An Investigation of E-mass Customization as a Branding Strategy

A thesis submitted for the degree of Doctor of Philosophy

by

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Dedication

To my mother Huiping Lin and my father Zhicheng Yan for their continual love and supports that helped me achieve this dream.

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Publications

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Abstract

Companies need branding to distinguish themselves from their competitors in increasingly fierce competition to stand out. Due to digital devices and the internet, customers have more choices than ever. In this case, customer needs deserve more brand attention, in turn. In other words, the changing environment prompts companies to shift their branding strategy away from a manager-dominated focus on corporate names, logos, products, and social images.

This thesis explores plausibly effective branding strategy from the stream of e-mass customization. It also explores the role and instrumentalities of technological-, technical-, and managerial means and tools and their deployment in the e-mass customization strategy based on the resource orchestration theory. A triangulated research approach was employed using qualitative data (15 interviews) and quantitative data (129 questionnaires) with top managements in China's apparel and footwear industries. While qualitative data was initially used to gain a deeper understanding of the subject of the study, quantitative data were statistically examined using EFA, CFA and PLS-SEM to test the structural model.

This study's qualitative and quantitative results clarify the concept of e-mass customization and its critical role in branding, including enhancing customer brand loyalty, brand identification and long-term competitiveness. In addition, the findings show that multiple means and tools must be bundled and leveraged to realize their full value for creating competitiveness to deter better the challenges in implementing e-mass customization. Based on the qualitative and quantitative results, this study proposes a two-tier orchestration plan that includes machine learning, product modularization, process modularization, innovativeness, supply chain integration, and production automation.

This paper discusses branding strategy from the aspect of e-mass customization. It provides a feasible direction for the future branding and management research streams. In addition to clarifying the definition of e-mass customization, this study also encourages the academic community to deploy technological-, technical- managerial tools to achieve the e-mass customisation goal from the resource orchestration perspective. Based on the potential of e-mass customisation, academics are encouraged to incorporate e-mass customization into the branding framework. In addition, by studying the outcomes of e-mass customization as a branding strategy, this research provides a plausible strategic plan for decision-makers and managers in future branding. At the same time, the study proposes a two-tier orchestration plan that illustrates the deployment of critical resources to head off challenges, providing specific guidance for managers to implement e-mass customization.

To sum up, this research is one of the first that investigates a new era of branding from the stream of e-mass customization. In addition, this study is the first to explore how to implement e-mass customization based on resource orchestration theory. The researcher strongly believes that it forms a foundation that facilitates a variety of avenues for research.

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Chapter 1

Introduction

1.1 Introduction

The concept of modern branding emerged when companies began to differentiate their name, logo and trademark, and their identity, image and personality from their competitors, as prominent characteristics enable customers to identify a company as a specific brand to choose from, which ultimately helps the company gain competitive advantage in fierce competition (Bastos and Levy, 2012; O'Neill, 2015; Holland, 2017; VanAuken, 2022). Chang et al (2018) and Odoom and Mensah (2019) suggested brand performance, referring to the value a brand gains from its initiatives. The concept of brand performance proposed corresponds to the purposes and goals of branding mentioned. Modern branding requires managers to formulate strategies and schemes, considering the current context, such as the market environment, shopping environment, customer demand etc. (Aaker, 1991; Keller, 1993; Aaker, 1996; Keller, 2003; Keller, 2009; Aaker, 2012; Isarabhakdee, 2016). On this basis, researchers divide branding into four eras: branding 1.0, in which companies started to focus on using names to create signature products and (or) services and to distinguish themselves from their competitors (Fournier and Avery, 2011; Isarabhakdee, 2016). In branding 2.0, managers aim to establish a unique image and deliver it to customers in different geographics with cultural backgrounds. (Chan-Olmsted and Shay, 2015 Isarabhakdee, 2016). In branding 3.0, managers focus on creating a positive social image to build up brands; more specifically, they pay attention to social responsibility, such as company value sharing and philanthropy (Daye, 2020). Managers are now trying to understand the branding 4.0 concept of brand–customer cooperation to view customers as a part of the brand, and shift from branding being dominated by managers to being jointly created by brands and customers (i.e., customers have changed from being brand adaptors to partners) (Isarabhakdee 2016; Hedden, 2018; Wallace, 2018; Daye, 2020; Santos et al., 2021).

E-mass customization allows customers to co-create their own products (Kaplan and Haenlein, 2006; Lee and Chang, 2011; Yoo and Park, 2016, Lang et al., 2020) and receive their custom-made products in a short waiting time at an affordable price (Lee and Chang, 2011; Yan et al., 2019). Managers and researchers pointed out that e-mass customization can bring hedonic value, creative achievement value, self-express value, uniqueness value as well as utilitarian value to individual customers (Merle et al., 2013) thus racing their willingness to purchase and willingness to make a recommendation for friends (Lee and Chang, 2011; Yan et al., 2019). Companies, in many industries are beginning to experiment with e-mass-customization programs. Current data and anecdote show that companies that well-adopted e-mass customization gained a strong competitive position against stiff competition and even witnessed a 62% growth in performance in 2017-2019 (Gaffney, 2019). In those industries that face fierce competition, such as the clothing and footwear industry, many well-known brands have been experimenting with e-mass customization in attempt to expend the brand's reach and its competitive advantage in the industry; for example, Nike launched "Nike by You", allowing customers to select the co-design their products, i.e., through Nike official website or Nike APP on the exclusive customized page, customer can coordinate colors for the selected shoes (such as the shoe uppers, linings, logos and so on.) and add personalized text on it. Nike received more active customer engagement and a more satisfying experience due to the launch of e-mass customization; while their sales grew by 42%, in the first fiscal quarter of 2019 (Risley, 2019).

The implementation of e-mass customization by companies at the current stage of branding provides excellent support to their competitive position and therefore attracts the researcher's attention; accordingly, this study aims to investigate the impact of e-mass customization as a branding strategy on performance for companies through empirical evidence. More specifically, this study aims to discuss whether e-mass customization can be a viable branding strategy for companies wishing to achieve competitiveness and satisfactory performance.

Technology progress is proposed as possibilities for mass customization (Davis, 1987; Duray, et al., 2000; Yan et al., 2019; Yan et al., 2022). Machine learning, which is the most advanced technology, is model predictions is highlighted as a priority for utilization by decision-makers and executives in fields such as education, healthcare, spacecraft engineering as well as marketing (Jordan and Mitchell, 2015; EI Naqa and Murphy, 2015). Machine learning algorithm has been expanded to forecasting customer demand in the marketing domain; for example, it drives 35% of the purchase made by customers on Amazon and 80% of the streaming choices on Netflix (Gomez-Uribe and Hunt, 2015; Krawiec, 2018; West et al., 2018; Yan et al., 2022). In addition, automation technology, also considered the most advanced technology field today, is considered to advance Industrialization. 4.0. Using automation technology to control manufacturing support systems and manufacturing equipment in production can significantly help improve productivity and flexibility (Kolberg and Zühlke, 2015; Fawcett, 2017; Shin et al., 2017; Lu et al., 2020). More specifically, managers applying automation technology in production, on the one hand, to manipulate activities of the physical equipment belonging to the shopfloor, executing the actual production operation, and on the other hand to control information-processing activities to manage overall production procedures, can help reduce error and production costs, and improving product quality (Kolberg and Zühlke, 2015; Fawcett, 2017; Shin et al., 2017; Lu et al., 2020). In addition, automation in production is also seen as a way to substitute people doing high-risk work or (and) to assist people working in high-risk environments (Shin et al., 2017). However, the fact is that many managers lack a technology-related background, which hinders their decisions to introduce high-tech, in particular, machine learning and automation technology into production, and the lack of relevant background also makes it difficult for them to adopt cutting-edge technologies to achieve e-mass customization. The advantage these two fields of technologies can bring, particularly to e-mass customization, still requires further research.

Modularity at the production level refers to decomposing a complex system into smaller modules. (Tu et al., 2004; Yan et al., 2022). Studies suggest that modularity enables companies to implement customization at scale (Sturgeon 2002; Tu et al., 2004; Fixson and Park, 2008; Wang et al., 2014; Seyoum, 2020). Manufacturers can create different signs of progress by rearranging, dividing, removing or adding modules (Cooper, 1999; Tu et al., 2004). Brands and manufacturers can gain sufficient flexibility through modularity to handle the complex production and operations process (Baldwin and Clark, 2006; Tu et al., 2004; Wang et al., 2018; Yan et al., 2022). Some scholars point out that using product modularity can improve product diversity while reducing the complexity and the time needed for design (Duray et al., 2000; Tu et al., 2004). For customers, it is proposed that modular products are easier to customize and update (Tu et al., 2004), thus potentially leading to user-friendly co-design activities. In addition, process modularity is believed to improve production flexibility, shorten lead time, and reduce production costs (Worren, et al., 2002; Tu et al., 2004; Wang et al., 2014). Given the advantages of product modularity and process modularity for production, several scholars proposed that it is worth studying the support brought by the alliance of modularity, in particular, product modularity and process modularity with other management technological solutions for e-mass customization (Tu et al., 2004; Lee and Chang, 2011; Aichner and Coletti, 2013).

Innovativeness is one of the essential factors that help a firm to be successful in the market. It is proposed that innovativeness in thought and behavior would help a firm gain better performance (Odoom and Mensah, 2018). More specifically, maintaining innovativeness in thought within an organization as well as maintaining innovativeness in products, services, and processes, enable firms to generate differentiated processes and brands with the ultimate intention of obtaining a competitive edge (Drucker, 1998; Wong and Merrilees, 2008; Tellis et al., 2009; Odoom and Mensah, 2018). Moreover, high levels of innovation help firms build robust brand images and reputations (McDermott and O'Connor, 2002; Odoom and Mensah, 2018). For these reasons, the researcher is concerned that supply chain integration is one of the determinants of e-mass customization; therefore, worth further exploration.

Supply chain integration refers to the coordination and synchronization between a firm and its upstream and downstream supply chain partners (Liu et al., 2016). Firms cooperating with advanced upstream and downstream suppliers and establishing a relatively complete supply chain would gain greater convenience and flexibility and respond more quickly to unpredictable trends and markets (Flynn et al., 2010; Liu et al., 2016; McKinsey, 2021). Companies in the most vulnerable industries in the value chain can gain individual accumulation and complementary synergies, such as purchasing smaller batches, allocating production tasks, increasing the value of their resources, and reducing inventories through information sharing and collaborative development with supply chain partners (Flynn et al., 2010; McKinsey, 2021). For these reasons, the research concerns that supply chain integration is one of the determinants of e-mass customization and, therefore, is worth further exploration.

Resource orchestration theory views a firm can achieve the full value of its resources when resources are management effectively (Sirmon et al., 2007; Sirmon et al., 2011; Liu et al., 2016). Accordingly, to achieve the goal, the firms must integrate resources across diverse business divisions, improve cooperation among, and, more importantly, highlight one or two resource-related actions ahead (Sirmon and Hitt et al., 2003; Sirmon et al., 2007; Chirico et al., 2011; Chadwick et al., 2015; Liu et al., 2016). This research explores how companies can achieve the goal of e-mass customization, based on resource orchestration theory, through arranging technological-, technical- and managerial tools (i.e., product modularity, process modularity, innovativeness, supply chain integration, production automation and machine learning).

1.2 Research Gap(s) and Relevance of This Research

The existing literature points to the need for branding and the possible positive effects of branding by companies. Although some anecdotal suggests possible core contexts for branding at the current stage, no literature explicitly explores in detail and empirically analyses possible strategies for the current branding phase. The literature demonstrates the value that mass customization brings to the customer, such as creative achievement value, hedonic value, self-express value, uniqueness value and utilitarian value (Merle et al., 2010), as well as the positive impact that companies practising mass customization receive, such as customer willingness to purchase and willingness to make a recommendation (Lee and Chang, 2013). However, no literature specifically explores the role and impact of e-mass customization from a branding perspective. Although previous studies have discussed some resources that could deter the challenges in applying e-mass customization, there needs to be literature investigating how to deploy different resources, including modularity, innovation, supply chain management and cutting-edge technologies to superior the potential to realize the goal of e-mass customization. In a word, the role of e-mass customization in the current branding phase and the implementation to achieve the goals of mass customization is worth to acquaint.

1.3 Research Aim and Research Question

This study aims to broaden academic horizons and further develop knowledge in branding-related areas. More specifically, this study aims to explore whether, in the current environment, companies can differentiate themselves from the fierce competition by branding themselves through an e-mass customization strategy. As there is no existing literature on the e-mass customization concept, the possible influencing factors and the consequences of branding are fully discussed. This study develops a process model to explain the determinants of e-mass customization and its plausible consequences for branding, i.e., brand performance. In addition, to fill an academic gap, this study aims to explore how companies successfully implement e-mass customization, explaining how companies deploy multiple resources to optimize their potential for e-mass customization implementation. In line with the aims of the study, the researcher posed the following questions:

RQ1: Can e-mass customization enhance brand performance?

RQ1a: What elements constitute e-mass customization?

RQ1b: What is the role of e-mass customization in 4.0 branding?

RQ1c: What factors determine e-mass customization?

RQ1d: What are the consequences of e-mass customization towards the brands?

RQ1e: How to orchestrate multiple resources to successfully implement e-mass customization?

1.4 Research Context and Research Sampling

This research studies companies in China’s clothing and footwear industries. Firstly, many Chinese clothing and footwear companies are becoming well-known brands. In becoming famous brands, these companies have implemented strategies or projects related to mass customization, i.e., committing customers to a personalized product by co-designing their products. These companies are actively innovating, introducing cutting-edge technologies and management solutions, using marketing and cutting-edge technologies such as machine learning, robotics and modularity as solutions.

Chinese companies in the apparel and footwear industries make suitable subjects for analysis in this study as their practices are aligned with the objectives and questions of this study. In other words, this study provides an opportunity to address knowledge gaps and contribute to the academic literature by using companies in the apparel and footwear industries in China as the research context and research sample for analysis (Qi et al., 2009). The survey of these firms enabled the researcher to gain a detailed understanding of the concept of e-mass customisation, its role and function in branding; furthermore, the survey of these firms enabled the researcher to gain an in-depth understanding of the efforts made by firms to achieve e-mass customisation in terms of resource deployment.

Companies in China's clothing and footwear industries make suitable targets for analysis in this study, as their practices are in line this study's objectives and questions. In other words, this study provides an opportunity to address knowledge gaps and contribute to the academic literature, taking companies China's clothing and footwear industry as the research context and research sampling of the analysis, (Qi et al., 2009). By investigating these enterprises, researchers and managers can understand the concept of e-mass customization, its role in branding; furthermore, by investigating of these companies, researchers and managers can knowledge the efforts made by firms to achieve the goals of e-mass customization in terms of multiple resources deployment.

Given that the study focuses on companies in China's clothing and footwear industries, the researcher conducted in-depth interviews with 15 senior executives from different brands (such as Fortune Global 500, Top 20 Costume in China, and nd small and medium-sized enterprises honored as "The Highly Influential Emerging Designer Brands"). In the quantitative research stage, the researchers distributed questionnaires to 1,283 companies that came to China's Garment Industry Association and successfully recovered 129 questionnaires.

1.5 Research Methodology

The study uses mixed research methods. First, the research explores the questions asked in in-depth interviews; the researchers then applied questionnaires to empirically validate the focuses and the proposed framework (Churchill, 1979; Dodd and Whipple, 1976; Hussey and Hussey, 1997).

This study adopts the paradigm proposed by Churchill 1979) as the procedure, which consists of four steps: reviewing literature specifying the domain of construct; then combining literature review, in-depth interview as well as expert judgment generating measurement items of each component. Further, coefficient alpha, item-to-total correlations, as well as exploratory factor analysis (EFA) are examined to purify the measurement items; also, confirmatory factor analysis (CFA) is conducted to validate measurement items; Finally, this study adopts PLS-SEM to assess the measurement model and structure model to validate the proposed hypotheses.

The following software was adopted as analytical tools in this study: first, Nvivo was adopted to code and analyze qualitative data; Second, the SPSS software package was used for descriptive analysis, and outliers, missing values, reliability test, normal distribution assessment as well exploratory factor analysis. Third, Mplus was used to test confirmatory factor analysis. In addition, this study uses Smart PLS software package to evaluate the measurement and structural models.

1.6 Contribution of This Study

Academic Contribution: emerging anecdotes and literature are beginning to explore what e-mass customization entails (Isarabhakdee, 2016; Hedden, 2018; Daye, 2020). However, to the best of our knowledge, very limited academic works have specifically examined its importance for businesses and what strategies companies implement to achieve their branding goals. This study explores the means and implications of e-mass customization, specifically targeting brand performance, opening up a new avenue of research related to branding. The main contribution of this study is to suggest a theoretical framework and a two-tier orchestration framework detailing the impact of multiple resources, including product modularity, process modularity, innovativeness, supply chain integration, production automation and machine learning on supporting e-mass customisation and how these resources can be deployed to optimize their potential for e-mass customisation implementation.

Management Contribution: this study provides decision-makers and managers with a viable branding strategy, i.e., e-mass customization, for companies to differentiate themselves from the fierce competition. Indeed, the clarified concept and consequences of e-mass customization articulated in this study will provide managers with a better understanding of e-mass customization; in addition, the two-tier orchestration plan suggested in this study will help decision-makers and managers to make the optimal decisions and arrangements on what resources to focus on and how to deploy them to implement e-mass customization successfully.

1.7 Structure of this Thesis

This thesis includes 6 chapters along with references and appendices. In more detail, this thesis constructs as follows:

Chapter 1- Introduction: this chapter presents the background, the rationale and the scope of the study. The research aims, and research questions are proposed in this chapter. In addition, this chapter gives an overall view of the study, the research methodology and research method, research context and sampling, as well as the contribution of this study in brief.

Chapter 2- Literature Review: the second chapter presents the literature review about constructs, including the concept of the paradigm in the field of mass customization and e-mass customization, product modularity, process modularity, innovativeness, supply chain integration, production automation and machine learning as well as brand performance. This chapter also reviews the literature on relevant streams of resource orchestration theory. The research gaps in details are proposed in this chapter, followed by a conceptual framework.

Chapter 3-Research Hypotheses: this chapter presents hypothesized relations based on the proposed framework, which includes 11 hypotheses.

Chapter 4-Research Methodology and Research Method: this chapter presents rationales for the methodology and research method adopted by this research. Also, the steps and procedures for data collection and analysis are pointed out in this chapter, followed by an explanation of the analysis technique used for analysing data in this study.

Chapter 5-Discussion of Findings: this chapter presents qualitative data and quantitative data analysis procedure and key findings. In addition, this chapter presents an interpretation of the research findings from qualitative and quantitative research and a two-tier orchestration plan generated from qualitative and quantitative findings.

Chapter 6- Conclusion: this chapter summarises the research background rationale, aim, questions and findings. In addition, both theoretical and managerial implications of this research are presented, followed by the limitations and research directions for future research.

Chapter 2

Literature Review

2.1 Introduction

The aim of this literature review is multifaceted. First it intends to identify related concepts, thus revealing how knowledge on the subject topics are structured and organized. Also, it aims to display existing definitions and taxonomies. In addition, the literature review is to reveal the implications as well as implementations of the relevant topic by displaying the existing focuses and discussions. For that reason, firstly, this chapter introduces the development of branding and delineates on the different connotations of modern branding to varying stages of development. Secondly, the chapter unfold the construct of e-mass customization by presenting various streams of literature starting from mass customization, then e-mass customization; Thirdly, the chapter display the different measurements for mass customization and e-mass customization from the relevant literature. Fourthly, the chapter brings up factors that may determinate e-mass customization including modularity (i.e., product modularity and process modularity), innovativeness, supply chain integration, production automation and machine learning. Fifthly, the chapter reviews relevant literature related to e-mass customization across brands. Also, the chapter presents relevant literature on resource orchestration theory to provide a theoretical basis for the advantages of synergies arising from the combination of resources. Through reviewing literature on these dimensions, this chapter provides a more comprehensive picture for the research of e-mass customization for this paper. Finally, the chapter present the research gaps followed by an overall summarization.

2.2 Brand and Branding

Branding refers to companies distinguishing themselves in customers' minds then competitors by practices. (Aaker, 1991). It considers how to create, maintain and deliver specific brand values to audiences to drive positive brand sentiment and customer loyalty, which in turn leads to such brand competitiveness and profitability etc. In other words, branding consists strategies, management and activities to establish brands and ensure that the audience perceives the brand element as veritable (Aaker, 1991; Kapferer, 1992; Aaker, 1996; Kapferer, 2008; Keller, 2009). When formulating schemes for branding, it is necessary to concern the context at the time, such as the business environment, competition environment, and brand-customer relationship (Aaker, 1991; Kapferer, 1992; Aaker, 1996).

Underlying the philosophy of branding that has been determined, the companies brand themselves through different strategies and means in different stages, according to the actual contextual background and conditions. It is proposed that modern branding goes through four stages: Branding 1.0, Branding 2.0, Branding 3.0 and Branding 4.0 (Isarabhakdee, 2016; Hedden, 2018; Wallace, 2018; Daye, 2018; Yan et al., 2022). Branding 1.0 is viewed as the product-centric branding era, while the focus of Branding 2.0 is building and maintaining a consistent brand image; Branding 3.0 is the human-centric branding era, while managers now are trying to understand the Branding 4.0 concept of brand.

