

## THE COMPARATIVE STUDY OF MASS CUSTOMIZATION: SME(S) VS. LE(S)

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### ABSTRACT

MC is the ability to produce varieties of customized products quickly, on a large scale and at a cost comparable to mass-production through technical and managerial innovations. Moving from traditional mass production to mass customization, firms can enhance their ability to customize their offerings by involving customers and suppliers at early stages in their product design and manufacturing processes. While much research on MC reports significant contribution of MC capability to organizational performance, the study comparing this relationship in different organization sizes is still lacking. Using data collected from 220 manufacturers, various aspects of SMEs and LEs affecting this relationship can be explored.

**Keywords:** Mass Customization; Comparative Study; Small and Medium Enterprises; SME; MC Capability

### INTRODUCTION

Mass customization (MC) results when a firm produces a variety of customized products quickly, on a large scale at costs comparable to those of traditional mass producers [30]. MC is a way for firms to address new market realities while duplicating the efficiencies of traditional mass production [30][39][28][10]. Currently, the literature reports important points regarding MC which are of interest to this study concerning the relationship between MC capability and organizational performance (OP). O'Grady [26] reports the existence of three powerful forces driving the success of MC: (1) the accelerating rate of technological change, (2) the increasing sophistication of products, and (3) empowered customers demanding greater product variety due to increasing global competition and growing disposable incomes. Many companies are increasingly using information technology (IT) to directly connect with their customers; thus enabling them to know individual customer preferences for tailoring products accordingly, and producing them in a timely manner at reasonable costs [26][38]. IT can facilitate customer involvement in designing specialized products that enhance flexibility, implement process improvements, involve suppliers, and control manufacturing operations. Firms are then able to customize products and sell them at lower prices. Customers reap the benefits from using the specialized products [8][40][41].

The literature has reported a higher degree of association between MC capability and OP [40][41]. Moving from a traditional mass production paradigm to a mass customization paradigm, firms can enhance their ability to satisfy customized demands and improve performance by involving customers

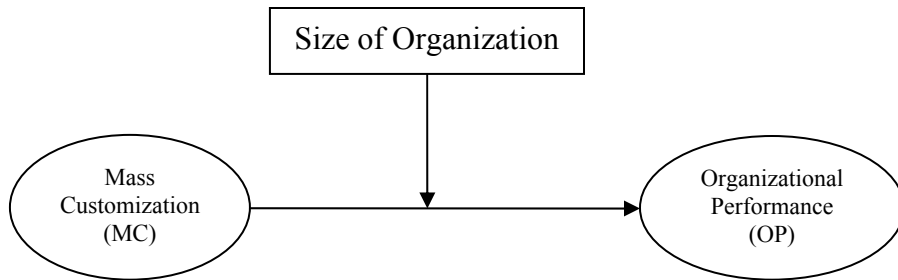
and suppliers at early stages in their product design and manufacturing processes [32]. While much research on MC reports significant contribution of MC capability to organizational performance, the study exploring this relationship in different environments such as organization size is still lacking. The purpose of this study is to explore various ways in which Small and Medium Enterprises (SMEs) and Large Enterprises (LEs) may affect this relationship. Fisher [9] argues that these two types of firms inadvertently fall into the trap of mismatching desired supply chain objectives which may lead to their adopting different mass customization strategies. The literature reports two streams of research regarding mass customization strategy adoption. The first group contends that LEs are better at providing mass customization (the proponents of LEs) and the second group contends that SMEs are better at providing mass customization (the proponents of SMEs).

The first group of researchers contends that large enterprises (LEs) have been at the forefront of initiating and implementing supplier-customer relationships [4][27]. LEs are more likely to form stronger relationships with their customers and suppliers through greater purchasing power as they are mainly interested in minimizing risk by using single or dual-sourcing [37]. As a result, LEs are likely to perform better in offering MC to customers because of having enough purchasing muscle to force suppliers to adopt detailed product specifications, certain quality management techniques and practices as a contractual condition [19]. LEs in some situations force their suppliers to implement systematic forms of supplier-customer relationships that help enhance the process of MC [43]. For example, suppliers are expected to invest in such technologies as E-commerce, ERP systems, flexible machines, and CAD equipments that help expand the ability of their customers to customize their choices [21]. Suppliers seldom take a proactive role in initiating or implementing a supplier-customer relationship [3]. Rather they concentrate on complying with LEs' requirements in order to remain in the shrinking LEs' supplier base.

The second group of researchers favors SMEs in providing better MC. This study speculates that because SMEs lack power to initiate supply chain relationships, they choose to form strategic alliances with customers and suppliers rather than being aggressive. Several studies report that SMEs gain significant benefits of closer customer-supplier relationships [15][13][1]. Research by Bradley, Meyer, & Gao [6] shows that the SME's attitude toward supplier-customer relationships may enhance the longevity of the relationship, the strength of the supplier-customer bonds, the number of its supplier-customer relationship customers, and the likelihood of winning new customers aboard. Although SMEs might not be able to influence the suppliers and customers to implement systems that enhance the process of MC, achieving higher levels of MC is possible. Because of being part of small supply chains, SMEs are able to devote resources to identify customer needs and work closely with suppliers to fine tune products to match those needs. Suppliers are willing to work with SMEs as opposed to LEs because they have a sense of security in sustaining their supplier-customer relationship. Working with SMEs, customers also enjoy the sense of commitment and fast response time. SMEs are able to offer a greatly detailed product that is customized to fit the customer needs.

