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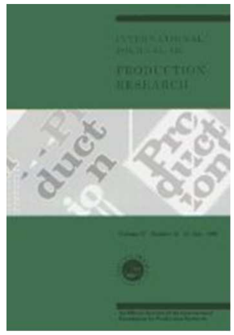

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Organisation design strategies for mass customisation: An information-processing-view perspective

The need to transform the organisation for mass customisation has long been recognised in literature, but the discussion has largely relied on anecdotal evidence or case studies and has limitedly taken advantage of insights from organisation theory. In this paper, we draw on organisational information-processing theory to develop solid theoretical links between mass customisation capability and four organisation design strategies aimed at either increasing an organisation's information-processing capacity or decreasing its information-processing needs. We then test the hypothesized relationships using a sample of 238 manufacturing plants from three industries and eight countries and find that mass customisation capability is positively related to self-containment of tasks, environmental management, and use of lateral relations. We conclude by discussing implications of our results for both research and practice.

Keywords: Mass Customisation; Organisation Design; Organisational Information-Processing Theory; Survey Research.

1. Introduction

Mass customisation denotes the ability to fulfil each customer's idiosyncratic needs without substantial trade-offs in cost, delivery, and quality (Pine, 1993; McCarthy, 2004; Liu et al., 2006). Mass customisation combines the product-customisation advantages of craft manufacturing with the operational-performance advantages of mass production (Duray, 2002; Squire et al., 2006). Since customers nowadays are less and less willing to buy a "one size fits all" product and competitive pressure intensifies, mass customisation is becoming an increasingly widespread concern among companies (Squire et al. 2006; Huang et al., 2008).

Academe has promptly reacted to the growing importance of mass customisation to the business community (Da Silveira et al., 2001). Among the accomplishments of prior research are classification of different approaches to mass customisation (e.g., Gilmore and Pine, 1997; MacCarthy et al., 2003), discussion of its potential benefits and costs (e.g., Kotha, 1995; Zipkin, 2001), identification of mass customisation enablers (e.g., Feitzinger and Lee, 1997; Tu et al., 2001), and discussion of mass customisation potential in different industries (e.g., Li et al., 2010; McIntosh et al., 2010).

While much is written in literature about product-related and manufacturing process-related enablers of mass customisation, relatively less attention has been given to its organisational antecedents (Rungtusanatham and Salvador, 2008). Since Pine's (1993) seminal work, prior research has pointed to a number of organisational variables, such as organisational layers (Lau, 1995), inter- and intra-organisational coordination (Kotha, 1995), employee skills (Pine et al., 1993), and reward systems (Hart, 1995), as crucial to the implementation of mass customisation. The discussion, however, has mostly been scattered and case-based and has limitedly relied on large-scale hypothesis-testing studies. Liu et al. (2006) find empirical support for the hypotheses that mass customisation capability is positively related to nine work-design practices grounded in socio-technical systems theory, such as feedback to shop-floor employees, high standards for recruiting, and employee-contribution willingness, and conclude their paper with a call for additional research on the organisational enablers of mass customisation.

In response to this call, we draw on organisational information-processing theory (Galbraith, 1977; Tushman and Nadler, 1978) to identify four organisation design strategies relevant to the development of mass customisation capability. The unit of analysis in our study is, at the theoretical level, a manufacturing organisation, and, at the empirical level, a particular instance of manufacturing organisation: namely, a manufacturing plant. We test the hypothesized relationships through multivariate analysis of variance, using a sample of 238 manufacturing plants from three industries and eight countries. The analysis results support the hypotheses that mass customisation capability is positively related to self-containment of tasks, to environmental management, and to the use of lateral relations within the firm boundaries. Our findings add to the debate surrounding the organisational enablers of mass customisation by viewing development of mass customisation capability through the lens of organisational information-processing theory and by offering empirical evidence with a high degree of generalisability. Our results also contribute to the organisation design literature by providing empirical support for an information-processing view of organisational design.

The remainder of this paper is organised as follows. In Section 2, we present our theoretical background and develop our research hypotheses. In Section 3, we describe our data, the measures and their psychometric properties, as well as our data analysis strategy. Section 4 presents the results of the empirical analyses, while Section 5 concludes by discussing the theoretical and managerial implications of this study, as well as its limitations and the associated directions for future research.

2. Theoretical background and hypotheses development

In this section, we begin by briefly presenting organisational information-processing theory. Subsequently, we draw upon this theory to link a company's decision to develop mass customisation capability with the amount of task uncertainty facing the company. Finally, we expound our research hypotheses concerning the relationships between mass customisation capability and four organisation design strategies aimed at either reducing or coping with task uncertainty.

2.1 Organisational information-processing theory

A basic assumption underlying organisational information-processing theory is that organisations can be seen as information-processing systems, where organisational information processing refers to the carrying out of the ad hoc or prescribed activities through which organisational members gather, store, assess, alter or use organisationally relevant information (Tushman and Nadler, 1978; Huber, 1982; Egelhoff, 1991). The difference between the amount of information required to perform a task and the amount of relevant information already possessed by the organisation executing the task is what Galbraith (1973) calls task uncertainty. By this definition, task uncertainty is the amount of information that the organisation has to process during task execution (Galbraith, 1973).

The amount of task uncertainty facing an organisation is influenced by several factors, both internal and external to the organisation (e.g., Tushman and Nadler, 1978; Daft and Lengel, 1986; Egelhoff, 1991). Based on Galbraith's (1973; 1977) seminal work, four fundamental contributors to task uncertainty can be identified. First, task uncertainty increases with environmental complexity, defined as the number of diverse factors in the environment that are at least potentially relevant to the organisation's task (Duncan, 1972). Greater environmental complexity implies a larger variety of external factors, such as products/services offered or markets/customers served, about which information must be collected, stored, and distributed in the organisation (Galbraith, 1977). Additionally, greater environmental complexity may involve greater internal complexity and, hence, more parts, technologies, processes, etc. about which information must be processed (Galbraith, 1973; Skinner, 1974; Flynn and Flynn, 1999). Another determinant of task uncertainty is environmental dynamism, defined as the rate at which the environmental factors that the organisation chooses to deal with change over time (Duncan, 1972; Tushman and Nadler, 1978). As environmental dynamism increases, the information that the organisation already possesses by virtue of its prior experience becomes less relevant to the execution of the task and, therefore, more information has to be processed during task performance (Galbraith, 1977). A third contributor to task uncertainty is the level of performance that the organisation wants to achieve in executing the task (Galbraith, 1973; 1977). Higher performance standards entail less availability of slack resources, such as safety stocks or excess capacity, to uncouple the activities of either different organisational subunits or different actors within the organisation's supply chain (Galbraith, 1977). Therefore, as the required level of performance increases, so too do the interdependence of the organisational parts as well as the organisation's reliance on the larger environment, and task uncertainty grows because of the consequent internal and external coordination problems (Tushman and Nadler, 1978; Crowston, 1997). Finally, a fourth determinant of task uncertainty is division of labour within the organisation, since greater labour division increases the number of internal factors, such as roles or salary categories, about which information must be processed and gives rise to internal interdependencies and the subsequent coordination requirements (Galbraith, 1977; Thompson, 1967).

