

4th International Conference on Mass Customization and Personalization in Central Europe (MCP - CE 2010)

MC&OI and the Financial Crisis - Challenge and Opportunity September 22-24, 2010, Novi Sad, Serbia



# ALUMINUM INDUSTRY, CHANCE FOR MASS CUSTOMIZATION AND ADVANCEMENT OF SMALL ENTERPRISES

**Sasa Randjelovic<sup>1</sup>, Bratislav Denic<sup>2</sup>, Srdjan Mladenovic<sup>3</sup>, Goran Djordjevic<sup>4</sup>** <sup>1,3,4</sup>University of Nis, Faculty of Mechanical and Electronical Engineering, <sup>2</sup>JP Zeleznice Srbije

Abstract: Every increase implementation of aluminum products in real life obviously indicates degree of society development and the level of technical culture. The modern automotive industry, as well as up to date building and architectural solutions, are impossible without using this extreme light, reliable and durable material. On the other hand, aluminum production demands light production capacities which offer a number of possibilities for new product design, free lines and shapes that are maximally customized by final customers. Such processes engage a number of employees on realization from ordinary tasks to most creative demands which are set up by global market.

Key Words: Mass Customization, Aluminium Industry, Products Design.

# **1. INTRODUCTION**

The traditional understanding of the window as the building elements still almost can not recognize on the modern buildings, it has long time become standard. In short, in addition to basic functions, which means it is now and decorative elements to the building exterior facade and interior of the housing or internal business place (fig.1).







Fig. 1.

In this sense, such a robust product must meet a series of demands that are placed on the market to find the way to your customer [1]. These requirements are becoming exacting and more complex in terms of comfort and culture of the reside [2].

When you look at the structure of these demands (fig.2), most of them belong to that group enthusiasm, on the Kano curve, that his appearance on the market and to provoke curiosity and customers [3].

## 2. BASIC FUNCTIONS AND DESIGN SOLUTIONS

A quality window maintains the temperature interior and can also save money. Heat loss through windows can be as much as 25%; for this reason it is important that a frame has the right features to insulate the home. The main quality components is level and accuracy of aluminium extrusion technology, materials and quality of accessories, the type of glass and etc. influence on the window's ability to maintain the temperature.

For the most dominant process of design and development in the second house of quality (fig. 2), there are three main groups of customer requirements that can be realized in this process [4,8,9]. These are the requirements of functionality, sealing requirements and requirements relating to the aesthetic appearance (fig. 2). From the listed requirements can be seen that these requirements relate to the most common and most

wanted products and that is the facade joinery. It has already been pointed out that the requirements listed

include the much simpler products and semi products.