There is no definite answer to this paradox; however, this study may shed some light on the issues regarding the level of MC-driven performance different in SMEs and LEs. A theoretical framework can be formulated based on an extended literature review. Lau [20] states that MC may be the basis for the next "industrial revolution" as it encourages and enables firms to design and produce specialized products on a large scale without sacrificing efficiency. Pine [30], Tu et al. [40], and others claim that MC is the ability to design, produce, and deliver products quickly to meet specific customer needs at prices close to those of traditional mass production. The foundation of MC is the ability to achieve customer responsiveness, cost efficiency, and high volume production, simultaneously. Figure 1 illustrates that the relationship between MC and OP may be moderated by organization size.

**FIGURE 1: Mass Customization Framework**



MC construct is the firm’s ability to quickly produce customized products on a large scale at costs comparable to traditional non-customized mass-produced products [38][5][18][20][30]. An organization’s MC is responsively, cost effectively producing large quantities of differentiated products. Based on a thorough review of MC research [16][17][8][36][40][41], MC is defined as the ability to produce varieties of customized products quickly, on a large scale and at a cost comparable to mass-production through technical and managerial innovations. The back-end of the framework shows the organizational performance construct. Organizational performance (OP) refers to the ability of a firm to fulfill its market and financial goals. The OP construct consists of customer retention rate, sales growth, return on investment, production throughput times, and overall competitive position, which are comparable to the measurement used in equivalent studies [42][33][11][24].

Table 1 provides a definition for each variable in Figure 1 as well as important references. The following sections discuss these variables and propose and support the hypothesis illustrated in the framework.

**TABLE 1: Definition and References for Mass Customization and Organizational Performance**

Variable	Definition	References
Mass Customization	Mass customization is the ability of a firm to produce a variety of customized products quickly, on a large scale, and at a cost comparable to mass production.	Pine, 1993; Piller, 2003; Frank and Piller, 2003; O’Grady, 1999; Sophie Lee et al., 2000; Lau, 1995; Tu et al., 2001.
Organizational Performance	The ability of a firm to fulfill its market and financial goals.	Frohlich, 2002; Narasimhan and Kim, 2002; Wisner, 2003; Rosenzweig et al, 2003.

**HYPOTHESES DEVELOPMENT**

**Mass Customization in SMEs vs LEs**

Morrissey & Pittaway [22] revealed that the basic disadvantage for SMEs is their smaller size and lack of power when trying to offer MC to customers. Mudambi et al. [23] confirmed that size asymmetry was a determining factor affecting the levels of negotiation between a purchasing firm and its suppliers. Ultimately LEs were found to be able to dictate their preferred degree of closeness in their relationship with their smaller customers, and were also able to negotiate in the higher level of quality and detailed

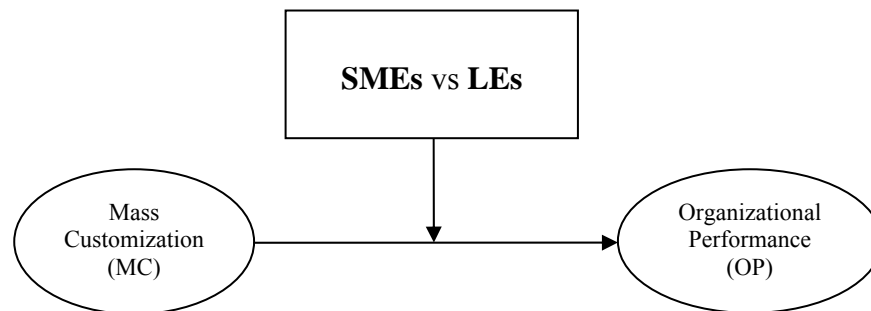
specifications from the suppliers thus benefiting more from the mass customization. Scully and Fawcett [35] conducted a survey of 500 US firms to compare and contrast International Sourcing (IS) activities between SMEs and LEs and confirmed that SMEs were very limited in expanding their IS capabilities to support mass customization. Although some SMEs realized the benefits of such capabilities, they were reluctant to do so.

Regarding the purchasing power, Axelsson & Larsson [2] asserted that, irrespective of the source, power can result in compliance and can drive the adoption of new practices. LEs can force suppliers to expand their envelope to adopt new systems which enhance the mass customization process. In this position dominant buyers are able to make demands, not only for the deliveries and quality of the product, but for sake of mass customization [14][34]. The confirmation from these studies leads to the following hypothesis:

***H1: LEs have a higher level of mass customization-organization performance relationship than SMEs***

Figure 2 shows the updated framework in the hypothesized format. LEs is heightened to express the stronger relationship.

