7th International Conference on Mass Customization and Personalization in Central Europe (MCP-CE 2016)

Mass Customization and Open Innovation
September 21-23, 2016, Novi Sad, Serbia

CONCEPTUAL MODEL OF CONTRIBUTIVE FACTORS IMPORTANT IN MASS CUSTOMIZATION APPLICATION: THEORETICAL VIEWPOINT

Orošnjak Marko[1]

[1]University of Novi Sad, Faculty of Technical Sciences, Novi Sad, Republic of Serbia

Abstract: *Mass customization and personalization strategy is a competitive application which main goal is to provide customers enough and/or exactly the type of product/service that he/she wants at a reasonable price. In context of aforementioned author have developed a conceptual model based on his research to the related topic in order to obtain factors that impact mass customization paradigm the most. From results and discussion author have realized critical factors that have significant influence on competitive advantage.*

Key Words: ***mass customization, processes, factors, modeling, quality, competitive advantage***

1. INTRODUCTION

Mass customization (hereon referred to as "MC") is a competitive strategy that aims at providing enough product and service variety so that almost every customer finds exactly what he/she wants at a reasonable price[1].

The term "mass customization" was first coined in early 90's by Stanley Davis[2]. The obstacles in that period, he concluded, was the inability in terms of satisfying customer's needs due to lack of technology and knowledge to transform from mass production to mass customization. Therefore the idea and a way to accomplish what had been done aftermath, was limited. Another thing worth mentioning is that era was so called "profit era", or "rule of the profit" and instead of focusing on what customer really wants market was deployed on capturing the scale of economies.

Although these definitions provided by Pine[1] and Davis[2] sketch the essence of mass customization, they do not possess the specificity required or a way for a company to achieve mass customization capability[3].

Similar investigations related to customization but not on the same paradigm are performed under the phrase "Customer-order-driven" production. This approach is similar, if not the same, as mass customization and includes low stockpiles[4] flow of material and goods in a time efficient and cost effective manner while providing customers specific orders from their part. Those firms who adopted the approach of customer-order-driven have significantly obtained a higher profits, lower marketing costs and increased customer loyalty[5]. Murakoshi[6] identifies customer focus (CF) and operational competence as two key concepts that are critical to the success of MC implementation. CF indicates a change to customer-driven manufacturing. It requires a mass customizer to place their focus on customers, and construct their products, organization, manufacturing systems, and concepts accordingly to fulfill the changing customer's needs[7].

Mass customization defined Hart[8] as "the use of flexibile processes and organization structures to produce varied and often individually customized products and services at the low cost of standardized, mass-production system". The key of achieving MC capability also could lies in organizational structures which later will be discussed.

Another thing worth mentioning is that achieving MC is a challenge for many manufacturing firms since MC may increase the costs, uncertainty, and complexity of manufacturing processes and a manufacturer's dependency on supply chain partners[9]. To align a manufacturer with customer needs, MC demands not only advanced manufacturing and information technologies, but also unique operational capabilities[10].

The challenge of achieving highly increased customized products at competitive cost and expeditious distribution time can only be done by seizing the two noteworthy functional areas of business that must cooperate in accomplishing the upper hand – marketing and operations[11]. The foregoing analysis does not exlude the other functions of company which must devote towards achieving the sketched out customer requests, its just prima facie hallmark of the paradigm. Therefore, it was omitted that other functions, for instance, logistics which must always be included in fulfilling demands (i.e. material handling, packaging, bundling, et cetera), or R&D (being situated in front end of the innovation cycle) and so on, are also highly germane. Feitzinger & Lee[12] point out that forecasting the mix of options that customer wants in product lifecycle involves at least five areas of a company: marketing, R&D, distribution, manufacturing and finance.

Another ineluctable factor while differentiating mass customization from mass production is distinguishing product variety from mass customization. Variety is not nor it is similiar to mass customization. Also it can be dangerously expensive[1]. Mass customization on one hand must include customer involvement in specification

of the product or service, while mass production, which undertakes variety, doesnt need the customer involvement at all (if one does not consider purchasing), on the other. In mass production can only be included, for example, predicting what customer wants (make-to-forecast) from previous demands and then making changes on the product. Therefore, product variety is making similiar or completely different products, shapes, etc., on a principle "make-to-stock" or in LEAN systems it is familiar by the term "push strategy". Beforehand said, it later can be habituated to slice costs or to remove the product which has the lowest sales/deals (i.e. utilizing ABC chart), grabing economies of scale or to foresee customer demands. Acomplishing mass customization could not be undone if mass production didnt subsist afore it. Considering that market has changed overtime and transformed from "brand subordinate" to "customer subordinate", i.e. mass production to mass customization respectively, so did the customer desires.

