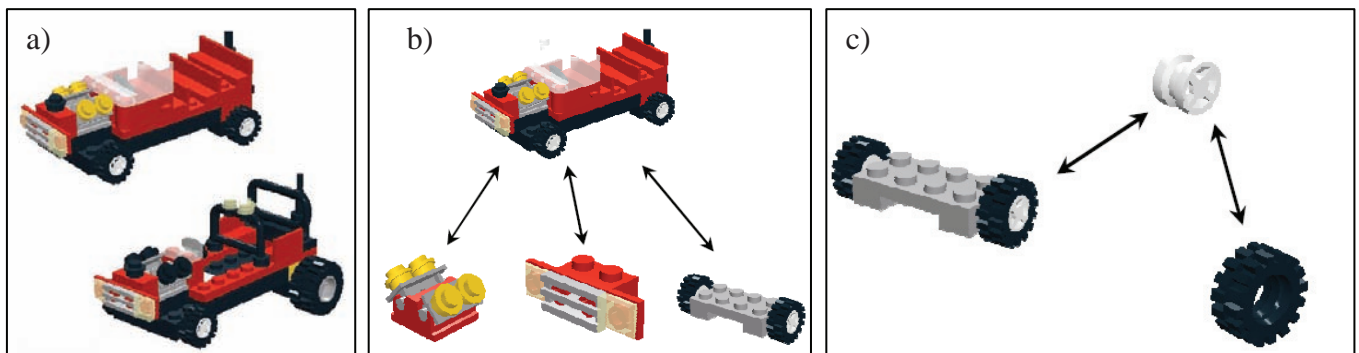

Fig. 2. The image of the product depending on the detail level: a) the final product dedicated to a customer, b) component elements of the configuration, c) the production demand for the order

Adjusting the functionality of an existing information system requires working out additional modules which are meant to communicate with the existing information system by taking and transmitting data to the existing databases presented on Fig. 3. The access to the new system is granted by means of the Internet via a World Wide Web site. A solution of that kind makes the system available to the partners of the project. The access to the system is limited by the rights granted to a user. User's account may impose: the language of the program, the language of generated documents, the technical requirements of the selected geographical area, the selection of material according to the preference of products in a particular country, access to model solutions depending on one's technical knowledge etc.

The structure of the system proposed (Fig. 3) allows for remote access to new tools by means of the Internet. The access to the system is coordinated by individual user's access rights. The system has integrated databases and the generator allowing for the exchange of data with other modules by means of XML format.