Differences in the amount of task uncertainty facing an organisation lead to differences in the best way to design the organisation (Galbraith, 1973). This is because, to effectively execute its task, an organisation must fit its information-processing capacity to the amount of task uncertainty or information-processing needs it faces during task performance (Tushman and Nadler, 1978). As task uncertainty increases and can no longer be absorbed by rules, goal setting and the hierarchy, the organisation must take organisation design action to realign its information-processing needs and capacity (Galbraith, 1973). Galbraith (1977) presents five organisational design strategies that the organisation can choose to follow, individually or in some combination, to realign its information-processing needs and capacity. Three strategies, namely creation of slack resources, environmental management and creation of self-contained tasks, reduce the need for information processing by lowering the level of performance that the organisation wants to achieve in executing its task, the complexity and dynamism of the environment relevant to the organisation's task, and division of labour within the organisation (Galbraith, 1977). Another two strategies, namely investment in computer-based information systems and creation of lateral relations, increase the organisation's information-processing capacity by overcoming people's limited ability to handle information and by increasing horizontal communication across pre-existing departmental boundaries (Galbraith, 1977).

2.2 Task uncertainty and the decision to develop mass customisation capability

Mass customisation capability denotes the ability to fulfil each customer's idiosyncratic needs without substantial trade-offs in cost, delivery, and quality (Pine, 1993; McCarthy, 2004; Liu et al., 2006). Low mass customisation capability is associated either with mass production, where operational performance is preserved but products are standardised, or with custom manufacturing, where products are individualised but operational performance deteriorates (Duray, 2002; Squire et al., 2006). When a company decides to achieve higher mass customisation capability, this strategic choice per se tends to increase task uncertainty, for reasons that are different according as the company is a custom manufacturer or a mass producer.

A custom manufacturer must improve its operational performance in order to develop mass customisation capability, and the higher level of performance required adds to task uncertainty. To mitigate the trade-off between customisation and responsiveness, for example, more information has to be extracted and exchanged between customer, sales personnel, and technical personnel in order to avoid specification of products that could not be delivered on the promised due-date or even could not be produced at all (Salvador and Forza, 2004; Chen and Tseng, 2010). Similarly, improving compatibility between product customisation and operational performance may require that manufacturing and marketing closely coordinate to establish "time fences" for accommodating customers' requests for specification changes after order placement (McCutcheon et al, 1994) or to implement innovative production strategies, such as make-to-forecast (Meredith and Akinc, 2007) or form postponement (Forza et al., 2008; Trentin et al., 2011).

A mass producer must cope with greater environmental complexity and dynamism in order to develop mass customisation capability, and the increase in the complexity and dynamism of the environment relevant to the organisation's task adds to task uncertainty. To more closely meet each customer's idiosyncratic expectations, the company must offer a larger variety of pre-engineered products and/or adapt its products and possibly its order fulfilment processes to the individual customers' requirements (MacCarthy et al., 2003). As more and more product variants are added to the company's offer, information about each variant must be stored, retrieved, distributed, and updated both within and across functional boundaries (Flynn and Flynn, 1999). In addition, information-processing requirements increase because of the need for constantly collecting data on customer transactions, behaviours or experiences and because of the need for analysing those data to determine customer preferences and to identify demand changes or possibly unsatisfied needs (Salvador et al., 2007; 2009). More information exchange is also necessary between marketing and operations to iteratively negotiate product line extensions and to determine optimal product assortment (Morgan et al., 2001).

By intrinsically raising the level of performance required or environmental complexity and dynamism[1], a company's decision to develop mass customisation capability tends to create a mismatch between information-processing needs and information-processing capacity of the company. In accordance with organisational information-processing theory, this gap has to be closed in order for the firm to successfully implement its decision to achieve higher mass customisation capability. Development of mass customisation capability is therefore facilitated by organisation design strategies that help the company re-align its information-processing needs and capacity during task execution. However, not all the five strategies identified by Galbraith (1977) to achieve such re-alignment (i.e., creation of slack resources, environmental management, creation of self-contained tasks, use of computer-based information systems, and utilisation of lateral relations) are viable when mass customisation is the goal. In keeping with Liu et al. (2010), we argue that creation of slack resources is not a viable option in this case. The reason is that creating slack resources means to reduce performance targets (Galbraith, 1977), whilst transition from custom manufacturing to mass customisation necessitates improving operational performance and transition from mass production to mass customisation ideally requires that operational performance be preserved

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[1] Whilst intrinsically raising the level of performance required or environmental complexity and dynamism, the decision to achieve higher mass customisation capability per se does not affect another contributor to task uncertainty: namely, division of labour. Stated otherwise, the mismatch that the decision to develop mass customisation capability tends to create between information-processing needs and capacity is not explained by increased division of labour. Division of labour, however, may play a role in the effective implementation of that decision. As discussed further in this section, the effective achievement of higher mass customisation capability necessitates re-aligning information-processing needs and capacity, and this can be accomplished also by reducing division of labour through the creation of self-contained tasks (Section 2.3).

(Hart, 1995; Beaty, 1996). Unlike creation of slack resources, the other four organisation design strategies suggested by Galbraith (1977) allow a company to realign its information-processing needs and capacity without deteriorating performance level and, therefore, are viable alternatives when mass customisation is the goal. Each of those four strategies facilitates development of mass customisation capability by enabling a firm either to reduce the amount of task uncertainty it faces or to increase its information-processing capacity during task execution[2].

2.3 Self-containment of tasks and mass customisation capability

Self-containment of tasks enhances mass customisation capability by alleviating the organisation's information-processing load during task performance. Creating self-contained tasks means "to change the subtask groupings from resource (input) based to output based categories and give each group the resources it needs to supply the output" (Galbraith, 1974: 31). This organisation design strategy reduces information-processing needs by lessening the amount of output diversity handled by a single organisational subunit as well as the sharing of resources across different subunits (Galbraith, 1977).