In the same time economies were growing and customers were leaving common markets and turning towards someone who can fulfill their requests. Hence, many firms were turning towards implementing this type of strategy, but only few have managed to implement it and benefit from it. For example Toyota, who is known for its legendary Continues Improvement strategy, run into trouble and has had to retreat from its final goal of becoming mass customizer[13]. The key to mass customizing effectively and efficaciously is postponing the task of differentiating a product for a specific customer until the latest possible point in the supply network[12].

2. LITERATURE REVIEW

The literature on mass customization is extensive. Most researchers focus on investigating product modularity and far less on service modularity, since it is a key for delaying the customer involvement point. The purpose of this paper is to investigate existing research linked to mass customization features and models and to conduct a conceptual model from most influenced factors in order to contribute a better MC capability and to discuss about future research opportunities.

Analysis was performed from the top tier articles in the field of mass customization. From those articles, findings are identified, examined, compared and relegated. All articles are reviewed and analyzed from which author came with slightly different conclusions. Mostly, mass customization capability of organization depends on four factors: product modularity, postponement, customer involvement, organizational structure and information technology.

2.1 Product modularity

Product modularity allows part of the product to be made like standard modules but with slightly product distinctiveness achieved through combinaton or modification of modules[3]. Therefore, some would say that product modularity is a key enabler of mass customization, which enables product parts to be flexibly combined to provide high variety [14].

Modularity serves the purpose of delaying the customer requests to be included as later as could reasonably be expected in production chain in order to higher the large scale manufacturing of assembly modules. This must be done in number of reasons, for instance, lowering stocks, lowering logistic expances, easier arrangement schedules, work assigns, faster delivery time, etc.

Modularization is basically a framework of mass customization which corresponds to what extend can mass customization be done in order to satisfy customer demands. In addition, it is used to measure the degree of customization according to Caglar[15].

Squire, et al.[16] identifies two MC archetypes - full and partial. Full is appropriate when customers value a high degree of customization and responsiveness, and partial MC which is suitable for price and time sensitive customers who are willing to accept a lower level of customization. In their study they concluded that postponement enables partial to achieve greater scale than full MC. Which means that full MC is much more expensive and modularization is much more limited. Their conclusion is pretty obvious if one takes into account that its likely to constrain the feasibility of high production volumes when implementing full MC. So its still cost-dependent production volumes which have higher feasibility and ROI in partial MC.

It is argued by some authors [17][18] that MC strategy generally refers to customized products, while others [19][20] argue that it is equipollent adequate only just while utilizing different approaches or rearranging organization.

It has been mentioned that modularity in the design of products and services should be "reflected" in terms of organizational modularity[21]. Silvestro & Lustrato[20] did the research in the scope of nascent concept "mid-office" in a case study on BSG corporation bank and come with a conclusion that mid office facilitates streamlining of employee adaptive behaviors between front office (FO) and back office (BO), with lower levels of discretion in the front office. Mid office is used to evaluate the trade-offs implied by new service design configuration in which the mid office acts as a service interface between front and back office.

Therefore, earlier mentioned research on Squire et al.[16] between partial and full MC is often used in production firms which are trying to facilitate MC strategy, while term "mid office" is used in service organizations. The BSG case analysis suggests that the mid office is a key enabler of service modularity, facilitating a move away from combinatorial to menu driven customization.

2.2 Customer Involvement

Customer involvement in mass customization can be said as one of the most important things considering the price differentiation. Companies that do not use customer involvement nor some type of modularity in the production process or while creating a service, cannot be considered as mass customizers[22].

Customer involvement can happen in different way and time, and by that it can be decided how much customization will it have on product/service

differentiation. If customer involvement happens downstream in the value chain of a product the price will therefore be lower and vice versa, as earlier as it gets the price will go up. Different models explain the point and impact of customer involvement and several of them will be brielfy explained.

One of the most famous model is Rudberg & Wikner[23] which explains the Customer point of involvement or "Customer order decoupling point". Customer order decoupling point (CODP) is the position in the value chain where customer is involved in product differentiation – customization. It separates those activities which are "mass produced" from those which are influenced by the customer. Similiar articles were involved in researching the customer involvement and impact that it has on costs and benefits in the value chain. Some worth mentioning are order-penetration-point (OPP) by Olhager[24] and demand-penetration-point (DPP) by Christopher[25]. Figure 1. shows Rudberg model of customer order decoupling point.

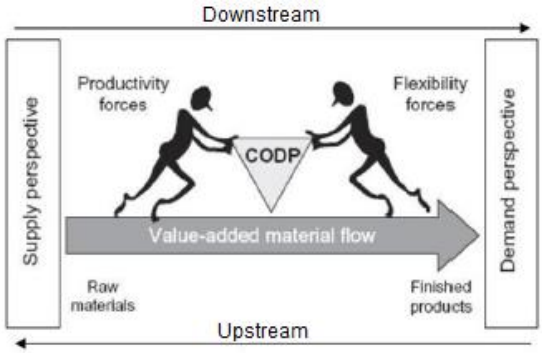

Figure 1. *Positioning of the CODP*[23]

Four of the customer order decoupling points have been identified (figure 2): engineer to order (ETO), make to order (MTO), assemble to order (ATO), make to stock (MTS).

