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ORGANIZATIONAL ANTECEDENTS OF MASS CUSTOMIZATION

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Abstract: *Due to more and more sophisticated customer needs and intensifying competition, mass customization has increasingly drawn the attention of companies and scholars. The importance of transforming organizations to build mass customization capability has long been acknowledged. However, the discussion is generally scattered and disorganized in literature. This paper reviews the mass customization literature with the twofold purpose of providing a comprehensive and structured overview of prior research on mass customization organizational antecedents and highlighting future research opportunities on this topic. By using an established framework in organizational theory, the paper provides a comprehensive coverage of organization-related issues and a reference for future research opportunities.*
Key Words: ***Mass Customization, Organization Design, Literature Review.***

1. INTRODUCTION

Since customers nowadays are less and less willing to buy a 'one size fits all' product and competitive pressure is intensifying, mass customisation is becoming an increasingly widespread concern among companies [1, 2]. Mass Customization (MC) indicates the ability to provide customized products and services that fulfil each customer's idiosyncratic needs without considerable trade-offs in cost, delivery and quality [3, 4]. Both the growing adoption of MC strategies by firms and the considerable increase of academic publications on MC during the last two decades witness the relevance of this topic. The importance of transforming organizations to build MC capability has been acknowledged since the introduction of the MC concept [3]. However, relatively less attention has been given to the organizational antecedents of MC [4-6], as compared with its technological enablers [7]. This paper reviews the MC literature with the twofold purpose of providing a comprehensive and structured overview of prior research on MC organizational antecedents and highlighting future research opportunities on this topic.

2. LITERATURE REVIEW METHOD

Consistent with our aim to provide a comprehensive and structured overview of prior research on MC organizational antecedents, we followed a deductive approach in selecting and analyzing the body of literature. This means that both search keywords within all relevant databases and content classification criteria were chosen based on an *a priori* defined framework. As our reference framework, we used Galbraith's [8] star model, which identifies five categories of organization design variables: strategy, structure, processes, rewards and people (Figure 1).

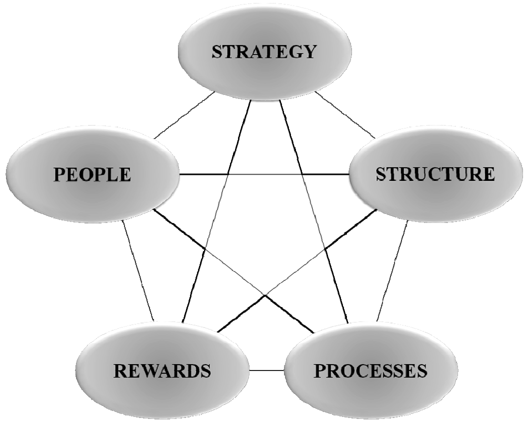

Fig.1. *Galbraith's Star Model*

The search for related publications was performed on the following scientific databases: Scopus, Ebsco, Web of Knowledge, JSTOR and Wiley. The search was conducted on Article Title and Abstract fields always, and on Keywords field where allowed. Except for JSTOR, the search terms used were "mass custom*" in combination with at least one of the following terms: "strateg*", "structure*", "process*", "reward*", "people" and "organi*". As JSTOR does not support such a complex search phrase, we decided to conduct a broader search on that database, using the following search phrase: "title=mass custom* OR abstract=mass custom*". The databases search was not limited by others criteria, such as Date Range, Document Type or Subject Areas. The databases search provided 3,071 total publications (1,727 from Scopus, 489 from Ebsco, 748 from Web of Knowledge, 52 from JSTOR and 55 from Wiley). These publications were imported in Endnote. The first cleaning step was to remove duplicates automatically with the Endnote command "Find Duplicates". The number of publications after this first cleaning step was 2,447, but still included many duplicates that were identified during the subsequent cleaning step based on abstract reading. As a result of this second cleaning step, many publications that are clearly beyond the scope of the study were excluded, and 136 publications were selected for full text reading. As a result of full text reading, 59 publications were included in the analysis. In addition, references cited in these publications were used as a secondary source. This led to the inclusion of only eight additional papers, which can be taken as an indication of the comprehensiveness of the initial set of publications. The final set of 67 publications were subsequently classified. In general, coding categories for classification of the reviewed literature can be derived deductively or inductively [9, 10]. Using a deductive approach, categories are chosen before the material is analyzed, while in an inductive approach they are developed from the selected material [9, 10]. In this paper, we opted for a deductive coding approach, using the five categories of design policies included in Galbraith's [8] star model to classify prior research results (Table 1). Noteworthily, in Galbraith's [8] view, processes are the information and decision processes that overcome the internal boundaries and provide collaboration across these boundaries and integration of activities.

