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COMPARATIVE ANALYSIS BETWEEN CPQ SYSTEMS

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Abstract: The industry nowadays is faced with a new generation of fully digitalized factories. Industry 4.0, as the fourth industrial revolution, is already underway in many countries. This ensures the survival of the industry and its competitive development in modern conditions. One of the most important part of digitalization is communication between customers and manufacturing via product developers. Many products today can be automatically driven between customers and production via Configure Price Quote software (CPQ). In this modern systems, the role of product developer is to make an automatic bridge between customers and production. An example of CPQ in in-house solution software is shown in this paper. The aim of the paper is to show advantages and disadvantages of CPQ system usage.

Key words: automatic design, configure price quote, manufacturing and product development

1   INTRODUCTION

Nowadays, the industry is growing very fast and as a consequence of that, it is faced with a new generation of fully digitalized factories. With digitalization and process automation, the today's industry is called Industry 4.0. The digitalization and automation ensures industry and its competitive development in modern conditions. One of the most important part of industry digitalization is communication between customers and manufacturing via product developers and product designers. Today, many products can be automatically designed and put to manufacturing automatically between customers and production via Configure Price Quote software packages (CPQ). In this modern systems the role of product developer-product designer is to make an automatic bridge between customers and factory production. These systems are very suitable for typical products such as: truck trailers, process equipment, doors, windows, aquariums, cars etc.

The ideas of automatic products configuration by customers comes in the

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Internet era. One of the first researches on this topic was conducted by *Franke* [1], who introduced an idea of configuration procedures and problems scaling. *Balakany* et al. [2] developed one of the first automatic design configuration algorithms. *Bowen* [3] used a functional reasoning approach to develop automatic configuration processes. At the following years, a whole conference sessions were made based upon this topic [4]. Nowadays, customers want mass customization in a large portion of the industry. Due to this need, many solutions appeared with sales configurators which helped customers tailor all kind of goods and services to their specific needs [5]. Some of those solutions are based on functional reasoning and some of them are based on product configuration design matrix [6]. As a results of research, some of those solutions are developed as in-house solutions [7]. Some of them are developed for mass commercial usage such as ConfigureOne [8] and DriveWorks [9]. Many students used these tools in performing their doctoral, masters or bachelor thesis tasks [10-12].

An example of CPQ in in-house solution software is shown in this paper. The aim of the paper is to show advantages and disadvantages of CPQ system usage.

2   DESIGN PROBLEM STATEMENT

The company, which makes acrylic windows for pools, is presented as the example of CPQ system usage. This example is given because of the products simplicity and easier understanding of the CPQ system functioning. The acrylic pool window types, which are implemented into the CPQ system are given in Figure 1.

a)

b)

c)

d)

Figure 1. *Acrylic* pool *window types: a) 3 side supported window; b) 4 side supported horizontal window; c) 4 side supported vertical window and d) L shaped vertical window*

For all acrylic pool window types shown in Figure 1 it was necessary to make a complete CPQ solution from customer inquiry to the production and installation documentation.

