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APPLICATION OF A SALES-TOOL FOR AN OPTIMIZED TENDER PREPARATION IN SMALL AND MEDIUM-SIZED COMPANIES

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ABSTRACT

Global competition and the high cost of production in particular in Central Europe are forcing companies to develop innovative products in shorter cycles and to increase the quality of products. To meet the expectations of customers is a key success factor. This paper describes an optimized methodology for fast, high-quality design of individual customized products. For the modeling of product knowledge are presented here methods that are being tested in a benchmark company.

Furthermore, software is presented, which allows small and medium-sized companies, to configure products for small batch and single production. The aim is to enable these companies to respond to individual customer inquiries in less time with suitable offers.

Index Terms **-** design methodology, complex custom products, early design phases, product configuration

1. MOTIVATION

The success of a production company is determined primarily by the quality of its products. This quality depends on how well the requirements of the customer, e.g. technical characteristics, delivery times and acquisition and operating costs are met.

In terms of global competition, medium-sized German companies, especially those engineering complex products, are in a good competitive position to successfully offer customized solutions that are flexible as well as economical and can be developed with relatively short delivery times [1] [2].

2. INTRODUCTION

Therefore the BMBF joint project "Optimized quotation and order transaction of complex products with conflicting requirements" (KOMSOLV) aims to develop a design methodology-oriented, integrated software solution that provides an early and deep system understanding of the offered and/or developed product.

The picture below depicts the basic idea for accelerating the quotation process while, at the same time, increasing product quality. The initial step in the process is the inquiry, in which a customer gives unstructured and unfiltered information to the company. Through the next step of the process, the information becomes structured as classes of requests are stored in templates and queried using checklists. To create these checklists, a black-box model is used to derive product-specific checklists.

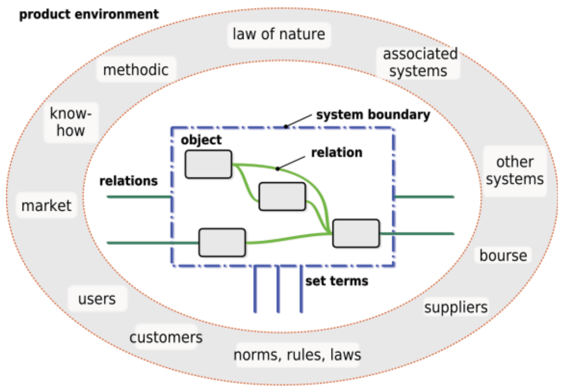

Figure 1 – black-box model

Company know-how is required to make the requested product available, but in most cases this product knowledge is not available across all departments. For this reason, a relationship system which maps all the explicit and implicit relationships within the complex product is necessary. For product configuration these relations are as a constraint-based parametric utilized. Under parametrics are here understood to include 3D-CAD models, that contain further product features in addition to the geometric information. The product characteristics are described as functional, material and economic constraints. Using this approach the sales and construction department of the company will be supported to examine the technical feasibility of the project. The holistic view of the product facilitates the preparation of a quotation, which contains fewer uncertainties than conventionally produced offerings.

To reduce the lead time for a complex technical product without sacrificing quality, the important technical specifications must be defined early for a consistently priced quotation. For this to occur, the sales department needs to have the necessary technical background to ask targeted questions about specifications during conversations with customers. During the quote preparation, however, delays arise because the sales person may not be aware of all of the relationships between individual product specifications. Thus, conflicting positions are selected during the sales process and identified only in subsequent iterations with the technical departments.

To reduce the number of iterations, a tool that reveals the relationships between conflicting technical specifications during the project planning must be available for the sales people. In context of the BMBF joint project, a software solution was developed that enables a firm to offer and develop customized complex products successfully and economically in terms of technology and time. During the software development, the aim was to create an easy-to-use and product-independent software solution. The solution provides, in particular, small and medium-sized companies with a simple and inexpensive sales-tool. In addition to this software solution, a method that can be used for knowledge acquisition and procurement within the software solution was developed [4].

3. EXAMPLE OF A COMPLEX PRODUCT

The company DESMA manufactures equipment for the manufacture of footwear. Figure 2 shows an example of a direct soling machine. In this method, shoe soles are made in an injection molding process and permanently connected to an already-made stock upper. The soles can be made of different materials and consist of several layers with different properties and colors. In many cases, midsoles with good cushioning properties can be achieved through the use of polyurethane foam and attached to a sole made of denser material. The reactions of the materials will take place in molds that are located on the so-called closing units at the rotary table. Assembly and handling equipment are centrally positioned around the rotary table.

