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SOME RESULTS OF THE IMPLEMENTATION OF THE MC CONCEPT IN SMALL COMPANIES

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ABSTRACT
The paper will show some practical results of the implementation of mass customization in small companies. Two production programs will be presented, suitable for involving customization in the particular market segments. The first industry solution deals with a furniture production program for shops and boutiques where strategy enables variation of available modules, dimensions, colors and shapes, while the second industry solution offers possibility to design and personalize gates, fences, balcony rails and stair rails made of wrought iron. In both cases, modules used for customization are prefabricated in mass production. The paper will focus on the developed product configurators for the above mentioned production programs concerning product structure, choosing relevant product features, programming language and some early results of their implementation.

KEYWORDS
Mass Customization, Product Configurators.

1. INTRODUCTION

1.1 Product Configurators

Recently, a new set of design solutions, called Product Configuratiors (PC), have become significant in addressing many of the design issues related to mass customization. They are systems that create, maintain, and use electronic product models that allow complete definition of all possible product option and variation combinations, with a minimum of data entries. This capability is essential for companies offering unique configurations to satisfy specific customer needs. Configuration is "*…the construction of a physical system according to specifications by selecting, parameterizing, positioning and assembling instances of suitable existing component types from a given catalog*" [2]

Despite a huge number of variations, the electronic systems with a mass customization interaction platform consist of tree main components:

- The *core configuration software* presents the possible variations and guides the user through the configuration process, asking questions or providing design options. Consistency and manufacturability are also checked at this stage.
- A feedback tool is responsible for presenting the configuration. Feedback information for a design variant can be given as *visualization* and in other forms (e.g. price information, functionality test etc.) and is the basis for the trial-and-error learning of the user.

- *Analyzing tools* finally translate a customer specific order into lists of material, construction plans, and work schedules. They further transmit the configuration to manufacturing or other departments.

One of the basic divisions among configurator solutions is the type of interaction with customers. Figure 1 shows online and offline options with possibilities of different programming language realization.

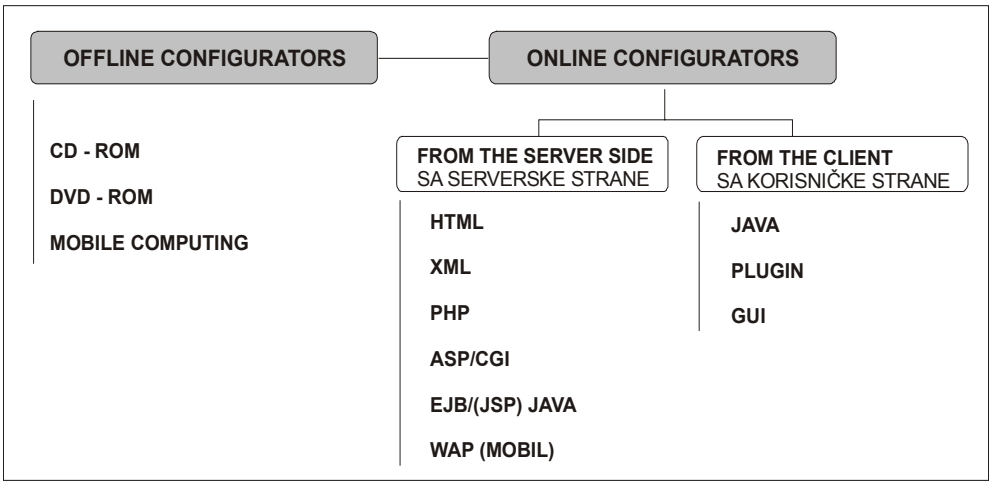


Figure 1. Available technologies for configurator design

Product configurators in conjunctions with CAD/CAM systems and flexible automation (e-factories of the future) have the potentials to achieve the goals of data management systems with regards to rapid product development. These product configurators have emerged as the newest design tools for 21st century product development and will play a key role in realizing the goals of mass customization. Since, CAD is essentially the design portal for products, software that directly translates customer requirements into design concepts in the CAD system in necessary. Product configurators fill this need to link the customer requirements to the design stage. Designers or end customers use product configurators to create a product from a set of predefined options or variables. Configurators range from simple tools within limited options to complex rules based systems that bring together all of the parts, products and processes to meet the customer specifications.