2.2.1 The Nature of Brand and Branding

The term brand originally means ‘to burn’ (Cantor, 2020). More specifically, in Ancient Scandanavian language, the term brand was written as “brandr’ which means ‘to burn’ (Holland, 2017). Similarly, in Icelandic, the words ‘brond’ (brand) and ‘oom’ (fire) are synonyms (Bastos and Levy, 2012). Also, in German, the word ‘der brand’ means the fire, and the word ‘es brennte’ expresses ‘it is burning’. (Moore and Reid, 2008; Bastos and Levy, 2012). The existing evidence indicates that the root of brand includes such elements as fire, and hot iron (Moore and Reid, 2008; Bastos and Levy, 2012), and ‘firing up’ expresses the meaning of giving life (Bastos and Levy, 2012; Holland, 2017; VanAuken, 2022). In ancient Greek mythology, Prometheus stole fire from Apollo which brough light to the human word; since then, people use the fire to cook food and keep warm, so that life and hope continues. In other words, in ancient period of time, the term ‘brand’ was viewed as fire which give life, light the way and ‘characterize people who care strongly about their ideas and feeling’ (Bastos and Levy, 2012),

Since the development of human society, the term ‘brand’ has been considered both as a ‘sign’ (such as a mark, a label, a logo, a symbol, or a name, etc.), and as a ‘symbol’ (such as an identity, a personality or an association). It is viewed that brand carries the potential for devotion and distinction, which could consequently generate power and excitement, even partnership and opposition (Bastos and Levy, 2012; O’Neill, 2015). Accordingly, the term ‘branding’ is proposed (Bastos and Levy, 2012; Neill, 2015; Holland, 2017; VanAuken, 2022). “The root of branding activities is the human desire to someone of consequence, to create a personal and social identity, to present oneself as both like other people (e.g., to belong) and unlike other people (e.g., to stand out), and to have a good reputation” (Bastos and Levy, 2012). In earlier period of civilization, the purpose of branding is to claim ownership; for example, craftsmen burn marks onto the products that they made. Around 2000 BC in Egypt, stonemasons carved signs into the pyramids, which helped to distinguish their work from those of other artisans, ensuring they were paid fairly (Holland, 2017). Later on, the advent of trade has given ‘branding’ the meaning of highlighting specific information for identification in trade, in addition to claiming ownership. Since then, venders and barterers have been starting using various ways to distinguish themselves from their competitors.

2.2.2 Branding and Brand Performance

Today, successful branding can lead to good performance for companies in a highly competitive environment (Duncan and Mulhern, 2004; Reid, 2005; Kapferer, 2008; Luxton, et al., 2015; Piehler, 2018; Aness-ur-Rehman et al., 2018; Chang et al., 2018; Odoom and Mensah, 2018), i.e., successful branding enables enterprises to perform well financial performance in the face of fierce competition (Duncan and Mulhern, 2004; Reid, 2005; Kapferer, 2008; Luxton, et al. al., 2015; Piehler, 2018; Aness-ur-Rehman et al., 2018), and(or) can enhance long-term competitiveness (Isarabhakdee, 2016; Chang et al., 2018; Odoom and Mensah, 2018; Wallace. 2018; Daye, 2020). More specifically, the purpose of managers' branding and measuring their branding success is related to the tangible and intangible performance. Tangible brand performance can be measured regarding product price, sales volume, and market share (Duncan and Mulhern, 2004; Reid, 2005). Similarly, Aness-ur-Rehman et al. (2018) suggest that the tangible performance regarding profitability, such as turnover, profit, market share and return on investment, and return on asset.

In recent years, the intangible performance has received increasing attention from managers and academics; they emphasise the intangible value branding brings to the brands and the momentum it brings to the brands' long-term development (Isarabhakdee, 2016; Chang et al., 2018; Odoom and Mensah, 2018; Wallace, 2018; Daye, 2020). Some academics highlight that strong customer attachment and intensity can enable the enterprise to compete in the marketplace (Piehler, 2018), stimulating customers' willingness and frequency to purchase branded products (Duncan and Mulhern, 2004; Reid, 2005). Chang et al. (2018) and Odoom and Mensah (2018) propose that brand performance refers to *the value that a brand gains from its initiatives, from which the company can maintain marketplace positions of competitive advantage.* Moreover, they proposed the constructs of intangible brand performance. More specifically, Odoom and Mensah (2018) suggested that brands’ intangible performance includes the following four points; first, the enterprise has a good brand reputation; second, the enterprise has strong brand awareness in the market; third, the enterprise has built a strong customer brand loyalty; fourth, the enterprise has reached the desired image in the market. Similarly, Chang et al. (2018) suggested intangible performance included the following five points: first, customers are willing to pay more to do business with the brand them the brand’s competitors; second, customers expect to continue the long-term relationship with the brand; third, the brand has built customer brand loyalty; fourth, he brand is in an advantageous position in the competition; fifth, the brand is successful in maintaining current customers. This thesis adopts the definition of brand performance proposed by Chang et al. (2018) and Odoom and Mensah (2018), i.e., *the value that a company gains from its initiatives in branding, in, from which the company can maintain marketplace positions of competitive advantage*. Also, the thesis adopts the 5-point constructs on brand performance proposed by Chang (2018).

2.2.3 The Eras of Branding

Branding 1.0 is the product-centric branding era; branding emerged when companies started to focus on using their names to create signature products to distinguish themselves from their competitors. T (Fournier and Avery, 2011; Isarabhakdee, 2016). In other words, branding 1.0 requires managers to develop iconic products that differentiate themselves from competing brands. Since Coca-Cola and Pepsi became opponents, they have adopted different products, packaging, and advertising schemes to differentiate each other. Coca-Cola has launched Coca-Cola Zero, Diet Coca-Cola, Cherry, Vanilla Coke etc. In contrast, Pepsi has launched different varieties such as Mountain Dew, Pepsi's MAX and Pepsi NEXT etc. (Saxena, 2018). Coca-Cola advertising emphasizes family and friendship, while Pepsi focuses on sports, fun and music. (Aaker, 1996; Saxena, 2018).

The core of branding 2.0 is about building and maintaining a consistent brand image (Isarabhakdee, 2016; Chan-Olmsted and Shay, 2015). On one hand, managers deliver brand image by identifying specific brand characteristics and reflecting them in their products and services (Kotler et al., 2019); On the other hand, managers began to pay attention to customers' different needs and segment the market according to the different needs of customers in the demographics （Isarabhakdee, 2016). As managers realized that the customer is essential to branding, they ensured to launch products and services to meet the needs of consumers in each segment. In brief, in the 2.0 stage, managers focused on conveying a brand image to consumers in different market segments while ensuring integrity. On this basis, standardization and localization are essential strategies in the era of brand 2.0. When it opened its first store in Mumbai, Starbucks focused on localization. In addition to ensuring the flavors and quality of their drinks and keeping up with the Starbucks tradition, they worked with a local company to help with localizing strategies for the Indian market. In their first store in Mumbai in 2012, an Indian signature is shown on the welcome board, and the store has wooden tables with traditional carvings to make local people feel comfortable inside the store.

Branding 3.0 is the era of human-centered branding where managers align the mission and vision of their companies with the human mind, heart and spirit to achieve branding (Isarabhakdee, 2016 Kotler et al., 2019; Dye,2020). On this basis, managers consider products and services to meet customers' emotional needs and spiritual desires by engaging in social responsibility (Isarabhakdee, 2016). More specifically, customers are now concerned with their own lives and building a better place. Accordingly, when managers establish identities and images need to align with the needs of society (Kotler et al., 2019). In other words, in addition to providing products and services, a company must establish and demonstrate its commitment to customers' need for social and environmental justice (Kolter et al., 2019; Daye, 2020). On the other hand, the development of social media provides an effective tool and means for company publicity and promotion. Many companies reflect their corporate identity and image through social responsibility, corporate shared values and philanthropy (Daye, 2020). For example, HP (Hewlett-Packard) introduced sustainable ink and toner cartridges, using plastic bottles from Haiti as the cartridge material and realizing closed-loop recycling of ink and ink cartridges. HP's efforts to turn trash into opportunity have reduced the use of global materials and created jobs for Haitians. This commitment improves social and environmental outcomes, enabling HP to establish and promote a positive brand identity and image.

Managers are now trying to understand the Branding 4.0 concept of brand. The rapid development of networks and technology makes e-commerce a critical business model. The new business model has helped many businesses broaden their sales channels. However, companies need help to easily maintain their unique characteristics with the continuous rise of competitive enterprises into the online platform. On the other hand, customers, faced with rising choices, are more likely to opt for other brands than ever. Based on this context, some managers and scholars propose that the new branding stage should emphasize establishing the relationship between the brand and the customer. In other words, branding 4.0 has shifted from branding being dominated by managers to being jointly created by brands and consumers, i.e., consumers have changed from being brand adaptors to partners.

Although there is limited research on Branding 4.0, some scholars highlight hyper-customization as the core. Hyper-customized experiences make consumers feel unique and serve their needs for belonging, esteem, and self-fulfillment (Hedden, 2018; Wallace, 2018, Santos et al., 2021). (Hedden, 2018; Wallace, 2018, Santos et al., 2021). Similarly, some managers suggest that customer participation in collaborative product design processes enables them to get a sense of hedonic and creative achievement, thus positively influencing their attitude toward the brand (Merle, et al., 2010; Lee and Chang, 2011). Moreover, some scholars have proposed that Branding 4.0 essentially refers to the collaboration between the brands and their customers through co-creation, i.e., allowing them to design their version of the on-brand message (Wallace, 2018); more specifically, allowing customers to design their products; meanwhile, brands provide customers tools that are still confined to the brand message's original articulations (Isarabhakdee,2016). These limited materials indicate that providing personalized customer service is the core of branding to enterprises in the new era (Lee and Chang, 2011; Aichner and Coletti, 2013; Yoo and Park, 2016). In other words, the strategy of an enterprise in the new branding stage should be about the brand responding to the myriad of customer desires through personalization while keeping its core visual mnemonics' authentic elements consistent. Existing literature suggests that companies allow customer co-creation, which helps to increase customer attachment and strength to the brand (Isarabhakdee, 2016) and brand loyalty (Hedden, 2020), allowing companies to gain long-term competitiveness ultimately (Daye, 2018).

Overall, existing body of work appears to suggest that branding 4.0 focuses on hyper-personalize experience engaging, empowering and endorsing customer, aiming to enhance brand performance. However, the existing literature remains abstract. They do not attempt to operationalize this highly abstract concept into more accessible dimensions; also, there is a need for more discussion and empirical evidence about how companies strategize and execute within the branding 4.0 paradigm.

2.3 E-Mass Customization

Since the twentieth century, customers' increasing desire on gaining personalized products has driven firms coping from two different ways, either offering individualized and often expensive products, or offering mass customized and affordable products. The second way, described in Davis' (1987) book *Future Perfect*, namely "mass customization".

Research on the area of mass customization over the last few decades has put forward evidence that mass customization is associated with the ability of delivery of customized products quickly, on a large scale at low costs (Tu et al., 2001; Tu et al., 2004). In recent years, the concept of e-mass customization has been proposed viewing as the extension of mass customization. Kaplan and Haenlein, 2006; Lee and Chang, 2010; Yoo and Park, 2016; Yan, et al., 2019). E-mass customization is proposed as strategy, with the focus of company-customer interaction and delivery of customized products (Kaplan and Haenlein,2006; Lee and Chang; 2011; Yoo and Park; 2016; Yan et al., 2019; Lang et al., 2020). Despite that the concept of e-mass customization is a relatively new concept, and there is only limited literature discussing the topic of e-mass customization, it is still indicating that e-mass customization benefits to the brands for example, it would deliver value to customer and consequently enhance the relationship between business and the customer (Lee and Chang, 2010; Yan and et al., 2019); and it would positive influences customers satisfaction and loyalty (Yoo and Park, 2016) and customers willingness to purchase and make a recommendation (Lee and Chang, 2011). Accordingly, examining mass customization and e-mass customization literature can provide estimated knowledges of e-mass customization to its concept, meanings and implications.

2.3.1 The Concept of Mass Customization

The concept of mass customization was first coined by Stanley Davis (1987). He considered mass customization as brands delivering individually customized products with an efficiency comparable to mass production. Later on, Hart (1994) suggested a visionary concept and a practical concept of mass customization and indicated that mass customization is a brand's capability; more specifically, mass customization can be defined, in visionary, as "the ability to provide your customers with any they want profitably, any time they want it, anywhere they want it, any way they want it (Hart, 1994, p.36)"; while from a more pragmatic perspective of view, mass customization is concerned as "the use of flexible processes and organizational structures to produce varied and often individually customized products and services at the low cost of a standardized, mass-production system (Hart, 1994, p.36)".

Later scholars stressed "trade-offs" as one key characteristic of mass customization. Joneja and Lee (1998) proposed that mass customization is about producing an increasing variety of products without a significant trade-off in production costs and (or) lead time. Zipkin (2001) proposed that based on trade-offs between customization and cost and lead time, the company can reduce consumer sacrifices to gain mass customized products such as price and delivery time. Accordingly, researchers proposed that providing different degrees of customization, i.e., between pure customization and pure standardization, is one of the main points to realize the "trade-off". Gilmore and Pine (1997) proposed four types of mass customization which includes: 1) adaptive customization, i.e., standardized products can be altered by customers during the stage of use; 2) cosmetic customization: standardized products can be packaged and marketed differently to individual customers; 3) transparent customization: products can be adapted to individual needs; and 4) collaborative customization: producer conducts a dialogue with the individual customers. Similarly, Spira (1996) proposes four types of mass customization, namely: 1) customized packaging; 2) customized services (providing additional services); 3) additional custom work (performing additional custom work); and 4) modular assembly (assembling standard components).

Da Silveira et al. (2001) further extended mass customization to six levels, Ranked from highest to the lowest level of customization; these levels of mass customization can be named respectively: 1) fabrication (customer-tailored products following pre-defined designs), 2) assembly (arranging of modular component into different configurations), 3) additional custom work and 4) additional services (simply adding custom work or services at the point of delivery),5) package and distribution (distributing or packaging similar products in different ways using), 6) usage (mass customization occurs only after delivery, and products can be adapted to different function or situations).

Numerous researchers discussed the concept of mass customization from the management science perspective, mentioning that mass customization is inseparable from managerial and technical innovations to reach the balance between customization, cost, and lead time. Kay (1993) emphasized the importance of new techniques for mass customization. In particular, Kay (1993) argued that mass customization is “information technology-driven”, to help produce and deliver highly differentiated products or services efficiently to meet the needs of individual customers at costs comparable to mass production. Similarly, Kotha (1996) mentioned that mass customization is related to technical and managerial innovations, i.e., to respond quickly and flexibly to manufacture highly diversified products through technical and managerial innovations. Peters and Saidin (2000), when discussing the concept of mass customization, mentioned that mass customization management is related to the use of “flexible processes” and “organizational structures” so that companies can enhance their mass customization capabilities to produce highly differentiated products at the prices of mass-produced alternatives.

Tu et al. (2001) when mentioned the concept of mass customization, referring to “the ability to produce differentiated products with cost effectiveness, volume effectiveness, and responsiveness.” They delineated mass customization included three essential components, i.e., 1) customization cost-effectiveness, which is the ability to customize products without highly increasing manufacturing costs; 2) customization cost-effectiveness, which is the ability to add product variety without sacrificing production volume; 3) customization responsiveness which is the ability to reorganize manufacturing process quickly in response to customer requirements (Tu et al., 2001). In their research, time-based manufacturing practices was proposed (which include shop floor employee involvement in problem-solving, reengineering setups, cellular manufacturing, preventive maintenance, quality improvement efforts, dependable suppliers and pull production) to be the managerial and technical innovations to achieve mass customization capabilities (Tu et al., 2001). Similarly, Broekhuizen and Alsem (2002) mentioned mass customization as the ability to provide customized products and services to individual customers at optimal production efficiency and cost levels. When Da Silveira et al. (2001) discussed, the concept of mass customization is related to product design, development, manufacturing, and delivery. In other words, Da Silveira et al. (2001) proposed that mass customization management involves the full circle from product scaling, development, production and delivery, and from the customer option up to receiving the end product (Da Silveira et al., 2001).

Some scholars discussed the concept of mass customization from the perspective of strategy. Duray et al. (2000) proposed the concept of mass customization, mentioning it as a strategy that combines "the unique products of craft manufacturing" with "the cost-efficient manufacturing methods of mass production" for brands to achieve higher performance. Franke and Piller (2003, p.2) emphasized that mass customization is "a mechanism for interacting with the customer and obtaining specific information to define and translate the customer's needs and desires into a concrete product or service specification." Kaplan and Haenlein (2006) proposed that mass customization is a strategy involving customers co-designing their own product at the fabrication or assembly stage to gain differentiated products at affordable costs.

Several researchers mentioned mass customization as a marketing strategy. Chinnaiah and Kamarthi (2000) proposed that mass customization is related to "satisfying individual customer's unique needs." Fiore (2004) suggested that mass customization is a strategy for providing customizable products or services to customers. Similarly, MacCarthy (2004, p.347) mentioned that mass customization is "a strategy that seeks to exploit the need for greater product variety and individualization in markets." Subramoniam and Babu (2010) proposed that mass customization is about making each customer purchase a customized product for a price near that of a mass-priced item. It is related to a brand offering a sufficient variety of products and services. Piller and Müller (2004) mentioned mass customization as a strategy in that "goods and services are produced to meet individual customer's needs with near mass production efficiency." (p.583). Later on, Piller (2021) mentioned the concept of mass customization, referring to offering products or services that meet each customer's demands but can be produced and delivered with mass production efficiency.

A careful literature review indicates that the concept of mass customization is described from visionary to pragmatic in the existing literature. Scholars view the term mass customization from the perspective of (operational, manufacturing and organizational etc.) management to the standpoint of strategy when discussing the concept of mass customization. According to scholars' description of the mass customization concept in recent years, mass customization is linked with strategy and management programs. It is designed to allow customers to experience customized products and services, which requires the brand to achieve through a series of management.

Recent advances in internet and internet-based technology have invigorated online shopping and drive mass customization to be adopted online. Because of this, some researchers concerned with a different definition of e-mass customization, i.e., e-mass customization taking the specific characteristic of internet-based mass customization into account.

2.3.2 The Concept of E-mass Customization

Existing researches explore the necessity to shift the focus from offline-based to online-based mass customization, mentioning mainly three points: first, as digital customers who usually use networked devices for their shopping activities, there would be potential benefits for them in the e-mass customization business (Fiore, 2004). Second, the use of the Internet and Internet-based technologies enables effective and spontaneous company-consumer communication, and utilizing online interfaces allows companies to engage in customized collaborative design activities with each customer (Anderson, 2002; Hibbard, 1999; Kim, 2002; Seock, 2007; Lee and Chang, 2011; Lang et al., 2020). Additionally, existing literature (e.g., Lee et al., 2000; Kaplan and Haenlein; 2006; Lee and Chang, 2011; Aichner and Coletti, 2013; Yan et al., 2019) suggests that companies that adopt e-mass customization appear to be more profitable.

The term e-mass customization was first proposed by Kaplan and Haenlein (2006), emphasizing e-mass customization as a strategy when any of the three following components that are traditionally offline are brought up to digital can be defined as e-mass customization; the three components are players (e.g., buyers, intermediates etc.) processes (e.g., interactions between market players and activities such as product choices etc.) products.

In the limited literature on e-mass customization, many researchers emphasized e-mass customization as a strategy to make customers perceive customization-related experiences. For example, Lee and Chang (2011) proposed that co-design activities are a key component of e-mass customization that can involve customers in the design process and increase customer satisfaction by enhancing individuality by creating a unique product.

Similarly, Aichner and Coletti (2013) also emphasized the aspect of company-customer interaction in e-mass customization. They mentioned co-creation according to web interfaces; more specifically, they proposed that the suitable interface is a crucial point, which must be easy to use, complete and provide all the possible choices with good default choices, thus can turn the purchase process into a pleasant experience, and further induct the desire for a personalized object (Aichner and Coletti, 2013)

Yoo and Park (2016) mentioned the term e-mass customization, referring to applying the latest Internet technology to provide customers with customizable products or services in an online form. They further discussed the possible benefits of co-design, specifically in terms of customer-perceived value.

Yan et al. (2019) discussed the concept of e-mass customization in their research. They proposed e-mass customization as a strategy with the components of mass-custom production and co-design activity, i.e., e-mass customization combines internet-enabled collaborative design activities with fast high-quality delivery of custom products. Additionally, Yan et al. (2019) mentioned that the application of e-mass customization would enhance customer loyalty and brand performance, while their research is conceptual and needs empirical evidence.

In brief, although the research on e-mass customization is still limited, the existing literature proposes that e-mass customization is based on mass customization while characterized by Internet-supported. The current literature mentions e-mass customization as a strategy involving collaborative design activities and providing customised products in a low-cost, large-volume and fast manner. The discussions about e-mass customization have focused on its possible benefits in enhancing company-customer relationships. (Kaplan and Haenlein, 2006; Lee and Chang, 2010; Yoo and Park, 2016; Yan et al., 2019).

The tables below (Table 2.1 and Table 2.2) present the conceptual definition of mass customization and e-mass customization proposed in the existing literature.