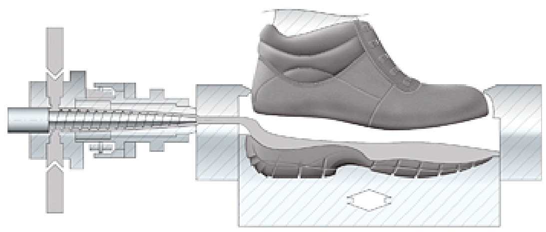

Figure 3 – direct soling [5]

During the manufacturing process, work is carried out by persons as well as robots during some steps. The manufacturing units require the use of material supply units consisting of several components to deliver color and necessary materials. When putting together a quote, all requirements and restrictions are to be considered. These requirements and restrictions arise in part from the wishes and expectations of customers, other are a result of technical and economic "necessities", laws, standards, and the corporate strategy. Sometimes the technical functions required by units to produce a specified sole can be realized by implementing pre-existing modules, equipment that has already been designed. However, in the event that the customer should require special sole qualities, characteristics that are not feasible with existing modules, new components can be constructed. The complexity of the product creation process can be demonstrated by the multitude of possible equipment combinations and varying customer requests.

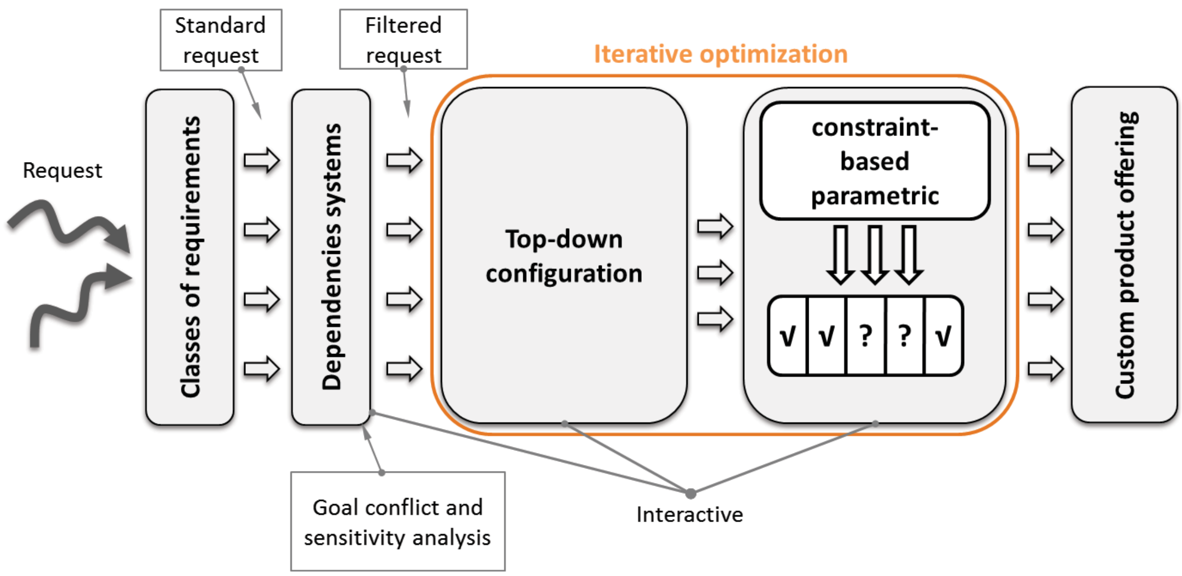

Figure 2 – The idea behind the project KOMSOV

4. TENDER PREPARATION IN THE REFERENCE COMPANY

In order to achieve the project objectives, the basic process in preparing tender preparations has been determined in the previously described reference company. This procedure can also be applied to other companies that also offer complex technical products. The basic process is shown in Figure 5.

To create an offer for a complex technical product, the overall process is divided into several sub-processes. At the beginning of this process, the customer has to ask for a customer-specific product. Therefore the customer usually gets in contact with the sales department of the company. In this phase of the process the sales person pursues the objective to determine and to clarify the task that was asked by the customer. For complex technical products, already in this phase the sales persons are in the challenge that, in addition to the economical requirements, also technical requirements for the realization of the technical product must be fixed. Thereby the sales person can use different tools, like e.g. checklists or templates. The checklists help the sales person to determine the economical and the technical requirements as completely as possible. In addition to the completeness, e.g. the order of the questions in the checklist is also important, because several questions can be based on previous questions or some questions are already excluded by previously asked questions or previously given answers. In addition to the checklists the templates support in this phase to consider technical knowledge and business strategies. In this way, e.g. conflicts between the determined requirements can be identified and avoided.