Table 1. *Categories for classification*

CATEGORIES	SUBCATEGORIES
STRATEGY	-
STRUCTURE	Specialization Distribution of Power Shape Departmentalization
PROCESSES (Information and Decision Processes)	Vertical Processes Lateral Processes
REWARDS	Reward System Metrics
PEOPLE	Recruitment and Selection Training and Development

3. RESULTS

3.1. MC strategy

In Galbraith's [8] star model, the choice of the organization's strategy is the first and fundamental decision which drives all the other choices in organizational design. While the basic idea of any MC strategy is to combine high performance in product customization with high performance in cost, delivery and quality, different types of MC strategy can be distinguished based on the degree of product customization that a firms aims to provide [1, 3, 11-15]. The degree of product customization is related to the point of initial customer involvement along the value chain, where a higher degree of product customization means that customers are involved at an earlier stage of the value chain [1, 3, 11-15]. The degree of product customization is, therefore, a key decision when a company decides to pursue a mass customization strategy [16]. By combining some of the MC strategy typologies based on the degree of product customization [3, 11-13], Da Silveira, Borenstein and Fogliatto [16] generated eight levels of MC, ranging from pure customization to pure standardization (i.e., no customization). Duray, Ward, Milligan and Berry [17] added another dimension to the classification of MC strategies by developing a two-dimensional framework that considers both the point of customer involvement and the type of product modularity. The same classification criteria were applied by Bask, Lipponen, Rajahonka and Tinnilä [18] to MC strategies in service industry. MacCarthy, Brabazon and Bramham [19] further enriched the debate by distinguishing five fundamental MC modes based on the characteristics of six fundamental operational processes for MC. Ross [14] also looked at MC strategy from another perspective, by distinguishing three types of MC depending on the product features that can be customized (i.e., cosmetic, selectable functional options, core customization). A similar perspective was adopted by Piller [20] (i.e., style or aesthetic design, fit or measurements, and functionality). Gilmore and Pine [11] combined, in their framework, the type of customer involvement with the type of product features that are customized. Even though the debate on the types of MC strategy is lively, most of organizational studies on MC have overlooked this fundamental contingency variable. The type of MC strategy should therefore be included in future studies on MC organizational antecedents.

3.2. Organizational structure for MC

According to Galbraith [8], organizational structure determines the location of the authority and power in the organization. There are four categories of structure policies: specialization, shape, distribution of power and departmentalization.

Specialization. It concerns the types and numbers of specialties to be used in performing a work [8]. Having multi-functional employees is important for MC [4, 6, 21-24]. Employee multi-functionality is related to the enlargement of the jobs performed by employees, who should be capable of performing a diverse range of tasks, beyond their immediate functional specialization. Multi-functional skills are necessary for employees to appropriately respond to the increased uncertainty in the environment and the increased complexity in the production system that characterizes MC [4]. In particular, the jobs of shop-floor employees should be enlarged to include maintenance of the equipment [4, 6]. This improves MC capability by enabling timely control of variance and reduction of operational disruptions, since shop-floor employees have the best knowledge about operating problems and can control variance at the origin [4]. Specialization should also be reduced in the production planning process, as combining the two roles of master production scheduler and materials requirement planner improves the organization's ability to quickly respond to unforeseen changes in customer demands [24]. In addition to the enlargement of existing roles, MC can also require the creation of new roles within the organization, such as those in charge for the development and maintenance of a product configurator [25].

Shape. It is determined by the number of hierarchical levels and the number of people forming departments at each hierarchical level. The more people per departments, the fewer the level. The number of people in a department is usually referred to as the span of control of the department manager [8]. Flatness of organizational structure plays an important role in building MC capability [21, 26] because deep organizational hierarchies, with a large number of layers, reduce effective and timely communication and cooperation. In a MC environment, the number of unforeseen requirements arising from frequent changes needs faster communication and authority response. Flatness enhances effective communication and timely cooperation [21].