					$\langle$																
	ſ	Ň	X	Ă	X	X	X	X	》 1	Konkurencija						Plan					
		Kako	- CAD Aluminijumskih profila	<ul> <li>CAD alata za istiskivanje</li> </ul>	Analiza rizika pri konstruisanju	<ul> <li>Karakteristike proizvoda, QFD</li> </ul>	Pracenje konstruktivnih parametara	<ul> <li>Simulacija procesa plasticn deformacije</li> </ul>	Automatizacija procesa istiskivanja	<ul> <li>DOE konstruktivnih parametara</li> </ul>	– Usavrsavanje i obuka ljudi	Proizvod NISSAL Alvii Veka					Planirana vrednost	Pobolišava se na	Faktor marketinga	Apsolutni	Relativni
Šta		İ	1	2	3	4	5	6	7	8	9	1	2	3	4	5					
Lako rukovanje		5	۲	0	۲	0	Δ			Ο				V	ſ		5	1,3	1,0	6,3	4
Broj i raspored komora profila		4	۲	۲	$\Delta$	۲	۲	$^{\circ}$	۲		0				₿		5	1,3	1,0	5,0	3
Postojanost na ekstr. temperaturi		5	۲	0	۲	$\circ$		0		0	Ο		⊲	ſ			5	1,7	1,0	8,3	5
Izvodjenje nepravilnih oblika		3	0		0	0	0	$\bigtriangleup$					⊲	₹			4	1,3	1,0	4,0	3
Krutost i topl. dilatacija profila		4	۲	۲	۲			۲	۲	۲			V		¥		5	1,3	1,0	5,0	3
Kombin. sa drugim materijalima		4	۲		۲					0				V	뾧		5	1,3	1,0	5,0	3
Dobra toplotna izolacija		5	۲		۲	۲	۲	۲		۲	۲		V	₹ <sup>Ŕ</sup>			4	1,3	1,0	6,7	4
Dobra hidro izolacija		5	۲		۲	0	۲			۲	۲			Ļ	Δ		5	1,7	1,0	8,3	5
Smanjenje kvasenja i orosavanja		4	۲		0	0	۲			0			Þ		¥		4	1,0	1,0	4,0	3
Visok koef, prolaza svetlosti		5				0	Δ			0	0				₽		5	1,3	1,0	6,3	4
Efikasno provetravanje		4	۲			۲				۲	Ō			Ť			4	1,3	1,0	5,3	4
Savremen spoljasnji izgled		4	۲	۲	0	۲	0		0		-		~	ŧ.			4	1,3	1,0	5,3	4
Savremen unutrasnji izgled		5	۲		Ō		ō		Ō		0			Ľ			5	1,7	1,0	8,3	5
Savremene boje i dizajn		4	_	_	õ	•	-		$\overline{\Delta}$		-			v				0,0	1,0	0,0	1
Apsolutna			620,	256,	431,	387,	281,	149,	131,	317,	234,	Projekat Prerada Al tehnologijom									
Ocene	Relativna		5	3	4	3	3	2	2	3	3	stiskiva Status					rija				
Stepen složenosti			5	5	4	4	4	5	3	4	4	Autor laki									
			Profili bilo kog	Ğ	FMEA	Potpuno presli	Potpuno prace	Potpuna simul	Bez prekida	Potpuno ispitiv	Say	Kreirano 25.5.20				.5.20	05				
				nstrukcija sl							/remenoik	Modifikovano 17.6.20				.6.20	05				
												Kuća 2, zahtevi kupaca prema					ı				
Ciljne vrednosti			oblika	ozenil		kava	anje	acija		anje j	ontinu	Faza 1									
			-	h alat,		Je.		ΞΕM		oarametar	onler	Autor laki									
				ω								Modifikovano 17.6.2005									
1					⊽			≛													
Poređenje		2			Þ	•	-	_ ∖	\ ⊽	Æ	-∎_										
		3	•	┥		Á	Δ		¥		Δ										
		4	Δ	Á																	
		5										1									



The choice of a window that best fits in with the feel of the home? Thanks to the wide selection of customized options, it is possible to create a made-to-measure window, choosing both the design and finishes to create quality windows to suit every taste.

A large number of component elements and components provides the opportunity for selection by the criterion of price, quality, functionality, durability, design and so on which makes this product suitable for customization at every level of the process according to the customer. On the cross section of such window structures can be identified following main elements:

1. Aluminium frame with extruded tubular profile of alloy 6060. The supporting framework of the entire structure is in aluminium, upon which are placed the corner brackets (glued and caulked), multiple closure points for handles and perimetric hardware (entirely adjustable on three axes), with hooking latches on the leaf to guarantee complete protection.



2. Oak or solid cherry wood frame. The wood finishes are: natural oak, walnut stained oak, mahogany stained oak, cherry wood and etc. The wood is treated with a special type of impregnating means finished with anti-yellowing acrylic.

3. Frontal hinge housing.

3A. Rotating hinge housing. These hinges allow for the complete replacement of wood parts without having to dismantle the window and also guarantee complete non-contact between the two frames with respect to different dilation of the relevant materials.

- 4. Central sealing gasket.
- 4A. External rubber gasket.
- 4B. Wood insulation tack.
- 4C. Acoustic gasket.