Figure 2. Example of Škoda wehicle configurator

The procedure for building product configurator systems is based on several theoretical domains including:

- **Modeling concepts** – based on object orijented modeling,
- **Product analysis** – dealing with the transformation of product knowledge into a product model,
- **Organizational aspects** – how to organize the development of product configuration systems,
- **Development of business process** – how to identify and redesign new business process.

1.2. A procedure for building configurator systems

Procedure for building configurator systems for mass customization, takes few steps as follows:

1. **Process Analysis**

Analysis of the existing specification process (AS-IS), statement of the functional requirements to the process. Design of the future specification process (TO BE). Overall definition of the product configuration system to support the process.

Tools: flow charts, Activity Chain, Model, key numbers, problem matrix, SWOT, list of functional describing characteristics and gap analysis.

2. **Product Analysis**

Analysing products and eventually life cycle systems. Redesigning/ restructuring of products. Structuring and formalising knowledge about the products and related life cycle systems in *a product variant master*.

Tools: List of features and product variant master.

3. **Object Oriented Analysis**

Creation of object classes and structures. Description of object classes on CRC-cards. Definition of user interface. Other requirements to the IT solution.

Tools: Use cases, class diagrams and CRC-cards.

4. **Object Oriented Design**

Selection of configuration software. Defining and further developing the OOA-model for the selected configuration software. Requirements specification for the programming including user interface, integration to other ITsystems.

5. **Programming**

Programming the system based on the model. Testing the configuration system.

6. **Implementation**

Implementation of the product configuration system in the organisation. Traning users of the system, and further training of the people responsible for maintaining the product configuration system.

7. **Maintenance**

Maintenance and further development of the product and product related models.

2. INDUSTRY SOLUTION

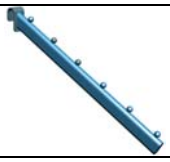
This chapter deals with building and implementation of the configurator systems on two production programs in domestic companies.

2.1. Furniture for shops and salons

The first example, presents the successful application of MC concept on production program of furniture for shops «ŽAKO» Stara Moravica. Production program is developed using modular principle, and operational group of parts are formed, giving them max. level of customization according to technological capabilities of manufacturer. Table 1 shows ten operational groups of parts from which one can easily build wall shelf, as well as attributes allowed to be customized.

Figure **3** shows structural scheme of the complex product – product master, capable to encompass all modules (subassemblies and parts) and their operational groups. Configurator system for this product is developed in offine internet surrounding, and Figure 4 presents one segment of the customized wall shelf.

Table 1 Operational group of parts of the furniture

OG1 Metal bar	OG2 Wall clamp	OG3 Adjustable foot	OG4 Shelf carrier	OG5 Shelf
				
Attributes: Dimensions: Color:	**Attributes:** Color:	**Attributes:** Color:	**Attributes:** Dimensions: Color:	**Attributes:** Dimensions: Material: Color:
OG6 Wooden ball	**OG7 Connect. bar**	**OG8 Stend carrier**	**OG9 Stand**	**OG10 Cons. shelf carrier**
				