Table 2.1 The conceptual definitions of mass customization

No.	Concept of mass customization	Sources
1.	Brands reach out to customers as in the mass market economy but treat them individually.	Davis (1987)
2.	Developing, producing, marketing and delivering affordable products and services with enough variety and customization that nearly everyone finds what they want.	Pine (1993)
3.	Mass customization commits to offering consumers the option to create personalized items at an affordable price quickly.	Boynton et al., (1993)
4	Mass customization is “an information technology driven production and delivery system of products or services designed to efficiently meet the needs of individual customers at costs in the range of mass production.” (p.15)	Kay (1993)
5	The visionary definition of mass customization is "the ability to provide your customers with anything they want profitably, any time they want it, anywhere they want it, any way they want it." (p.36) The practical definition of mass customization is "the use of flexible processes and organizational structures to produce varied and often	Hart (1994)

	individually customized products and services at the low cost of a standardized, mass-production system." (p.26)	
6	Mass customization is about the company's ability to respond quickly and flexibly to manufacture highly diversified products through technical and management methods.	Kotha (1996)
7	Mass customization is a complex of custom and mass production designed to provide customers with unique value efficiently.	Gilmore and Pine (1997).
8	Mass customization is about low cost, quick delivery of highly differentiated products.	Feitzinger and Lee (1997)
9	Mass customization is about producing an increasing variety of products without a significant trade-off in production costs and (or) lead time.	Joneja and Lee (1998)
10	Mass customization refers to "combines the unique products of craft manufacturing with the cost-efficient manufacturing methods of mass production." (p.605)	Duray et al. (2000)
11	Mass customization is about using flexible processes and organizational structures to produce various customized products and services at the prices of mass-produced alternatives.	Peters and Saidin (2000)
12	Mass customization focuses on "satisfying individual customer's unique needs with the help of technologies such as agile manufacturing, flexible manufacturing systems, computer integrated manufacturing, and information and communication systems." (p.283)	Chinnaiah and Kamarthi (2000)
13	Mass customization is a strategy "to produce customized goods and services with mass-production efficiency and cost."	Lee et al. (2000)
14	Mass customization is about producing varieties of customized products on a large scale and at a cost comparable to mass production.	Tu et al. (2001)
15	Mass customization is "a systemic idea involving all aspects of product scale, development, production and delivery, full-circle from the customer option up to receiving the finished product."	Da Silveira et al. (2001)
16	Mass customization is a method "to deliver customer a unique value via differentiated products and services." (p. 1)	Totz and Riemer (2001)
17	Mass customization refers to "the ability to provide customized products and services to individual customers using technology (information) at optimal production efficiency and cost levels." (p.309)	Broekhuizen and Alsem (2002)

18	Mass customization is a strategy about the customer's involvement in the design, production, or delivery process before the actual sales transactions, using technological and managerial means to limit the cost.	Kamali and Loker (2002)
19	Mass customization refers to "the mass production of individually customized goods and services." (p. 835)	Fiore et al. (2002)
20	Mass customization is defined from the basic level as "making products which are tailor-made to each individual's request, in which even the base components are varied." Mass customization is defined from a company perspective as "the ability to provide customers with whatever they want, whenever they want it, wherever they want it and however they want it."	Bardakci and Whitelock (2003)
21	Mass customization is "the capabilities offered by new manufacturing technologies (CIM, flexible manufacturing systems) reducing the trade-off between variety and productivity." The main principle of mass customization is "a mechanism for interacting with the customer and obtaining specific information in order to define and translate the customer's needs and desires into a concrete product or service specification." (p.2)	Franke and Piller (2003)
22	Mass customization is "the ability to provide individually-designed products and services to customers through high process flexibility and integration."	Fogliatto et al. (2003)
23	Mass customization is a strategy of providing customizable products or services to customers.	Fiore (2004)
24	Mass customization is "a strategy that seeks to exploit the need for greater product variety and individualization in markets." (p.347)	MacCarthy (2004)
25	Mass customization is a strategy in that "goods and services are produced to meet individual customer's needs with near mass production efficiency." (p.583)	Piller and Müller (2004)
26	Mass customization is "the ability to provide customized products and services at a comparable price and speed of equivalent standardized offerings.	Squire et al. (2006)
27	The working definition of mass customization is: "a strategy that creates value by some form of company- customer interaction at the fabrication/ assembly stage of the operations level to create customized products with	Kaplan and Haenlein, 2006)

	production cost and monetary price similar to those of mass-produced product.” (p.177) The visionary definition of mass customization is "a strategy that creates value by some form of company-customer interaction at the design stage of the operations level to create customized products, following a hybrid strategy combining cost leadership and differentiation” (p.177)	
28	Customers, through equipped design toolkits, create their own unique products. Then manufacturers produce these products through flexible manufacturing systems so that customers with heterogeneous needs are delivered what they want.	Schreier (2006)
29	Mass customization is “the ability to manufacture a relatively high volume of product options for a relatively large market that demands customization, without substantial trade-offs in cost, delivery, and quality.” (p.520)	Liu et al. (2006)
30	Mass customization is “a business strategy that aims at satisfying individual customer needs at costs that do not considerably differ from the costs of similar standard products.” (p.908)	Blecker and Abdelkafi (2006)
31	Mass customization is “to provide a web-based user toolkit that allows the individual customer to design a product which suits her individual preferences and is then produced exclusively for her.” (p.93)	Franke and Schreier (2008)
32	Mass customization is “the ability to quickly produce customized products in large volumes and with a cost, quality, and delivery comparable to that achieved by mass production.”	Huang et al. (2008)
33	Mass customization is a process for aligning an organization with its customer’s needs.	Salvador et al. (2009)
34	Mass customization is about “process in which consumers can choose levels from a set of predefined product modules to compose their own most preferred alternative.” (p. 44)	Dellaert and Dabholkar (2009)
35	Mass customization refers to “provides sufficient variety products and services so that each customer can purchase a customized product for a price near that of a mass priced item.” (p.115)	Subramoniam and Babu (2010)
36	Mass customization is “a production strategy focused on the broad provision of personalized products and services, mostly through	Fogliatto et al. (2012)

	modularized product/service design, flexible processes, and integration between supply chain members.” (p. 15)	
37	Mass customization refers to “a strategy to offer affordable goods and services with a wide variety of personalization options.” (p.20)	Aichner and Coletti (2013)
38	Mass customization is about producing high-variety products while maintaining mass production by leveraging modular principles.	Wang et al. (2017)
39	Mass customization is “a strategy that pursues differentiation against near mass production costs.” (p.135)	Torn and Vaneker (2019)
40	Mass customization refers to providing products or services that meet each customer's demands but can be produced and delivered with mass production efficiency.	Piller (2021)
41	Mass customization is about quick customer response, cost-competitive products, product design tailored to customers’ needs and achievement of corporate objectives through adopting managerial methods and manufacturing frameworks.	Jain et al. (2022)

Table 2.2 The conceptual definitions of e-mass customization

No.	**Concept of E-mass customization**	**Sources**
1	E-mass customization is “a strategy that creates values by some form of company-customer interaction at fabrication/assembly stage of the operations level to create customized products with production cost and monetary price similar to those of mass-produced products, where at least one of the three market dimensions-player, product, and process is digital.” (p.178)	Kaplan and Haenlein (2006)
2	E-mass customization is about “a combination of mass and custom-made production process, in which the production can be specialized to each consumer.” (p. 171)	Lee and Chang (2011)
3	E-mass customization is about applying the latest Internet technology to provide customers with customizable products or services in an online form.	Yoo and Park (2016)

4	E-mass customization is that brands allow customers to co-design their own products and quickly produce customised products at a cost comparable to mass production.	Yan et al. (2019)
5	E-mass customisation focuses on customer participation and co-designing their products to improve the relationship between businesses and consumers.	Lang et al. (2020)

In summary, a careful literature review expresses that e-mass customization is a variety of mass customization taking the specific characteristics of internet-based into account; it is a strategy that includes co-design activity and mass-custom production processes to bring customers a personalized experience and products at a reasonable price and within a short waiting time.; e-mass customization included two sub-dimensions, i.e., mass-custom production and co-design activity. More detailed, e-mass customization involves co-design activity, using interactive, user-friendly interfaces for individual customers to define their own products through a collaborative design process, and low-cost, large-scale and quick production of differentiated products for each individual to obtain customized products at an affordable cost within a short waiting time. The discussion focuses on e-mass customization in the current literature on the aspects of implementing e-mass customization and the benefits of e-mass customization brings in terms of brands, such as company-customer relationships, and the outcomes e-mass customization brings to the brands.

A few scholars mentioned that mass customization or e-mass customization relates to brand performance. For instance, some academics stated that the successful implementation of mass customization could help products made from the specific brand to be distinguished products made by the brand's competitors; consequently, brand differentiation can be generated (Totz and Riemer, 2000). Moreover, some researchers mentioned that the degree of customer satisfaction can be improved when customers perceive value from co-design activities and customized products (Merle et al., 2010; Yoo and Park, 2016; Yan et al., 2019), and because customers have highly degree of satisfaction, they become loyal to the brand and be more willing to purchase and make a recommendation of the brand (Piller and Müller, 2004; Lee and Chang, 2011; Spaulding and Perry, 2013; Yoo and Park, 2016; Yan et al., 2019). In addition, in several studies, mass customization contributes to return on investment (ROI) and return on assets (Duray et al., 2000), which are about tangible performance.

A careful literature review indicates a linkage between mass customization and brand performance. Accordingly, this research proposes connections between e-mass customization and brand performance. In the existing researches and anecdotes that mentioned the relationship between mass customization or e-mass customization and brand performance, most of them put forward conceptual ideas about the linkage between these two rather than providing intensive investigation with empirical evidence. Generally speaking, the existing literature research on e-mass customization and its results for the brand is still a black box, and this point is still worth further discussion. Accordingly, one of the objectives of this study is to discuss the influence of e-mass customization on brand performance.

On the other hand, literature on implementing e-mass customization touches upon technological-, technical-, and managerial- methods. For instance, adopting product modularity offers enhanced variety in product design via component commonality (Duray et al., 2000), increased product variety, shortened delivery lead times, and improved economies of scope (Ulrich, 1995; Duray et al., 2000). Moreover, modularity makes it easier for customers to customize and update their choices (Tu et al., 2004), and it may lead to user-friendly co-design activities. Also, the firm's innovative thinking and behaviour help them capture and adapt to the changing customer needs (Wong and Merrilees, 2008). It would help the firm gain better performance (Odoom and Mensah, 2018). Many companies, especially those in the most vulnerable industries in the value chain, such as apparel and textiles, are expected to have consolidated suppliers (McKinsey, 2021). By shifting from transactional relationships to favouring partnerships and collaborating with large, more advanced suppliers, brands may attain greater agility, source smaller batches, and react faster to emerging trends, markets, and customers (Flynn et al., 2010; McKinsey, 2021). In addition, some scholars proposed that technology constrains/progresses possibilities for mass customization (Davis, 1987; Duray, et al., 2000; Yan et al., 2019; Yan et al., 2022). For example, machine learning, the most advanced technology, and its model predictions are highlighted as a priority for utilization by decision markers, and automation technology is one of the most advanced technology; the use of automation technology to control and monitor manufacturing support systems and manufacturing equipment in production can be able to improve productivity and flexibility (Kolberg and Zühlke, 2015; Fawcett, 2017; Shin et al., 2017; Lu et al., 2020). Accordingly, it is crucial to understand the concept of these terms (i.e., modularity, innovation, supply chain integration, production automation and machine learning), and the potential links between these factors to e-mass customization proposed in the existing literature.

2.4 Modularity

The term modularity was first introduced by Simon (1962), referring to a nearly decomposable system. Star (1965) proposed that modularity can help control diversity and increase interchangeability, so industries and businesses first adopted it in a turbulent environment. Since the 1990s, more attention has been commanded to modularity, in particular from manufacturers, because modularity has seen vastly increase in the flexibility and agility of manufacturing, which further helps to shorten production time and reduce the overall cost of production (Sanchez, 2000; Sanchez and Collins, 2001; Ketchen and Hult, 2002; Tu et al., 2004). During the same period, scholars in related disciplines began conducting in-depth discussions on modularity.

Sanchez and Mahoney (1996) conceptualized modularity as 'decomposable systems' possessing a high degree of independence. Later on, Schilling (2000) and Schilling and Steensma (2001) delineated the concept of modularity from the practical perspective, stating that modularity is related to the degree to which a system's components can be separated and recombined into new configurations with loss of functionality. Campagnolo and Camuffo (2009), in addition to supporting Schilling's (2000) and Schilling and Steensma's (2001) studies about the concept of modularity, stressed that the degree of modularity highly depends on whether the gains achievable through a modular structure are greater than those attainable by an integral one. This indicates that the benefits of managing various complex systems with high modularity-based management outweigh the benefits of integrated management. In addition, the study of Campagnolo and Camuffo (2009) indicates that modularity includes multiple types; Modular management can help simplify the complexity of system operations.

Duray et al. (2000) argued that “modularity is multifaceted in concept and is generally described either in relative terms or as a typology” (Duray et al., 2000, p609). They considered the concept of modularity encompasses six types. By selecting and using these types of modularity, enterprises can achieve the ability to deliver highly differentiated products in terms of mass customization quickly (Duray et al., 2000). In other words, these modular types can help achieve repeating sequences across products, thereby reducing the complexity that arises in producing high-variety products. Tu et al. (2004) also suggested the concept of modularity, referring to typology. More specifically, Tu et al. (2004) first mentioned that modularity is considered a way to help simplify complex systems. Moreover, they stressed that modularity, product modularity and process modularity are two main types which help improve flexibility and agility in product design and production process (Tu et al., 2004). Wang et al. (2014), when they mentioned modularity, also referred to product modularity and process modularity. More specifically, Wang et al. (2014, p679) said product modularity is “the extent to which a product is separated into standardized modules that can be easily recombined into different product features or shared across different product lines”, and process modularity is “the extent to which the production process is separated into standardized modules that can be easily re-sequenced into new processes that fulfil the requirements of producing new product features".

Some studies mentioned that the use of modularity in production improves flexibility and responsiveness to help industries that face dynamic market conditions, such as corporate, computer and apparel industries (Sanchez, 1995; Warren et al., 2002), such as computer (Baldwin and Clark, 1997), automobile (Nobeoka and Cusumano, 1991; Warren et al., 2002) apparel industry (Merle et al., 2010; Raimondo and Farace, 2013; Yoo and Park, 2016). In addition, previous studies have indicated the connection between modularity and mass customization. For example, Duray et al. (2000) pointed out that modularity helps to increase the speed required to produce these products while improving the diversity of products, thus reducing the pressure on the company to respond to the diversified needs of customers. Tu et al. (2004) proposed that applying the modularity principle in product design and manufacturing and collaboration between work units can help reduce production costs. Accordingly, this study considers that modularity, including product modularity and process modularity, is related to online mass customization. The following two chapters present the concepts of product modularity and process modularity proposed in existing research, respectively.

2.4.1 Product Modularity

Product modularity has been proposed to have a connection with mass customization. For example, Suzik (1999) stressed that adopting product modularity is related to bringing diversified end-products while reducing piece cost and investment. McCutcheon et al. (1994) mentioned that product modularity is a way to provide strategic flexibility and faster speed to market change while the lower the cost of production design.

Several researchers discussed the concept of product modularity underlying the context of product design and production management. Tu et al. (2004) when suggested the idea of product modularity, referring to the practice of using standardized product modules in product design and production. More specifically, Tu et al. (2004) defined product modularity as "the practices of using standardized product modules shared across different product lines", and the core of product modularity is to allocate the functional elements to structurally independent physical components and to create interfaces to omit the unnecessary changes when components need to substituted (Tu et al., 2004, p151). Similarly, Jacob et al. (2011), when conceptualizing product modularity, mentioned it as "the use of standardized and interchangeable architectural elements that enable the configuration of a wide variety of end products. The definition presupposes loose coupling, ease of disaggregation, heterogeneous outputs, and a one-to-one matching of function to module." Wang et al. (2014), when discussing the concept of product modularity, mentioned it as the application of the unit substitution principle in product design. Specifically, they pointed out product modularity as "the extent to which a product is separated into standardized modules that can be easily recombined into different product features or shared across different product lines" (Wang et al., 2014, p679).

On the other hand, several researchers considered the concept of product modularity not only includes the use of standardized modules to help companies simplify the complexity of designing high-variety products but also includes the use of the standardized practice to help companies simplify the complexity of customer participation in the design of customized products. Duray et al. (2000, p609) mentioned modularity is "as a relative property with products characterized as more or less modular in design", and modularity help to involve the customers to participate in designing their own products while helping to decrease the possible variety of components, thus allowing for the repetitive manufacturer. These researchers further delineated modularity includes six types, which are 1) cut-to-fit modularity, which "alters the dimensions of a module before combining it with other modules"; 2) component-sharing modularity, which uses common components in the design of a product, so that products are uniquely designed based on the common components; 3) component swapping modularity, which allows modules that selected from a list of options to be added to a based product; 4) mixed modularity, which is mentioned to be similar to component swapping, while the modules lose unique identity after combined; 5) bus modularity, which allows a new module to be added to an existing series; 6) sectional modularity which focuses on arranging standard modules in a unique pattern (Duray et al. 2000, p609). And they stressed that applying modularity selected from these six types is the key to achieving low-cost customization. Seyoum (2020, p6) defined product modularity as "the use of standardized and interchangeable components or units which allow for the configuration of a wide variety of end products". This perspective also indicates that the concept of product modularity includes the use of standardized product modulus in dimensions of 1) designer product design and 2) customer product co-design.

One concern of this study is the impact of modularity on e-mass customization, more precisely, the impact of product modularity on the two constructs of e-mass customization, namely, co-design activity and mass-custom production. Accordingly, this study agrees with the concept of product modularity suggested by Duray et al. (2000), Tu et al. (2004) and Seyoum (2020). Consequently, this study adopts the definition proposed by these scholars on product modularity, i.e., in this research, product modularity is defined as “the use of interchangeable product modules which allow being combined/arranged into different end-product.” And the following 5-item measurements of product modularity proposed by Duray et al. (2000), Tu et al. (2004) and Seyoum (2020) are also adopted, including "product can be decomposed into separate modules that can be re-combined into new designs; we can make changes in the key components without redesigning others; product components can be reused in various products; the product has a high degree of component carry over; we have a high degree of components between different products" (Seyoum, 2020, p15).

Academics emphasized that product modularity is the way to support firms to achieve mass customization capabilities. For example, some researchers mentioned that using interchangeable product modules to reconfigure end-product enables product variations while reducing time and cost; more specifically, configuring different end products by substituting product components saves time and cost over redesigning the product by minimizing coordination and communication, which consequently reduces new product entrance barrier (Ulrich, 1995; Sanchez, 2000; Warren et al., 2002; Tu et al., 2004; Lau et al., 2011; Persson and Åhlström, 2006; Magnusson and Pasche,2014). Few researchers mentioned that product modularity eases the tracing of defects that may occur in a particular module, which reduces the costs of correcting the defects (Baiman et al., 2001; Susarla et al., 2010; Seyoum, 2020). In addition, some researchers stated that product modularity enables customers to directly customize and upgrade product through product variation (product options) (Tu et al., 2004), which further reduce the time and cost of company-customer communication (Yan et al., 2019).

2.4.2 Process Modularity

Paralleling product modularity, process modularity is also viewed as a supportive way for complex production through standardized schemes. A number of studies proposed that process modularity, apart from product modularity, facilitates firms to gain mass customization capability. Scholars indicate the contribution of applying process modularity into production. For example, Wand (1994) and Cooper (1999) mentioned that process modularity allows routines and interfaces to be reconfigured and rearranged frequently, creating different process capabilities. Some researchers (e.g., Pine, 1993; Sanchez, 1996; Meyer and Lehnerd, 1997; Feitzinger and Lee, 1997; Hoek and Weken, 1998; Gualandris and Kalchschmidt, 2013; Wang, 2014) mentioned that process modularity enables production processes to be resequenced and postponed easily and frequently, a firm increases its manufacturing flexibility. In addition, a few researchers (e.g., Feitzinger and Lee, 1997; Van Hoek and Weken, 1998; Gualandris and Kalchschmidt, 2013; Wang, 2014) mentioned that the application of the unit substitution principle in the production process could help reduce manufacturing costs.

Academics defined process modularity from different perspectives. Some researchers refer to process modularity concerning using modular principles to decompose/recombine steps in the manufacturing process, intending to simplify highly differentiated processes. Tu et al. (2004, p151) defined process modularity as “the practice of standardizing process modules so that they can be resequenced easily or new modules can be added quickly in response to changing product requirements”. These researchers further proposed three principles to follow when the use of process modularity: first, to break down the process into standard sub-processes and customization sub-processes; second, to resequence the subprocesses so that standard sub-processes occur first, while customization sub-processes occur last; third, to postpone customization sub-processes until a customer order is received to achieve maximum flexibility. Similarly, Wang et al. (2014) suggested that the concept of process modularity is about using the substitution principle in the manufacturing process; more specifically, they argued that process modularity is about “the production process is separated into standardized modules that can be easily resequenced into a new process that fulfil the requirements of producing new product features” (Wang et al., 2014, p679).

Several scholars emphasized process modularity with standardization in production processes, whereby each production operation is independent of previous procedures. Worren et al. (2002) discussing the concept of process modularity, suggested that it is related to the application of the modularity principle in the key activities of the company, i.e., it is about “decompositions of the company’s key activities into specific routines and interfaces that allow frequent reconfiguration of processes” (Warren et al., 2002; p1123)Jacob et al. (2011, p 126) defined process modularity as “the incorporation of adaptable and reconfigurable tooling and routings into production operations to meet heterogeneous demand effectively”; that is, process modularity is about the applying of the modularity principle into operations and activities in production (such as the manufacturing process, the daily workflow and so on) which allows the activities to be combined or re-configurated easily and frequently according to the requirements.

Combining the concepts suggested by the existing literature, this study proposes that product modularity is related to the application of the modularity principles of the production process, in particular, the using of modularity principles to decompose the key activities of the production processes into specific routines which can be combined and resequenced into new processes that fulfil the requirements. Accordingly, the author of this study defined process modularity as decomposing key activities of the production process into modular routines which allow combined or frequent re-configuration

In brief, the previous studies have brought up the evidence that modularity, either as a term or as a typology, refers to product modularity and process modularity, which helps firms gain mass customization capability (Tu et al., 2004; Wang et al., 2014, Ye et al., 2019, Ye et al., 2022). In addition, existing studies indicate that product modularity and process modularity are the application of the modularity principle in different aspects of the production process, which can help and support complex production from various aspects (Tu et al., 2004; wang et al., 2014; Yan et al., 2019). Accordingly, this study views modularity as a product and process modularity typology. It proposed that the two types, i.e., product modularity and process modularity, have linkages to e-mass customization. The detailed hypotheses are shown in Chapter 3, in section 3.2.1.