3   COMERCIAL SOLUTION

For showing a commercial solution example a Driveworks CPQ software is considered. The DriveWorks has six stages in creating the bridge from customer to manufacturing. The administrator panel of DriveWorks is shown in Figure 2.
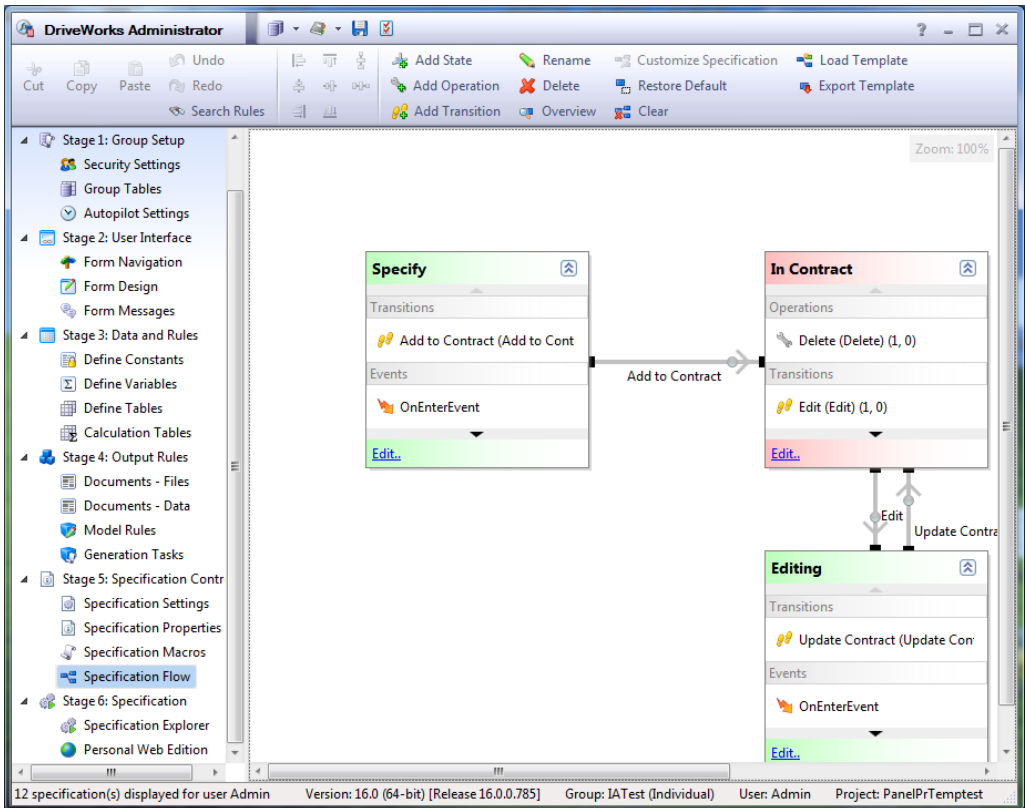

Figure 2. *DriveWorks administrator panel*

The stages in establishing the CPQ system with DriveWorks are: 1. product group creation; 2. user interface design; 3. data and rules processing; 4. output rules setup; 5. product specifications control setup and 6. product publishing.

A product group is shown in Figure 1. The product group is defined by enterprise needs and products, which they can offer. Usually the products with large amount of similarities are grouped together.

User interface is strongly connected with product group. User interface can have a static product images or interactive 3D views which are changed when customer picks up some characteristics from interface (as for the some reducers or pneumatics manufacturers sites are doing). The proposal of product interface is shown in Figure 3.

Choose from our Pool Products

Please select the product type you wish to quote.

a)

3 Side Support Vertical Panel   4 Side Support Horizontal Panel   4 Side Support Vertical Panel   3 Side Support L Shape Panel

Panel Length	10
Panel Height	24
Panel Thickness	4

3D Preview is not supported in this mode.

370

b)

625

Figure 3. *User interface: a) product pick page; b) product configuration page*

The interface has a most important task, which is to take all the necessary data from customer in order to have a product completely defended. In the showcase, it is panel length, height and thickness. As well it can be setup in the way that customer gives a water depth for panel and the DriveWorks does a thickens calculation in the background.

Based on the entered data into the interface the rules stage is acting. The rules stage is used to perform a necessary background calculation and prepare the entered data to be used in CAD software.

Output rules does the CAD part. Those rules are connected with CAD models and drawings. When the CAD model, based on call function is complete it is sent to the next stage.

A pre-final stage, product specifications control setup, is used for human factor involving. In this stage, a supervisor checks an automatically driven documentation, and decides whether it is going to the production after the customer signs order or to be done manually.

In the final stage customer is getting a custom drawings for requested product all along with quote and order to be signed. After customer signs order, signed drawings are going to the production. Many of these workflows can be automatically driven so the possibility of error occurring is minimal. The commercial CPQ solution is automatically connected with enterprise site, so the updates are momentary. The CAD communication can be directed with up and running SolidWorks or via call function commands.