Critical point is finding where the appropriate customer involvement is the most cost-efficient. The further downstream it can get the lower the costs are of modularization. ETO approach offers much complex product with higher benefits but additionally withdraws a much higher expences, while MTS or ATO is referred to as computer industry where consumer can choose between components.

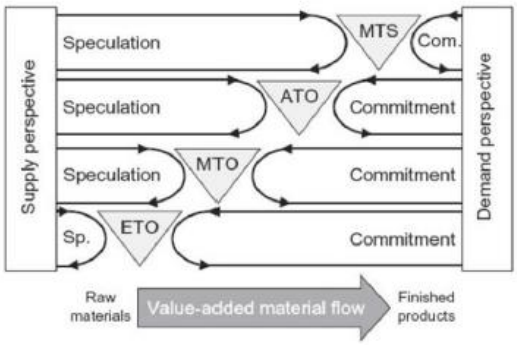

Figure 2. *Four approaches in CODP*[23]

Similiar investigation based on Rudberg & Wikner's model have been done by Akinc & Meredith[11][26]. They conducted a hybrid make-to-order (MTO) and make-to-stock (MTS) strategy, so called make-to-forecast (MTF), in order to achieve customization while maintaining quick delivery (figure 3). By implementation of the make-to-forecast (MTF) hybrid strategy they have discovered that can be achieved as much as 50 percent shorter delivery time for highly customized products than it could be possible with MTO operation.

In this mixed strategy products for particular customers are launched based on the forecast while maintaining modularity but later in the value chain so it can later be modified by consumer and benefit with fast delivery time. However, there are many companies that requirement of this strategy cannot be met bacause certain types of product differentiation must start before and cannot be postponed. For example in the airplane industry. The production starts only when airlines have booked an order of a airplane. Another interesting point Akinc and Meredith give is that once a two sided airplane is started based on MTF it cannot be finished if a customer wants a single-aisle small plane.

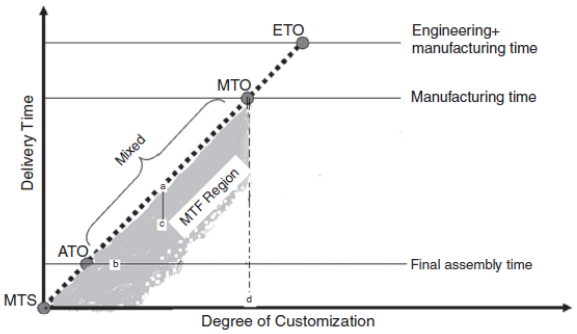

Figure 3. *MTF and traditional fulfillment strategy*[11]

Demand infrequently coincides with the forecast and consequently results fall short from customer expecations. With that type failure of predictions companies miss out potential sales and end up stucked with substantial amount of stock which is time-dependent, i.e. inventory without customer is money stocked and maintenance expences. This can only lead to discounts and sellout and consequently eroding of ROI. So the key to succes with this approach may be hidden in Assembly-to-order (ATO) approach[21] which finished product can later be modified acording to customer specification, for example, computer industry.

Lampel & Mintzberg [27] developed the idea that the level of customer involvement in the production cycle can play a critical role in determining the degree of customization and their proposed model is represented by figure 4.

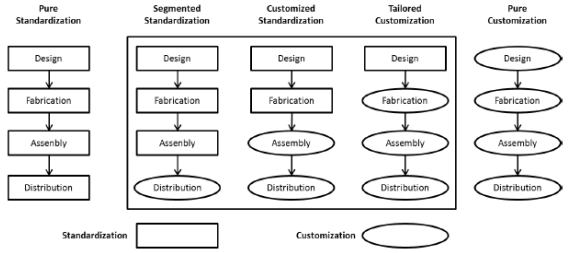

Figure 4. *Lampel and Mintzberg model* [27]

They have distinguished three types of standardization and two types of customization. Pure standardization the customer has no interaction with production of a product/service in the value chain. In

segmented standardization customer is involved in distribution and it represents only a small group of customers.

Customized standardization involves the consumer at the point of assembly and delivery, while tailored and pure customization involves the customer in fabrication and design process, respectively. Pure customization is the point of complete customization, similar as it is in the Rudberg and Wikner's model (ETO) so the customer is involved in complete value chain of the product.

Gilmore and Pine's[28] model of customization is separated in four approaches. The model is given in figure 5. and represents approaches: collaborative, adaptive, cosmetic and transparent.