2.5 Innovativeness

Innovativeness has been considered a desirable company characteristic that can lead to reaping advantages. Moreover, Subramanian and Nilakanta (1996) mentioned that keeping innovativeness can improve organizational performance. Furthermore, some scholars mentioned that keeping innovativeness can enhance the long-term competitiveness of enterprises. For instance, Lei et al. (2013) and Odoom and Mensah (2018) claimed that firms with highly innovative capabilities could control risk easily and respond quickly and effectively to market changes. Wong and Merrilees (2008) pointed out that firms that keep innovate in products and services can draw target customers' attention.

The literature proposes perspectives and ways in which innovativeness has been conceptualized. Ravichandran (1999) pointed out that 'innovation' emphasizes the creation of newness, while 'adoption' stresses familiarity and predictability; however, these two terms can be equated. And on this basis, Ravichandran (1999) pointed out that there is "a "general lack of conceptual clarity, eventually precluding a definition and a measure for organizational innovation", indicating that the term innovativeness contains dual connotation, i.e., 'creation' and 'adoption.

Several researchers have suggested that the concept of innovativeness contains different levels and layers. For instance, Midgley and Dowling (1978) referred to innovation as 'persisting characteristics' by which a person can be distinguished from another. More researchers in management science put forwards the concept of organizational innovativeness. Ravichandran (1999, p257) defined organizational innovation as "the actualization of the creation of a new product, process, methods or service by an organization, through concerted and committed efforts of its members and by other resources, exhibiting a perceptual departure from its antecedent and demonstrating one or more utility value". Wang and Ahmed (2004) mentioned that an organization's innovation contains individual, team, and management innovativeness. More specifically, maintaining a high level of innovation capability in an organization requires 1) the willingness and commitment of management to encourage new ways of doing things; 2) the team remains dynamic and proactive in responding to change; 3) individuals can leverage their expertise play to work.

Some academics have proposed that the concept of innovation contains different dimensions. Thompson (1965) mentioned that innovation involves product innovations and process innovations. Ravichandran (1999) supports this point of view, and the scholar suggested that innovation contains process innovation and product and service innovation. Similarly, Odoom and Mensah (2018, p158) proposed that organizational innovation is related to "firm's products, services and processes depart from existing products or services and technologies". This point of view stresses that the dimension of organization innovativeness includes product innovation, service innovation as well as innovation of production process technology.

On the other hand, few scholars proposed that innovation contains the dimension of technical innovation and non-technology innovation. Damanpour (1991) stressed that policy and administrative innovation are also important apart from product, service, device and system innovation. Similarly, Armbruster (2008) mentioned that the concept of innovation contains product, service, and production process technology, which are technical, management, and workflow innovation, which are administrative innovations. In addition, Wang and Ahmed (2004), when conceptualizing the concept of innovation, mentioned not only technical and non-technical innovation but also stressed strategic innovation, which is a firm that combines strategic orientation with innovative behaviour and process.

When Wong and Merrilees (2008) conceptualized the concept of 'innovativeness' by combining the perspective of the connotation layer and dimension of innovation, more specifically, Wong and Merrilees (2008, p373) defined it as "the means by which firms either create wealth-producing resources or endows existing resources with enhanced potential for creating wealth", and Wong and Merrilees (2008, p373) emphasized innovation "goes beyond the products and service level to include process and systemic change."

Synthesizing the conceptualizations of innovativeness as proposed by scholars in the extant literature, this study considers the concept of innovativeness to comprise of 'creation' and 'adoption', involving individual teams and top management keeping forward thinking in order to update product, service, process, management and work activity from a technical level and administrative level and even strategic level. Accordingly, this research defines innovativeness as keeping forward thinking on resource updating and creation.

Existing literature suggests a linkage between innovativeness and e-mass customization, indicating that innovation helps companies respond faster to market changes than competitors and enables companies to maintain customer attention. Accordingly, this research proposed linkages between innovativeness and e-mass customization. The detailed hypotheses are shown in Chapter 3.

2.6 Supply Chain Integration

Supply Chain Integration (SCI) is considered to support product development and production. Literature mentioned that companies that maintain good relations with channel partners obtain markets and (or) customer-related information, which helps the companies adjust and improve products and production effectively (Simatupang et al.,2002, Parente and Gu, 2005). In addition, having a relatively complete supply chain is believed to help lower production costs and increase production speed and flexibility (Kotabe et al.,2007, Flynn et al.,2010; Seyoum, 2020).

Existing literature conceptualized the concept of supply chain integration from different perspectives. Several researchers refer to internal integration when mentioning the concept of supply chain integration. For example, Flynn et al. (2010) pointed out intra-organizational integration, which is about a firm structuring its organizational strategies and practices into a collaborative, synchronized process. These authors further mention that internal integration helps break down operational barriers by improving operational flexibility and operational performance in changing customer demands (Flynn et al., 2010). An increasingly competitive environment has prompted companies to look for allies and partners in order to improve their competitiveness (Lambert and Cooper, 1998; Wisner and Tan, 2000; Zhao et al., 2008; Flynn et al., 2010). Many companies have begun to focus on external and internal integration. Flynn et al. (2010) pointed out inter-organizational integration, referring to a firm to structure, such as practices and processes with its external partners. Liu et al. (2016, p. 14) mentioned that supply chain integration is related to a firm "collaboratively deploys its resources and capacities with channel partners" Similarly, the aspect of inter-organizational integration is also suggested by Seyoum (2020). Seyoum (2020) proposed that supply chain integration refers to a firm's practices to collaborate strategically with upstream and downstream suppliers.

Several studies have discussed the concept of supply chain integration from the dimensions it may contain. Simatupang et al. (2002) proposed that the content of supply chain integration includes the following dimensions: 1) effective communication, 2) information exchange, 3) partnering, and 4) performance monitoring. Fabbe-Costes et al. (2008) mentioned that supply chain integration involves four aspects of activities including: 1) integration of flows (e.g., physical, information and financial), 2) integration of processes practices, 3) integration of technologies, and 4) systems, integration of actors (e.g., structure and organizations). Flynn et al. (2010) proposed that supply chain integration activities involve the flow of products and services, information, money and decisions. Liu et al.

(2016) suggested that supply chain integration refers to strategic cooperation with channel partners, including the following dimensions: 1) information integration, 2) synchronized planning, 3) operational coordination, and 4) strategic partnership. Liu et al. (2016, p15) explained these four dimensions in more detail: information integration is related to "a firm shares information about various supply chain activities with channel partners"; synchronized planning is associated with a firm collaborating with channel partners in designing plans"; and operational coordination denotes "a firm streamlines and automates its supply chain processes with channel partners" while the strategic partnership is related to "a firm establishes long-term relationships with channel partners to achieve strategic goals".

Several academics put forward that the focus of the supply chain integration should be on the integration fit, that is, to balance the integration degree of internal, external and various dimensions to achieve synchronization of cooperation. Drazin et al. (1985), Venkatraman and Prescott (1990), and Milgrom and Roberts (1995) proposed that supply chain integration reflects the degree of consistency between a firm structure and the strategy it pursues in response to its external environment. Similarly, Flynn et al. (2010) mentioned that supply chain integration is about the fit to which a firm collaboratively manages its internal structure and strategy with its external environment. Other researchers pointed out that the central point of supply chain integration is the intensity of supply chain integration. Saraf et al. (2007) and Liu et al. (2016) brought up the view of high-level supply chain integration and low-level supply chain integration, i.e., low-level supply chain integration is about a firm sharing information broadly with its partners, while a high-level supply chain integration is about a firm exchanging in-depth tacit knowledge with its partners. In other words, the intensity of supply chain integration reflects the firm's degree of exchanging knowledge with its partners to meet business needs. However, Flynn et al. (2010) stressed that integration intensity and integration fit affect firm's performance.

A careful review of the literature indicates a divergence in the conceptualization of supply chain integration. Scholars conceptualized supply chain integration considering the aspect of scopes, layers, and degrees of integration. Regarding the stream of supply chain integration, researchers referred to intra-organizational integration (Flynn et al., 2010) and inter-organizational integration (Flynn et al., 2010; Liu et al., 2016). When mentioning the layers of supply chain integration, researchers referred to cooperation with upstream and downstream partners in various aspects (Simatupang et al., 2002; Fabbe-Costes et al.,2008; Liu et al., 2016). And the degrees of supply chain integration refer to the intensity of integration (Saraf et al.,2007; Liu et al.,2016) and (or) fit of integration (Drazin et al., 1985; Venkatraman and Prescott, 1990; Milgrom and Roberts;1995; Flynn et al.,2010)

Despite that existing literature does not form a unified concept of supply chain integration, it provides an idea that the concept of supply chain integration contains multiple dimensions. In other words, the term supply chain integration is about an enterprise's overall planning and practice for its cooperation with upstream and downstream suppliers (Kulp et al., 2004; Lee and Whang, 2004; Rai et al.,2006; Seyoum, 2020). Consequently, the researcher of this study combines the three dimensions mentioned in the literature when defining the concept of supply chain integration. To be more specific, the researcher of this study concerns with the layers of integration is about inter-organizational integration (Kulp et al., 2004; Lee and Whang, 2004, Rai et al., 2006; Flynn et al.,2010), as external integration enables enterprises to gain complementarity (Simatupang et al., 2002; Seyoum,2020). Secondly, the researcher refers to the degrees of supply chain integration to an enterprise looking for the highest degree of supply chain integration after a comprehensive assessment of its strategic goals and needs to obtain the maximum synergistic benefits (Liu et al., 2016, Seyoum 2020). Regarding the scope of integration, the researcher adopts Liu et al." s (2016) mentions, referring to information integration, synchronized planning, operational coordination, and strategic partnership. Accordingly, this research defines supply chain integration as integrating upstream and downstream suppliers into the supply chain practices.

Existing literature indicates a relationship between supply chain integration and e-mass customization. Seyoum (2020) mentioned that supply chain integration enhances complementarity and coherence so that firms increase the value of their own resources; for example, transferring knowledge facilitates learning between companies and channel partners from experiments and knowledge, for example, knowledge transferring facilitates companies and their channel partners to learn from each other's experiments and expertise which in turn helps reduce the time and cost required by product development and production process of enterprises, and helps improve production quality (Seyoum, 2020). And trust between firms and partners encourages innovation to improve performance (Simatupang et al., 2002). Accordingly, this research proposes linkages between supply chain integration and e-mass customization.

2.7 Cutting-edge Technology

Technology is essential to improve brands' mass customization capability (Duray et al., 2000; Da Silveira et al., 2001; Yan et al., 2019). In 2000, Duray, Ward, Milligan and Berry mentioned three cutting-edge technologies that could enhance brands' mass customization capability. In detail, the types of technologies that Duray et al. (2000) mentioned include the following three: 1) design technologies such as computer-aided engineering (CAE) and computer-aided process planning (CAPP); 2) manufacturing technologies such as computer numerical control (CNC); computer-aided manufacturing (CAM); robotics, real-time process control system, group technology (GT), FMS and barcoding/automatic identification; 3) administrative technologies, for example, electronic data interchange (EDI), material requirement planning (MRP) and decision support systems (DSS). During the same period, Da Silveira et al. (2001) also pointed out some cutting edge of technologies; they categorized these technologies into two types: 1) advanced manufacturing technologies (AMTs) such as computer numeric control (CNC) and flexible manufacturing systems (FMS) which enhance agility and flexibility; 2) communication and network technologies such as computer-aided design (CAD); computer-aided manufacturing (CAM), computer integrated manufacturing (CIM) and electronic data interchange (EDI).

Although numerous studies (e.g., Davis, 1987; Pine 1993; Kotha, 1995; Duray et al., 2000; Lee and Chang, 2010; Yan et al., 2019) pointed out the linkage between cutting-edge technology and e-mass customization, their research period, relevant studies were 10 or even 20 years ago, which was before the concept of automation technology and artificial intelligence technology (AIT) introduced. Automation technology and AIT are proposed as enablers of smart manufacturing (Sharp et al., 2018; Li et al., 2020). More specifically, production automation which is a subset of automation, and machine learning which is a subset of artificial intelligence, are proposed can help to produce highly differentiated products via responsive autonomous manufacturing operations at a competitive cost (Ye et al., 2019; Lu et al., 2020; Ye et al., 2022).

Despite that, both production automation and machine learning are indicated to affect complex production positively. At the same time, the distinction between the concepts of these two constructs still needs to be clarified. Their impacts on e-mass customization, independently, should be discussed more. Accordingly, it is worth further discussing the concept of production automation and the linkage between these technologies and e-mass customization. The following two sub-sections delineate the concept of production automation and machine learning generated from existing literature.

2.7.1 Production Automation

Production automation is a relatively new concept. Masayuki (2020), when mentioning the term automation technology, pointed out that it includes robotics, artificial intelligence as well as big data analysis system. Masayuki (2020) further mentioned that these technologies could complement and help human work during the production processes and enable the production processes to be automated. Li et al. (2020) mentioned automation technology, referring to humanoid service robots, collaborative robots, drones, artificial intelligence, and machine learning algorithms, and further emphasized that the using of these technologies can help to reduce waste and fault and increase productivity for a firm Li et al. (2020).

Lu et al. (2020) mentioned that production automation is related to manufacturing processes and system automation. They delineated manufacturing process automation as the use of automation technology to realize computer operation of design, planning, manufacturing and inspection, and manufacturing system automation as the systems continuously and collaboratively self-optimizing their setups and configuration, which requires more advanced intelligent technology to support the systems to self-optimizing themselves independently (Lu et al., 2020). Lu et al.'s (2020) point of view indicates that automation technology and artificial intelligence technology, like machine learning, are jointly mentioned, which enables an automated manufacturing system. For example, production automation is related to using computer-based systems and equipment to complement and support human work in the production process (Shin et al., 2017). However, machine learning is concerned with applying learning algorithms to different systems to analyze and provide insights, predictions, or optimization solutions (Mitchell, 2015; Athey, 2018; Sharp et al., 2019)

Shin et al. (2017) proposed a concept of production automation, mentioning it is related to automatized manufacturing support system and automatized production system, i.e., "computerized operations of the manufacturing support system and automated manipulation of facilities belonging to the production system" (Shin et al., 2017, p479). Shin et al. (2017) further delineated three layers in which automation technologies are used to automatize the production process: 1) layer one: business planning and logistics; for example, using of automation technology to automate planting production scheduling in the domain of the enterprise and managing operations in the domain of the enterprise; 2) layer two: manufacturing operation and control; for example, using of automation technology to automate releasing production orders to a manufacturing system, and controlling the progress of the orders; 3) layer three, activities of the physical equipment belonging to the shop floor and automated executing of the actual production operations.

Existing literature indicates a linkage between production automation and e-mass customization. For example, Lu et al. (2020) mentioned that production automation could help realize flexible and efficient production of a variety of personalized products simultaneously while maintaining production costs in a reasonable range. Similarly, Shin et al. (2017) mentioned that production automation helps to increase system flexibility and the quality of products. Kolberg and Zühlke (2015) pointed out that production automation helps to control production costs by avoiding waste and mistakes. Lu et al. (2020) proposed that using production automation contributes to a firm's profitability revitalization. Accordingly, machine learning in this research defines as the application of mechanical, electronic and computer-based technology to automate the production process (Groover, 2016; Westrom, 2020), and this research proposes a positive linkage between production automation and e-mass customization; the detailed hypothesis is displayed in Chapter 3, at section 3.2.4. The following sub-section presents the machine learning concept proposed in existing literature and anecdotes.

2.7.2 Machine Learning

Machine learning has attracted the attention of managers and academics as it enables disparate systems to self-learning, thus approaching desired outcomes (EI Naqa and Murphy, 2015). Machine learning has been applied to health care, education, financial modelling, entertainment, manufacturing and marketing, and so on (Jordan and Mitchell, 2015).

Several academics mentioned the concept of machine learning from its nature, referring to algorithm systems which can analyse heterogeneous data. For instance, Athey (2018) mentioned machine learning as a computational algorithm that facilitates learning from the environment, such as data and experience. Bajic et al. (2018, p29) defined machine learning as a subdimension of artificial intelligence; ML as a collection of algorithms which "learn directly from the examples, data, and experience and can figure out how to perform important tasks by generalizing from them." Carleo et al. (2019) pointed out that machine learning includes deductive, inductive and transudative learning algorithms, which can infer based on specific test cases and predict outputs from the earner has not been encountered before. Some studies delineated types of learning algorithms which can be summarized as the following four supervised learning, unsupervised learning, semi-supervised learning, and reinforcement learning (Jordan and Mitchell, 2015; EI Naqa and Murphy, 2015; Athey,2018; Yan et al., 2022), and it is mentioned that learning algorithm can facilitate prediction, classification, and clustering or grouping tasks (Athey, 2018; Bajic et al., 2018; Sharp et al., 2018; Ye et al., 2022). More specifically, supervised learning refers to learning from the available samples where output is labelled, thus estimating an unknown mapping (Athey, 2018). Unsupervised learning is mentioned to be used to clusters of observations that may be similar in the aspect of covariates (EI Naqa and Murphy, 2015; Athey, 2018), thus can be applied to categorize comments and videos to help segment market and customer (Athey, 2018) Semi-supervised learning is mentioned to be used to analyze labelled data partially to infer other parts that are not labelled (EI Naqa and Murphy, 2015). In addition, reinforcement learning is proposed to determine whether an action is correct, i.e., it is applied to indicate if the output is correct for a given input (Jordan and Mitchell, 2015).

Scholars, when mentioned machine learning, emphasized the benefits it brings. Sharp et al. (2018, p175) suggested the concept of machine learning referring to "a subset of artificial intelligence that focuses on autonomous computer knowledge gain", and it is related to "a computer update a model or response based upon new data or experiences through its learning lifetime". Moreover, Sharp et al. (2018) addressed the strengths that machine learning can bring when adopted in manufacturing, including the following five: 1) decision support. For example, machine learning can help optimize estimation for making a product from a fundamental level and finding solutions to complex questions; also, machine learning can obtain and present groups of solutions from which a decision maker can choose one that best suits; in addition, machine learning helps to optimize the scheduling of machine time for operations on a production line and maintaining scheduling; 2) plant and operations health management; for example, machine learning can diagnose issues and prognosis knowledge at all levels of manufacturing systems which help extend the life of manufacturing equipment. 3) data management; for example, the machine learning system can administrate large amounts of data and store these amounts of critical data in the cloud; also, machine learning systems allow relevant subjects to access resources in real time; 4) life cycle management, i.e., machine learning may in the future support direct communication between systems, as well as between systems and human; 5) identified gaps and needs; machine learning may in the future help a user troubleshoot equipment on the production floor and provide contextually pertinent information at times and situations where it can have the most impact. Based on the above five points proposed, Sharp et al. (2018) emphasized that the current machine learning systems have been able to achieve decision support, workshop health management and data management, but more advanced machine learning algorithms still need to be developed, to achieve life cycle management and identify gaps and needs.

When discussing machine learning, several researchers mentioned the advantage it brings in the aspect of company-customer communication. Jordan and Mitchell (2015) proposed that the learning algorithm supports prediction and forecast based on observations from customers' past searches, like images and videos, which helps firms retain customers. Athey (2018) mentioned that learning algorithms could help segment customers even into individual units. And by skill-based learning from the environment and analysing heterogeneous data from inter and intra-organizational, machine learning can help decision-makers, senior management, department managers, and relevant executives make optimal decisions and execute planning (Athey, 2018; Sharp et al., 2018).

After a careful review of the literature on relevant areas, it is viewed that machine learning is a relatively new concept, and there is no one universal definition of machine learning; existing literature, when referring to learning, mentions the benefits of using machine learning systems when referring to learning. Combining with the concept suggested by researchers, machine learning, in any case, seems Algorithm-based computer systems capable of providing deep insights for performing tasks through autonomous learning. (Bajic et al., 2018; Sharp et al., 2018; Yan et al., 2022). Although a few studies proposed a linkage between machine learning and customization, empirical evidence of their relationship still needs to be provided. One of the objectives of this study is to investigate the relationship between machine learning and e-mass customization through empirical evidence from the present facts, which can help academics and managers understand the impact of machine learning in different production dimensions on company strategy and execution.

In brief, product modularity, process modularity, innovation, supply chain integration, production automation and machine learning have each been proposed as enablers for flexibility and brand development.

2.8 Contextual Factors

2.8.1 Government Policy

Government policy could affect organizational strategy and performance (Rahman et al., 2004; Chowdhury, 2007; Chulanova et al., 2019). Government policy actively supports the solution, protects community institutions, and strengthens business performance (Eniola and Entebang, 2015; Obaji and Olugu (2014). On the other hand, when the government introduces a policy restricting autonomy, a firm's performance can likewise be hindered (Sriram and Mersha (2010). Obaji and Olugu (2014) suggested that the definition of government policy includes three aspects: supportive government policy, policy implementation and government funding.

Effective government is crucial in encouraging and supporting business; Obaji and Olugu (2014) suggested that government policy, including direct subsidies, tax incentives and government procurement, are helpful for the development of companies. Santosa et al. (2020) mentioned that government policy protects community institutions in facing competition, developing human resources and providing opportunities, thus supporting the firm's performance. Santosa et al. (2020) summarized that distributive and regulative government policies are the two categories to increase a firm's performance. Effendi et al. (2013) stated that government policy impacted improving business performance. However, Sathe (2016) mentioned that government shift designs and frameworks cause organizations to change how they operate accordingly. Thus, firms' performance is vigorously laid low by government policy. In addition, Santosa et al. (2020) pointed out that government should consider organizational needs when launching policies. For example, large enterprises have different needs and desires for support than SMEs each enterprise has different needs and desires for supports. On this basis, the research treats ‘government policy’ as a contextual factor.