In spite of using supporting tool during the clarification of the task, it is usually not possible to consider all economical and technical requirements needed to define the product. Also the requirements are generally not determined without conflicting requirements. This is for example the case, if single components or assemblies of the technical product were developed, but the static checklists and templates are not updated until now. For this reason, the customer wishes and needs, the complex technical product should achieve, will be discussed and evaluated by the sales person and the technical departments after the conversation. In the discussion with the technical departments possible conflicts between requirements are detected. Thereby several conversations with the customer have to be done to determine the complex product's requirements finally. The iterations, however, do not encourage the customer's satisfaction and decelerate the tender preparation.

If the requirements are finally clarified, the complex technical product will be configured as a part of the tender preparation. Thereby supporting tools are also available. An example for a tool can be the product's structure and how each individual component is built. Also a number of different data of the individual components encourage assembling these into a complex technical product. The product and component data are usually stored in data management systems that facilitate finding and mapping the required information. To assemble the individual components into a complex product also the use of parametrics can help. Parametric CAD-tools e.g. can check the interfaces between the individual components and detect any conflicts. Finally in the configuration phase, the product can be analyzed by simulation tools, which can optimize the overall system and the individual components as well.

In this phase of the tender preparation, the results of the configuration are reviewed and improved, if any conflicts are found. This step also decelerates the tender preparation.

After the complex product is finally configured the tender for the customer and the additional information are created. Here e.g. visualization tool help to show the customer the offered product.

5. TOOLS FOR PRODUCT CONFIGURATION

Especially for highly standardized products, numerous systems are available to support the configuration of products. Available configurators can be classified by varying characteristics, such as the

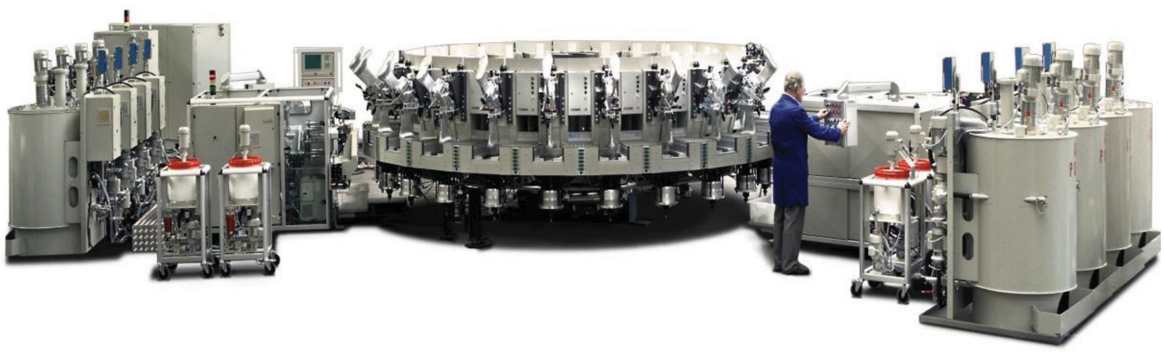

Figure 4 – Picture of a direct soling machine

nature and structure of the stored knowledge base, the type of access options and integration into a system landscape, or the possible exchange formats and interfaces [2] [3]. Usage differences exist among Configurator users. Customers can use the configurator directly to send a request to the manufacturer or the supplier. The other group of users consists of manufacturers who use a configurator to configure their own products, allowing them to meet the requirements and desires of customers. This can further be distinguished by whether the configuration is carried out by the sales department or is used by the engineering department of the company. The underlying knowledge base must store product knowledge in a form suitable for the particular application [3].

A popular example of product configurations is configurators for automobiles, which are available on the Internet. These configurators can be operated directly from end users and usually rely on a sequential logic of rules.

6. APPLICATION

In order to show a sales person conflicting relationships, thorough technical knowledge about a complex product must be gathered first. Usually, complete knowledge of a technical product is not available centrally, but rather locally in the individual technical departments. Often, initial problems with the acquisition of data become apparent at this early stage because conflicting relationships between the technical specifications are not readily known among different departments. Therefore, a challenge with the software solution was to model the locally available product knowledge in a common data structure and to be able to correct possible changes in the data structure easily.