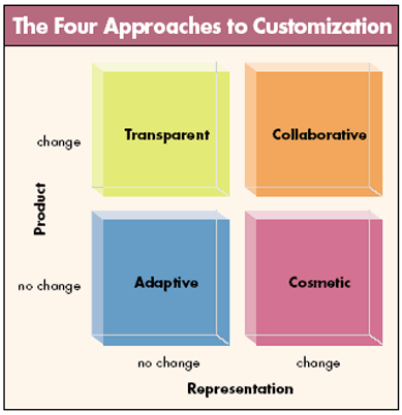

Figure 5. *The four approaches to mass customization*[28]

They explained that collaborative customizers conduct a dialogue with individual customers to help them articulate their needs. Tipical example as they explained is Mikissmes Design System (eye tailor in the US). Adaptive approach offers one standard but customizable product that users can alter themselves. Cosmetic approach represents a standard product differently to different customers, for example, packaged specially for each customer, while transparent approach provides a unique goods or services without letting them know that it is customized only for them. A tipical example they give is ChemStation, a company that produces industrial soap for car washes and industry factory floor cleaning. After independently analyzing each customer's needs, ChemStation custom-formulates the right mixture of soap, which goes into a standard ChemStation tank on the customer's premises.

Through constant monitoring of its 80-to-1000–gallon tanks, the company learns each customer's usage pattern and presciently delivers more soap before the customer has to ask [28].

Rebecca Duray [22] developed the model based on the previous research[3] of mass customization typology which uses key identifiers. The first identifier, customer involvement, is used to operationalize the degree of customization and the second explores the "mass" in mass customization. Modularity is used as a critical aspect for gaining scale volume where customer involvement provides customization, while component modularity restricts the range of choice. Bringing this concept of two critical aspects together author have suggested four mass customization archetypes: fabricators, involvers, modularizers and assemblers.

Fabricators include both customer involvement and modularity during design and fabrication process. It is similar as pure customization. Involvers involve customer in product design and fabrication stages but use modularity during the assembly and delivery stages.

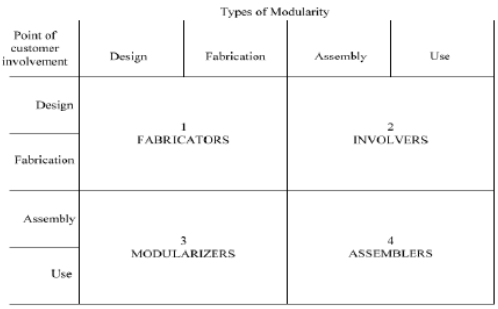

Figure 6. Operationlized configurational model[22]

Assemblers most closely resemble standard producers which brings both customer involvement and modularity to bear in the assembly and use stages. Modularizers also mirror mass production methods but not as directly as assemblers. Companies include customer during the assembly and delivery but incorporate modularity earlier in the production cycle in the design and fabrication stages[22].

2.3 Organizational structure

Organizational structure is critical component in production strategy[29], whether that is mass customization or mass production. Many theorists and researchers are arguing whether organizational structure is one of the most important factor in adopting innovation and mass customization capability [13][30][31]. Even beside manufacturing, "*service companies need to modify, and sometimes transform, if necessary, their organizational structure to facilitate mass customization*" [32].

Pine[1] have suggested that keeping in mind the end goal to create succesful MC capability company must transform from mechanistic to organic structure[33]. Mechanistic structure is also known as bureaucratic structure, describes an organizational structure as formal, centralized network which authority is generally referred to as top-down approach. Therefore, decision making is from top level managers to employees. While organic structure is most oftenly used in unstable environment that needs to quickly change and adapt, and therefore it is suited for MC capability rather than mechanistic structure. Same suggestions gave Kotha[30] and Lau[31]. Another thing to point out is that these investigations do not have significant bearing on various MC strategies yet on empirical evidence and on a few case studies[34].

Some researches queried the relevance of MC strategy in services since the customer involvement in service industry is allready inherently included[35]. They concluded that the concept of MC is then tautologous, but Silvestro & Lustrato[20] disaccord with the statement. Even though it is evident that some degree of customer involvement must be included in service processes, providing mass customized services for managers is much more of a challenge than it is for manufacturing managers[20]. In order to overcome the

obstacles and to further research the roles of contact personnel in service customization Silvestro & Lustrato[20] used new service interface namely "mid office". They have concluded throughout an intense discussion and case study (BSG bank) that in fact mid office is one of the key enablers of service modularity which model have been developed from traditional to newly proposed based on thier investigation (figure 7).