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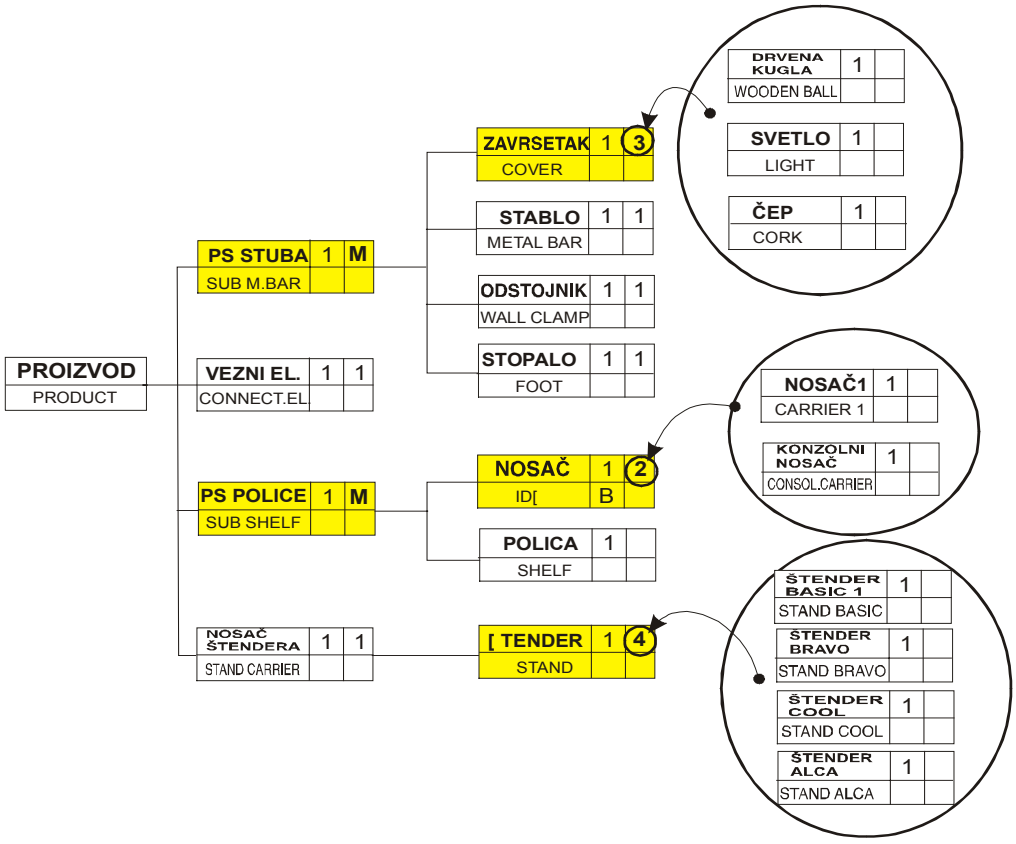