Self-containment of tasks is exemplified by the creation and operation of manufacturing cells (Flynn and Flynn, 1999) in which functionally dissimilar machines are dedicated to families of parts or products with similar processing requirements and in which subtasks and those who perform them are tightly connected in terms of time, space, and information (Hyer and Brown, 1999). Cellular manufacturing enables firms to improve both cost effectiveness and responsiveness of product customisation (Tu et al., 2001; Liu et al., 2006), for instance by

[2] According as a company chooses to predominantly follow strategies to increase its information-processing capacity or strategies to reduce its information-processing needs during task execution, the task uncertainty variation associated with the effective achievement of higher mass customisation capability will eventually be different.

allowing cross-trained operators to visually scan all workstations and to quickly go where workload is accumulating in order to avoid or reduce bottlenecks (Hyer and Brown, 1999). Self-containment of tasks reduces information-processing requirements also because the shift to an output-based criterion for grouping resources into organisational subunits necessitates reducing division of labour within each subunit, owing to the decreased volume of demand faced by each subunit (Galbraith, 1977). This reduction can be accomplished by means of employee empowerment and cross training, both of which improve the compatibility between product customisation and operational performance (Liu et al., 2006). Allowing cell operators the latitude to adjust production schedules based on materials availability, for instance, can ensure a smoother production flow and avoid costly delays (Hyer and Brown, 1999), whilst cross training of workers can make it easier to promptly respond to demand-mix changes without impairing cost and quality performance (Trentin and Forza, 2010). Therefore, it is hypothesized that:

> ***Hypothesis 1.*** *Self-containment of tasks is positively related to mass customisation capability.*

2.4 Environmental management and mass customisation capability

Similar to task self-containment, environmental management facilitates achievement of mass customisation capability by reducing the organisation's information-processing needs during task execution[3]. In Galbraith's (1977) terms, environmental management denotes a set of mechanisms by which an organisation attempts to modify the environment, influencing the behaviours of the relevant others (suppliers, customers, regulatory groups, etc.) whose support

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[3] This is not to deny that environmental management may influence mass customisation capability through other mechanisms as well, which do not involve the reduction of information-processing requirements during task performance (e.g., inventory cost savings due to shorter sourcing lead-times ensured by cooperative relationships with select suppliers (Magretta, 1998)).

is needed by the organisation to perform its task. In the presence of low to moderate levels of task uncertainty, the organisation may achieve environmental support by simply drawing on its own resources, for instance through better offerings and internal efficiency or by fostering a favourable image via the mass media, without sacrificing its autonomy (Galbraith, 1977). However, when task uncertainty tends to increase, as happens with the decision to develop mass customisation capability, organisations must give up some autonomy in exchange for environmental support, developing and maintaining cooperative relations with suppliers, customers, etc. (Galbraith, 1977).

On the one hand, the development of close relationships with select suppliers is identified in literature as an important supporting factor to improve supplier performance (Krause et al., 2000; Modi and Mabert, 2007). Greater supply reliability and flexibility alleviate a company's information-processing needs by reducing supply-side sources of variability and by removing, or at least loosening, the supply constraints that must be considered in production planning.

On the other hand, the development of cooperative relationships with customers is identified in literature as an important factor to induce customers to place small orders on a regular basis rather than large orders irregularly (Womack and Jones, 1996; Forza, 1996). A smoother demand flow alleviates a company's information-processing needs by reducing the demand-side constraints that must be considered in production planning.

Less information-processing requirements in production planning help a firm defer differentiation of product variants until customer order receipt, thus saving on inventory-holding costs, without impairing delivery performance (Trentin and Forza, 2010). Preserving delivery performance requires that all activities after customer order arrival be accelerated, including the administrative ones (Brown et al., 2000). The reduction of information-processing needs in production planning shortens administrative lead-times by making it easier to quickly generate feasible production schedules in line with customer expected delivery dates (Trentin and Forza, 2010). Based on the above discussion, we posit the following hypothesis:

> ***Hypothesis 2.*** *Environmental management is positively related to mass customisation capability.*

2.5 Use of enterprise-wide information systems and mass customisation capability

The use of computer-based information systems enhances mass customisation capability by increasing the organisation's information-processing capacity during task execution. Provided information is quantifiable or formal in nature, computer-based information systems allow for overcoming people's limited ability to process information by exploiting the information processing power of the combination of information technology and operations research/management science (Galbraith, 1977; Tushman and Nadler, 1978). Computer-based information systems enable organisations to systematically collect and store larger amounts of data in a formalized manner, to more efficiently access those data and feed them into computationally complex decision algorithms, as well as to do all these activities more often, so as to quickly incorporate any newly available information into decision making (Galbraith, 1977).

The support provided by computer-based information systems to the development of mass customisation capability can be appreciated in all areas of activity of a company. In the marketing and sales area, for example, information systems can help efficiently and effectively collect, store, and analyse data on customers' previous purchase decisions and shopping behaviours in order to develop and maintain the company's product offerings (Salvador et al., 2007; 2009; Song and Kusiak, 2009). In the area of after-sale services, information systems may help precisely identify the spare parts that are compatible with a specific product configuration (Forza and Salvador, 2008), thus improving compatibility between product customisation and service quality. In the operations area, information systems can play an essential role in enabling a company to efficiently utilise its production capacity when building a large number of product variants on a to-order basis, so as to simultaneously avoid excessive inventory-holding costs, long production lead-times, and high production costs (Steger-Jensen and Svensson, 2004, Dean et al, 2009). In the technical area, information systems may improve the compatibility between product customisation and operational performance by ensuring consistency in the creation and revision of product data as well as by supporting control and coordination of design activities assigned to different actors both within and outside the company's boundaries (Forza and Salvador, 2008). In the human resource management area, information systems may recommend where to recruit shop-floor employees capable of efficiently performing flexible manufacturing tasks (Broderick and Boudeau, 1992), as required in a mass-customisation environment (Liu et al., 2006). In the firm infrastructure area, finally, information systems can enhance mass customisation capability by providing valuable support for quality control and improvement activities (Forza, 1995) in a manufacturing context in which the number of control points tends to increase due to product variety and customisation (Suzue and Kohdate, 1990). The foregoing discussion leads to the following hypothesis.

> ***Hypothesis 3.*** *The use of enterprise-wide information systems is positively related to mass customisation capability.*

2.6 Use of lateral relations and mass customisation capability

Similar to enterprise-wide information systems use, utilisation of lateral relations facilitates achievement of mass customisation capability by improving the organisation's information-processing capacity during task execution. Lateral relations are defined as "joint decision processes which cut across lines of authority" (Galbraith, 1974: 32). Lateral relations are non-hierarchical, coordinative mechanisms, such as direct contacts, liaison roles, task forces, or teams, which increase the amount and frequency of communication across pre-existing departmental boundaries (Joyce et al., 1997). Utilisation of lateral relations enhances the organisation's ability to exploit local information in decision making as well as its ability to simultaneously deal with multiple dimensions of the decision environment, such as customers' demands, suppliers' performances, workforce skills, technology capabilities, etc. (Huiskonen and Pirttilä, 2002). The use of lateral relations permits problems to be solved at the level at which they occur, where information relevant to solving the problem exists (Flynn and Flynn, 1999). Additionally, the use of lateral relations allows information to quickly permeate the organisation, thereby improving the organisation's ability to adapt to a dynamic environment (Joyce et al., 1997).