4   IN-HOUSE MADE CPQ SOLUTION

In-house solution has a similar logic, but a bit different procedures. In the in-house solution there are a bit of more manual work. The interface of this solution is same like for the commercial solution. The product configuration page, called the intake form as well is a bit different. The product configuration page for 3 side supported window is shown in Figure 4.
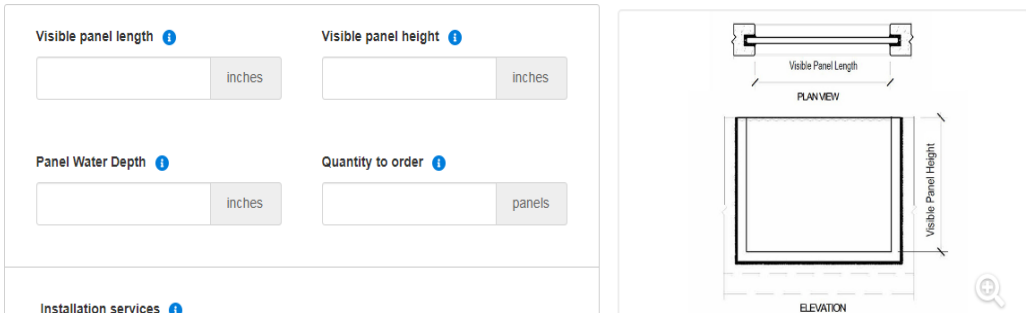

Figure 4. *Product configuration form*

The product configuration form for the in-house solution is a less attractive related to the commercial one. This page has stationary images, which are not attractive as 3D interactive views. When the customer fills this form, the information can be stored on enterprise website or it can be sent to the CRM system or even can trigger the CAD software automatically.

The biggest difference between this solution and commercial one is in the rules. If the rules calculation is simple it can be implemented directly into website and send the final data to CAD software or, if is a bit complicated it can be sent as taken to the CAD software for calculations and further operations. This is the biggest challenge in in-house solution. Commercial solutions are directly connected to CAD software, while the in-house solution requires rules programming directly into CAD based on the data taken from customer. This action requires the advance CAD users with strong background in physics, mechanics, economics and programming. For this example the CAD software used for problem solving is Autodesk Inventor. The communication form between CPQ webpage and Autodesk Inventor is shown in Figure 5.
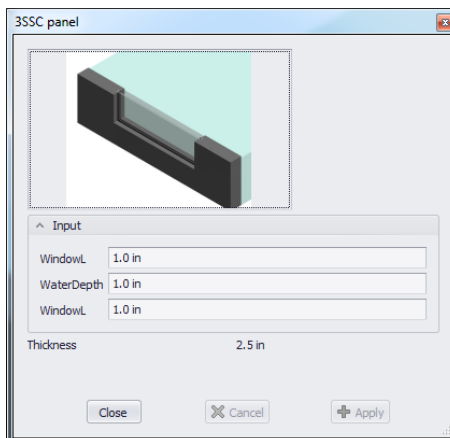