2.8.2 Talent

Some studies found that companies harnessing employees’ talent can optimize business performance (Ingham, 2016; Ashton, 2005; Heinen and O’Neill, 2004). Ingham (2006) proposed that companies harness talents in different positions and departments, and managerial skills increase their ability to respond and survive inevitable upheavals. Harter (2000) emphasized, “When organizations select talented managers, the engagement of their employees in the business objectives is more likely”. For example, managers with operational talents and relationship-building skills can build a sense of teamwork and greater clarity of expectations, allocating assignments and providing support to the teams — which improve operational performance and business performance like competitiveness.

Heinen and O’Neill (2004) in their research pointed out that companies which attract, develop, motivate, manage and reward their talents can create enduring competitive advantages. In addition, Ashton (2005) indicated that companies with a strategic, holistic approach to talent management improve talent execution which supports operational excellence and thus enhances performance. Ingham (2006) pointed out that acquisition, allocation, development, retention and succession of value-adding people are important ways to create competitive advantages for organizations. Accordingly, ‘talent’ is considered a contextual factor in the research.

2.8.3 International Conflict

Conflict refers to the attempt of one part to achieve a goal but undermines the other in a competitive or corporative situation (Gowa and Mansfield, 1993; Mansfield, 1995; Henisz et al., 2010). International conflicts usually include diplomatic conflicts, military conflicts, environmental resource conflicts etc. (Gowa and Mansfield, 1993; Mansfield, 1994; Henisz et al., 2010). Different from a peaceful and stable environment, conflict can disrupt economic relations (Henisz et al., 2010) and disrupt the market while increasing risk and uncertainty (Collier and Duponchel, 2013), which then affects the perceptions of the severity of several businesses (Petracco and Schweiger, 2012). In other words, conflict can directly influence firms’ performance. Camacho and Rodriguez (2010) pointed out that conflicts can affect a firm’s sales, exports, profitability and decisions. And Petracco and Schweiger (2012) mentioned that those companies that launched strategies and invested resources with international law and norms and engaging communities based on international practices may still face the case of operational disruption. Some scholars mentioned that conflict influences technology, organizational structure, management practices (Bloom and Van Reenen, 2010), and the number of employees and their skills (Iranzo et al., 2008), which affect productivity at a firm level and ultimately influence a firm's performance. On this basis, the factor of international conflict is suggested as a contextual factor in this study.

2.9 Resource Orchestration Theory

Resource orchestration theory views an organization can realize the total value of its resources only when the resources are managed effectively (Sirmon et al., 2007; Sirmon et al., 2011; Liu et al., 2016). Resource orchestration stems from resource-based theory, i.e., it combines resource management with asset orchestration considering the dynamic perspective.

First, the resource-based view (RBV) suggests that an organization's resources drive value creation by developing competitive advantage (Ireland et al., 2003; Sirmon et al., 2007). In detail, the resource-based theory emphasizes that possessing valuable and rare resources provides the foundation for value creation (Sirmon et al., 2007); and this value may be sustainable when the resources are inimitable and lack substitutes (Barney, 1991). In other words, "value, rarity inimitability and nonsubstitutability are the commonly cited characteristics that provide the core logic linking resources to competitive advantage" (Sirmon et al., 2011). Hansen et al.'s (2001) empirical results suggested that "what a firm does with its resources is at least as important as which resources it possesses." Possessing resources alone does not guarantee the development of competitive advantage; instead, resources must be managed effectively, meaning the total value of resources for creating competitive advantages (Sirmon and Hitt, 2003; Sirmon et al., 2007). For an organization to realize value creation, it must accumulate, combine and exploit resources (Grant, 1991).

Regarding how organizations accumulate and configure their resources to create competitiveness, some academics (e.g., Hansen et al., 2001; Sirmon and Hitt, 2003; Sirmon et al., 2007; Sirmon et al., 2011) proposed a framework based on resource management, i.e., structuring the portfolio of resources, bundling resources to build capabilities and leveraging capabilities in the market place. Sirmon et al. (2007) and Sirmon et al. (2011) delineated structuring the resource portfolio involves acquiring, accumulating and divesting to obtain the resources that the organization will use for bundling and leveraging purposes; and bunding refers to stabilizing, enriching, and pioneering to integrate resources to form capabilities; and leveraging is about mobilizing, coordinating and deploying to exploit capabilities to take advantage of specific market's opportunities. On the other hand, some academics (e.g., Adner and Helfat, 2003; Helfat et al., 2007) proposed a framework on the basis of asset orchestration. They suggest asset orchestration to create value and competitive advantages for an organization. More specifically, asset orchestration includes two dimensions, i.e., search/selection and configuration/deployment. The search/selection process is about identifying assets, investing assets, and governing structures for the organization; and configuration process is about the coordinating of assets and nurturing innovation (Helfat et al., 2007; Sirmon et al., 2011). Furthermore, some researchers (Donaldson, 2001; Sirmon et al., 2007) mentioned the "fit" between environment and internal configurations may result better understanding of how to take actions on resources so as to optimize value creation and competitive advantage (Donaldson, 2001).

These theories identify requirements that the resources and capabilities must satisfy if they are to be a source of competitive advantage, however, neither theory explains how firms can develop these capabilities and resources. Some academics (Sirmon et al., 2011, Liu et al., 2016) suggested that these two frameworks complement one another and to pay attention to resource-related actions will facilitate how the actions influence outcomes like value creation and the development of competitive advantages (Sirmon et al., 2011). In other words, management of resources, assets and capabilities are dynamic and an organization's resource-related actions can produce different outcomes and to achieve the organization's expectations. Accordingly, organizations must take resource-related actions and highlight one or two actions according to internal configurations and environment (Sirmon and Hitt, 2003; Sirmon et al., 2007) Resources orchestration draws upon both resource management and asset orchestration, combining the dynamic perspective of view. Based on resource orchestration., organizations must integrate resources across diverse business divisions and improve cooperation among them to realize synergy; also, organizations must identify and highlight one or two resource-related actions ahead, in order to realize value creation and competitiveness.

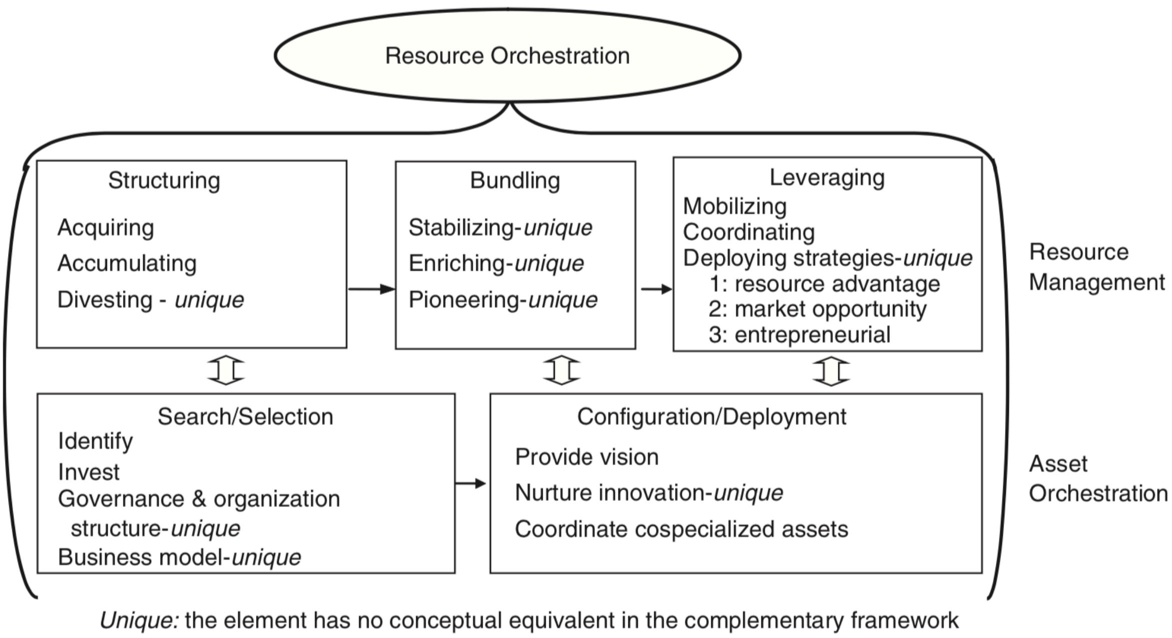

Figure 2.1 Resource orchestration (Sirmon et al. 2011)

Initially, resource orchestration theory was developed at the firm level. Resource orchestration theory views a company as a set of resource, assets and capabilities in which the development of sustainable competitiveness relies on managers’ skill in generating synergistic efforts by the configuration of resources, assets and capabilities (Helfat et al., 2007; Sirmon et al., 2007). To generate synergies depends on the potential complementarity of the resources and on a firm's effectiveness in orchestrating resources within and across firm boundaries (Baert et al., 2016). The essential factor in business management is not the identification of the best combination of assets and capabilities but how management coordinates and synchronizes them. Practices can be imitated, but it is difficult to imitate a set of capabilities and even more difficult to imitate how these capabilities are synchronized. Resource orchestration is precise for understanding the complementary effect of the product modularity, process modularity, innovativeness, supply chain integration, production automation, and competence of machine learning on developing these resources. Accordingly, we ground our framework in resource orchestration.

2.10 The Research Gaps

Theoretically, e-mass customization would enable customers to obtain customized products and experiences. Using such technological, technical and managerial solutions would reduce the trade-off between producing high variety of products, and cost and lead time, thus supporting brands to deliver customized products quickly, on a large scale and at a cost comparable to mass production. Academics have mentioned modularity, supply chain management, innovative thinking and behaviour and advanced technologies to enhance production flexibility and quick responsiveness. However, the impacts of orchestrating these resources on e-mass customization remain a black box. From the resource orchestration theory, orchestration resources and management acumen can realize potential advantages (Chirico et al., 2011; Chadwick et al., 2015; Liu et al., 2016). In other words, the joint effect generated by the combination of resources can achieve better performance as a positive result (Zaefarian et al., 2013; Liu et al., 2016). Accordingly, it is worth understanding the respective effects of different resources, including product modularity, process modularity, innovativeness, supply chain integration, production automation and machine learning on e-mass customization, and knowledge on how to organize these resources to generate superior potential to deter the challenges in applying of e-mass customization.

Current studies mentioned e-mass customization, the focal construct of this study, as the variation of mass customization with the feature of ‘online-based’. Several studies in relevant areas proposed the nature of mass customization as quick and large-volume delivery of customized products (Pine et al., 1993; Duray et al., 2000; Tu et al., 2001; Tu et al., 2004; Wang et al., 2014), and some researchers while pointed out co-design activity as one dimension of mass customization (Lee and Chang, 2010; Aichner and Coletti, 2013). A few studies proposed the term e-mass customization (only five works of literature are found, please see table 2.3, mentioned in 2.4.2) and suggested the concept involves the dimensions of mass-custom products and co-design activity (Kaplan and Haenlein, 2016; Yan et al., 2019), these studies are conceptual and lack empirical evidence. In other words, it is still worth discussing a clear concept of e-mass customization.

A careful literature review indicates that product modularity and process modularity can improve production efficiency and reduce production costs when producing highly differentiated products (Warren et al., 2002; Tu et al., 2004; Wang et al., 2014). Some studies mentioned product modularity and process modularity could increase responding time, thus shortening the time of product delivery to the customers while reducing the price (Duray et al., 2000; Warren et al., 2002; Tu et al., 2004; Jacob, 2011; Wang et al., 2014; Seyoum, 2020). Duray et al. (2000) and Yan et al. (2019) mentioned that companies that apply mass customization supported by modularity would gain outstanding performance (Duray et al., 2000; Yan et al., 2019). Despite that, numerous studies indicate the connection between modularity, i.e., product modularity and process modularity, and mass customization, while the potential of product modularity and process modularity in combination with other means and tools for implementing e-mass customization remains to be investigated.

Previous studies have mentioned that keeping innovativeness can improve responding efficiency and enhance a company's risk control capabilities in a volatile environment (Wong and Merrilees, 2008; Odoom and Mensah, 2018). Some academics in their studies pointed out that keeping innovation in products and services can retain customers' attention, thus could lead to customers' long-term brand attachment (McDermott and O'Connor, 2002; Odoom and Mensah, 2018). Although a careful literature review indicates the importance of innovativeness to positive outcomes, empirical evidence is still needed, and the linkage between innovativeness and e-mass customization, as well as the joint efforts of innovativeness with other technological-, technical- and managerial tools and means towards e-mass customization remains to be investigated.

Previous studies have mentioned supply chain integration as an enabler of mass customization. Academics emphasized that a stable supply chain could enhance the companies' capability in response to customers' changing needs whiles shortening production time, hence increasing the companies' mass customization capability (Simatupang, 2002, Seyoum, 2020). Moreover, current researches mention in-depth communication with channel partners could enable companies to obtain more helpful customer information from channel partners, helping them better understand the customer and the market (Simatupang et al., 2002; Fabbe-Costes and Jahre, 2008; Flynn et al., 2010;

Liu et al., 2016). A careful literature review indicates a linkage between supply chain integration and e-mass customization, while in-depth investigation with empirical evidence is still needed; also, the impacts of supply chain integration when orchestrated with other methods of e-mass customization are worth discussing.

Some existing researches highlight that cutting-edge technology is important in implementing mass customization. However, research on this stream mainly appeared 10-20 years ago, before the concepts of automation technology and artificial intelligence technology were put forward. Although those studies mentioned using automation technology to automize production system increase production efficiency and reduce production cost and lead time (Shin et al., 2017; Lu et al., 2020; Li et al., 2020), no literature explores the connection between production automation and e-mass customization from an interdisciplinary perspective. In addition, machine learning, another cutting-edge technology, can support decision-making, plant management, operations health control, and data management (Bajic et al., 2018; Sharp et al., 2018). Applying machine learning to different systems can provide better solutions to problems through data analysis, knowledge generation, and problem-solving capabilities (Bajic et al., 2018; Kim et al., 2018; Lee et al., 2018). However, the roles and efforts of machine learning in e-mass customization remain for further investigation and empirical evidence.

Some current studies indicate the outcomes of mass customization (Duray et al., 2000), pointing out that mass customization increases customers' willingness to purchase and customers' willingness to make a recommendation to friends (Lee and Chang, 2011). However, no in-depth research investigates the outcomes of e-mass customization as a branding strategy towards companies in the 4.0 branding stage. In sum, the concept of e-mass customization, its role in branding for companies, and how companies can overcome the challenges of implementing e-mass customization is worth exploring through an interdisciplinary, resource orchestration perspective. Table 2.2 presents the key research that discusses the relevance of technological-, technical- and managerial resources to e-mass customization. These studies help us to understand the state-of-art and provide the basis for our analytical framework. At the same time, the table below reveals no study synthesizing the 6 proposed resources (i.e., product modularity, process modularity, innovativeness, supply chain integration, production automation and machine learning) to explore their role in e-mass customization and investigate how companies can configure these resources to implement e-mass customization successfully. This study objects to fill these gaps.

Table 2.3 Representative studies on proposed resources

	Author(s), Year	Definition	Research context	Study objectives	Research gap / theoretical contributions	Major findings
Modularity	Duray et al. (2000)	"A relative property with products characterized as more or less modular in design." (p. 609)	Mass customization	To assess whether mass customization is a robust concept applicable across a range of industries.	- Developed a conceptual model of mass customization to identify and classify mass customizers. - The research explored different approaches to mass customization and compared the impact of each approach on brand performance.	A firm's performance is better when they use standard modules and employ modularity in the production cycle assembly stage.
	Worren et al. (2002)	Product modularity is about using modular product architectures which are "created by decomposing a product design into relatively independent components and by specifying standard interfaces that define the inputs and outputs that flow between interacting components" (p.1123) Process modularity is about using of modular process architectures which are "decompositions of the company's key activities into specific routines and interfaces that allow frequent reconfiguration of processes, in the same way as for modular components in physical products" (p 1123)	Management in home appliances industry	To assess the impact of using of modular product architectures and modular process architectures on the firms in the home appliances industry.	- Added to the existing knowledge base by focusing on the home appliances industry. - Investigated mediates the links between product modularity and strategic flexibility, including managerial perceptions of the market context, the firm's strategic intent, and organizational climate and structure. - Discussed antecedents, contributing factors and strategic outcomes of modularity and explored the relationships between single variables and the fit of a complex overall model with reinforcing and counteracting causal links.	- A positive relationship exists between modular product architectures and performance, with product model variety as a mediating variable. -There is a linkage between perceptions of market context and the use of modular product architectures and between complementary organizational capabilities and brand performance.
	Tu et al. (2004)	Modularity refers to "the degree to which a system's components can be separated and recombined" (p. 150). Modularity-based manufacturing refers to "the use of modular principles to create components and processes that can be configured into a wide range of end products to meet specific customer needs." (p. 147)	Mass customization	To investigate the relationship between modularity-based manufacturing practices and mass customization to identify a good strategy for improving a firm's mass customization ability.	- Defined modularity-based manufacturing practices and developed an instrument to measure them. - Proposed a theoretical model of the relationships among customer closeness, modularity-based manufacturing practices, and mass customization.	- Modularity-based manufacturing practices and their subdimensions (including product modularity, process modularity, and dynamic teams) positively impact mass customization. - Customer closeness has a positive impact on mass customization. - Customer closeness positively impacts modularity-based manufacturing practices, positively impacting mass customization.
	Jacob et al. (2011)	Modularity represents a hierarchically nested system where product modularity is defined as "the use of standardized and interchangeable architectural elements that enable the configuration of a wide variety of end products" (p. 125). Process modularity is defined as "the	Manufacturing	"To build on general modular systems theory by examining empirically the effects of both product and process modularity on intermediate and final performance outcomes." (p. 123)	Empirical evidence on the impact of product modularity on a firm's manufacturing and performance; provides a theoretical basis for modularity-based manufacturing strategies.	Product modularity is key in modular systems, facilitating process modularity, enhancing manufacturing agility, improving growth performance, and increasing market share.

		incorporation of adaptable and reconfigurable tooling and routings into production operations to meet heterogeneous demand effectively.” (p. 126)				
	Wang et al. (2014)	Product modularity is “the extent to which a product is separated into standardized modules that can be easily recombined into different product features or shared across different product lines.” (p679) Process modularity is “the extent to which the production process is separated into standardized modules that can be easily re- sequenced into new processes that fulfill the requirements of producing new product features.” (p.679)	Mass customization	To examine how managerial mechanisms help transform the engineering efforts involved in product and process design into mass customization capability.	- Investigated the linkages among product modularity, process modularity, organizational learning practices and mass customization capability. - Proposed organizational learning practices are intervening factors (mediators) between modularity and mass customization capability.	Customization knowledge utilization and business process improvement are the two organizational learning practices mediating the relationship between modularity and mass customization capability.
Innovativeness	Wong and Merrilees (2008)	Innovation is “the means by which firms either creates new wealth-producing resources or endows existing resources with enhanced potential for creating wealth.” (p.373)	Product and Brand management	To investigate the nature and magnitude of potential benefits that accrue to firms that have a high level of brand orientation.	Investigated the linkage among the factors of brand barriers, brand orientation, brand distinctiveness, innovation, brand performance and financial performance.	- There is a strong positive relationship between brand orientation and brand performance. - Brand orientation exerts a less direct influence on performance via brand distinctiveness. - Innovation mediates the effect of brand distinctiveness
	Odoom and Mensah (2018)	Innovation describes “the degree to which firms’ products, services and processes depart from existing products or services and technologies.” (p.158)	Brand management	“To investigate the moderating effects of innovation capabilities and social media capabilities on the relationship between brand orientation and brand performance among small- and medium- sized enterprises (SMEs).” (p155)	-Extends knowledge on “how enterprises’ capacities to align complementary firm capabilities/efforts impact their brand performance.” (p.157) - Provided evidence from contexts relatively under-represented empirically in the branding and small business literature.	- The moderating effects of two capabilities, i.e., innovation capabilities and social media capabilities to enterprises are conditional and disaggregated based on enterprise sizes - It is suggested that “enterprise owners/managers to identify optimal combinations of enterprise capabilities, based on their sizes, for which their complementarities with brand orientation efforts are more potent” (p. 155)
Supply chain integration	Flynn et al. (2010)	“The degree to which a firm strategically collaborates with its supply chain partners and collaboratively manages intra- and inter organization processes.” (p. 59)	Operations management and Performance	To examine the relationships between SCI and both operational and business performance.	Expands the dimensions of SCI and adds to the literature on the interaction of these dimensions and their impact on firm operations and business performance.	The three dimensions of SCI (i.e., internal integration, customer integration, and supplier integration) are directly and indirectly related to operational performance, within which internal integration is also directly related to business performance.
	Liu et al. (2016)	“The degree to which a firm collaboratively deploys its resources and capacities with channel partners.” (p. 14)	Operations management and performance	“To investigate how organizations can deploy IT [information technology] competency in a manner that is conducive to materializing the benefits of SCI.” (p. 13)	Theorized how IT and SCI interact to affect firm performance.	Firms with high SCI achieve higher performance than firms at other levels. The interaction between SCI and IT impacted higher performance, while firms with different SCI levels need to align with varying IT capabilities to gain those impacts.