Figure 3. Structural scheme of wall shelf for shops and salons – product master

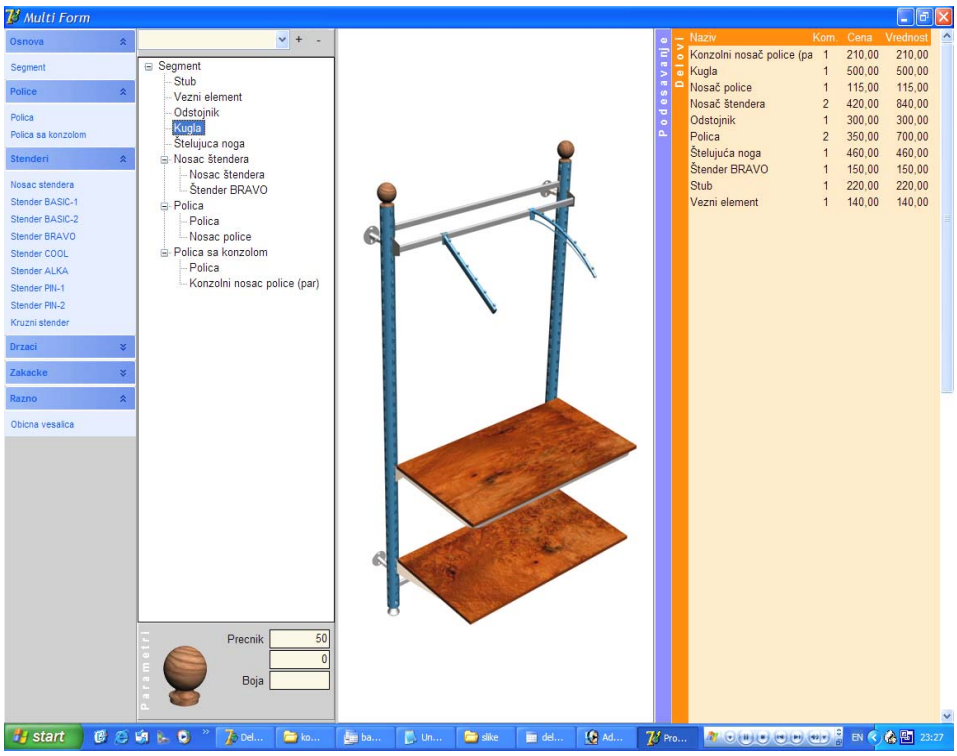

Figure 4. Product configurator – furniture for shops and salons

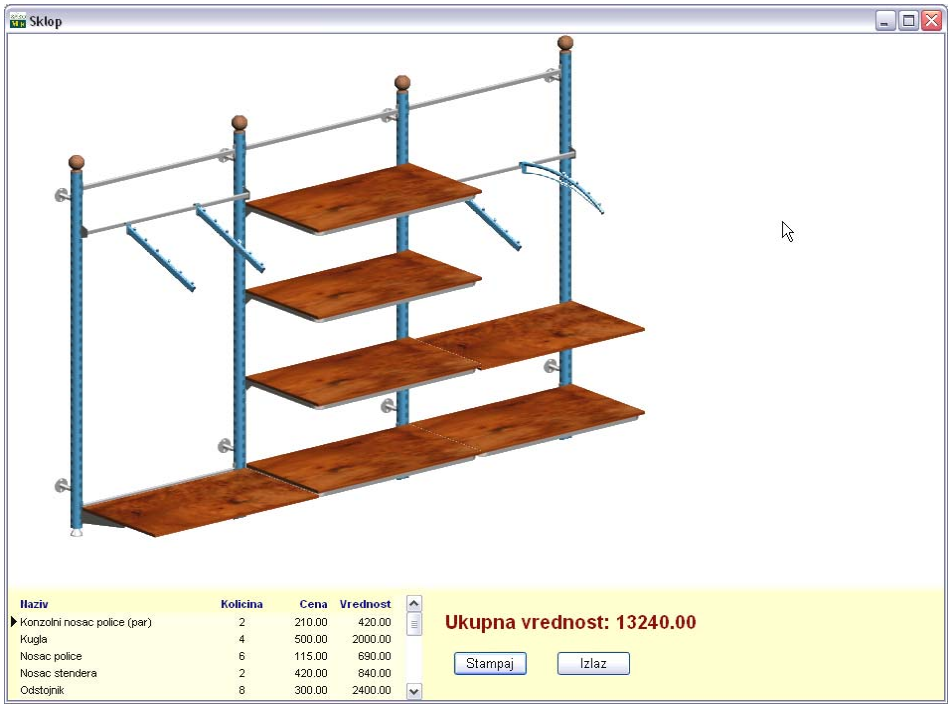

Figure 5. Report preview of the configured product - ready for printing or e-mailing

2.2. Wrought iron products

Assortment of products made from wrought iron is quite wide, but the main representatives are:

- gates,
- balcony rails,
- fences,
- stair rails,
- furniture and other objects.

gates

balcony rails

fences

stair rails

Figure 6 Basic products from wrought iron

Products made from wrought iron have several centuries long history, and traditional technology assumes comple-tely hand forged manufacturing. Recently, there is huge number of mass produced elements present on the market, manufactured on high productive forging machines, available at every large supplier of building material. Emerged situation opened the possibilities of applying MC concept in this area, though designing of customized products from prefabricated elements, slightly expensive from classic metalwork made from steel shapes.

Current situation on market in this field and the prices are given bellow (materian and work included):

- products made from steel shapes, the price is 100 €/m2,
- product made prom prefabricated forged elements, the price is 200 €/m2,
- taylormade products, completely hand forged, the price is 600 €/m2,

which has opened possibilities for new niche markets, similar to other fields.

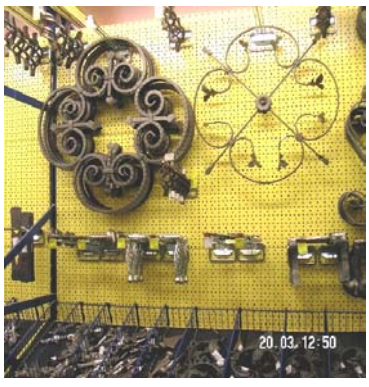

Figure 7. Mass produced elements made with forging machies

2.3. Building product configurator

Due to limitation, the paper will cover only principial development of the gates, as a part of the production program. After the anlyse of available gates made from wrought iron, four basic types are pointed out:

- sliding gates,
- one wing gates,
- two wing gates,
- four wing gates

Figure 8 shows sketches of basic gate types, which are in the same time complex products representatives.

In addition, seven operational group of parts are given, with the minor part of the total number of elements, together with parameterized sketches for the complex representative of the group, used for designing all four types of gates.