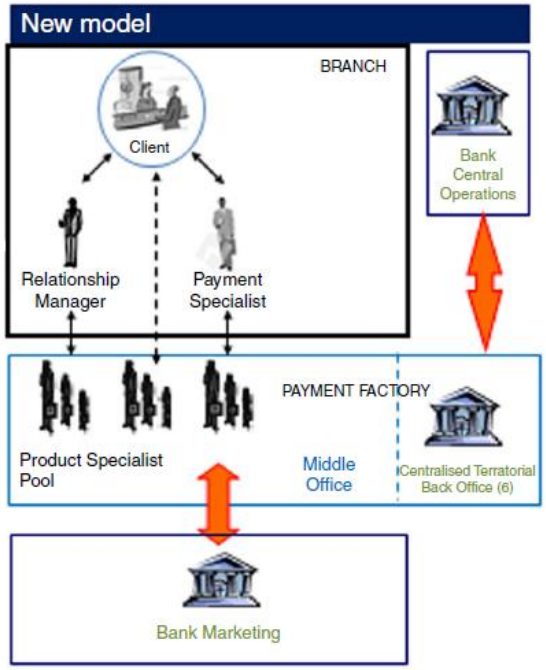

Figure 7. BSG model of organization structure[20]

Mid office was developed to support back office and to provide product based expertise to support front office staff. Through their research they concluded that, mid office can act as an enabler of both service and organization modularity, and thus facilitate service MC. Another thing Silvestro & Lustrato point out is that mid office is not necessarily performing only the role of a key enabler of service and organization modularity, but also might be created in order to provide some kind of knowledge based support to front lines, IT technical support, risk assesment, or to customize services for individual customers, so they do not contend to confirm that the role of mid office is exclusively used to facilitate MC.

Huang et al.[34] posit that positive relationship exists between organic structure and MC capability. They also posit that positive relationship is stronger for full customizers than for partial ones. Their empirical analysis was conducted using survey for mid and large sized manufacturing firms located in three industries (automotive, electronics, and machinery). They conducted a research through 167 firms, which is fairly large sample with 74 partial customizers and 93 plants identified as full customizers. From results both of their proposed hypothesis show positive relationship and confirm the aforementioned that really organic structure suits better MC capability and its also stronger for full customizers. However, concerning organic structure, as they said, it may be an "over-fit" for partial customizers.

2.4 Information & Technology

Entering the era of so called Industry 4.0[36] it is unavoadable to say that impact of Information and Technology has a great impact on the performance of organization.

Loker & Oh[37] examined technology needed by apparel manufacturers to implement customization. By studying 46 apparel companies, primarly in New York State, they concluded that some technologies were vital to the implementation of time-based, consumer-focused strategies. Brown & Bessant[38] in a case study, examined strategic formulation for six companies to co-implement a mass customization focus and agile manufacturing practicies. They noted that plant level strategies, with operational information, were important in succesful implementation. Howard, Young, & Graves[39] suggests that, while investigating key technological opportunities for BTO[1] (build-to-order) in vehicle design, emerging technology can shorten the lead time and better meet customer demands.

It can be obviuos that new 3D printers are coming on the market, so in providing customized service or customized product one can only imagine how much of a impact will it have in the next ten to twenty years concerning MC capability.

3. DISCUSSION & CONCEPT

Throughout the research of the literature author have realized four significant interrelated factors that have been included in MC approach and have the greatest impact on product differentiation in terms of MC capability while withdrawing cost/benefits comparasion. Author points out that due to exponentional growth of modern technology he didnt researched the impact of IT on MC capability, although it must be inherently included factor, instead focus was on the next four. These factors represent: modularization, postponement, organizational structure and customer involvement.

In order to facilitate higher branch of customized products organization must be capable of transforming from usual work schedule to customer order organizational archetype (resembling organic structure) in a very short period of time due to dynamic customer demands. Therefore, the more organization is capable of changing it work schedules and transform modularity of a product, the more it will be able to answer many customer requests. One can conclude that, achieving this differenation, company must have good comunication, information/technology and work ethics. To respond quickly to customer demands, modularization must be sufficient to "snap" together when required[40]. One thing needs to be highlighted in product modularity, and that is to which extension does it go, because it may withdraw a huge expences. Product modularity also depends on forecasting, which depends on what type of customization consumers have requested earlier. Zhang & Chen[5] findings on inventory in vehicle manufacturing indicate that the frequent changes in

[1] One of the oldest production strategies whereas production is not starting without order from a customer. Is often used in highly customized products or low volume products.

schedule led to quality problems and delivery in parts supply which caused high level of inventory. Therefore constructing product modularity while not knowing customer demands could lead to high level parts (modules) and it can appear as a piling problem. That can and probably will lead to risk of outdated components and then to strategic discounts and promotions. When compared to other industries even the best example (Dell) carries five day stocks[41]. Figure 8. describes beforehand said problem.