Distribution of power. It refers to the distribution of decision-making power and authority [8]. Employees should be empowered in order to achieved the flexibility and responsiveness required by MC [4, 6, 22, 28]. For example, the practice of autonomous equipment maintenance by shop-floor employees, which increases MC capability [4, 6], also includes an aspect of job enrichment, as shop floor employee are empowered to make autonomous decisions about their jobs. However, decentralization of operation authority may be insufficient. According to Boynton, Victor and Pine Ii [29] and Kakati [30], an MC system should be made up of a dynamic network of modular and flexible processing units coordinated by a central decision-making unit. Therefore, decentralization of the operational authority within the process unit module should be combined with centralization of the coordination and control in the hub of loosely coupled processing units [29, 31]. In particular, Park and Nahm [32] suggest that the optimal level of (de)centralization of decision making authority is contingent on the degree of customization offered by a mass customizer and the level of modularity of its products.

Departmentalization. It refers to the choice of departments to integrate the specialized work and form a hierarchy of departments. Departments are usually formed to include people working in one of the following areas: a function or specialty, a product line, a customer segment, a geographical area, a work flow process. Each of these structures has their own strengths and weaknesses. Weaknesses can be overcome with hybrid structures and lateral processes [8]. Previous research suggests that MC capability is enhanced by the adoption of output based departmentalization criteria, instead of input (or resources) based criteria. By creating organizational sub-units focused on specific outputs and by giving them all the resources they need to supply the output, an organization reduces information-processing needs, thus lowering coordination costs and increasing responsiveness [6]. This is well exemplified by cellular manufacturing, which enables firms to improve both cost effectiveness and responsiveness of product customization [4, 33].

To summarize, according to Huang, Kristal and Schroeder [21], an organic structure (characterized by flatness and decentralization of decision-making, multifunctional and empowered employees) seems suitable for MC companies. The main important consequence of an organic structure is to enhance organizational flexibility [34]. Flexibility is necessary to cope with the internal manufacturing complexity and the environmental turbulence that characterize MC companies. However, when distinguishing between full mass customizers (which provide customization at the design or fabrication stage) and partial mass customizers (which provide customization at the assembly or delivery stage), Huang, Kristal and Schroeder [21] found empirical support for the positive relationship between organic structure and MC capability only in the case of full mass customizers. The importance of using a contingency approach is stressed by Liu, Shah and Schroeder [4] too, when they discuss the lack of empirical support for the positive relationship between employee empowerment and MC capability in their study. They suggest that empowerment initiatives should be designed using a contingency approach, instead of a universalistic one, because its effectiveness depends on business strategy, leader characteristics and environment.

3.3. Information and decision processes for MC

Information and decision processes can be classified in vertical and horizontal (or lateral) processes. The former ones deal with the allocation of scarce resources, such as funds and talent, while the latter ones enable joint decision making across functional boundaries [8]. An important role in both horizontal and vertical processes is played by information technology (IT).

Vertical processes. These processes allocate the scarce resources of funds and talent. Vertical processes are usually business planning and budgeting processing. [8]. MC literature related to business planning and budgeting processes is still scarce and only deals with manufacturing planning processes [7]. Some authors proposed a number of quantitative approaches and techniques to allocate manufacturing resources so as to enhance flexibility, responsiveness and efficiency in manufacturing [e.g. 35, 36-38]. In addition, insufficient responsiveness and flexibility in the production-planning process may hinder the application of form postponement [24, 39-41], thus lowering MC capability [42].

Though not related to the allocation of scarce resources, another result regarding vertical information flows is the importance of providing timely and accurate quality and process information and feedback to shop-floor employees [4]. This enables fast manufacturing process variance detection and correction and gives opportunities of continuous improvement [4].