Table 2.Operational group of parts from the wrought iron

Operational group of parts		Complex product
SHARP END	p_{11} p_{12} p_{13}	OG1
S-CURVES	p_{21} p_{22} p_{23}	OG2
VERT.BARS	p_{31} p_{32} p_{33}	OG3
C-CURVES	p_{41}	OG4
CENT.DETAIL	p_{51} p_{52}	OG5
LOCKS	p_{61} p_{62}	OG6
HINGES	p_{71} p_{72}	OG7

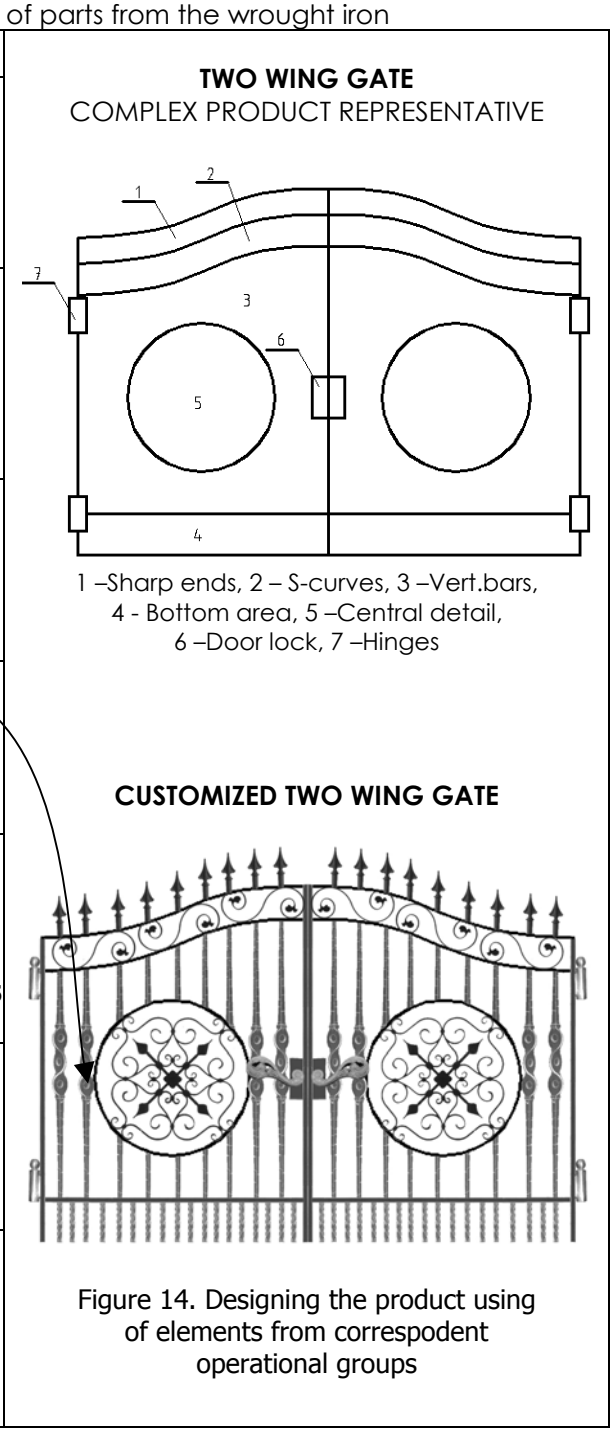

Figure 14. Designing the product using of elements from correspodent operational groups