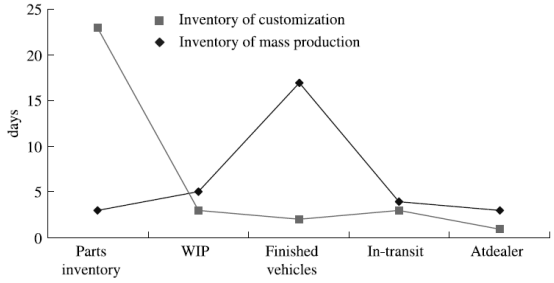

Figure 8. Average inventory distribution: mass production vs mass customization[5]

In order to avoid aforementioned, organization must have characteristics of organic structure rather than mechanistic and also a high level of management expertise. The second is referred to as high level of support provided by the mid office, whether that is service or production company. Mid office in production could be referred to as middle management, if mid office is serves the purpose as service interface between FO and BO[20] and middle management acts as catalyst by targeting efforts made by everyone to common objective hence facilitating collaboration and cordination[42]. But author wants to point out that during research he didnt came up with significant comparison between "mid office" and "middle management" so it could be taken as an assumption and it could be used as a target of research in the future.

Hence it would be interesting to investigate what type of benefits production company would have if they implement the role of "mid office".

3.1 The concept of MC

If one considers first three factors (modularization, organizational structure, and postponement) compared to last factor, which is far the most important in MC strategy, customer involvement, the first three are meaningless without it. But in order to achieve even first three factors manufacturer must poses a quality. Without quality no improvement cannot be achieved nor further transformation to MC strategy. For instance, Feigenbaum[43] claimed that quality is what the customer says it is. Therefore, getting closer to customer is getting closer to quality. What does this mean? Notably, quality has often been recognized as a generic competitive capability that should be first developed in sequential progression towards the building of other capabilities[44]. Following this type of claims it is reasonable to comprehend that one of the main contributors to operational compentence is quality. Even so, one of the best examples Toyota, which is best known for Continual Improvement, formed on a cornerstone of quality – PDCA[2] – had a dificulty implementing MC strategy in her so called pioneering efforts[13]. It is questionable that if company does poses a total quality management (TQM) is it really enough to transform from mass producer to mass customizer? Apparently, on the case of Toyota, it still needs a hard effort to achieve MC capability.

Based on general review of state-of-the-art literature in the field of mass customization author came with a newly developed concept (figure 9) of comparasion between MC firm and customer involvement. Concept resembles point of customer involvement and what impact does it have on operations and organizational behaviour.

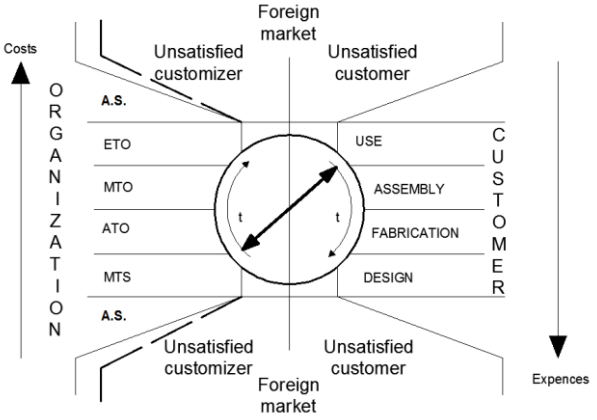

Figure 9. Organization versus customer demands in mass customization environment model

First zone in customer involvement is buying a product at dealer. Dart is showing on the other side of a circle what does that mean for organization. It will show that customized product is taken from a stock (MTS). Further, if customer does optate more customization he will be involved in assembly stage and therefore organization must produce further service and satisfy customer which withdraws minor expences for customer and costs of resources for customizer. If the customer still isnt satisfied with the product he will continue to go further down the stages where the next is fabrication. This means that organization must produce a product personally customized, to some extent, with special request of consumer. If it still doesnt satisfy the customer he will go further and customer involvement will be at end zone of customization at the design stage. The organization then must satisfy the customer's needs for a given product by completely changing the structure of a product in the design stage. Notice that, further the customer goes down the stages more the expences and costs will be, for customer and customizer, respectively. Another thing to point out is that the zone of customer involvement also corresponds to a time (t). Therefore, if the customer-decoupling-point[23] is in the design zone it will take longer time to finish and deliver the product, since the customizer is in engineer-to-order[11] stage, and vice versa, if customer is involved in "use" zone the time of delivery of a customized product will be shorter or practically eliminated.

Another thing worth mentioning is, based on a previous discusion, organization can expand its

[2] Plan, do, check, act circle or so called Deming circle of quality.

modularity, whatever if its a product or organizational modularity. Every customizer's objective is to keep the customer in MTS stage ("use" zone) to fulfill the goal of seizing the economies of scale. So, based on a product modularity it will reflect whether that will transpire in MTS stage or customer wants to be involved a further downstream in the value chain of a product. The same thing applies to organizational structure. If organizational modularity[21] is high it will be facile to rearrange its operations, faster answer to a customer demands or even provide additional service ("A.S." figure 9). Organizational modularity is shown by the dashed line on the figure 9.