5. Aluminium glazing beads. Contributes to the insulation of the wooden frame, preventing stress from external forces.

The speedy snap lock application on the supporting structure, simplifies installation and maintenance of the glass.

6. Spacer couplers, aluminium glazing bead, wooden frame.





Fig. 4.

The new solutions brings out the qualities of aluminium and wood, materials that together complement each other to create a superior quality product. Strong and resistant over time thanks to the aluminium and beautiful and warm looking thanks to the wood. Modern windows are a balanced combination of engineering and design, and adapt perfectly to various environments and architectural styles [5,6,7].

The new windows are made from a combination of two semi-profiles, in aluminium on the outside and wood on the inside, that can be customized thanks to the wide range of colours and wood types available.

These windows have a supporting frame made from aluminium alloy profiles 6060, upon which are installed the opening, movement and closing accessories.



Fig. 5. Basic functions of window with inevitable accessories

The thermal break profiles, along with the doubleglazing, provide both a heat and an acoustic barrier.

Acoustic effect is an even more frequent problem in the inner cities especially with regard to big towns. For many years, each local government has already used a series of tables giving the noise reduction values with which you must comply. For this reason, it is very important to pay particular attention to the shutter and frame type as well as to the glass to be mounted. The criterion used to indicate shutter and frame acoustic capacity is the decibel value (dB). Choosing doors and windows must take two factors into account: the use of the room in which they are located and the level of external noise.

Inside, the warm appeal of wood. Outside, the permanent protection of aluminium. Up to date doors and

windows combine elegance with performance and can be customised to stylishly adapt to any home.

You can choose from a wide range of colours and wood effects, including the possibility to combine two different colours for the inside and the outside. The only restriction is your imagination.

For particularly wet environments (gardens over winter, non-residential rooms, pools) the inner profile can be in aluminium, using the same aluminium-wood constructions and structure.

For example, the appearance of condensation and moisture is one of the worst consequences of poor ventilation. It was found that the average family during the day just breathing produces 15 liters of water. Not to mention the large temperature fluctuations in winter and flying time, which cause drops of water drops dry on the inside surface of window glass. On the other hand, poor ventilation adversely affect health. This is the main reason that the law requires the installation of ventilation systems.



Fig. 6. Roster of window

The stagnant air is a dangerous bacteria multiply and spread the suffocating cigarette smoke, dust and the like. Because of sealing alloy doors and windows, ventilation is reduced to a minimum. With the help of a specially constructed roster, fresh air can be brought into the room without opening windows and doors. Through the ventilation channel can not enter rain and snow, while a good barrier to the passage of insects.

Roster are folding and can be cleaned and made from top quality aluminum profiles increased accuracy and quality of treated surfaces. The user is the possibility of subsequent mounting even on the set with aluminum windows. These there are dozens of manufacturers in the world with different constructive solutions adapted to customers; requirements and the type of premises in which they were built (fig.6).

Manufacturers go so far as to suggest different roster to go to the bedroom window from the terrace of the glass or office. Opening and closing the air is fresh and simply use a number of systems, from mechanical to electrical and digital sensor solutions with timers and remote control. After such a solution surely is only one thing that stands in the background, hard work and research to meet the finest customer requirements. Of course all these features of the finished product may not have the same importance and their normalization was performed in the range 1 to 5

In the continuation of "second house" can be seen the current image of the company in the market and plans to meet demands. For these "wishes" can accurately identify what is missing in the market and what is required, as well as a producer able to realize. Contrary to the wishes of the characteristics are "how" that reflect the global characteristics of the product, the desired values for properties, degree of complexity, the target value of technical and technical comparison of the products of competing companies.

The central matrix was established by the transition of information from the market by main subprocesses which can be realized above requirements. The fact that there is a relationship between the input size (product features), and subprocesses marked Weights symbols corresponding to the intersection of columns and rows, and that indicate the level of dependency.