By creating horizontal communication channels and joint decision-making processes between the sales, manufacturing, and purchasing departments, for example, a company with a large number of make-to-stock varieties can enhance its ability to quickly incorporate any updated demand-mix information into the production-planning process and to accordingly revise its production schedules so as to reduce overstock and stock-out costs (Trentin and Forza, 2010). Likewise, increased intra-firm coordination and integration facilitate the successful implementation of product modularity (Sanchez, 1999; Lau Antonio et al., 2009) and of advanced manufacturing technologies (Ettlie and Reza, 1992; Swink and Nair, 2007), both of which are widely acknowledged enablers of mass customisation (Pine, 1993; Duray et al., 2000; Da Silveira et al., 2001; Berman, 2002). Therefore, we propose the following hypothesis:

> ***Hypothesis 4.*** *The use of lateral relations is positively related to mass customisation capability.*

3. Method

3.1 Empirical data

The data used for the empirical analyses in this research are part of the third round of the High Performance Manufacturing (HPM) study, an international survey aimed at investigating manufacturing practices, processes, and performance (Schroeder and Flynn, 2001). The sample includes 238 mid- to large-sized manufacturing plants in three industries (machinery, electronics, and automobile supplier) and eight countries (U.S., Japan, South Korea, Italy, Germany, Austria, Finland, and Sweden,) representing North America, Asia, and Europe. The breakdown of the sample by country and industry is reported in Table 1.

<INSERT TABLE 1 HERE>

HPM researchers developed twelve different questionnaires directed to as many different respondent categories. The survey items were divided between the questionnaires in order to obtain information from the respondents who were most knowledgeable. The respondent categories included production workers, supervisors, and various managers, such as the production control manager, the human resources manager, and the plant manager. To maximise the response rate, HPM researchers first solicited plants participation and then sent the questionnaires to those plants that had agreed to participate. In return for participation, each plant received a detailed report comparing its manufacturing operations profile to those of other plants in its industry. With this approach, the response rate was approximately 65% in each country, thus reducing the need to check for non-response bias (Flynn et al., 1990; Liu et al., 2006; Heim and Peng, 2010). Additional details of the data collection procedures can be found in Schroeder and Flynn (2001) and in Liu et al. (2006).

3.2 Measures

The constructs of interest in this study were measured by means of multi-item scales. Where possible, we used existing scales from the literature that have demonstrated reliability and validity. To further ensure that the scale items were reliable and valid, we conducted item analysis for each scale and modified the scales when necessary. The final scales and the sources of these scales are listed in the paper appendix.

We modelled self-containment of tasks, environmental management, and use of lateral relations as reflective second-order latent constructs. Task self-containment (TSC) is exemplified by the creation and operation of manufacturing cells (Flynn and Flynn, 1999) in which machines dedicated to specific product families are laid out in close proximity to one another, so that throughput time, work-in-progress inventory, and materials handling are reduced (Wemmerlöv and Hyer, 1989). The effective operation of manufacturing cells requires that workers be multi-functional, be in charge of maintenance subtasks, and be empowered to take action in response to signals (Hyer and Brown, 1999). Consequently, TSC is reflected by four first-order constructs: cellular layout, employee empowerment, cross-functional training, and autonomous maintenance by shop-floor employees.

Consistent with the theoretical argument developed in Section 2.4, we conceptualise environmental management (EM) as the establishment of cooperative relationships with those elements in an organisation's environment upon which the organisation is dependent to effectively perform its task. Among those elements, an important role is undoubtedly played by suppliers and customers. The quality of a manufacturer's products and processes, for example, is directly influenced by the quality of the incoming materials from suppliers and by the availability of customers' feedbacks on quality (Flynn et al., 1994; Forza, 1995; Ahire et al., 1996). Consequently, two out of the three first-order constructs measuring EM (i.e., supplier partnership and customer involvement) respectively capture coordinated actions with suppliers and customers towards some common goal of interest (Schermerhorn, 1975), such as supplier development efforts to improve supplier quality performance or customer involvement in new product development to achieve better fit between products and customer needs. The third construct measuring EM (i.e., external cooperation) was included to also capture cooperation with an organisation's surrounding community.

As for lateral relations use (LRU), this construct is exemplified by adoption of a team-based approach to solve problems (Flynn and Flynn, 1999), which involves group problem-solving sessions during which an effort is made to get all team members' opinion and ideas before making a decision. More generally, lateral relations are joint decision processes which involve concerted decision making and interdepartmental integration (Joyce et al., 1997). Consequently, LRU is reflected by three first-order constructs: coordination of decision making, integration between functions, and small group problem solving.

To operationalise enterprise-wide information systems use (EWISU), we drew on Heim and Peng's (2010) formative measure of the extent to which a plant utilises information technology. Heim and Peng (2010) counted how many of 31 separate application areas were supported by software at each plant. Consistent with the theoretical argument developed in Section 2.5, we adapted Heim and Peng's (2010) measure to assess the extent to which the use of computer-based information systems covers the various types of activities carried out in each plant. Accordingly, we mapped the 31 application areas considered in the third round of the HPM study into the primary and support activities of Porter's (1985) value chain. Seven application areas concern operations (OP_i, i= 1,…, 7)[4], five relate to inbound and outbound logistics (LO_j, j= 1,…, 5), another five regard marketing and sales (SA_k, k= 1,…, 5), three pertain to technology development (TE_m, m= 1, 2, 3), eight refer to firm infrastructure (IN_n, n= 1,…, 8), and three respectively concern service (SE_1), procurement (PR_1), and human resource management (HR_1). The number of application areas ranges from one to eight according to the value-chain activity considered. To the best of our knowledge, the existing

[4] Each application area pertaining to a given value-chain activity is associated with a binary variable whose value is "1" if the corresponding application area is supported by software and "0" otherwise.

literature does not give clues as to the relative importance of information technology to the development of mass customisation capability in different value-chain activities. To avoid overestimating the importance of the value-chain activities with more application areas in our data set, therefore, we measured the use of information systems in each value-chain activity as the fraction of the corresponding application areas that are supported by software ($\frac{1}{7}\sum_{i=1}^{i=7} OP_i$ for operations, $\frac{1}{5}\sum_{j=1}^{j=5} LO_j$ for inbound and outbound logistics, etc.). By adding such fractions, we obtained a formative index capturing the extent to which the use of computer-based information systems covers the various types of activities carried out in each plant.