The most relevant element of the system proposed is product configuration module. This module consists of models which define the typical usage of products indicated by particular catalogue numbers (Fig. 4). A frame construction for an air conditioning device (Fig. 5) was chosen as a test model of a typical system solution.
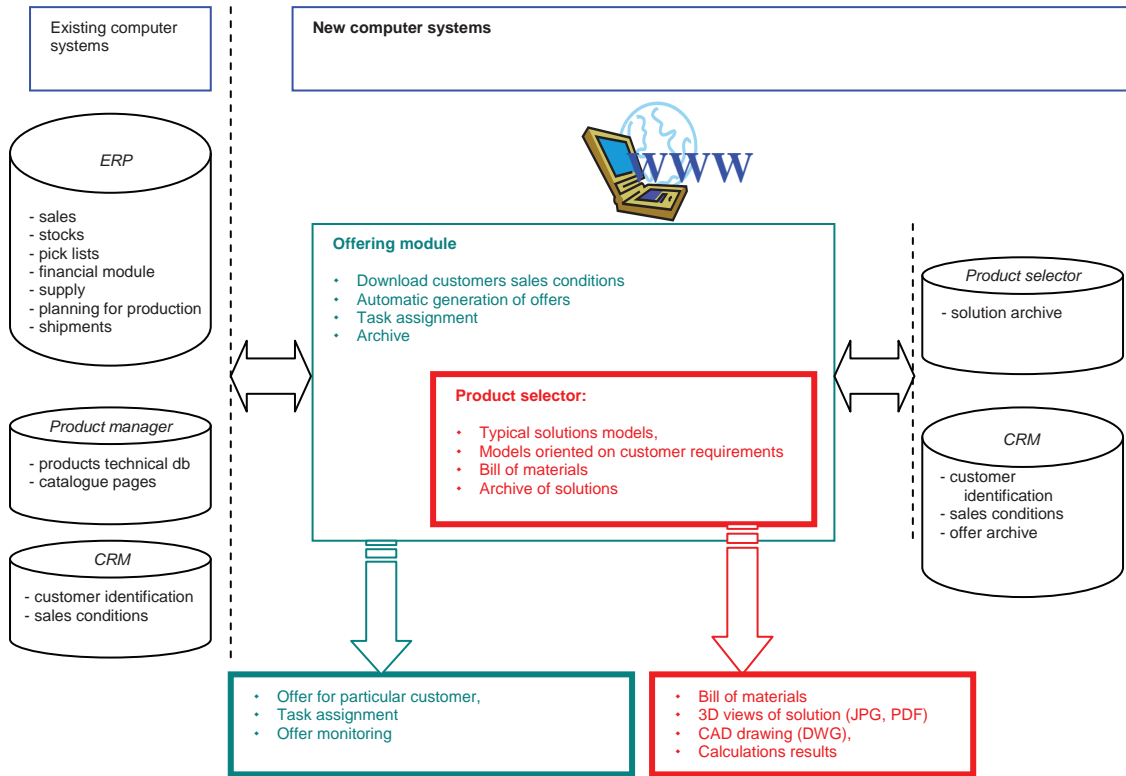
Fig. 3. The functional scheme of the existing system's expansion in order to make new tools available
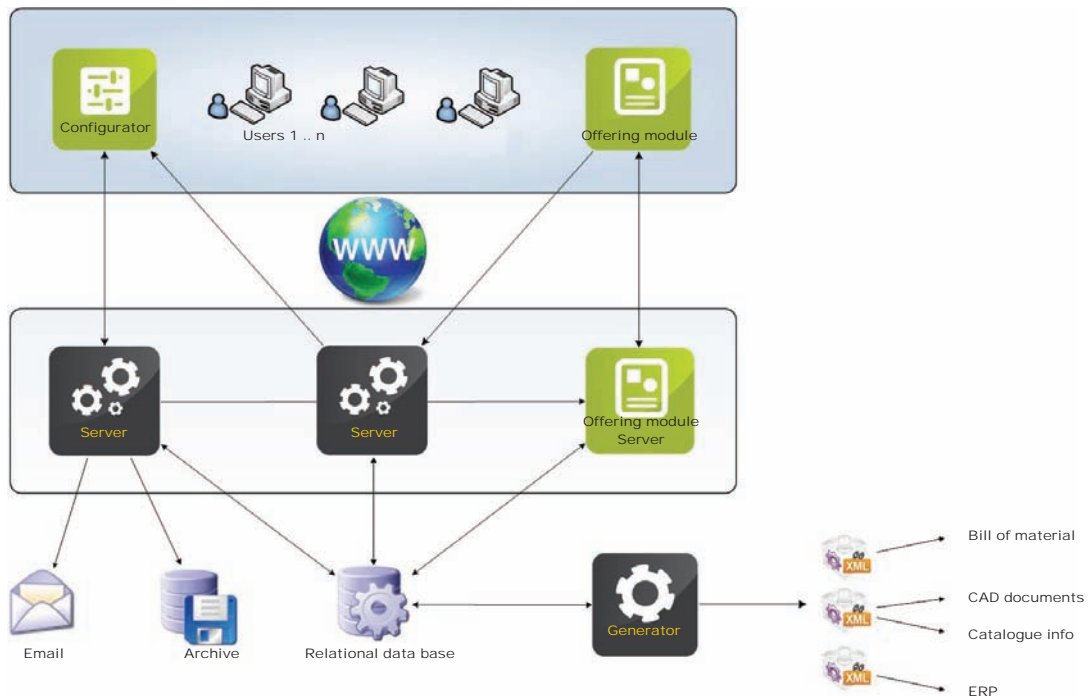

Fig. 4. The structural scheme of the existing information system's expansion

The exemplary frame is a repetitive solution, which, depending on the parameters in question, can be built of the minimum of nine products (catalogue numbers). The most complex version can be made of 19 products. The following typical solution models are even more developed and they can contain a few dozen or even hundreds of potential products. A small number of products make the working out of a model and its graphic interpretation easier. The worked out graphic model is

exported on the phase of offer generation to a format chosen by user – Fig. 5. Those can be CAD dwg files or solution images with extensions like jpg or pdf.
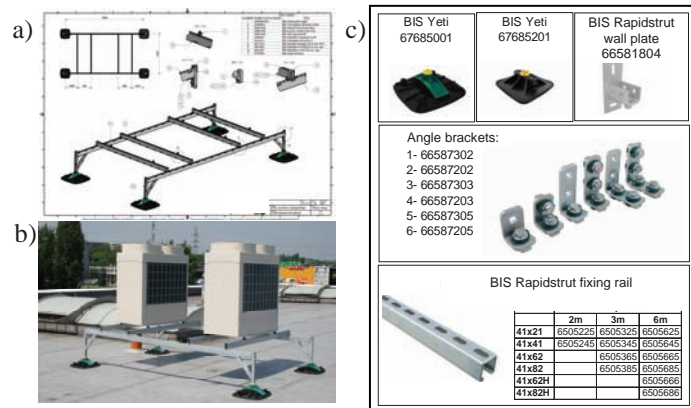

Fig. 5. A typical solution model – ACU Frame: a) a 3D picture, b) the fixed frame, c) sample products with their catalogue numbers