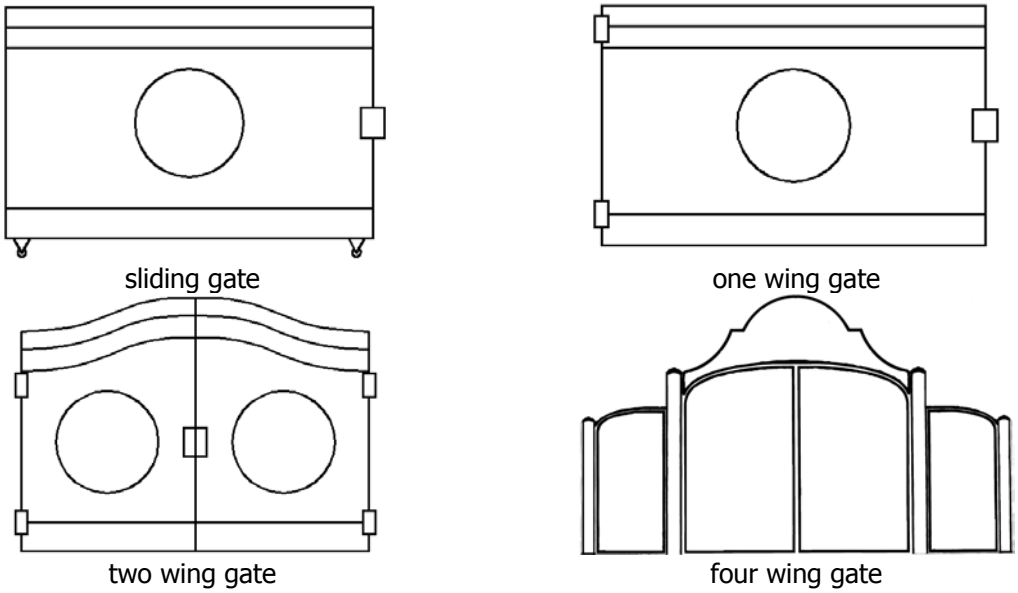

Figure 8. Basic types of gates

Designing of the gate can be easily performed using drag and drop technique. Customer just has to select desired element from the correspondent operational group and to drag it to the field in the chosen type of the gate. Product configurator system performs positioning of the element, and/or necessary number of instances that have to be copied, having in mind standard distance between elements of 120 mm and the overall wide of the gate defined by customer. Product configurator is built in Delphi programming language, in *offline mode*, according to the category of the product. It is expected that customer download configurator file, perform customization and upload desired solution for further quotation and adjustment.