Mass customisation capability (MCC), finally, was measured by means of Huang et al.'s (2008) multi-item scale. The items of this scale reflect a plant's ability to offer product variety and customisation without substantial trade-offs in the plant's operational performance.

All reflective multi-item scales were assessed for inter-item reliability and unidimensionality by computing Cronbach's alpha and conducting exploratory factor analysis, respectively. No scale has an alpha lower than the cut-off value of 0.70 recommended by Nunnally (1978) for established scales, with the exception of the EM and TSC scales, both of which are newly developed. The former, however, exhibits an alpha above the cut-off value of 0.60 recommended by Nunnally (1978) for that type of scales. As for the EM scale, its alpha of 0.59 is slightly below but very close to 0.60. Since this is a newly developed scale for a broadly defined construct, we considered its value acceptable (O'Leary-Kelly and Vokurka, 1998). Furthermore, each scale is significantly associated with only one latent factor having an eigenvalue greater than one and all factor loadings are greater than 0.50, well above the commonly recommended threshold of 0.30 (Hair et al., 1992).

We also assessed discriminant validity by performing pair-wise chi-square difference tests, as recommended by Bagozzi et al. (1991). Chi-quadro differences range from 91.86 to 457.96 and are all significant at the 0.001 level, which indicates discriminant validity among the theoretical constructs.

To aggregate each scale into a single variable, we took the mean score of the item measures. Where there were multiple respondents within a plant for an item, an average was taken to obtain a single value for each plant. Inter-rater agreement among the respondents was evaluated using the ratio method developed by James et al. (1984). The inter-rater coefficients are all above the cut-off value of 0.80 suggested by Boyer and Verma (2000), indicating good agreement among the respondents.

3.3 Analysis

Our research hypotheses link mass customisation capability with four organisation design strategies aimed at either increasing an organisation's information-processing capacity or decreasing its information-processing needs. Theoretically, we expected these strategies to be inter-correlated, since an organisation can choose a combination of several of them in order to close the gap between information-processing needs and capacity (Galbraith, 1977) that the decision to develop mass customisation capability tends to create. For instance, the use of computer-based information systems and the utilisation of lateral relations may be complementary approaches to increase the organisation's information-processing capacity, with the former being most amenable when information is quantifiable and the latter being more appropriate for information that is less quantifiable (Tushman and Nadler, 1978). Therefore, we suspected that regression analysis could be inappropriate to test our hypotheses. We regressed mass customisation capability on the four organisation design strategies of interest[5], but the results suggested significant multicollinearity among the independent variables. Three out of the four organisation design strategies have a variance inflation factor value above 2 (range: 2.01– 3.22), which indicates that more than a half of their variance (between 50% and 69%) can be explained by the other independent variables. Multicollinearity among the independent variables in linear ordinary least square regression is a serious problem if one aims to assess the contribution of each independent variable (Hair et al., 1992). Therefore, we looked for another statistical technique that is less impacted by multicollinearity. Multivariate analysis of variance (MANOVA) enables a researcher investigating the relationships between a set of variables and a single variable to take into consideration the inter-correlations among the set of variables and still to assess their individual relationships with the single variable (Bray and Maxwell, 1985; Haase, 1987). Accordingly, we regarded MANOVA as a suitable technique to test our hypotheses.

Since MANOVA requires that the single independent variable be categorical, the plants in the data set were ranked by mass customisation capability and, then, were divided into three equal-size subsamples by rank (high, medium, and low). Consistent with related previous studies (e.g., Liu et al., 2006), we decided to control for possible effects of country, industry, and plant size before evaluating the relationships between the four organisation design strategies and mass customisation capability. Therefore, in the same way as Liu et al. (2006), we classified the plants into the three above-mentioned groups using the standardised residuals from a linear ordinary least square regression model including only the control

[5] Consistent with related previous studies (e.g., Liu et al., 2006), we decided to control for possible effects of country, industry, and plant size. We measured plant size as the natural log of the sum of the number of hourly and regular salaried employees (e.g. Heim and Peng, 2010).

variables as the independent variables and mass customisation capability as the dependent variable[6].

4. Analysis results

With the three groups of low, medium, and high mass-customisation capability plants, respectively, we were able to specifically test each of our four hypotheses by means of MANOVA. Before running the analysis, we checked for the presence of multivariate outliers using the Mahalanobis distance and standardised residuals. Two outliers were detected and were eliminated from subsequent analysis. In addition, because of missing responses needed for the MANOVA, we checked if those variables are missing completely at random (MCAR) by performing Little's MCAR test. The resulting *p*-value is non-significant at the 0.10 level, indicating the variables are MCAR. Thus, in the MANOVA, we list-wise deleted the plants having missing values. Finally, we examined the assumptions needed for MANOVA: namely, randomly sampled and statistically independent observations, multivariate normality of the dependent variables within each group, homogeneity of variance for each dependent variable, and equality of covariances between any two dependent variables in all groups (Bray and Maxwell, 1985). The first two assumptions are met, as the plants were randomly selected in each country-industry combination and each individual plant completed the surveys independently (Liu et al., 2006). As for the third assumption, relating to multivariate normality, "in practice, this can usually be thought of as a requirement that each separate variable follow a normal distribution" (Bray and Maxwell, 1985: 32). We tested univariate normality of the dependent variables within each group by means of the Kolmogorov-

[6] We measured plant size as the natural log of the sum of the number of hourly and regular salaried employees (e.g. Heim and Peng, 2010). We examined assumptions critical for the analysis, including independent and normally distributed errors, linearity, and homoscedasticity, ruling out potential violation of these assumptions. One outlier was detected using the Mahalanobis distance and was eliminated from subsequent analysis.

Smirnov test. The resulting *p*-values (Table 2) are all non-significant at the 0.05 level, indicating the normality assumption is met. As regards the last assumption, relating to variance-covariance matrix equality, Box's test of equality of covariance matrices and Levene's test of equality of error variances were performed. The results of these tests (Table 2) show that this assumption is met too, since all results are non-significant at the 0.10 level.

<INSERT TABLE 2 HERE>

The MANOVA results are reported in Table 3. Pillai's trace, Wilks' lambda, Hotelling's trace, and Roy's largest root are all significant ($p<0.05$), indicating that application of the four organisation design strategies significantly differs among the three groups of plants. Additionally, an inspection of the between-subjects effects output from SPSS indicated that there are significant differences ($p<0.01$) among the three groups on all the four strategies considered but enterprise-wide information systems use.