To choose the right frame elements, making various calculations is necessary, They allow for the preparation of material balance sheet and technical documentation. The process of designing and realizing the typical solution models is continuous; it is to begin after one model prototype, ACU Frame (Fig. 6) is tested. The configuration model allows, at the design phase, for the preview of current warehousing balance so as to enable usage of substitutes or determine the closest delivery date in case of shortage of required materials.
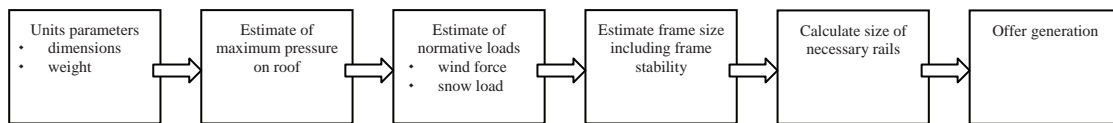

Fig. 6. The basic calculation phases of the frame material selection

The customer quotation module, on the basis of the material balance sheet prepared by the configuration model and trade regulations between customers and CRM, generates a trade offer. Depending on the customer, different offer forms (Fig. 7) may be used:
- a general one – just the value of the project,
- a detailed one – bill of material sheet
- a technical one – a full set of documents with figures and calculations.

Depending on the chosen form, a document with all the essential information is generated automatically. For an offer sent, objectives are assigned to different people by the CRM system, which defines their responsibility for the realization of the entire project.
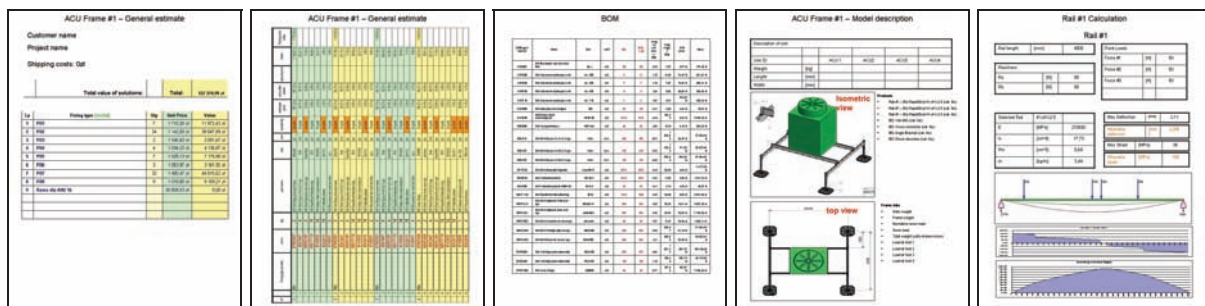

Fig. 7. View of automatically generated offer, page 1: total value of the project; page 2: detailed list of products per solution; page 3: BOM/pick list; page 4 view of solution; page 5: technical data for solution

Chosen programming platform makes possible communication with existing system modules over XML files, it provide flexibility necessary to connect existing old systems with newly designed. Moreover selected system, include object-oriented programming (OOP). It's programming using "objects" – data structures consisting of data fields and methods together with their interactions – to design applications and computer programs. Programming techniques may include features such as data abstraction, encapsulation, messaging, modularity, polymorphism, and inheritance.

Prototype version of system was developed and is running (Fig. 8), up to full operational stage of the system, information about exact worked solution are prohibited for publishing. Worked solution is unique on the market in the range of fixing systems what a reason to limit outgoing detailed information is.

a)   b)   c)

Fig. 8. View of working prototype applications: a) main application window; b) modeller window; c) view of generated *.dwg file

3. Summary

The introduction of information systems enhancing the selection of materials and the documentation building process are of particular relevance because they result in increasing work effectiveness of technical section of each company. Conjoining the material selection support system and the CRM system and supervising the realization of offers worked out provide new improvements for enterprise management. However, it is a long-term and difficult process which requires substantial expenditures and involvement in defining algorithms describing the technical solutions in use, as well as the way in which the enterprise itself functions.

Achieved prototypes generate impressive output, with reduction of 70% of time necessary to designs the same solutions with "traditional" tools. Quantity of mistakes on product list is almost gone, and quality of designed solutions also is significantly improved with very precise and detailed drawings.

Initial results allow confirming that commence of this project it was right decision.

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Selected designations and abbreviation denotations

ERP	Enterprise Resource Planning
CAD	Computer Aided Design
2D	2 Dimensional Space – a common name for Euclidean space with two dimensions
3D	3 Dimensional Space - a common name for Euclidean space with three dimensions
CRM	Customer Relationship Management
Product Manager	the name of the application used to manage product data (catalogue cards, technical specifications, photographs etc.)
Relational database	a database consisting of two or more tables connected by means of relations
ACU	Air Conditioning Unit
XML	eXtensible Markup Language – the way of describing by means of marking systems, which allows for faster and less formalized preparation of all transportable and adoptable to different kinds of media text-and-graphics documents
OOP	object-oriented programming - programming using "objects" – data structures consisting of data fields and methods together with their interactions – to design applications and computer programs.