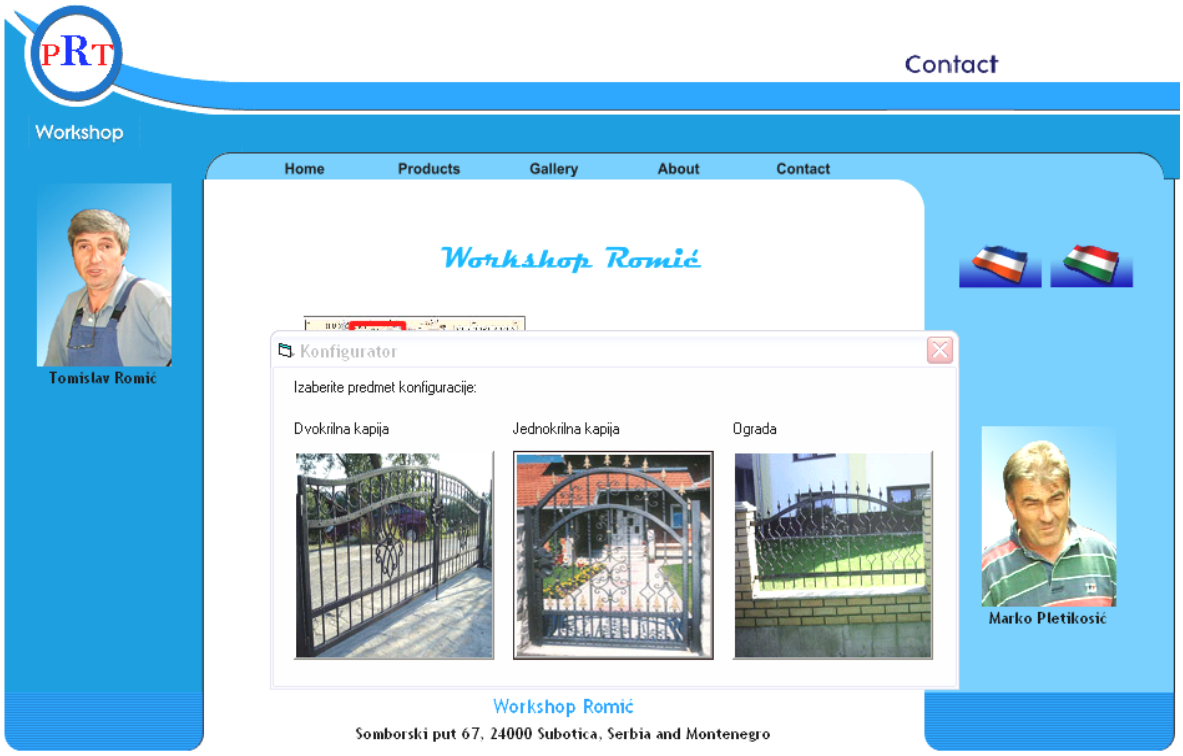

Figure 9. Website of the manufacturer www.romic.co.yu

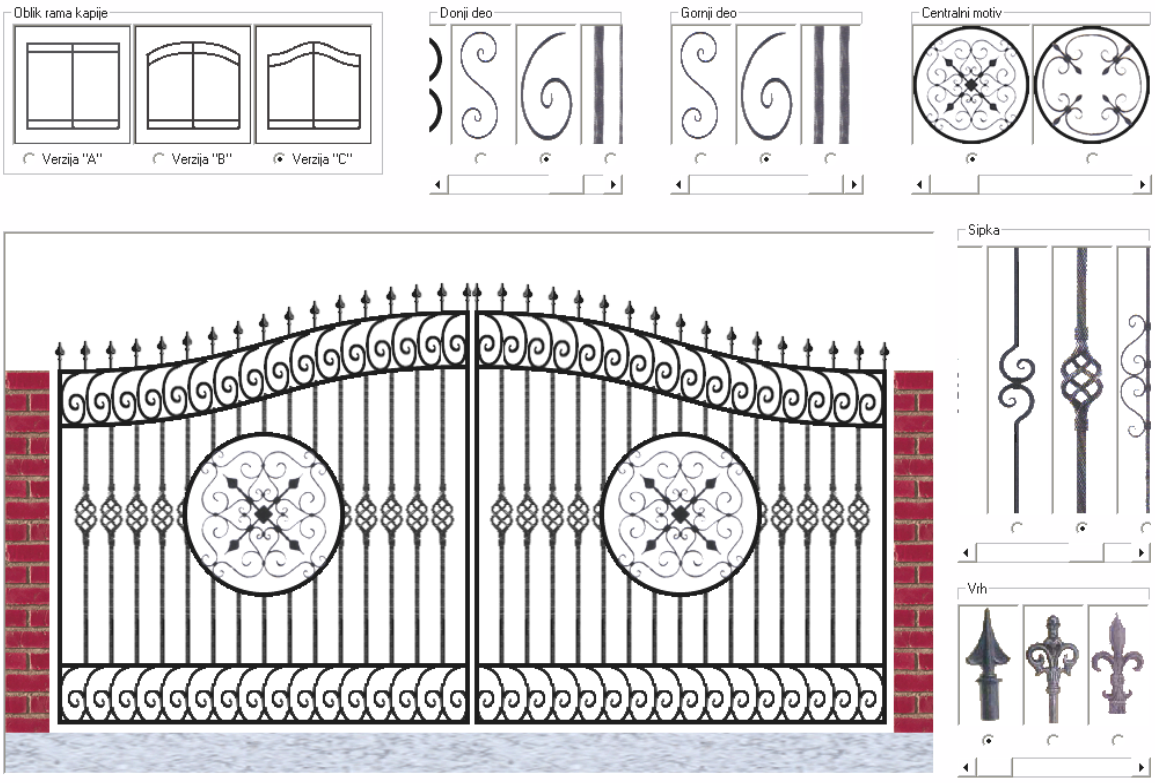

Figure 10. Wrought iron product configurator

3. CONCLUSION

From the given examples, it can be concluded that for large number of production programs certain segments of the market suitable could be find, for applying MC concept. It is a relatively narrow market niche positioned between the cheapest products, mass produced and very expensive taylor made products, manufactured on special demand. Constant and progressive development of IT, especially in domain of product design, process planning and control, necessary for MC sustainability, opens possibilities for widening this market segment, giving him perspective for the future.

Beside the mentioned market situation, product configurator development is very important regardless on the applied level MC concept. Product configurator enables easily processing large number of inquiries and forwards them to production system for further designing of nonstandard parts and process plans for manufacturing. Visualization of the product through showing possible modification on computers impressing customers and they are more readily for buying even the possibility for customization is minimal.

The fact is, that in this moment, only large international leading companies have power for implementation of the MC concept but small and medium enterprises could have benefits even now, though the application of the certain segments', concerning configuration and visualization of products. Introduction of the approach and refreshment of the marketing promotion - offering personalized products will strengthen their competitive position on the market for surely.

Having in mind, that the configurators described in the paper are only few months in use, there is no valid reverse information concerning behavior of the customers or achieved benefits for the manufacturers. There is just left to track every single request in order to improve effects.

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