Lateral processes. They are information and decision processes that coordinate activities across different organizational units and increase the amount and frequency of communication across pre-existing departmental boundaries, providing mechanisms for decentralizing general management decisions [8]. There are five basics types of lateral processes and they vary in the amount of management time and energy invested in them: informal or *voluntary* lateral processes, *e-coordination*, *formal group*, appointment of *integrators* to lead full-time the formal group and *matrix* *organization* [8]. The need for internal integration is essential for MC because integration breaks down the functional silos to facilitate coordination across different organizational units and increase the amount and frequency of communication across pre-existing departmental boundaries, which leads to a more connected and coordinated response to environment changes and disruptions [43, 44]. Previous studies suggested that internal integration is crucial in the new product development process to achieve higher degrees of product modularity [27, 45-47] and form postponement [48-50]. Integration mechanisms are also crucial in a MC manufacturing system [46, 51], because modularity in production creates a dispersed assembly system that needs coordination [51]. Tu, Vonderembse, Ragu-Nathan and Ragu-Nathan [52] found that MC capability is predicted by the practice of dynamically reorganizing manufacturing teams quickly and linking them to necessary resources in response to product design or manufacturing process changes. A typical approach for lateral coordination both in manufacturing and new product development processes is the use of teamwork. Brown and Bessant [28] found that teamwork is largely adopted by companies with a manufacturing MC strategy in place. Teamwork facilitates joint problem-solving efforts by bringing together different points of views, knowledge and skills from individual team members. The use of small groups for solving production problems is an important practice for quality management and, therefore, for MC [53]. More generally, the use of lateral relations increases MC capability by providing mechanisms for decentralizing general management decisions, using quickly information where it exists, solving problems where they occur and improving the ability to adapt to a dynamic environment such as the MC environment [6, 24].

IT support to vertical and lateral processes. IT organizational infrastructure is crucial for coordination purposes in a changing environment such as MC [54-58]. In the dynamic network of modular and flexible processing units described by Boynton, Victor and Pine Ii [29], a vertical IT-based system permits central coordination and evaluation of product and process capabilities without interfering with local responsiveness. It also allows the firm to maintain global and decentralized operations because local and specific information can be transmitted in a universal language rapidly and accurately to senior managers in order to increase the speed of decision making. IT systems play an important role in supporting horizontal processes, as well. In particular, IT-based product configuration systems contribute to increasing the effectiveness and efficiency of customer order acquisition and fulfilment processes and offers mass customizers a way to codify product knowledge otherwise retained by individual employees [25]. In addition, new product development IT increases MC capability by facilitating modular product design [59].

With regard to information and decision processes for MC and enabling IT, however, a contingency perspective is lacking at all. For example, different types of lateral processes can be used for coordination purposes [8], and future research could investigate which types of lateral connections are most appropriate according to the pursued MC strategy. Another research opportunity is to investigate the role of business planning and budgeting processes in the pursuit of MC.

3.4. Rewards for MC

Reward system and the related metrics aim to align individual behaviors and performance with the organization's goals [8].

Reward system. It motivates employee and reinforces the behaviors that add value to the organization through policies such as regulating salary, bonuses, stock, recognition, benefits [60]. A reward system that aligns people toward plant goals and recognizes the differential contributions of people in pursuing plant strategy seems to be essential for MC [4]. In a MC environment, a reward and incentive system should motivate shop-floor employees to grasp multiple skills [4]. In addition, compensation and incentives practices should be based on team performance and company performance, besides individual performance [22]. Finally, a structure of pay that encourages and supports numerical flexibility, that is the readiness with which the number of persons employed can be adjusted to fluctuations in demand, is also important [30].

Metrics. They are the measures used to evaluate individual and collective performance [60]. While a few measures of MC capability on the organizational level are available in the existing MC literature [33, 61, 62], no contribution can be found in literature regarding metrics specifically designed for reward systems in an MC environment.

3.5. People for MC

The appropriate combination of human resource policies produces the talent required by the organization, generating the skills and mind-set necessary to implement its chosen direction and also build organizational capabilities to execute the strategic direction [8]. In this study two main categories of human resource policies are used: recruitment and selection, on the one hand, and training and development, on the other hand.

Recruitment and selection. According to Armstrong [63]: recruitment is the process of finding and engaging the people for the organization needs, selection is that part of the recruitment process concerned with deciding which applicants or candidates should be appointed to jobs. High standards for recruiting have a positive impact on MC capability [4]. This type of recruiting is based on an effective interview instrument and tries to select employees who have work values and particular attitudes and have the competencies of team working, problem solving, initiative and organizational commitment, in addition to technical and task-related competencies. It ensures that shop-floor employees are able to efficiently perform the complex and flexible manufacturing tasks that characterize MC contexts [4].