<INSERT TABLE 3 HERE>

To further test for differences in each organisation design strategy between individual pairs of groups, we used Scheffé's pairwise comparison procedure, whose results are reported in Table 4. Scheffé's pairwise comparisons show that plants with high mass customisation capability apply all four organisation design strategies except enterprise-wide information systems use to a significantly greater extent ($p<0.01$) than plants with low mass customisation capability. Furthermore, plants with high mass customisation capability apply self-containment of tasks significantly more ($p<0.10$) than plants with medium mass customisation capability. In turn, the latter plants rely on both environmental management and lateral relations to a significantly greater extent ($p<0.10$) than plants with low mass customisation capability. Overall, these results indicate that all four organisation design strategies except enterprise-wide information systems use are positively related to mass customisation capability, providing support for all our hypotheses but Hypothesis 3.

<INSERT TABLE 4 HERE>

5. Discussion and conclusion

This study contributes to the mass customisation literature by improving the current understanding of the organisational enablers of mass customisation capability. Thus far, the relevant literature has pointed to a number of organisational variables that can play an important role in the development of mass customisation capability (e.g., Pine, 1993; Lau, 1995; Kotha, 1995). However, the discussion has limitedly taken advantage of insights from organisation theory to provide stronger rationales for the proposed relationships between organisational variables and mass customisation capability. In this paper, by relating the pursuit of mass customisation capability to the amount of task uncertainty facing an organisation, we are able to draw on organisational information-processing theory to develop solid theoretical links between mass customisation capability and four organisation design strategies aimed at either increasing an organisation's information-processing capacity or decreasing its information-processing needs. Whilst organizational information-processing theory has been occasionally applied in mass customisation research (Salvador et al., 2007; Liu et al., In Press; Peng et al., In Press), our paper exhibits a first effort to fully explore the potentials of this theory in explaining the impact of organisational design features on mass customisation capability.

Our theoretical argument that the organisation design strategies of task self-containment, environmental management, enterprise-wide information systems use, and creation of lateral relations positively influence mass customisation capability complements Liu et al.'s (2006) finding that mass customisation capability is positively related to nine out of ten work design practices grounded in socio-technical systems theory. Such complementarity of contribution can be easily appreciated if we consider the three decision areas that form the building blocks of Galbraith's (1977) conceptualisation of organisation design. By examining the roles of self-contained tasks, information systems and lateral relations in the development of mass customisation capability, we deal with what Galbraith (1977) calls the "choice of the organizing mode", which comprises decisions as to how to decompose the overall task into subtasks and how to reintegrate the subtasks into the completion of the whole task. Furthermore, by examining the effect of environmental management on mass customisation capability, we also treat what Galbraith (1977) calls the "choice of strategy", which consists of choosing the organisation's domain and the relations with the external entities whose support the organisation needs to complete its task. We do not touch, however, the third decision area identified by Galbraith (1977), that is, "integrating individuals", which comprises choices as to the policies to integrate individuals into the organisation, including selection and training of people and design of reward systems. Conversely, Liu et al. (2006) pay considerable attention to this area. Additionally, whilst overlapping with our research on one dimension of the "choice of the organizing mode" (i.e., task decomposition into subtasks), their study does not consider the other dimension of this decision area (i.e., inter-unit coordination for completion of the whole task), nor does their study deal with the "choice of strategy". In summary, our paper responds to Liu et al.'s (2006) call for additional research on the organisational enablers of mass customisation by developing solid theoretical links between mass customisation capability and a number of organisation design strategies not captured by the work design practices considered by Liu et al. (2006).

The present study makes a further contribution to the mass customisation literature by strengthening its empirical foundation. Almost one decade ago, Da Silveira et al. (2001) warned against the lack of large-scale empirical studies in the area of mass customisation. Our paper is among the few that have taken a step towards filling this gap. Our empirical results provide support for the hypotheses that mass customisation capability is positively related to self-containment of tasks, environmental management, and utilisation of lateral relations, thereby corroborating our theoretical argument. The lack of a statistically significant difference in the use of computer-based information systems among the three groups of low, medium, and high mass-customisation capability plants, however, is an unexpected finding. One possible explanation for this result is that organisations rely on a combination of the remaining three strategies to absorb the greater task uncertainty associated with the decision to achieve higher mass customisation capability, choosing human and management-intensive solutions to process information rather than technology-intensive solutions (e.g., Flynn and Flynn, 1999). We suspect, however, that this result arises from the limitations of our measure of enterprise-wide information systems use. That measure captures the extent to which the use of information systems covers the various types of activity carried out in a plant and assumes that the importance of information technology to the development of mass customisation capability is the same for all areas of activity. Whilst such an assumption is not at odd with the existing literature, there is definitely a need for further studies specifically devoted to in-depth investigating of the relative importance of information systems to mass customisation in different areas of activity. Another limitation of our measure of enterprise-wide information systems use is inherent in the secondary nature of our data. The effectiveness of computer-based information systems in improving mass customisation capability might be contingent upon the functionalities offered by those systems. Having software supporting production planning and scheduling, for instance, might be insufficient to enhance mass customisation capability, unless an available-to-promise and capable-to-promise functionality is provided (Steger-Jensen and Svensson, 2004). Unfortunately, our data do not allow us to understand which specific functionalities are offered in each application area supported by software at our sample plants, let alone the extent to which each functionality is used and supports activities in each area. Future studies could therefore be designed to identify a set of software functionalities supporting mass customisation in the various application areas and to develop more fine-grained measures of the extent to which each of these functionalities is used by an organisation.

Besides adding to the body of knowledge on mass customisation, the present study also makes an empirical contribution to the organisation design literature. Many years after Galbraith's (1977) information-processing view of organisational design was first proposed, our empirical results further corroborate the central prediction of Galbraith's (1977) model. That is, when faced with greater task uncertainty, an organisation must adopt at least one organisation design strategy among creation of slack resources, creation of self-contained tasks, environmental management, investment in information systems, and creation of lateral relations. In particular, if reducing the level of performance through the creation of slack resources is not a viable option, as happens with companies pursuing mass customisation, then the organisation must choose one or a combination of several of the remaining four strategies, and this is what our empirical findings suggest as well.

Pragmatically, we believe that our theoretical and empirical results support managerial decision making on the pursuit of mass customisation. First, our findings increase companies' awareness that, to enhance their mass customisation capability, they should redesign their organisation, in addition to their products and their manufacturing and supply chain processes. Secondly, our findings suggest some normative implications for the design of an organisation pursuing mass customisation. Developing mass customisation capability requires transforming the organisation so as to increase its information-processing capacity and/or reduce its information-processing requirements during task execution. A variety of specific organisational changes can be deployed to achieve this goal, and the difficulty and cost of implementing these changes should be taken into account when the enhancement of mass customisation capability is being considered.