	Seyoum (2020)	The practices of a firm to collaborate strategically with upstream and downstream suppliers.	Manufacturing in China's auto industry	To investigate the relationship between modularity and performance to identify good strategies for increasing performance.	Theorized the relationship among product modularization, SCI, firm's relative location advantage and firm performance, the mediating effects of SCI, and firm relative positional advantage in the relationship between product modularity and firm performance.	The mediating effects of SCI and firm relative positional advantage in the relationship between product modularity and firm performance may have implications for using modularity as an important framework for studying the strategy of global auto firms in China in their attempts to create dynamic capabilities.
Production automation	Shin et al. (2017)	Computerized operations manufacturing support systems and automated manipulation facilities belonging to the production system	Manufacturing in pyroprocessing industry	To explore how to automate equipment operation as well as supervisory systems in pyroprocessing industry in order to solve the obstacles created by manual operations in production systems	- Proposed a manufacturing execution system for an automated pyroprocessing facility. - Presented a simulation-based prototype system to explain the operability of the proposed Pyroprocessing Execution System (PES). - Demonstrated the interoperability of the material-handling equipment with processing equipment	- The proposed PES system is dispatching-oriented execution control system and employed a material-handling requestedriven event model, to automate production monitoring and execution for the pyroprocessing industry. - Production automation system involves computerized operations of the manufacturing support systems and automated manipulation of facilities belonging to the production system
	Lu et al. (2020)	One constituent part of smart manufacturing is on-demand responsive autonomous manufacturing operations via advanced sensing, data processing, and decision-making technologies.	Mass customization, smart manufacturing /Industry 4.0	To "comprehensive review of the current landscape of manufacturing automation standards, with a focus on end-to-end integrated manufacturing processes and systems towards mass personalization and responsive factory automation." (p.312)	- Reviewed existing standards for enabling manufacturing process automation and manufacturing system automation - Proposed several future-proofing manufacturing automation scenarios by integrating various existing standards	- Mass personalization and CPS-based automation have not changed the application grounds for manufacturing automation standards. - Existing standards need to be improved to ensure their applicability to manufacturing automation in the context of Industry 4.0. - In practice, "need-driven open-source implementation projects should be encouraged." (p.323)
Machine learning	Bajic et al. (2018)	A subdimension of artificial intelligence, ML is a collection of algorithms which "learn directly from the examples, data, and experience and are able to figure out how to perform important tasks by generalizing from them." (p. 29)	Manufacturing in Industry 4.0	"The objective lays behind the utilization of big data in order to accomplish cost-efficient, fault-free, and optimal quality manufacturing process." (p. 30)	- A preliminary literature review of ML techniques as a part of intelligent systems, the most used algorithms, as well as their advantages and disadvantages within Industry 4.0. - Analyzed the differences between ML and statistics. - Detailed the application, challenges, and future trends of ML.	- ML extracts knowledge from big data to achieve defect-free and fault-free processes. - ML algorithms have uses in optimization, control, troubleshooting, security, and verification, which are all further beneficial for cost reduction without affecting production quality.
	Sharp et al. (2018)	ML is "a subset of artificial intelligence that focuses on autonomous computer knowledge gain." (p. 170)	Smart manufacturing, Industry 4.0	- A literature review investigating areas where ML can play a vital role; - To optimize firms' schemes and applications of ML in production cycles.	A literature survey on ML in multidisciplinary, cross-domain focus areas, highlighting the current gaps in ML applications in manufacturing.	The results indicate that ML is vital in knowledge, data and life cycle management, and decision support. However, the study also suggests that to achieve more flexible, lean, and energy-efficient manufacturing, firms should apply ML and integrate it with other resources such as human

						resources, automation and data, and the industrial Internet of things.
	Kim et al. (2018)	A subset of artificial intelligence, which "allows machines to learn, improve, and perform a specific task through data without being explicitly programmed." (p.555)	Smart manufacturing, Industry 4.0	To review a machining process using machine learning techniques and algorithms and provide a perspective on the machining industry.	- Classified machine learning algorithms applied to machining processes according to machining type and process characteristics - Summarized different cases of smart machining processes - Suggested the core technologies for smart machining	- Smart machining will greatly improve the efficiency of the machining industry - There are safety and security issues that can arise from implementing smart processes; therefore, the countermeasures must be concerned
Brand performance	Odoom and Mensah (2018)	It is "brand- related performance benefits such as gaining loyal customers, increased brand awareness, good reputation, positive images." (p.157)	Brand management	"To investigate the moderating effects of innovation capabilities and social media capabilities on the relationship between brand orientation and brand performance among small- and medium- sized enterprises (SMEs)." (p155)	-Extends knowledge on "how enterprises' capacities to align complementary firm capabilities/efforts impact their brand performance." (p.157) - Provided evidence from contexts relatively under-represented empirically in the branding and small business literature.	- The moderating effects of two capabilities, i.e., innovation capabilities and social media capabilities to enterprises are conditional and disaggregated based on enterprise sizes - It is suggested that "enterprise owners/managers identify optimal combinations of enterprise capabilities, based on their sizes, for which their complementarities with brand orientation efforts are more potent" (p. 155)
	Chang et al. (2018)	The value created to the brands by customers' perception of the value brought by the brands.	Marketing management	-To investigate "the factors that influence whether managers adopt a brand orientation." (p.17) - To explore "the processes that allow B2B branding to influence brand performance." (p.17)	- Examined the influences factors that influence whether a B2B company applies brand orientations - Examined the relationship between brand orientation and brand performance.	- Brand orientation plays an important role in translating managerial and organizational resources into superior brand performance. - "Both entrepreneurial orientation and marketing capability positively influence a firm's brand orientation, and the brand orientation can influence a firm's brand performance both directly and indirectly by encouraging customer value co-creation activities." (p.17)

This research proposes a framework including the antecedents and consequences of e-mass customization (figure 2.2). In brief, this research suggests antecedents of e-mass customization, product modularity and process modularity, production automation, supply chain integration, innovativeness, production automation, and one moderator—machine learning; the framework puts brand performance as the possible outcomes of e-mass customization.

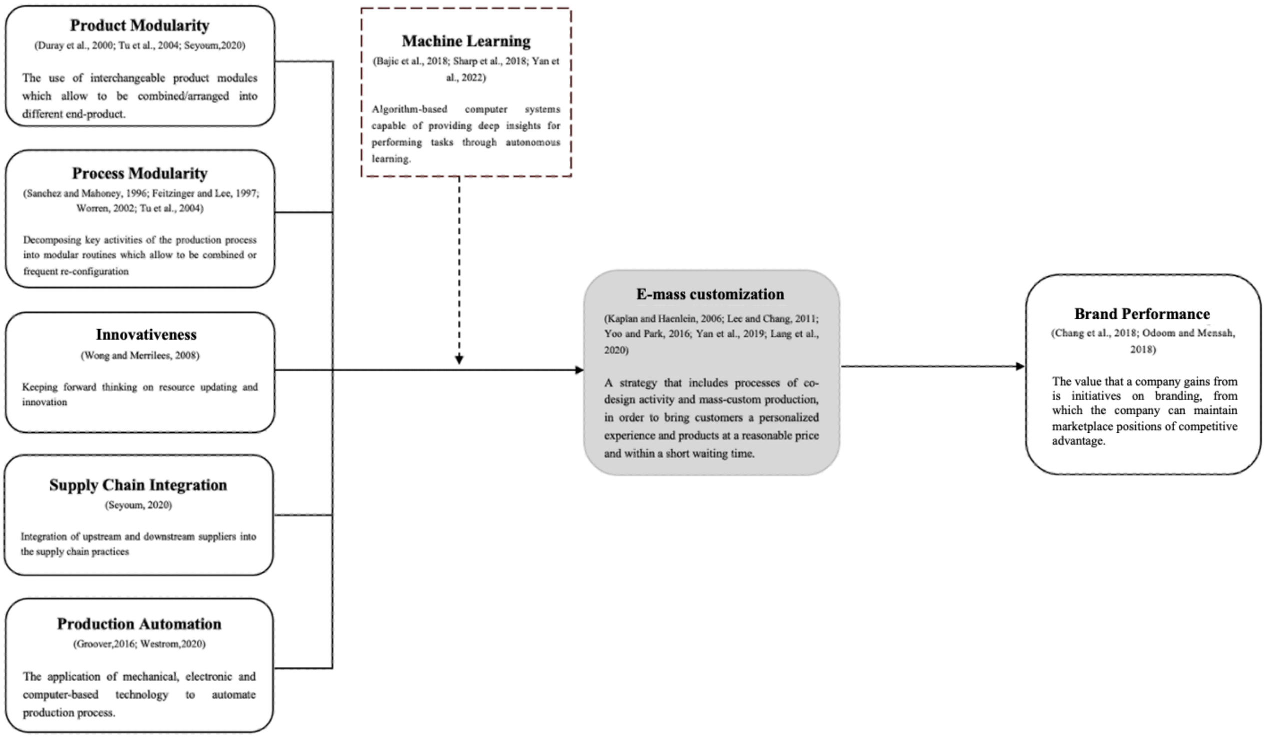

Figure 2.2 The framework of e-mass customization

2.11 Summary

This chapter reviewed academic and anecdotal literature on e-mass customization as related areas to establish relationships between antecedents and consequences of e-mass customization (Please see figure 2.2). The linkages of the mentioned components will be expressed by the hypotheses and discussed in the next chapter.

Chapter 3

Research Hypotheses

3.1 Introduction

The literature review points out the research opportunities. There is a shortage of research examining e-mass customization from a monolithic level, despite that research argued some factors could effort on e-mass customization, and indicated that e-mass customization is important concerning brand-customer relationship.

This research proposes an e-mass customization process framework. This Chapter presents eleven hypotheses which reflect the proposed framework. The proposed five factors, including product modularity, process modularity, supply chain integration, production automation, and innovativeness to e-mass customization, are delineated independently with indications or implications from existing studies or anecdotes. Machine learning is proposed as a moderator, and the apparent connection between each antecedent and e-mass customization is also delineated with suggestions from existing research. In addition, the Chapter also sketched the hypothesis on e-mass customization towards brand performance. This Chapter introduces each hypothesis in the research framework in detail.

Chapter 3 includes 4 sections. After the introduction, 3.2 presents proposed antecedents of e-mass customization and the moderators between antecedents and e-mass customization. 3.3 presents the proposed consequences of e-mass customization. Finally, section 3.4 offers a summary of the conclusion.

3.2 Antecedents to E-mass Customization

3.2.1 Modularity and E-mass Customization

Modularity is defined as decomposable systems possessing a high degree of independence (Sanchez and Mahoney,1996; Schilling, 2000; and Schilling and Steensma, 2001). Star (1965) mentioned using modularity can control interchangeability in a turbulent, uncertain environment. Tu et al. (2004) stated that a complex system could be managed efficiently by dividing the system into smaller modules, as modularity brings the advantage of standardization and flexibility. Also, they mentioned that using the modularity principle in production is important to a firm’s mass customization capability. Moreover, it is argued that different types of modularity, in particular, product modularity and process modularity, can help firms improve their mass customization capabilities from different aspects.

3.2.1.1 Product Modularity and E-mass Customization

Product modularity is defined in this research as the use of interchangeable product modules that can be combined/arranged into different end-products (Duray et al., 2000; Tu et al., 2004; Seyoum,2020). It is the practice of designing and using product modules that allow different end-product to be produced by substituting product modules without requiring changing or redesigning product components (Tu et al., 2004).

Salvador et al. (2002) studied the interaction among modularity, product variety, and production volume and found them positively related. Sanchez and Mahoney (1996) mentioned that interchangeable modular product architecture is a precursor to mass customization; more specifically, by recombining the interchangeable independent physical components divided according to the product architecture, it can be successfully configured into different end products quickly. Duray et al. (2000) proposed that designing and standardizing interchangeable product modules according to the product architecture can easily and frequently configure highly variety of end products, and these scholars also mentioned six different types of modularity.

Pine (1993) and Ulrich (1995) pointed out that product modularity can help achieve high flexibility. Baldwin and Clark (1997) proposed that designers and producers can obtain enormous flexibility by breaking up products when designed into smaller sets of interchangeable modules that can be reconfigured. Duray et al. (2000) mentioned that using product modularity can significantly reduce the cost of designing and producing different end-product while maintaining product quality. Suzik (1999) and Tu et al. (2004) also proposed preserving' quality': they suggested that using product modularity to configure different end-products can reduce the cost while maintaining product quality. Tu et al. (2004) emphasized that product modules can be rearranged/resembled into different end-product, which on the one hand, helps brands to design diversified products under an economic scale, and on the other hand, enable customers to customize. Upgrade repair quickly, thus having superb usability and serviceability. Sanchez (2000) proposed that using interchangeable modules to reassemble/rearrange products can improve the speed of products to market and a company's responsiveness to changing market demands. Accordingly, it is hypothesized that:

H1: Applying product modularity to configure products has a positive effect on e-mass customization.

3.3.1.2 Process Modularity and E-mass Customization

Process modularity is defined in this research as decomposing key activities of the production process into modular routines which allow combined or frequent re-configuration (Sanchez and Mahoney, 1996; Feitzinger and Lee, 1997; Warren, 2002; Tu et al., 2004). It is mentioned that using process modularity results in reducing production time and cost simultaneously (Ulrich, 1995; Sanchez, 2000; Person and Ahlström, 2006; Lau et al., 2011; Wang, 2014) while increasing production flexibility (Adler and Borys; 1996; MacDuffie, 1997; Feitzinger and Lee, 1997; Hoek and Weken, 1998; Warren et al.,2002; Gualandris and Kalchschmidt, 2013; Wang, 2014) during the wide production variety of products.

Tu et al. (2004. P151) mentioned process modularity follows three principles, i.e., process standardization, process resequencing, and process postponement, and process modularity increases brands' mass customization capability, i.e., postponement extends the final modular assembly into late sites, can achieve maximum flexibility; and "process modularity has the potential for reengineering entire supply chains to enhance customization." Pekkarinen and Ulkuniemi (2008) proposed modularity in processes leads to faster sales, shorter time-to-market, better efficiency and higher quality. Thus, it is hypothesized that:

H2: Applying process modularity to arrange key activities in the production process has a positive effect on e-mass customization.

3.2.2 Innovativeness and E-mass Customization

Innovativeness is defined as keeping forward thinking on resource updating and innovation (Wong and Merrilees, 2008). Innovativeness is emphasizing the thinking and behaviour of individuals, teams, and top management level focus on the creation as well as the adoption of newness in the aspects of technical innovation (e.g., products, services and technologies etc.) and administrative innovation (e.g., involves structures, administrative processes, policies etc.) (Daft, 1987; Damanpour, 1991; Brown and Dacin, 1997; Whetten, 1997; Brown, 1998; Ravichandran, 1999).

A few existing studies mentioned keeping innovativeness as one of the most critical factors determining business (Day, 1996; Wind and Mahajan, 1997; Kanter, 1999; Golder, 2000; Wong and Merrilees, 2008). For example, researchers have proposed that company that maintains innovativeness in products and (or) services, i.e., continuously improves and introduces products and (or) services that meet expectations according to changing market and customer needs, can keep customers attraction (Lei et al., 2013; Odoom and Mensah, 2018). In addition, some academics have pointed out that companies which maintain innovativeness, especially keeping resources updated and innovative, is conducive to risk control and maintaining competitiveness (Mone et al., 1998; Wilke and Zaichkowsky, 1999; Barwise and Meehan, 2004; Wong and Merrilees, 2008; Odoom and Mensah, 2018). It is proposed that updating or innovating products and services in response to changes positively affect how customers perceive a brand (Barwise and Meehan, 2004), consequently drawing the customers' attention (Wong and Merrilees, 2008). Brown and Dacin (1997) and Brown (1998) stated that keeping innovativeness in products and services could positively affect customers' evaluation towards the brands. Wong and Merrilees (2008) pointed out that a company can surpass its competitors only by staying forward-looking and continuously innovating its products and (or) services. Similarly, Wong et al. (2018, p374) emphasized that innovativeness is about "the practical application of ideas to make use of the firm's capabilities effectively", and they viewed staying innovativeness as one of the foundations of keeping a company competitive. Lei et al. (2013) proposed that brands which keep forward thinking in product, service and management innovations enable them easily control risks and improve responsiveness to market changes. Wilke and Zaichkowsky (1999) proposed that keeping innovativeness by creating value 'over their competitors helps companies gain competitive advantages. Similarly, Mone et al. (1998) suggested that firms keeping themselves innovativeness can enhance strategic competitiveness and thus would help performance.

In brief existing literature mentions that keeping forward thinking in resource updating and innovation, such as products, services, technology, management and so on, could help firms gain enormous benefits, including that help firms gain positive customer attitudes, and help firms enhanced risk control capabilities and responding quickly to market changes. Additionally, it is hypothesized that:

H3: Keeping innovativeness has a positive effect on e-mass customization.

3.2.3 Supply Chain Integration and E-Mass Customization

Supply chain integration is mentioned in this research as integrating upstream and downstream suppliers into the supply chain practices (Seyoum, 2020). Supply chain integration is related to the following four aspects of activities and exercises: information integration, synchronized planning, operational coordination, and strategic partnership (Liu e al., 2010).

Seyoum (2020) proposed that coordinating with channel partners can help firms save cost, achieve economies of scale, shorten responsiveness to customer needs and reduce lead time, leading to better firm performance. Similarly, Flynn et al. (2010) proposed that having an integrated supply chain can help firms cut costs, and improve flexibility and responsibility, positively influencing firms' performance. Tummala et al. (2008) and Handfield et al. (2009) argued that by cohering with channel partners, companies can quickly and high-quality delivery of products and (or) services. Simatupang et al. (2002) stated that manufacturers who share joint responsibility result in quick response, lower costs and lead time. These indicated that firms well-integrated with chain members can reduce production costs, lead-time, increase the speed of product introduction in response to market changes, and improve product quality.

Dyer and Singh (1998) and Liu et al. (2016) proposed in their research that by coordinating tasks and assignments with channel partners, firms can improve the utilization value of their own resources. Seyoum (2020) suggested that cooperation with upstream and downstream suppliers positively enhances the firm's performance. Simatupang et al. (2002) pointed out that for those industries facing a changing context, creating an environment in which upstream and downstream companies in the industry share information and resources is very important for companies and industry as a whole to gain advantages; in particular, they pointed out that obtaining information from channel partners helps companies better understand customer needs, so they can respond more quickly and provide more accurate feedback; in addition, the cooperation between channel partners in the supply chain help to shorten the time from research and development to the introduction of new products (Simatupang et al., 2002)

Similarly, Yan et al. (2022) proposed that through information sharing with channel partners, companies can obtain more information about customer needs to help predict consumer preferences more accurately and provide products and services according to different preferences. In addition, they mentioned that sharing operational and production management information with channel partners can help enterprises avoid errors and (or) find solutions to issues occurring in production and operation, thus reducing operating costs and improving operational efficiency. Accordingly, this research hypothesized that:

H4: Integration of the supply chain with upstream and downstream suppliers has a positive effect on e-mass customization.

3.2.4 Production Automation and E-mass Customization

This research defines production automation as applying mechanical, electronic and computer-based technologies to automate production processes (Groover, 2016; Westrom, 2020). Production automation is about the computerized controlling and managing of manufacturing support systems and facilitates belonging to the production systems (Shin et al., 2017).

Leitão et al. (2005) stated that adopting automation technologies to automate production processes helps increase system flexibility, minimize production time, and improve machine utilization. In their study, Lu et al. (2020) mentioned that using automation technologies to dominate production systems for the production process to be self-propelled helps companies to produce highly differentiated customized products simultaneously efficiently. Similarly, Kolberg and Zühlke (2015) pointed out that using automation technologies to automate production processes can be beneficial to demand-oriented production, i.e., using automation technologies to make the production systems self-propelled help to produce smaller batches in a short lead-time thus would increase brand capability in faster reaction on changing market demands. In other words, an automated production process is proposed to increase system flexibility and minimize production time to market.

In their research, Kolberg and Zühlke (2015) proposed that using automation technologies to automate production processes enables firms to produce different products with minimum costs and a short lead time. Li et al. (2020) summarized that an automated production process helps increase production efficiency, control production costs, and enable brands to realize diversity and subdivisions in the product market. In other words, existing studies pointed out that an automated production process enhances a brand's ability to low cost and high-quality produce different end-product.

In addition, researchers mentioned using automation technologies to dominate production processes helps to avoid errors occurring in the production process. Õno (1988) stated that using automated technologies to inspect the production process can reduce or avoid mistakes in the production process, thereby cutting costs and ensuring product quality. Similarly, Kolberg and Zühlke (2015) mentioned that using the automation system to inspect the production process helps reduce errors and waste (Kolberg and Zühlke, 2015). In brief, the current studies argue that an automated production process helps to increase flexibility, lead time, and product quality. At the same time, reducing errors and costs coincided while producing diversified products. Thus, it is hypothesized that:

H5 Applying automation systems to automate the production process has a positive effect on e-mass customization.

3.2.5 The Role of Machine Learning as a Moderator

Some academics, like Aichner and Coletti (2013, p20), mentioned that cutting-edge technology "allows companies to offer customized products and services without relinquishing economies of scale." Da Silveira et al. (2001) mentioned that advanced technologies "alter the economies of manufacturing and remove barriers to product variety and flexibility" and, on the other hand, allow "direct links between work groups", which can further improve the response time to customer requirements.

Machine learning is defined in this research as an algorithm-based computer system which focuses on autonomous knowledge learning and can figure out how to perform tasks and (or) update models by generating data and experience. Machine learning as a state-of-the-art technology and its emergence are considered the enabler of Industry 4.0 and smart manufacturing. Sharp et al. (2018) pointed out the data management function of machine learning. Vladimir (2017) proposed that the application of machine learning algorithms in customer analysis can help deal with massive amounts of customer information to help brands more accurately predict the preferences and demands of individual customers. Sharp et al. (2018) also mentioned the function of plant and operational health management of machine learning. More specifically, Sharp et al. (2018) stated that machine learning algorithms can help diagnose system faults and propose solutions, which reduce the error rate, thus can help reduce production costs and improve production efficiency.