**FIGURE 2: Mass Customization in SMEs VS LEs Framework**



## RESEARCH METHODOLOGY

Instrument development for mass customization, organization size, and organizational performance constructs was carried out in three phases: (1) item generation, (2) pilot study, and (3) large-scale data analysis. An extensive literature review was conducted to identify the domain of the major constructs. Based on theory development and a literature review, construct definitions and initial items were generated. Next, a pilot study was conducted three times using the Q-sort method. Analysis of inter-rater agreement helped to identify weaknesses in construct definitions as well as bad items. Third, a large-scale data set was collected and analyzed to validate the instruments and test the model.

### Item Generation and Pilot Study

A list of initial items for each construct was generated based on theory development and a comprehensive literature review. The number of items used in each category was 9 for MC, 1 for organization size, and 5 for OP. Scales for MC and OP items were five-point Likert-type scales where 1 = “Strongly Disagree”, 2 = “Disagree”, 3 = “Neutral”, 4 = “Agree”, 5 = “Strongly Agree”, and NA = “Not Applicable, or Do Not Know”. The organization size (S) is a categorical item representing the number of employees in the company. This variable was originally categorized into six stratifications, namely: 1-50 employees; 51-100 employees; 101-250 employees; 251-500 employees; 501-1000 employees; and over 1000 employees. It is then coded into nominal scale variables with 1 value representing SMEs (the number of employees

less than or equal to 500 employees) and 0 value representing LEs (the number of employees more than 500 employees).

Items for the various constructs were reviewed by five academicians and re-evaluated through structured interviews with two practitioners to check the relevance of each construct’s definition and clarify wordings. Based on the feedback from the academicians and practitioners, redundant and ambiguous items were either modified or eliminated. New items were added when necessary. A pilot study was conducted three times using the Q-sort method; however, the results are not shown here because of limited space. Interested readers may seek the pilot results directly from the authors. A confirmatory factor analysis (CFA) using structural equation modeling method - AMOS version 5 was conducted to refine the measurement models. Tables 2 and 3 list the items shown in the final measurement models. The asterisk \* marks the items that were used in the large scale data analysis.

**TABLE 2: Items for Mass Customization Construct**

<b>MC1</b>	Our capability of customizing products at low cost is *
<b>MC2</b>	Our capability of customizing products on a large scale is *
<b>MC3</b>	Our capability of translating customer requirements into technical designs quickly is *
<b>MC4</b>	Our capability of adding product variety without increasing cost is *
<b>MC5</b>	Our capability of customizing products while maintaining a large volume is *
<b>MC6</b>	Our capability of setting up for a different product a low cost is *
<b>MC7</b>	Our capability of responding to customization requirements quickly is
<b>MC8</b>	Our capability of adding product variety without sacrificing overall production volume is
<b>MC9</b>	Our capability of changeover to a different product quickly is

**TABLE 3: Items for Organizational Performance Construct**

<b>OP1</b>	Customer retention rate. *
<b>OP2</b>	Sales growth. *
<b>OP3</b>	Return on investment. *
<b>OP4</b>	Production throughput times. *
<b>OP5</b>	Overall competitive position. *

### Survey Methods, Data Collection, and Sample Characteristics

A cross-sectional self-administered mail survey was conducted. The sampling frame was obtained from the Society of Manufacturing Engineers (SME). Of 4,000 mailed questionnaires, 579 did not reach the targeted respondents because of bad addresses. A large number of respondents (235) wrote a refusal on their returned survey and 3,171 questionnaires did not return surveys. In addition, 14 questionnaires were returned empty. Therefore, the number of complete and usable responses was 220, representing a response rate of 6.94% (calculated as 220/3,171).

### LARGE SCALE INSTRUMENT ASSESSMENT METHODOLOGY

Reliability and validity assessments were based on 220 responses. Table 4 shows the results for unidimensionality, reliability, and convergent validity for mass customization and organizational

performance. Cronbach's alpha was used to assess the reliability. Values of 0.80 and higher are considered acceptable for basic research [7][25].

**TABLE 5: Model Fit Indices and Reliabilities for CI, SI, MC, AND OP**

<b>Constructs</b>	<b>Sub-Constructs</b>	<b>No. of items</b>	<b>GFI</b>	<b>AGFI</b>	<b>RMSEA</b>	<b>Cronbach Alpha</b>
<b>MC</b>	Mass customization (MC)	6	0.96	0.92	0.09	0.88
<b>OP</b>	Organizational Performance (OP)	5	0.99	0.96	0.05	0.84

### **HYPOTHESES TESTING**

To test hypotheses, linear regression analysis is applied. The following show the regression models tested for each hypothesis.

$$OP = \beta_0 + \beta_1 MC * S + r \quad (H1)$$

Where:  
 MC = mass customization  
 OP = operation performance  
 S = organization size  
 r = the residual  
 $\beta_0$  and  $\beta_1$  = intercept and slopes

### **RESULTS**

The authors would like to reserve the right to withhold the results at this point. The results will be presented at the conference. Since the results are not available, the discussion and implication part are also not available.

### **REFERENCES**

**References are available upon request.**