Whilst contributing both to the academic literature and to managerial practice, this study is not without limitations, which might be addressed in future research. A major limitation of this study is the weakness of measures, owing to the secondary nature of our data. The measures in the High Performance Manufacturing data set were not designed for the present research in the first place. Future studies could therefore be devoted to collecting primary data that allow for better empirical scrutiny of our theoretical argument. Another limitation of this research is inherent in the cross-sectional nature of our data, which limits our ability to establish causal relationships between organisation design strategies and mass customisation capability. Thus, an opportunity for further research is to design longitudinal studies that enable empirical evaluation of the linkages between mass customisation capability and organisation design strategies over time. Finally, a third limitation of this study arises from the fact that we adopt a logistical, rather than cognitive view of organisational information processing (Huber, 1982; Egelhoff, 1991). Accordingly, our theoretical argument focuses on how information processing, and hence the development of mass customisation capability, is influenced by organisational structures and processes, rather than by the individual characteristics of organisation members. Clearly, another direction for future research would be to develop and empirically test hypotheses about the relationships between individual competences and mass customisation capability.

Appendix: Measures of the constructs of interest

For all items except those used to measure enterprise-wide information systems use, respondents indicated the extent to which they agreed or disagreed with the statement on a seven-point Likert (7=strongly agree, 6=agree, 5=slightly agree, 4=neutrality, 3=slightly disagree, 2=disagree, 1=strongly disagree).

Mass customisation capability[1] (0,76[a], 51,73%[c])

We are highly capable of large scale product customization. (0.656[b])
We can easily add significant product variety without increasing cost. (0.668[b])
We can customize products while maintaining high volume. (0.804[b])
We can add product variety without sacrificing quality. (0.755[b])
Our capability for responding quickly to customization requirements is very high. (0.702[b])
(Respondents: Process engineer, Member of product development team, Plant superintendent. Inter-rater agreement: 0.873[d])

Self-containment of tasks (0.59[a], 46.50%[c])

Cellular layout[2] (0.85[a], 0.528[b], 76.80%[c])

We have laid out the shop floor so that processes and machines are in close proximity to each other. (0.863[b])
The layout of our shop floor facilitates low inventories and fast throughput. (0.882[b])
Our processes are located close together, so that material handling and part storage are minimized. (0.884[b])
(Respondents: Production control manager, Inventory manager, Supervisor. Inter-rater agreement: 0.854[d])

Employee empowerment[3] (0.87[a], 0.657[b], 79.21%[c])

Even small matters have to be referred to someone higher up for a final answer. (0.915[b]) (reverse scored)
Any decision I make has to have my boss's approval. (0.902[b]) (reverse scored)
There can be little action taken here until a supervisor approves a decision. (0.852[b]) (reverse scored)
(Respondents: Direct labour, Human resources manager, Supervisor. Inter-rater agreement: 0.802[d])

Cross-functional training[4] (0.86[a], 0.808[b], 70.47%[c])

Our employees receive training to perform multiple tasks. (0.827[b])
Employees at this plant learn how to perform a variety of tasks. (0.886[b])
Employees are cross-trained at this plant, so that they can fill in for others, if necessary. (0.855[b])
At this plant, each employee only learns how to do one job. (0.787[b]) (reverse scored)
(Respondents: Human resources manager, Supervisor, Plant superintendent. Inter-rater agreement: 0.917[d])

Autonomous maintenance[5] (0.76[a], 0.706[b], 58.98%[c])

Operators understand the cause and effect of equipment deterioration. (0.816[b])
Basic cleaning and lubrication of equipment is done by operators. (0.679[b])
Operators inspect and monitor the performance of their own equipment. (0.779[b])
Operators are able to detect and treat abnormal operating conditions of their equipment. (0.790[b])

(Respondents: Process engineer, Supervisor, Plant superintendent.
Inter-rater agreement: 0.887 ^{d})

Environmental management (0.64^{a}, 58.19%^{c})

External cooperation[6] (0.70^{a}, 0.746^{b}, 53.92%^{c})
We work as a partner with our suppliers, rather than having an adversarial relationship. (0.801^{b})
We work as a partner with our customers. (0.578^{b})
We believe that cooperative relationships will lead to better performance than adversarial relationships. (0.784^{b})
We believe than an organization should work as a partner with its surrounding community. (0.752^{b})
(Respondents: Inventory manager, Plant manager, Supervisor.
Inter-rater agreement: 0.933 ^{d})

Supplier partnership (0.76^{a}, 0.764^{b}, 60.53%^{c})
We maintain cooperative relationships with our suppliers. (0.800^{b})
We help our suppliers to improve their quality. (0.799^{b})
We maintain close communications with suppliers about quality considerations and design changes. (0.854^{b})
Our key suppliers provide input into our product development projects. (0.643^{b})
(Respondents: Inventory manager, Quality manager, Direct labour.
Inter-rater agreement: 0.900 ^{d})

Customer involvement[7] (0.79^{a}, 0.778^{b}, 56.09%^{c})
We frequently are in close contact with our customers. (0.810^{b})
Our customers give us feedback on our quality and delivery performance. (0.822^{b})
Our customers are actively involved in our product design process. (0.646^{b})
We strive to be highly responsive to our customers' needs. (0.791^{b})
We regularly survey our customers' needs. (0.656^{b})
(Respondents: Quality manager, Supervisor, Direct labour.
Inter-rater agreement: 0.929 ^{d})

Enterprise-wide information systems use[8]
Please check application areas supported by software at the plant:

Operations:
OP_1 Master production schedule
OP_2 Rough cut capacity planning
OP_3 Material requirements planning
OP_4 Capacity requirements planning
OP_5 Finite capacity scheduling
OP_6 Shop floor control
OP_7 Maintenance management

Inbound and outbound logistics:
LO_1 Inventory management
LO_2 Order management
LO_3 Distribution management
LO_4 Transportation management
LO_5 Simulation and optimization of production and logistics planning

Marketing and sales:

SA_1 Forecasting
SA_2 Demand planning
SA_3 Catalog and price management
SA_4 Business intelligence (query & report, OLAP, data mining)
SA_5 Product configuration

Service:

SE_1 Service management (after the sale)

Procurement:

PR_1 Purchasing

Technology development:

TE_1 Design (CAD,CAE)
TE_2 Product data management
TE_3 Project management

Human resource management:

HR_1 Human resource management

Firm infrastructure:

IN_1 General accounting
IN_2 Cost accounting
IN_3 Budgeting
IN_4 Quality documentation management
IN_5 Quality control and improvement
IN_6 Performance measurement system
IN_7 Workflow management
IN_8 Groupware tools (e.g. Lotus Notes)

(Respondent: Information systems manager)

$$EWISU = \frac{1}{7}\sum_{i=1}^{i=7} OP_i + \frac{1}{5}\sum_{j=1}^{j=5} LO_j + \frac{1}{5}\sum_{k=1}^{k=5} SA_k + SE_1 + PR_1 + \frac{1}{3}\sum_{m=1}^{m=3} TE_m + HR_1 + \frac{1}{8}\sum_{n=1}^{n=8} IN_n$$

Use of lateral relations (0.71[a], 63.50%[c])

Coordination of decision making[9] (0.79[a], 0.847[b], 61.79%[c])

Generally speaking, everyone in the plant works well together. (0.807[b])
Departments in the plant communicate frequently with each other. (0.828[b])
Departments within the plant seem to be in constant conflict. (0.718[b]) (reverse scored)
Management works together well on all important decisions. (0.787[b])

(Respondents: Plant Superintendent, Supervisor, Direct labour.
Inter-rater agreement: 0.905[d])

Integration between functions (0.87[a], 0.805[b], 72.51%[c])

The functions in our plant work well together. (0.888[b])
The functions in our plant cooperate to solve conflicts between them, when they arise. (0.830[b])
Our plant's functions coordinate their activities. (0.834[b])
Our plant's functions work interactively with each other. (0.853[b])

(Respondents: Plant manager, Plant Superintendent, Process engineer.
Inter-rater agreement: 0.817[d])

Small group problem solving[10] (0.88[a], 0.734[b], 62.33%[c])
During problem solving sessions, we make an effort to get all team members' opinions and ideas before making a decision (0.648[b])
Our plant forms teams to solve problems. (0.852[b])
In the past three years, many problems have been solved through small group sessions. (0.852[b])
Problem solving teams have helped improve manufacturing processes at this plant. (0.851[b])
Employee teams are encouraged to try to solve their own problems, as much as possible. (0.688[b])
We don't use problem solving teams much, in this plant. (0.820[b]) (reverse scored)
(Respondents: Quality manager, Supervisor, Direct labour.
Inter-rater agreement: 0.922 [d])

[1] Huang et al. (2008)
[2] adapted from Flynn and Flynn (1999)
[3] adapted from Liu et al. (2006)
[4] Cua et al. (2001)
[5] Liu et al. (2006)
[6] adapted from Heim and Peng (2010)
[7] Flynn and Flynn (1999)
[8] adapted from Heim and Peng (2010)
[9] Flynn and Flynn (1999)
[10] adapted from Cua et al. (2001)

[a] Cronbach's α
[b] Factor Loading
[c] Variance explained by 1st factor
[d] Computed using the ratio method

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Table 1: Sample profile

	Number of plants			
	Industry			Total
Country	Electronics	Machinery	Auto suppliers	
Finland	14	6	10	**30**
Germany	9	13	19	**41**
Italy	10	10	7	**27**
Japan	10	12	13	**35**
South Korea	10	10	11	**31**
Sweden	7	10	7	**24**
United States	9	11	9	**29**
Austria	10	7	4	**21**
Total	**79**	**79**	**80**	**238**

Table 2: Tests of MANOVA assumptions

Kolmogorov-Smirnov Test				
Variable	**Group**	**Statistic**[a]	**DF**	**Significance**
TSC	Low MCC	0.094	62	0.200[b]
	Medium MCC	0.084	59	0.200[b]
	High MCC	0.108	62	0.068
EM	Low MCC	0.086	62	0.200[b]
	Medium MCC	0.076	59	0.200[b]
	High MCC	0.088	62	0.200[b]
EWISU	Low MCC	0.091	62	0.200[b]
	Medium MCC	0.110	59	0.074
	High MCC	0.108	62	0.071
LRU	Low MCC	0.082	62	0.200[b]
	Medium MCC	0.065	59	0.200[b]
	High MCC	0.099	62	0.200[b]
Box's Test				
Box's M	**F**	**DF1**	**DF2**	**Significance**
17.487	0.846	20	115786.39	0.658
Levene's Test				
Variable	**F**	**DF1**	**DF2**	**Significance**
TSC	0.495	2	180	0.611
EM	1.280	2	180	0.281
EWISU	0.092	2	180	0.912
LRU	1.164	2	180	0.315

[a] Lilliefors significance correction
[b] This is a lower bound of the true significance.

Table 3: MANOVA results

Multivariate Tests							
Multivariate test	**Value**	**F**	**Hypothesis DF**	**Error DF**	**Signif-icance**	**Partial Eta Squared**	**Observed Power[a]**
Pillai's Trace	0.107	2.522[b]	8	356	0.011	0.054	0.911
Wilks' Lambda	0.895	2.532[b]	8	354	0.011	0.054	0.913
Hotelling's Trace	0.116	2.541[b]	8	352	0.011	0.055	0.914
Roy's Largest Root	0.092	4.080[b]	4	178	0.003	0.084	0.910

Tests of Between-Subjects Effects									
Dependent Variable	**Type III Sum of Squares**	**DF**	**Mean Square**	**F**	**Sig-nifi-cance**	**Partial Eta Squared**	**Observed Power[a]**	**R^2**	**Adjusted R^2**
TSC	3.089	2	1.544	6.222	0.002	0.065	0.890	0.065	0.054
EM	1.533	2	0.766	5.869	0.003	0.061	0.870	0.061	0.051
EWISU	2.403	2	1.202	0.324	0.724	0.004	0.101	0.004	-0.007
LRU	2.714	2	1.357	6.091	0.003	0.063	0.883	0.063	0.053

[a] Computed using alpha = 0.05
[b] Exact statistic

Table 4: Post-hoc analysis – Scheffé pairwise comparisons

	Low MCC (L)		**Medium MCC (M)**	**High MCC (H)**	
TSC					
Mean	4.9646		5.0493	5.2706	
Different w.r.t. group:	H***		H*	L***	M*
Std. Error	0.08947		0.09061	0.08947	0.09061
EM					
Mean	5.3634		5.5180	5.5794	
Different w.r.t. group:	M*	H***	L*	L***	
Std. Error	0.06572	0.06490	0.06572	0.06490	
EWISU					
Mean	4.9515		5.1903	5.1966	
Different w.r.t . group:	-		-	-	
Std. Error	-		-	-	
LRU					
Mean	5.1564		5.3439	5.4485	
Different w.r.t. group:	M*	H***	L*	L***	
Std. Error	0.8585	0.08478	0.08585	0.08478	

(*** *p<0.01; *p<0.10)*