Based on the feature that machine learning can obtain optimized plans from learning from the environment (Sharp et al., 2018), Yan et al. (2022) proposed that the application of a machine learning algorithm can suggest optimized brand strategy, as well as implementation plans and specific implementation details through heterogeneous data analysis, to improve the response-ability of the brands in the face of high change context. Similarly, Giglio et al. (2020) can help improve the speed and efficiency of brand response by obtaining more accurate information about market demand and change through in-depth analysis of the heterogeneous data collected, then feeding this information back to the enterprise in the form of knowledge, thus enabling the enterprise to respond more efficiently and accurately to changing needs.

In addition, Yan et al. (2022) proposed that the interaction of machine learning with modularity and supply chain integration can ultimately improve the companies' ability to respond to a great variety of requests, for instance, by applying a system based on machine learning during the integration of supply chains, helps to allocating tasks to best-suited suppliers and exchanging information among the channel partners in an honest, fast and accurate way.

In Brief, based on the current research, the machine learning system based on a machine learning algorithm has the characteristics of heterogeneous data analysis and knowledge transformation so that it can provide decision support, workshop and operation health management, and data management. In addition, integrating and infiltrating machine learning systems into other managerial-, operational- or technical- tools or means can help analyze issues that occurred in the systems and provide optimized response solutions to enhance the capabilities enterprises require to achieve their goals. Accordingly, this study hypothesizes that:

H6: Machine learning strengthens the relationship between product modularity and e-mass customization.

H7: Machine learning strengthens the relationship between process modularity and e-mass customization.

H8: Machine learning strengthens the relationship between innovation and e-mass customization.

H9: Machine learning strengthens the relationship between supply chain integration and e-mass customization.

H10: Machine learning strengthens the relationship between production automation and e-mass customization.

3.3 Consequences of E-mass Customization

3.3.1 E-mass Customization and Brand Performance

Brand performance in this research is considered as long-term and intangible performance, referring to the value that a company gains from its initiatives on branding, from which the company can maintain marketplace positions of competitive advantage (Chang et al., 2018; Odoom and Mensah, 2018). The brands which perceive performance as a positive outcome will have the characteristics including but not limited to having strong brand-customer relationships and customer-brand loyalty as well as an advantageous position in the competition (Chang et al., 2018).

The existing literature indicates mass customization can support companies to stay one step ahead of the competition. Pine (1993) stated that companies implementing mass customization "will be rewarded in spades-in customer loyalty, market leadership, productivity and profitability". In their research, Tu et al. (2004) argued that companies that successfully implement mass customization gain strategic competitiveness and higher profitability. Totz and Riemer (2000) claimed that mass customization by committing customers to personalized products and services enhances customers' brand loyalty and brand competitiveness and customer loyalty. Spaulding and Perry (2013) mentioned the outcomes of companies implementing mass customization include 1) the companies boost sales or obtain a share on a retailer's site, 2) the companies differentiate their products from those of their competitors, and 3) the companies raise being recognised by customers as a specific brand and thus gain customers' loyalty.

In addition, Lee and Chang (2011) mentioned that co-design activity, a variation of mass customization, influence customers' attitudes toward e-mass customization, thus influencing consumers' willingness to purchase mass-customized products and customers' willingness to recommend purchasing customized products to others. Similarly, Aichner and Coletti (2013, p30) mentioned: "By offering customizable products in a mass production environment, companies expect to realize significant competitive advantage through the generation of enduring customer value." Therefore, it is hypothesized that:

H11: Implementing e-mass customization as a branding strategy has a positive impact on brand performance.

A summary of the hypothesised relationships is provided in table 3.1.

Table 3.1 Summary of the hypotheses

H1	Applying product modularity to configurate products has a positive effect on e-mass customization
H2	Applying process modularity to arrange key activities in the production process has a positive effect on e-mass customization
H3	Keeping innovativeness has a positive effect on e-mass customization
H4	Integration of the supply chain with upstream and downstream suppliers has a positive effect e-mass customization
H5	Applying automation systems to automate the production process has a positive effect on e-mass customization.
H6	Machine learning strengthens the relationship between product modularity and e-mass customization
H7	Machine learning strengthens the relationship between process modularity and e-mass customization
H8	Machine learning strengthens the relationship between innovation and e-mass customization
H9	Machine learning strengthens the relationship between supply chain integration and e-mass customization
H10	Machine learning strengthens the relationship between production automation and e-mass customization
H11	Implementing e-mass customization as a branding strategy has a positive impact on brand performance

3.4 Summary

The framework reveals that product modularity, process modularity, innovativeness, supply chain integration and production automation may positively relate to e-mass customization; machine learning may strengthen the relationship between each proposed tool or mean and e-mass customization. In turn, gaining higher brand performance is offered as a positive outcome of e-mass customization. The methodology for testing the hypotheses is presented in the next chapter (Chapter 4).

Chapter 4

Research Methodology and Research Methods

4.1 Introduction

To develop research, researchers need to address why a research study has been undertaken and how to solve the research problem in what way (Kothari, 2004; Holden and Lynch, 2004). This requires researchers to justify the choice of methodology and methods (Holden, 2004). In other words, the details of chosen methods, including “the technique or procedures used to gather and analyse data related to research question or hypothesis” (Crotty, 1998, p3) and “the design lying behind the choice and use of particular methods and linking the choice and use of methods to desired outcomes” (Crotty, 1998, p3), should be justified clearly. This Chapter starts by presenting the philosophical foundation of the research, followed by an introduction of the research approach used in this research. Then, the Chapter presents the motivation for choosing methodological triangulation. Afterwards, the Chapter detailed the research design, followed by the key issues related to qualitative and quantitative research. Finally, a summary is presented.

4.2 Research Philosophy

Ontology and epistemology as philosophical foundations determining the methodology chosen must be defined before embarking on any research (Burrell and Morgan, 1979; Deshpande, 1983; Creswell, 2017). Epistemology underlying ontology addresses the nature of knowledge or where knowledge is to be sought, and how we know and what we know (Collis and Hussy, 2003); it is concerned with the nature, validity and limits of inquiry (Rosenau 1992; Holden and Lynch, 2004). Ontology and epistemology affect the view of human nature, which, in turn, influences the research methodology and methods in understanding the focus topic and achieving valid results (Holden and Lynch, 2004; Tuli, 2010).

4.2.1 Epistemological Basis of The Study

Epistemology addresses "the study of knowledge and what we accept as being valid knowledge (Collis and Hussey, 2003); it focuses on the relations between the researcher and observed social phenomena, which, in other words, in the way the research is conducted (Corbetta, 2003). Two main epistemological positions are positivism and interpretivism (Deshpande, 1983; Cassell and Symon, 1994; Collis and Hussey, 2003). The debates between these two positions centre where the social world can be studied according to the same principle as the natural sciences (Tuli, 2010; Bryman, 2016).

Positivism underlies the ontological assumption of objectivism (Morgan and Smircich, 1980; Holden and Lynch, 2004; Giddens, 2013); it positions those facts that exist apart from personal ideas or thoughts, and the causal law determines it (Crotty, 1998; Neuman, 2003; Marczyk et al., 2005, Tuli, 2010). Positivism concerns that social reality is stable and knowledge is additive (Crotty, 1998; Neuman, 2003; Marczyk et al., 2005) so that reliable knowledge is based on direct observation or manipulation of natural phenomena through empirical or experimental means (Lincoln and Guba, 1985; Neuman, 2003; Tuli, 2010), which, in turn, reflects that social world can be discovered through observation and measurement (Morgan and Smircich, 1980; Holden and Lynch, 2004; Gidden, 2013). Positivism generally employs a hypothetical-deductive process seeking objectivity (Denzin, 1989; Holden and Lynch. 2004).

Interpretivism aims to understand and explain a phenomenon in its contextual setting, projected by an individual's meaning of a situation (Hughes and Sharrock, 1997; Easterby-smith et al., 2002; Holden and Lynch, 2004). In detail, interpretivism views the world as constructed, interpreted, and experienced by individual interactions (Guba and Lincoln, 1985; Merriam, 1988; Bogdan and Biklen, 1992; Tuli, 2010; Maxwell, 2012), which sees that human-kind has freewill and is autonomous so that they can interact and shape the world by their own immediate experience" (Morgan and Smiricich, 1980; Holden and Lynch, 2004). Thus, the research underlying epistemology of interpretivism results will be guided by "the interpretive part of scientific observation and determined what researchers "saw" (Hunt, 1993). Interpretivists contend "to minimize the distance between the researcher and that which is being researched" (Collis and Hussey, 2013). In other words, the researchers who follow the epistemology of interpretivism observe the social phenomena that examine their characteristics and causal relationships by interpreting the observations while the subject develops and unfolds (Burrell and Morgan, 1979; Corbetta, 2003; Creswell, 2017). The paradigm of interpretivism is employed by inductive research, which develops ideas through induction from the simultaneous mutual shaping of factors (Holden and Lynch, 2004) to generate or build theory based on observations (Bryman and Bell, 2007; Creswell, 2017).

Although the material indicates the merits and criticisms of each paradigm, choosing appropriate epistemology is inherently dependent on the nature of the study. Based on this study's research questions and objectives, this study adopts the epistemological principles of positivism. Table 4.1 summarizes the application of epistemological beliefs in this study.

Table 4.1 Summary of epistemological belief of this study

Epistemological principles	Application to this research
The world is external and consists of phenomena that can be observed.	The role of e-mass customization for companies in branding 4.0 is perceived as an observable external reality.
Searching for regularities and causality between elements of the phenomenon being studied.	The research attempts to understand the antecedents and consequences of e-mass customization.
Understanding what is happening should include a search for causality and fundamental laws.	This research is grounded on existing sources about mass customization and e-mass customization as a starting point to investigate the antecedents and consequences of e-mass customization.

Developed by the author from the literature

Epistemology is influenced by ontology; in other words, how the researcher regards the form of nature affects what researchers think can be known about social reality (Fleetwood, 2005). Therefore, it is necessary to examine the ontological underpinning.

4.2.2 Ontological Basis of The Study

Ontology, from a more grounded and abstract level concerned with the nature of reality and what social science is supposed to study. (Bryman and Bell, 2007; Tuli, 2010; Collis and Hussey, 2013).

There are two major positions of ontological assumptions, namely realism and constructivism (Bryman and Bell, 2007; Tuli, 2010). The contentions between these two core positions focus on "whether social entities can and should be considered objective entities that have a reality external to social actors, or whether they can and should be considered social constructions built up from the perceptions and actions of social actors" (Bryman and Bell, 2007), which, in other words, addresses that whether the researcher considers the world as objective and external, or it can only be examined based on the perceptions of individuals (Collis and Hussy, 2013).

Realism holds that reality is before the existence of human consciousness, made up of concrete structure, and exists independently from the cognitive efforts of individuals (Collis and Hussey, 2013; Creswell, 2003; Bryman and Bell, 2007). Moreover, realism can be divided into two subgroups: '

naïve realism' and 'critical realism'. The difference between these two lies in the distinction and demonstration of experimental activities: naïve realists advocate that reality can be known through appropriate methods. In contrast 'critical realists accept no theory-neutral observation or interpretation (Danemark, 2002). Critical realists advocate that reality can exist independently of experience or knowledge (Bhaskar, 1978), while reality can be understood (Danemark, 2002). The theory established according to the understanding of reality is not an eternal truth, while it can be revised and improved according to the changes in scientific knowledge (Bhaskar, 1978).

In contrast, constructivism asserts that there are multiple realities by processes of continuous creation of individuals rather than objective and external factors (Hirschman, 1986; Tashakkori and Teddlie, 1998; Easterby-Smith et al., 2002; Corbetta, 2003). It maintains that reality reflects the social process projected by human imagination (Gill and Johnson, 2002, Neuman, 2003, Holden and Lynch, 2004; Bryman and Bell, 2007; Creswell, 2017). Interpretivism's epistemological position is linked with the ontological foundation of constructivism.

In this study, e-mass customization is an external reality in a social world. Through a branding perspective, the author attempts to understand the roles of e-mass customization and the antecedents and consequences of e-mass customization. Hence, the study underlying ontological assumption of its critical realism. The ontological beliefs of this study are summarised in Table 4.2.

Table 4.2 Summary of ontological belief of this study

Ontological principle	**Application to this study**
An entity can exist independently on experience or knowledge, and reality consists of social phenomena which can be understood (Bhaskar, 1978; Danemark, 2002)	Studying e-mass customization involves studying the causal relationships of e-mass customization as well as understanding the phenomena of e-mass customization as a whole.
Theory can be revised and improved according to the changes in scientific knowledge (Bhaskar, 1978).	E-mass customization represents an 'underlying reality'; investigating e-mass customization from a branding perspective, as well as antecedents and consequences of e-mass customization, help to understand e-mass customization for brands in businesses.
The theory affects behaviour and makes a difference (Fleetwood, 2005)	Examining e-mass customization from a branding perspective would provide some implications for managers alike to make

	branding strategy, tactics and operational management for their brands to succeed in current business surroundings.

Developed by the author from the literature review

4.3 Research Approach

Research approaches provide an informed choice and a more practical guide for the overall configuration of the study (Saunders et al., 2005). The two main research approaches mentioned are the deductive and inductive approaches. In brief, the deductive approach involves theory tests, while the inductive approach involves theory generation and development.

The deductive approach involves reductionism which is to reduce the problem to its tiniest elements and to use quantitative operationalization of concepts to test the smallest elements (Holden and Lynch, 2004), i.e., Deductive research entails formulating hypotheses developed from literature and theories, and to tests these hypotheses based on rich data (Deshpande, 1983; Holden and Lynch, 2004; Bryman and Bell, 2007). The deductive approach allows theories revision based on results generated from comprehensive data (Deshpande, 1983; Holden and Lynch, 2004; Bryman and Bell, 2007). In contrast, the inductive approach links to developing ideas through induction via qualitative data (Holden and Lynch, 2004) to generate or build theory based on observation (Bryman and Bell, 2007; Creswell, 2017).

Combining the deductive and inductive approaches is achievable and frequently used for theory development (Saunders et al., 2005). The study aims to establish a theory underlying an embryonic theoretical basis of e-mass customization—the research involves the process of recurring data gathering, analysing and theory development. Therefore, this study adopts a method of combination of these two approaches.

This study reviews the existing mass customization and e-mass customization sources while investigating the head of e-mass customization from a branding perspective. No previous research viewed e-mass customization from a monolithic perspective; hence, filling the gaps and riching the e-mass customization theory is the main key focus of this research. On this basis, this study collects qualitative data, particularly semi-structured interviews, to understand the role of mass customization in business from a branding perspective. At this stage, the research involves inductive characteristics. In turn, the theory development subjects to quantitative test, particularly questionnaire, which involves deductive factors. The researcher’s approach beliefs are summarised in table 4.3.

Table 4.3 Summary of approach belief of this research

Research approach principle	Application to this study
The searching and explaining relationships	This study searches and explains the cause-effects of e-mass customization.
The understanding of concepts and operationalization of concepts to measure facts quantitatively	In this study, the concept of each factor is based on literature as well as qualitative research. Also, literature and qualitative study provide measurements of each factor, which can be used to test the relationship between elements.
A rigorous, structured approach	This research involves theory development and theory test.

Developed by the author from the literature review

In brief, this research includes two stages. Involving of inductive approach, inducting ideas from qualitative data (from semi-structured interviews) supports the development theory of e-mass customization for brands in the business; in addition, a deductive approach supports testing the hypotheses proposed based on quantitative data (from questionnaire).

4.4 Research Design

Based on the ontological basis of critical realism, this study adopts a mixed research design, i.e., sequential research design, in which qualitative research is followed by quantitative research.

4.4.1 Qualitative and quantitative research

Quantitative research and qualitative research are the two main types of research mentioned. In brief, the quantitative research approach operationalizes to positivism, followed by the ontological assumption of realism, while the qualitative research approach generally operationalizes to interpretivism underlying the ontological assumption of constructivism (Remenyi et al., 1998; Easterby-smith et al., 2002; Holden and Lynch, 2004; Creswell, 2003; Collis and Hussey, 2013).

Quantitative research is oriented towards explaining and understanding regulations in human life (Collis and Hussey, 2013), which is linked with a deductive approach (Tuli, 2010). Quantitative research by separating the social world into empirical components called variables, with can be represented by frequencies or rates and uses statistical techniques to explore the association among variables (Payne and Payne, 2004). In other words, quantitative research testing proposed hypotheses using rich data to generalize findings to a broader population (Saunders et al., 2009). Quantitative research prescribes a fixed design and employs questionnaires, tests, inventories, checklists etc., in the data collection and statistical data analysis technique (Tuli, 2010).

In contrast, qualitative research emphasizes "everything is contextual; patterns identified-theories then developed for understanding" (Holden and Lynch, 2004). Qualitative research aims to: 1) lead to more profound insight into the context under study (Merriam, 1988; Tuli, 2010); 2); understand the meanings that people give o their lives (Silverman, 1993); 3) add richness and depth to the data (Merriam, 1998, Tuli, 2010). Qualitative research is linked with an inductive approach oriented towards discovery and has high validity (Tuli, 2010). The qualitative research approach prescribes flexible design, including in-depth interviews, group discussion and observation and non-numerical data analysis techniques, in which the researcher has unlimited freedom of movement between the research steps (Tuli, 2010).

Both quantitative research and qualitative research have limitations. Quantitative analysis is argued to be superficial: fixed measurement processes based on artificial precision which separate the social world from the individual and neglect the complexity of the social world (Payne and Payne, 2004; Bryman and Bell, 2007), while qualitative research is criticized for being difficult to scrutinize and restricted regarding the generalization of results (Payne and Payne, 2004; Bryman and Bell, 2007). Also, it isn't very objective to the researcher's personal views (Payne and Payne, 2004; Bryman and Bell, 2007).

However, it is also argued that no one research methodology is better or worse than another (Tuli, 2010), and "applying methods that suit problem rather than methods suit ontology or epistemology concerns" (Hughes,1997; Tuli, 2010); researchers "are free to choose the methods, techniques and procedures of research that best meet their needs and purposes" (Creswell, 2017), even applying method from an alternative philosophical stance helps to investigate better the problem (Holden and Lynch, 2004).

4.4.2 The Argument for Methodological Triangulation

Triangulation refers to applying more than one research method in a study (Denzin, 1989). It is argued that the implementation of triangulation is a way to produce understanding, make the research result bias-free, and increase the rate of certainty in finding, which helps to draw better an overall conclusion (Bryman and Bell, 2007).

There are four main types of triangulations, methodological triangulation, data triangulation, investigator triangulation and theoretical triangulation (Denzin, 1989). Methodological triangulation mentions the combination of quantitative and qualitative methods to study the same situation or phenomenon. The research aims to examine the antecedents and consequences of efficient e-mass customization. The conceptual framework which positions possible causal relationships of constructs has been generalized based on existing literature and theories, followed by the detailed hypotheses for each proposition. In other words, this research focuses on verifying and revising theories. Based on the epistemological position of positivism and ontological assumption of critical realism as well as a practical guide, i.e., adopting both deductive approaches as well as deductive approach, this research applies multi-methods, in particular implementing methodological triangulation: this research adopts qualitative methods to validate the measurement scales and to identify the lack of information concerning some variable of concept (Holden and Lynch, 2004); also, the research uses quantitative methods to verify hypotheses proposed based on theory (Holden and Lynch, 2004). In addition, the research compares the results on both qualitative and quantitative data to verify the accuracy of the results (Trochim, 2002). In other words, the study was conducted in two main phases: in the first stage, qualitative data were collected by semi-structured interview and analysed with the assistance of NVivo12; in the second stage, quantitative data was collected through a web-based questionnaire in order to investigate the antecedents and consequences of e-mass customization. After, the findings from qualitative research and quantitative research were discussed. The following figure shows the triangulation procedure of this research.

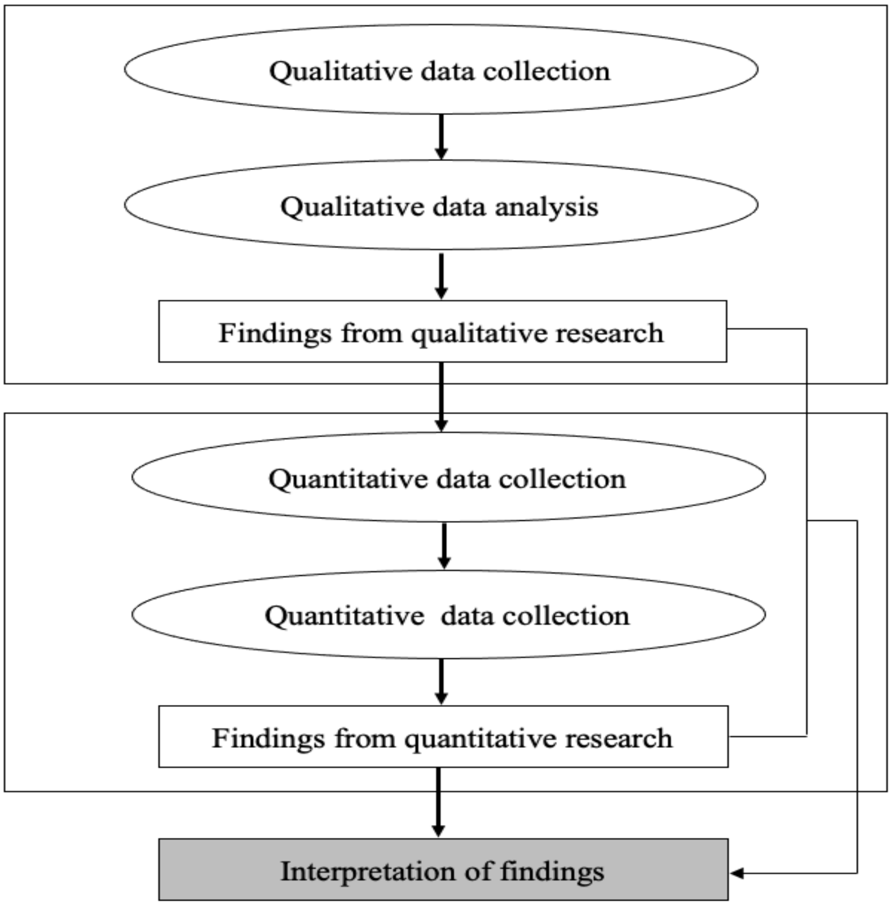

Figure 4.1 Triangulation procedures. Based on Creswell et al. (2003)

4.4.3 Research Setting: Industry and Spatial Location

Identifying a study's spatial location and industry is vital for successful research (Baker, 1999; Bernard, 2000). Some scholars (for example, Raimondo and Farace, 2013; Lee and Chang, 2011) mentioned that the apparel and footwear industries are highly competitive, and some companies are gaining a solid competitive position through e-mass customization. Even some well-known brands are maintaining their brand performance through e-mass customization, such Nike; implementing e-mass customization has boosted their performance by 62% between 2017-2019 (Gaffney, 2019; Formapace, 2020).