For this purpose, a user interface was created in which the product knowledge can be modeled graphically (see fig. 3). As part of this project independent configuration software was developed by the company SBS [6] for the realization of a constraint-based product configurator. In developing the software found the previously described processes of the users and knowledge about the different technics of tools for configuration systems consideration. For this purpose, a user interface was created in which the product knowledge can be modeled graphically. In the user interface, the sales-relevant components and parts of a technical product are created initially. These are represented symbolically by using simple boxes. To each component or part, several properties can be assigned. These properties are needed prepare and offer a consistent quote of the complex product to the customer. Following that, interdependent components and part boxes are hierarchically structured in a tree according to increasing complexity and are connected by lines. The lines between the boxes can have different characteristics and represent the implicit relationships that occur within the product structure. For example, “must”, “optional” or “either/or” relationships between two components or part boxes can be shown graphically. A few explicit connections that cannot be represented hierarchically can also be formulated in a separate text window as code.

Once the entire sales-relevant knowledge about a complex technical product is gathered in the user interface, the graphically generated data structure can be converted into a so-called product solution tree. Due to the implicitly and explicitly modeled relationships, this product solution tree can be formed in such a way that a customized solution can be configured. To validate the newly created solution, the software tool was used for knowledge acquisition in a medium-sized company. In order to thoroughly gather the sales-relevant knowledge of the entire product portfolio, about 1000 sales positions had to be included in the tool.

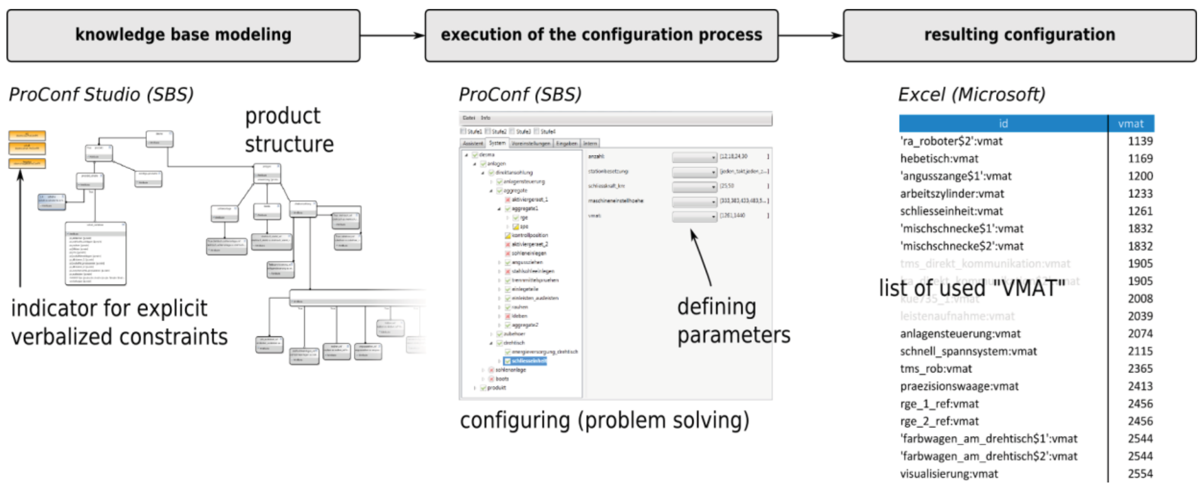

Figure 5 – The configuration process for complex technical products

Since the product knowledge in the reference company was only available locally, the technical products were analyzed and a provisional tree in the software was modeled prior to the acquisition of knowledge. Subsequently within two days, the product knowledge was gathered in the technical departments and added parallel into the previously created hierarchical tree structure. During the knowledge acquisition, any mistakes found in the preliminary tree were discussed with the departments and changed within the structure. In addition to the implicit relationships, which are graphically modeled parallel in the user interface, the explicit relationships between components, parts or component properties were initially verbally documented. Thereafter, cross-departmental relationships were compared and potential non-compliances were discussed with the departments extensively. This could also be initiated during the acquisition knowledge transfer between different departments. Finally, the explicit relationships were entered as code in the separate text editor of the user interface. After the knowledge acquisition, the data structure was converted into a product solution tree. Using the solution tree, the completeness of the results was checked by configuring a complex reference product. Here, the reference product was configured almost completely. Afterwards, those reference product relationships that had not yet been included in the user interface can be added easily. Thereby it was shown that the completion of product knowledge can be ensured in the software-testing phase in the engineering departments following the initial acquisition.