For these customers desire prompted the evaluation of products and where competition is clearly visible position on the market. This comparison is not limited only to the technical assessment, but the overall impression window and competitive companies in the market. Add Quality Plan comprises the following elements (fig. 2): the importance of customer criterion, given the value of the image in the market from the standpoint of the company, a relationship which aims to improve the image of the market and marketing activity. The obtained values are translated in the range of 1 to 5 [7,9].

Before any improvements specified by the customer must enter into a detailed cost analysis that has been given to improve the overall cost of the product. This leads to a very important issue, the total price of the product and the possibility of entering into investment fulfillment of some requirements.

In addition to these relationships exist and polumatrica, roof of the house of quality, which illustrates the conflict situation between the subprocesses that have influence on the set value. It must be said, that in real examples, there are both positive and negative correlations that indicate the opposite subprocesses requirements that must be addressed.

#### 4. CONCLUSION

Such a modern and complex product, which is very commonly found on the market, with many additional and related equipment is a challenge for any manufacturing process. On the other hand, structural and aesthetic requirements and desires of the customer imposed a number of tasks and problems can be solved in different ways in order to find the optimal solution. This provides the opportunity for small and medium enterprises obtain space on the market and to fulfill the wishes of each of its customers. These processes and products involve a great number of partners in a series of working to achieve a common goal and achieving high quality. It is a prerequisite for business survival and prosperity.

## **5. REFERENCES**

- H. W. Chesbrough, "Open Innovation. The New Imperative For Creating and Profiting from Technology". 2003, Boston, Massachusetts: Harvard Business School Publishing.
- [2] Tseng, M. M. and Piller F. "The Customer Centric Enterprise: Advances in Mass Customization and Personalization", 2003, New York / Berlin: Springer.
- [3] Erixon, G., "Modular Function Deployment (MFD), support for good product structure creation", 2<sup>nd</sup> WDK Workshop on Product Structuring, 3-4 June 1996, Delft, Netherlands.
- [4] Stone, R. B.; Wood, K. L. and Crawford, R. H., "A heuristic method for identifying modules for product architecture", Design studies, Vol. 21, No. 1, 2000, pp. 5-31.
- [5] Helo, P. T., "Product configuration analysis with design structure matrix", Industrial Management & Data Systems, Vol. 106, No. 7, 2006, pp. 997-1011.
- [6] Alfnes, E., L. Skjelstad, and J.O. Strandhagen. "How to implement the mass customisation strategy: guidelines for manufacturing companies. in The World conference of mass customization and personalisation. 2007. MIT Cambridge, USA.
- [7] Forza, C. and F. Salvador, "Managing for variety in the order acquisition and fulfilment process: The contribution of product configuration systems". International Journal of Production Economics, 2002. 76(1): pp. 87-98.
- [8] Duray, R., "Mass customization origins: mass or custom manufacturing? " International Journal of Operations & Production Management, 2002. 22(3): pp. 314-328.
- [9] Blecker, T. and N. Abdelkafi, "Complexity and variety in mass customization systems: analysis and recommendations". Management Decision, 2006. 44(7): pp. 908-929.

## CORRESPONDANCE



Dr Sasa Randjelovic, Ass..Prof. University of Nis, Faculty of Mechanical Engineering Aleksandra Medvedeva 14 18000 Nis, Serbia <u>sassa@masfak.ni.ac.rs</u>



B.Sc. Bratislav Denic, PhD student Zeleznice Srbije Trg Kralja Aleksandra br.11, 18000 Nis, Serbia <u>batadenic@hotmail.com</u>



B.Sc. Srdjan Mladenovic, PhD student, University of Nis , Faculty of Mechanical Engineering Aleksandra Medvedeva 14 18000 Nis, Serbia <u>maki@masfak.ni.ac.rs</u>



Dr Goran Djordjevic, Full prof., University of Nis , Faculty of Electronic Engineering Aleksandra Medvedeva 14 18000 Nis, Serbia goran@elfak.ni.ac.rs