Figure 5. *Communication form between CPQ and Autodesk Inventor*

In the background of the form shown in Figure 5. the hydrostatic pressure calculation is conducted. Based on the pressure value, other rule is calculated required panel thickness and determined the standard dimension. After all model rules are done the product configuration is automatically updated. After update, the automatic drafting is triggered by event rule. The output in the form of the manufacturing documentation is shown in Figure 6.
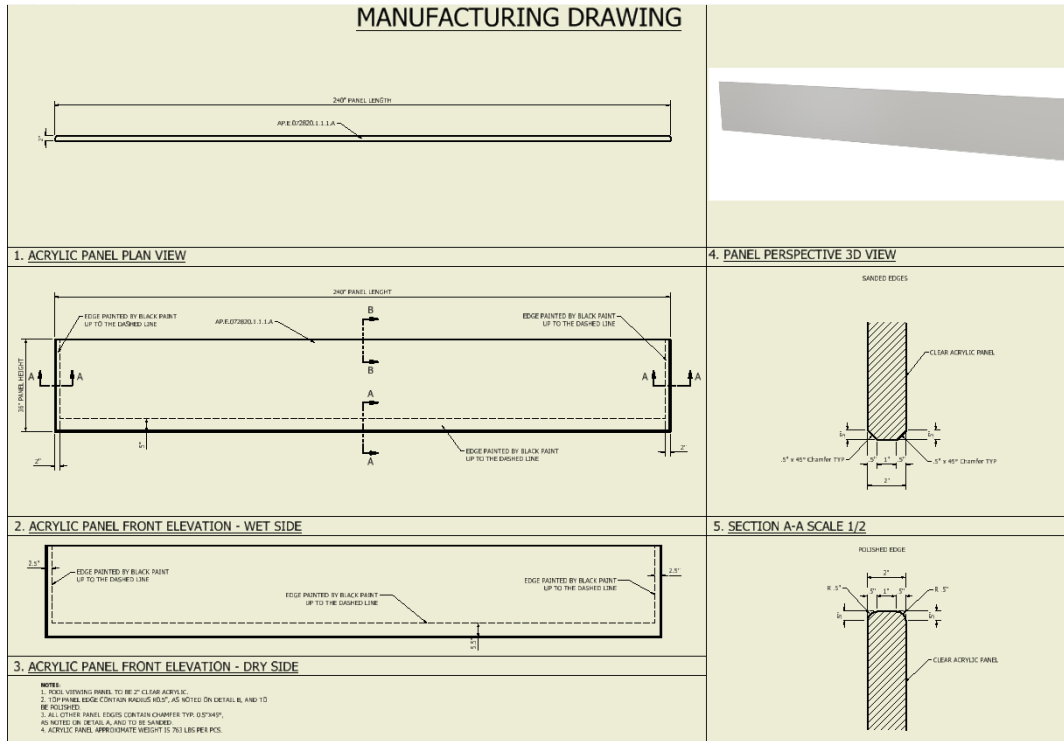

Figure 6. *Automatically gained manufacturing drawing*

The last step is to delegate the files. This action can be performed by CRM tool, or if the company does not possess it, if it is the small company, file delegation is performed simply by e-mail. Customer gets a quote and drawings. After signing order, the drawings can be sent to manufacturing.

5 CONCLUSIONS

Both solutions, commercial and in-house have, as well, their own advantages and disadvantages. However, the CPQ systems have a general disadvantages such as:
- the implementation of any CPQ solution is time consuming process;
- the CPQ solutions are expensive for small businesses;
- the adding of new products to the system can be expensive, time consuming and potentially it can cause problems in solution working;
- the CPQ is not suitable for all types of products, especially in products which is not supporting modularity.

But the CPQ systems has, as well a big advantages such as:
- when the system is built, the amount of necessary administrative and engineering staff can be significantly decreased, which is very positive for big companies;
- the mistakes in product design and documentation is fully avoided;
- the customer has a full control on the offered product options;
- the deals between enterprises and customers has a much easier flow etc.

The in-house CPQ solutions has one very big advantage related to the commercial ones. Their main advantage is the lower price and limitless flexibility in the system organizing. However, the problems like software bugs can occur, the product updates are harder and so on. The commercial CPQ are more expensive but they have a much easier integration with CAD software. For some CAD packages, a specialized CPQ software is made like Autodesk Inventor and SolidWorks. The commercial solution is much easier for product changes and updates conducting. The usage of these systems, its type choice must be based on company size, turnover, products customization level and so on.

The future authors work in this field will be related to implementation of these tools into advanced CAD courses at their Institutions as a very perspective and attractive tool, which can be very successfully used in practice.

ACKNOWLIDGEMENT

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