During project planning, all of the specifications of a complex technical product are usually not fixed by the customer. Instead, it is the task of the company to make decisions for the customer regarding several specifications. For this reason, it is possible within the tool to generate a sales view of the product knowledge in addition to the technical view. In this view, any questions can be determined individually. This gives each sales person the ability to configure his necessary questions tailored to their personal negotiation strategy. Due to the existing product solution tree, no contradictory sales positions can be selected.

To automate the complete selection of technical specifications, standard configurations can also be defined in the software solution. These standard configurations complement the specifications selected by the salesperson. For example, different default configurations for different customers or different markets can be preset.

The results of a configuration can be further used in subsequent process steps. These process steps include the visualization of the projected plant layout as a 3D model, the demonstration of shoe manufacturing using the 3D model, and preparation of a quote for the customer.

The identification of the sales positions as a so-called „Vertriebsmaterial“(VMAT) provides a unique key to further information associated with the final configuration. The chosen architecture of the developed software allows the output to be flexible. A list of all VMAT used in the configuration can be output as a structured text file in different formats , for example, as a comma-separated values (file) for further use in Excel or XML file for other specialized applications. The visualization and simulation of motion sequence is performed by 3D software called Create [web], which displays 3D components derived from the CAD construction data. As preparation for use in the model, an authoring tool is used to obtain the necessary information about the components' movements and location in the plant. Each individual component is identified by the VMAT. For the automatic assembly of the projected plant layout, it is enough to import the VMAT list.

The visualization of a shoe machine is shown in figure 6. The interaction between components can be seen in an animation of the 3D model. The components communicate with each other in the assembled state. Thus, the process of shoe making can

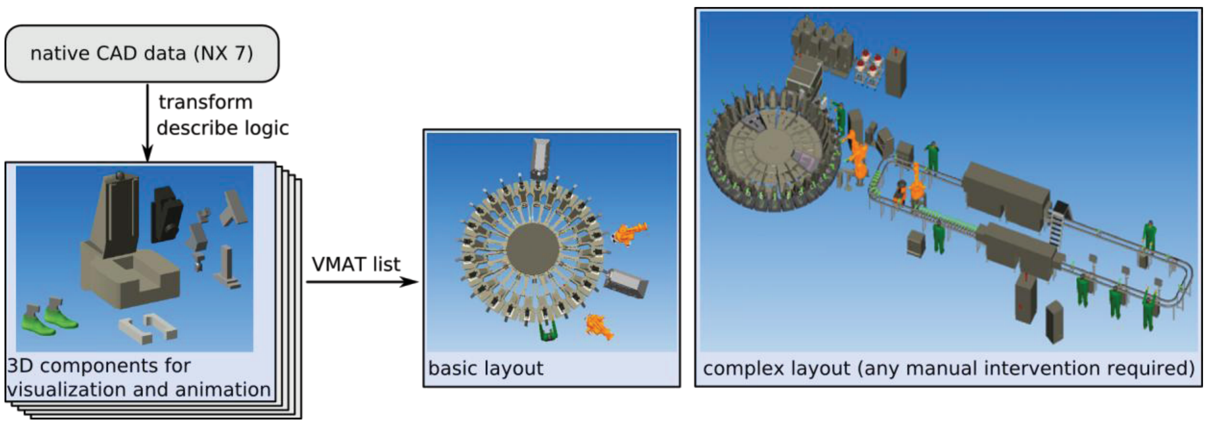

Figure 6 – Visualization of the layout

be presented through virtual reality, giving an advantage to the company DESMA when making sales calls with customers. Complicated procedures and innovative technology can be presented to the customer in a simple way.

The visualization and animation of a requested configuration file as an image and video or 3D Create Project file can be made available to the customer. For the display, the customer can use a free viewer for the software. The quote can now be done in Excel by using templates. Missing information such as the address of the customers can be manually entered into. The VMAT-list of the configuration is used as input for the generation of the quote. An export from the visualization software is also available.

7. CONCLUSION

The entire process from the customer's request to an individual offer is supported by methods and software. By using the configuration tool complex technical products can be offered in shorter time and the quote preparation will be enhanced. As a result of the complete knowledge acquisition, the product knowledge is documented in a sustainable manner and allows for an exchange between the technical and the sales departments. To use the product knowledge with other departments, interfaces to other tools such as SAP and CAD can be created.

For the process after the successful configuration and visualization of a project have to be established mandatory guidelines. In the case of the storage of the product knowledge, care must be taken to avoid redundancies and that there are clear interfaces to other systems.

8. ACKNOWLEDGMENTS

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