Predicated on a model given in a figure 9, one thing seems pellucid, and that is that no customizer wants the customer to get out of the given zones and turn to a foreign market. This will lead to unsatisfied customer and customizer. Therefore, the more skillful organization is to expand its organizational modularity and product modularity, the greater the chances are to keep the customer and in the same time strenghten its market position.

4. CONCLUSION & FUTURE RESEARCH

For as reported so far mass customization appears to transcend "flexibility" or "agility" to the provision of customized products/services. This denotes that making operational adjustment for specific buyers is not merely enough to grab the economies of scale. One must develop a process which can supply numerous customer-chosen variations and on every order to respond with short lead time or cost penalty[45]. To achieve aforementioned organization must be capable of transforming its structure in a cost-effective and time-efficient way. Achieving it, organization must possess some degree of organic structure, although it reflects stronger relationship to full customizers than it does to full MC[34]. In dynamic environment, such as MC, organization needs to possess highly skilled craftsmen, managers, expertise etc.

Author proposes that organic organizational structure must be an imperative in the begining of re-engineering or transforming from mass produced to mass customized environment. Same applies to providing additional service or to easily apprehend customer desires in upstream value chain (ATO, MTO, ETO). Author also proposes that organization which possesses more mechanistic structure can handle better in MTS stage. Therefore, this could be an interesting topic in future research, and that is to investigate to which extend does organic structure have interrelated impact on mass customization compared to mechanistic structure.

5. REFERENCES

[1] Pine, B. J. (1993). *Mass customization: The new frontier in business competition.* Boston, MA: Harvard Business School Press.

[2] Davis, S. (1987). *Future Perfect.* Pennsylvania State University: Addison-Wesley Publishing, Bussiness and Economics.

[3] Duray, R., Ward, P. T., Milligan, G. W., & Berry, W. L. (2000). Approaches to mass customization: configurations and empirical validation. *Journal of Operations Management, 18*(6), 605-625.

[4] Zapfel, G. (1998). Customer-order-driven production: an economical concept for responding to demand uncerainty. *International Journal of Production Economics, 56-57*, 699-709.

[5] Zhang, X., & Chen, R. (2006). Forecast-driven or customer-order-driven? An empirical analysis of the Chinese automotive industry. *International Journal of Operations & Production Engineering, 26*(6), 668-688.

[6] Murakoshi, T. (1994). Customer driven manufacturing in Japan. *International Journal of Production Economics, 37*(1), 63-72.

[7] Anderson, D., & Pine, J. (1997). *Agile Product Development for Mass Customization.* Irwin, Chicago, IL.

[8] Hart, C. W. (1995). Mass customization conceptual underpinnings, opportunities and limits. *International Journal of Service Industry Management, 6*(2), 36-45.

[9] Lai, F., Zhang, M., Lee, D. M., & Zhao, X. (2012). The impact of supply chain integration on mass customization capability: an extended resource-based view. *IEEE Transactions on Engineering Management, 59. No.3*, pp. 443-456.

[10] Salvador, F., De Holan, P. M., & Piller, F. (2009). Cracking the code of mass customization. *MIT Sloan Management Review, 50*(3), 71-78.

[11] Akinc, U., & Meredith, J. R. (2015). Make-to-forecast: customization with fast delivery. *International Journal of Operations & Production Management*, 728-750.

[12] Feitzinger, E., & Lee, H. L. (1997). Mass Customization at Hewlett-Packard: The Power of Postponement. *Harvard Business Review*.

[13] Pine, B. J., Victor, B., & Boyton, A. (1993). Making Mass Customization Work. *Harvard Business Review*, 178-180.

[14] Salvador, F. (2007). Toward a product system modularity construct: literature review and reconceptualization. *IEEE Transactions on Engineering Management. 54*, pp. 219-240. IEEE.

[15] Caglar Can, K. (2008). *Postponement, Mass Customization, Modularization and Customer Order Decoupling Point: Building the Model of Relationship.* Linkoping University, Departman of Management and Engineering: Master Thesis.

[16] Squire, B., Brown, S., Readman, J. J., & Bessant, J. (2006). The impact of mass customization on manufacturing trade offs. *Production Operations Management, 15*(1), 10-21.

[17] Ettlie, J., & Ward, P. (1997). US manufacturing in the earlie 1990's: the chase and chanllenge. *Business Strategy Review, 8*(4), 53-58.

[18] von Hippel, E. (1998). Economics of product development by users: impact of "sticky" local information. *Management Science, 44*(5), 629-644.

[19] Zipkin, P. (2001). The limits of mass customization. *Sloan Management Review, 42*(3), 81-87.