Training and development. According to Armstrong [63], development is concerned with ensuring that a person's ability and potential are grown and realized through the provision of learning experiences or through self-managed learning. It is an unfolding process that enables people to progress from a present state of understanding and capability to a future state in which higher-level skills, knowledge and competencies are required. Training involves the application of formal processes to impart knowledge and help people to acquire the skills necessary for them to perform their jobs satisfactorily [63]. The MC literature suggests that training should focus mostly on employees multi-functionality, adaptability and agility [2, 4, 6, 21, 28, 30] in order to help employees to perform well in complex and flexible environments. In addition to cross-functional training, having employees highly skilled in their job is also important for MC [4, 64]. To that purpose, task-related training is needed to provide employees with technical skills, trouble-shooting capabilities, and appropriate knowledge about the equipment and processes. In particular, enhancing technical skills increases the likelihood that operators will be able to offer meaningful suggestions to improve how work is conducted [4]. Learning should be organized on an on-going base [4, 28, 30] in order to shape a learning organization that can adapt quickly to a changing environment [2, 65].

With a more comprehensive view of human resource policies, finally, Leffakis and Dwyer [22] develop and test hypotheses on the most appropriate manufacturing human resource management system for full and partial mass customizer, respectively. Specifically, they argue that an innovative bundle of human resource management practices, such as sophisticated pre-hire screening devices, realistic job previews, supervisory and administrative training as well as interpersonal and communication training, is more appropriate for full mass customizers. Conversely, more traditional practices, such as formal structured interviews, horizontal cross-training and training that ensures conformance to preset standards, are more suitable for partial mass customizers. Their empirical study supports the latter hypothesis, but not the former one.

4. DISCUSSION AND CONCLUSION

The present paper analyzes prior research findings on the organizational antecedents of MC through the lens of Galbraith's [8] star model and it complements the results of previous literature reviews on MC. Da Silveira, Borenstein and Fogliatto [16] identify required conditions and situations suitable for the adoption of MC and discuss fundamental principles and concepts in the MC theory. The enablers of MC implementation are grouped in processes and methodologies (agile manufacturing, supply chain management, customer-driven design and manufacturing, lean manufacturing) and technologies (advanced manufacturing technology, communication and networks technologies). In updating their previous literature review, the same authors indicate the use of web-based tools (e.g. product configurators), rapid manufacturing technologies and more structured interaction with customers as the major developments in the MC literature during the last decade [7]. Kumar, Gattoufi and Reisman [66] provide statistical trend analysis of the MC literature, propose three taxonomic frameworks for classified MC researches and distil three distinct elements that characterize MC: modular design, finite solution space and customer co-design. Ferguson, Olewnik and Cormier [67], finally, explore the state-of-the-art in MC through the lens of the design process, broadly divided into three categories: marketing, engineering and distribution.

By classifying previous research results according to the five dimensions of organization design included in Galbraith's [8] star model, the present literature review highlight prior research focus on organizational structure variables and lateral coordination mechanisms. Relatively less attention has been given to human resource policies, rewards systems and metrics for MC.

Another major gap in the existing MC literature emerges if we consider the fundamental idea behind Galbraith's [8] star model. The basic tenet of Galbraith's [8] star model is that, for an organization to be effective, all its policies regarding organizational structure, information and decision processes, rewards and people must be aligned with the selected strategy. However, different types of MC strategies can be pursued. Even though the debate on the types of MC strategy is lively, most of organizational studies on MC have overlooked this fundamental contingency variable. The type of MC strategy should therefore be included in future studies on MC organizational antecedents. This is even more necessary in light of the results of the very few studies that include the type of MC strategy in their analysis. In particular, Huang, Kristal and Schroeder [21], in their empirical study, find that certain organizational design solutions that support full MC do not support partial MC.

While contributing to the MC literature by synthesizing prior research results into an integrative model and by outlining new research directions based on the unexplored areas of the integrative model, the present paper is not without limitations. Prior research results concerning inter-organizational level enablers of MC have remained out of the scope of this study. However, the peculiar relationships that an MC organization needs to build with its customers in order to satisfy their idiosyncratic needs and with its suppliers in order to build a robust and agile supply chain require peculiar inter-organizational solutions. A further research opportunity is therefore to enlarge the scope of the present review to include inter-organizational level enablers of MC.

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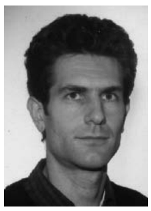

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