[20] Silvestro, R., & Lustrato, P. (2015). Exploring the "mid office" concept as an enabler of mass customization in services. *International Journal of*

Operations & Production Management, 35(6), 866-894.
[21] Sanches, R., & Mahoney, J. T. (1996). Modularity, flexibility, and knowledge management in product and organization design. *Strategic Management Journal (Winter Special Issues), 17*, 63-76.
[22] Duray, R. (2002). Mass customization origins: mass or custom manufacturing. *International Jornal of Operations and Production Management, 22*(3), 314-328.
[23] Rudberg, M., & Wikner, J. (2004). Mass customization in term of the customer order decoupling point. *Production Planning and Control, 15*(4), 445-458.
[24] Olhager, J. (2003). Strategic positioning of the order penetration point. *International Journal of Production Economics, 85*(3), 319-329.
[25] Christopher, M. (1998). Logistics and supply chain management: strategies for reducing cost and improving service. *International Journal of Logistics Research and Applications, 2*(1), 103-104.
[26] Meredith, J., & Akinc, U. (2007). Characterizing and structuring a new make-to-forecast production strategy. *Journal of Operations Management, 25*(3), 623-642.
[27] Lampel, J., & Mintzberg, H. (1996). Customizating customization. *Sloan Management Review, 38*(1), 21-30.
[28] Gilmore, J. H., & Pine, B. J. (1997). The four faces of mass customization. *International Journal of Operations and Production Management, 75*(1).
[29] Hayes, R. H., & Wheelwright, S. C. (1984). *Restoring Our Competitive Edge: Competing Through Manufacturing.* New York: John Wiley and Sons.
[30] Kotha, S. (1995). Mass customization: Implementing the emerging paradigm for competitive advantage. *Strategic Management Journal, 16*(5), 21-42.
[31] Lau, R. S. (1995). Mass customization: The next industrial revolution. *Industrial Management; Norcross, 37*(5), 18-19.
[32] Selladurai, R. S. (2004). Mass customization in operations management: oxymoron or reality? *The International Journal of Management Science, 32*(4), 295-300.
[33] Burns, T. E., & Stalker, G. M. (1961). The Management of Innovation. *University of Illinois at Urbana-Champaign's Academy for Entrepreneurial Leadership Historical Research Reference in Entrepreneurship.*
[34] Huang, X., M, K., & Schroeder, R. G. (2010). The impact of organizational structure on mass customization capability: a contingency view. *Production and Operations Management, 19*(5), 515-530.
[35] Kaplan, A. M., & Haenlein, M. (2006). Toward a prasimonious definition of traditional and electronic mass customization. *Journal of Product Innovation Management, 32*(2), 168-182.
[36] Brettel, M., Friedchrichsen, N., Keller, M. & Rosenberg, M. (2014). How Virtualization, Decentralization and Network Building Change the Manufacturing Landscape: An Industry 4.0 Perspective. *International Journal of Mechanical, Aerospace, Industrial, Mechatronic and Manufacturing Engineering, 8*(1), 37-44.
[37] Loker, S., & Oh, Y. J. (2002). Technology, customization and time-based performance in the apparel and sewn products industry. *Journal of Textile and Apparel, Technology Management, 2*(1), 1-13.
[38] Brown, S., & Bessant, J. (2003). The manufacturing strategy-capabilities links in mass customization and agile manufacturing. *International Jornal of Operations & Production Management, 23*(7), 707-730.
[39] Howard, M., Young, K., & Graves, A. (2001). Towards 3day car: vehicle design and its impact on rapid build-to-order. *International Journal of Vehicle Design, 26*(5), 455-468.
[40] Peters, L., & Saidin, H. (2000). IT and mass customization of services: the challenge of implementation. *International Journal of Information Management, 20*, 103-119.
[41] Hunter, D. (2001, May 14). How Dell keeps from stumbling - its the supply chain. *Business Week Magazine*, 38-40.
[42] Mehmet, M. K., Xiaowen, H., & Roger, G. S. (2010). The effect of quality management on mass customization capability. *International Journal of Operations & Production Management, 30*(9), 900-922.
[43] Feigenbaum, A. (1991). *Total Quality Control.* New York, NY (40th Anniversary Ed.: 3rd edition, revisied): McGraw-Hill.
[44] Ferdows, K., & DeMeyer, A. (1990). Lasting improvements in manufacturing performance: in search of a new theory. *Journal of Operations Management, 9*(2), 168-184.
[45] Ahlstrom, P., & Westbrook, R. (1999). Implications of mass customization for operations management. *International Journal of Operations and Production Management, 19*(3/4), 262-274.

CORRESPONDENCE

MSc Marko Orošnjak, Teaching Associate
University of Novi Sad
Faculty of Technical Sciences,
Trg Dositeja Obradovića 6
21000 Novi Sad, Serbia
orosnjak@uns.ac.rs