China's apparel and footwear industry was once labelled 'Made in China' and is known for its cheap manufacturing. However, with increasing competition, i.e., the growing number of homogeneous companies on the one hand, and the emergence of cheaper labour in the South East Asian market on the other, many companies with a focus on low-end manufacturing have realized that branding is a way to help transform themselves and differentiate themselves from homogenous companies. Some companies noticed that consumers have changed from being brand adaptors to partners and implemented mass customization strategies to make customers feel unique and serve their needs for belonging, esteem, and self-fulfillment to achieve branding. In addition, Chinese companies in the apparel and footwear industries have introduced advanced management techniques and cutting-edge technologies such as automation systems, machine learning systems and robotics to support the implementation of strategies and production operations. In other words, some Chinese apparel and footwear companies are introducing mass customization as part of their branding strategy. They are actively using advanced management means and technological tools to support the implementation of the strategy. This makes the apparel and footwear industries in place of China as the industry and spatial location for this research, which also leads to the unit of analysis of this study, 'company (brand)'.

4.4.4 Unit of Analysis

The unit of analysis is about which data is collected and analysed (Collis and Hussey, 2013), which requires the researcher to define on which level (such as the level of the individual, dyad, group, organization or country etc.) the data collection takes place (Zikmund, 2003; Kervin, 1992). Defining the unit of analysis is the first step for research (Bernard, 2000). The choice of unit of analysis is guided research aim and research question (Sekeran, 2003). This study investigates e-mass customization in companies from a branding perspective and the outcomes of e-mass customization turns to performance. Also, the study investigates the means and tools companies applied to achieve the principle and goals of e-mass customization. Consequently, 'company (brand)' is appropriate for this research's unit of analysis. Questionnaires were distributed to managers individually in companies, and the details about data collection are presented later in this chapter (Section 4.6.4).

In summary, companies were selected as units of analysis for this study; by investigating companies in China's clothing and footwear industries, the research aims to understand the role of e-mass customization and its role and outcomes of e-mass customization from a branding perspective. Also, the study aims to comprehend the means and tools used that could help achieve the principle and goals of e-mass customization, thus contributing to the academic literature and managerial practices.

4.5 First Phase: Qualitative Research

4.5.1 Reasons for Qualitative Research

Qualitative research is required when there is little knowledge available about the phenomenon; qualitative research, in particular, is helpful for researchers to explore such research problem, the concept of interests, and the linkages between interests (Jick, 1979; Malhotra and Birk, 2003; Creswell, 2017) when there is a little knowledge available about the phenomenon (Churchill Jr and Iacobucci, 2004).

The existing literature discusses the concept of mass customization, while only some brought up the term e-mass customization, mentioning its concept briefly without providing empirical evidence. Also, existing literature needs to investigate e-mass customization from a branding perspective. In other words, the construct of e-mass customization and its plausible outcome on branding, as well as the methods to support implementing e-mass customization, need to be investigated through qualitative research. Moreover, qualitative research is viewed to help examine developed processes (Bryman and Bell, 2007). Many researchers (e.g., Churchill, 1979; Bryman and Bell, 2007; Creswell, 2017) proposed that qualitative research can help with item generation and item refinement also help to avoid the risk of bias and obtain a richer explanation of research outcomes. Accordingly, this study adopts the qualitative research method as exploratory and explanatory. More specifically, the study collects qualitative data based on the following reasons:

- To assess the relevance of the proposed research questions
- To gain an in-depth understanding of research subjects of e-mass customization and unfolding the surrounding area of phenomena
- To explore the relationship and refine and revise the framework with the theme of e-mass customization
- To explore the role of machine learning in implementing e-mass customization
- To improve the reliability of scales of proposed themes
- To obtain a richer explanation of research findings

4.5.2 Qualitative Data Collection Methods

The research applied the interviewee technique for the first stage of data collection. Interviews began with “grand-tour questions” (Creswell, 2012) regarding participants’ personal details, positions, and years worked with their brands. Then, the interviewee discussed the participant’s understanding of the concept of e-mass customization, its role for companies in the 4.0 stage of branding, its antecedents and possible outcomes. Ethical approval to conduct this research was obtained from the author’s institution, Newcastle University, before the data collection. All interviewees were conducted in the participant’s offices using Mandarin, their native tongue, to make them more comfortable expressing their insights. In addition, the researcher takes into account observing nonverbal communication, such as the facial expression and behaviour of the interviewees, to deeper understand the attitude of interviewees when mentioning the proposed themes.

Semi-Structured interviews are adopted as it, on the one hand, enable questions and topics revolving around the key themes and, on the other hand, allow participants to actively engage and expand their views and insights upon the content, as well as discuss topics that generate during the communication. Conducting semi-structured interviews requires the researcher to identify a topic-based list of questions, i.e., an interview guide. This study identified an interview guide on E-mass customization consisting of 19 questions (Appendix 1).

4.5.3 Sampling

Qualitative research uses purposeful sampling to collect data. This study's qualitative research aims to understand and analyze the theme under investigation. More specifically, the theme of interest in this study relates to the concept and the role of e-mass customization and its determinants and possible consequences upon which a preliminary framework is formed based on the existing literature. The purposeful sample method helps gain an in-depth understanding of the subject by setting the research subject to a productive, experienced sample (Boeije,2002). Theoretical sampling is a method to enable theoretical coverage of the research conceptual framework (Boeije, 2002). Accordingly, theoretical sampling was applied in collecting qualitative data.

Sampling sizes in qualitative research are usually smaller than sample sizes in quantitative research. Moreover, data collecting underlying theoretical sampling does not end up with repeated patterns, but a category has been saturated with data (Bryman and Bell,2007). This study selects companies in Chinese apparel and footwear companies (member firms of the China Apparel Association). These selected companies have succeeded in becoming among the industry's leading brands by including comprehensive branding, being among the Fortune 500, the top 20 brands in Chinese apparel, and (or) " The Highly Influential Emerging Designer Brands". Upon contacting the managers or executives of these companies, the researchers first confirmed that these companies had implemented e-mass customization and that this strategy has played a crucial role in their branding process. Resource orchestration theory suggests cooperation among different divisions to achieve synergies (Sirmon and Hitt, 2003; Sirmon et al., 2007). This often requires managers from different divisions to liaise and build trust between them, facilitating information flow and encouraging joint decision-making. In other words, fluid cooperation between divisions is the key to orchestrating the various resources, thus optimizing the potential of these resources to help the companies to achieve their goals. With this in mind, the interviews were conducted with decision-makers, senior managers, and individual department managers (e.g., marketing managers, brand and supply chain managers, operations managers, etc.). The researcher of this study sought to understand from the responses of these managers and executives the role of their respective divisions, as well as other units, in the e-mass customization strategy in order to obtain information on their possible impacts on the objectives and the specific information of how these units are deployed in these companies for e-mass customization.

4.5.4 Analysis and Interpretation

The author of this research mainly follows an explanation building principle (Yin, 1994) to analyze content, involving 'identifying, coding, categorising, classifying and labelling the primary patterns in the data" (Patton,2002; p463). In other words, the analysis of qualitative data adopted Glaser and Strauss's (1967) theory approach carried out "open coding", "axial coding" and "selective coding". Nvivo 12 was used, and the researcher read and examined the data, identified categories and labelled the categories then, identify category attributes. Following by, the researcher using "axial coding" to discover and establish relationship. Finally, "selective coding" was used to extract a "core category" of all the previous categories. During the data analysis, the researcher constantly compared the relevant themes that were extracted from qualitative data and themes that mentioned in proposed framework and hypotheses (Erlandson et al., 1993).

4.6 Second Phase: Quantitative Research

Quantitative research is used as the main study of this research. It entails "the collection of numerical data and exhibiting a view of the relationship between theory and research as deductive" (Bryman and Bell, 2007, p154). Developing a valid and reliable measurement scale is the crucial step for the survey tool, i.e., a qualitative research questionnaire. More specifically, researchers can investigate many constructs that cannot be measured directly but can be observed and measured through multiple-item scales (Devellis, 2003). The study followed Churchill's (1979) scale development procedures. In the first phase, the researcher identified preliminary measurement scales through literature review and qualitative research (in-depth interviews); those measure scales then passed face validity by expert judgement. After these scales were tested through coefficient alpha, Item-to-total correlations, Exploratory factor analysis and Confirmatory factor analysis for their reliability and validity. The development process of the measurement scale is shown in Figure 4.2.

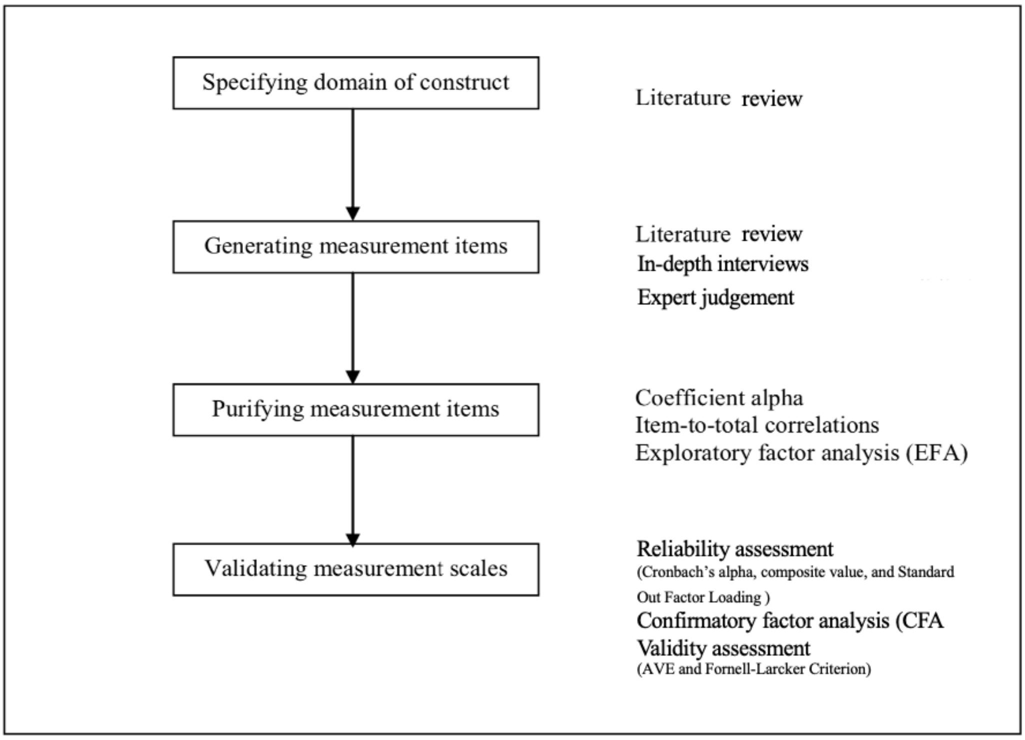

Figure 4.2 Scale Development procedures. Based on Churchill (1979)

4.6.1. Specification of the Domain Constructs

The first step of scale development is to identify the dimension of the theoretical construct. According to Churchill's (1979) development procedures, the researcher specified the preliminary domain of constructs and measurement scales by reviewing relevant literature.

4.6.1.1 E-mass customization

Derived from Lee and Chang (2011). Coronado et al. (2004), Pine (1993) and Yan et al. (2019), e-mass customization is defined in this research as a strategy that includes processes of co-design activity and mass-custom production in order to bring customers a personalized experience and products in a reasonable price and within a short waiting time (Kaplan and Haenlein, 2006; Lee and Chang, 2011; Yoo and Park, 2016; Yan et al., 2019; Lang et al., 2020). The notion of e-mass customization consists of two dimensions: mass-custom production (Tu et al., 2001; Tu et al., 2004) and co-design activity (Lee and Chang, 2011; Aichner and Coletti, 2013). Mass-custom product is to delivery of customized products quickly on a large scale in a cost-effective way' (Tu et al., 2001; Tu et al., 2004; Wang et al., 2014), And co-design activity is defined as involving the customer in defining their products with user-friendly co-design interaction (Lee and Chang, 2011; Aichner and Coletti, 2013; Raimondo and Farace, 2013).

4.6.1.2 Product Modularity

Product modularity is defined *as the use of interchangeable product modules which allow being combined/arranged into different end-products* (Tu et al., 2004; Seyoum, 2020); it is according to product architecture to set up interchangeable product modules which can be reassembled/rearranged into a wide range of end products. The research adopts 5 items as the measurement scales for product modularity based on Worren et al. (2002) and Seyoum (2020).

4.6.1.3Process Modularity

Feitzinger and Lee (1997) and Tu et al. (2004) proposed the notion of process modularity, mentioning the application of modularity principles in the manufacturing process and separating the production process into specific routines which can be easily and frequently resequenced. Sanchez and Mahoney (1996) and Warren et al. (2002) extended the concept of process modularity to using the modularity principle to decompose a company's key activities of the production process to make them reconfigured frequently and efficiently according to the requirements. Synthesizing the notion put forwards by these researchers, this study defined *process modularity* as *decomposing key activities of the production process into modular routines which allow being combined or frequent re-configuration* (Sanchez and Mahoney, 1996; Feitzinger and Lee, 1997; Warren, 2002; Tu et al., 2004). Wang et al. (2014) proposed 4-item scales to measure process modularity, which is adopted in this research.

4.6.1.4 Innovativeness

"Innovation is not only a process of creating a product or service from an invention, but also to do better than the competitors create" (Wong and Merrilees, 2008, p373). Accordingly, *innovativeness* in this research is defined as *keeping forward thinking on resource updating and innovation* (Wong and Merrilees, 2008), and the 6-item scales that they proposed are adopted in this research to measure innovation.

4.6.1.5 Supply Chain Integration

Supply chain integration is proposed to be linked to *strategic collaboration with supply chain partners and collaborative management intra and inter-organizational processes* (Flynn et al., 2010); it is related to companies collaborating with channel partners to deploy their resources and capabilities

(Liu et al., 2016). Seyoum (2020) summarized supply chain integration as the integration of upstream and downstream suppliers into supply chain practices, and this definition is adopted in this study. Liu et al.'s (2016) mentioned 4-item scales to measure supply chain integration, and the measurement scales are adopted.

4.6.1.6 Production Automation

Production automation is defined in this research as *applying mechanical, electronic and computer-based technology to automate systems or production processes* (Groover, 2016; Westrom, 2020). Production automation is a relatively new concept, and Shin et al. (2017) mentioned that the elements of automated production systems contain 'computerized operations of the manufacturing supporting systems' and 'automated manipulation of facilities belonging to the production system'; that is, the technologies and systems that enable automation are set for plant production scheduling and operations management in the domain of the enterprise, and for operational production management, as well as for direct controlling activities of the physical equipment (Shin et al., 2017).

4.6.1.7 Machine Learning

Machine learning is a subdimension of artificial intelligence; machine learning is a collection of algorithms which "learn directly from the examples, data, and experience and can figure out how to perform important tasks by generalizing from them." (Bajic et al., p. 29). This research adopts the definition of machine learning proposed by Bajic et al. (2018), Sharp et al. (2018), and Yan et al. 2022) and defines *machine learning* as *algorithm-based computer systems capable of providing deep insights for performing tasks through automatic learning*. This study generates 9-item scales, according to Sharp et al.'s (2018) mentions in their study, to measure machine learning.

4.6.1.8 Brand Performance

This study adopts the definition of brand performance proposed by Chang et al. (2018) and Odoom and Mensah., i.e., *brand performance is the value that a company gains from its initiatives of branding, from which the company can maintain marketplace positions of competitive advantage.* The 5-item scale proposed by Chang et al. (2018) was also adopted to measure brand performance.

A proposed conceptual framework (Table 4.4) was developed based on the theoretical information obtained. The definition of each construct shows in the table:

Table 4.4 Construct domains

Component	Definition	Source
E-mass customization	A strategy that includes processes of co-design activity and mass-custom production, in order to bring customers a personalized experience and products at a reasonable price and within a short waiting time	Tu et al. (2001); Tu et al. (2004); Kaplan and Haenlein (2006); Lee and Chang (2011); Aichner and Coletti (2013); Raimondo and Farace (2013); Wang et al. (2014); Yoo and Park (2016); Yan et al. (2019); Lang et al. (2020)
Product Modularity	The use of interchangeable product modules which allow to be combined/arranged into different end-product	Durry et al. (2009); Tu et al. (2002); Seyoum (2020);
Process Modularity	Decomposing key activities of the production process into modular routines which allows to be combined or frequent re-configuration	Sanchez and Mahoney (1996); Feitzinger and Lee (1997); Worren (2002); Tu et al. (2004)
Production Automation	The application of mechanical, electronic and computer-based technology to automate systems or production process	Groover (2016); Westrom (2020)
Innovativeness	Keeping forward thinking on resource updating and creation	Wong and Merrilees (2008)
Supply chain integration	Integration of upstream and downstream suppliers into supply chain practices	Seyoum (2020)
Machine Learning	An algorithm-based computer systems capable of providing deep insights for performing task through autonomous learning	Bajic et al. (2018); Sharp et al. (2018); Yan et al. (2022)
Brand Performance	The value a company gains from its initiatives of branding, from which it can maintain marketplace positions of competitive advantage	Chang et al. (2018), Odoom and Mensah (2019)

4.6.2 Initial Item Pool

The second step concerns item generation underlying Churchill's (1979) paradigm. The initial pool of items is extracted and (or) developed from literature and examined and refined by qualitative research. The following table (Table 4.5) reveals the constructs and their measurements from literature search and qualitative research, accounting for 49 items in total.

Table 4.5 Measurement items for the constructs of the study

Component	Measurements	Source
E-Mass Customization	We have the ability to produce highly differentiated products without increasing costs, significantly We have the ability to increase product variety without diminishing production volume We have the ability to reorganising production process quickly in response to customization products *We have the ability to reducing the time required to deliver customized products We have the ability to support user-friendly co-design activity for customer to identify their own products	All items are derived from the Tu et al. (2001) and Tu et al. (2004) * Derived from qualitative data Lee and Chang (2011); Aichner and Coletti (2013)
Product Modularity	Product can be decomposed into separate modules that can be re-combined into new designs We can make changes in the key components without redesigning others Product components can be reused in various products Product has a high degree of component carry over We have a high degree of components between different products	All items are derived from Worren et al. (2002); Lin (2003); Seyoum (2020)
Process Modularity	Our process can be adjusted by adding new process modules Process modules can be adjusted for changing production needs Our process can be broken down into standard sub-processes that produce standard base units and customization sub-processes that further customize the base units Process modules can be rearranged so that customization sub-processes occur last	All items are derived from Wang et al. (2014)
Production Automation	We automate production scheduling in our company We automate operational management in our company We automate the control activities of directing physical equipment * We automate the release of production orders * We automate order progress controlling * We automate real-time order status * We automate activities controlling the physical equipment in the shop floor * We automate the execution of production operations	Shin et al. (2017) Shin et al. (2017) Shin et al. (2017) * Derived from qualitative data
Innovation	We actively engage in wide search for new idea We carefully think through how new ideas need to be adapted for our business We have good system of identifying, selecting and implementing innovation on a regular basis	All items are derived from Wong and Merrilees (2008)

	Compared with competitors, we have a high rate of product/service innovation Compared with competitors, we have a high rate of process/organization improvement Over time, we have been successful with overall innovation in recent years	
Supply Chain Integration	Our company exchanges information about various supply chain activities with channel partners Our company collaborates with channel partners in designing plans Our company streamlines and automates its supply chain processes with channel partners Our company establishes long-term relationships with channel partners to achieve strategic goals	Items are based on Liu et al. (2016)
Machine Learning	We adopt machine learning to help optimise production from a fundamental level We adopt machine learning to help find solutions to difficult question We adopt machine learning to help obtain and present solutions We apply machine learning system to optimise scheduling of machine time for production line operations We apply machine learning to help manage produced diagnostic and prognostic knowledge at all levels of the manufacturing system We apply machine learning to help extend the life of manufacturing equipment We adopt machine learning to support to address the administration of large amount of data We adopt machine learning to support the storing of large amounts of critical data in the cloud We adopt machine learning to support the real time access of resources	Developed items are based on Sharp et al. (2018)
Brand Performance	Relative to our competitors, our customers are willing to pay more in order to do business with us Our customers expect to continue the business relationship, with us for a long time Our brand has built strong customer brand loyalty Our brand is advantageous position in competition Our brand is successful in retaining current customers.	All items are derived from Chang et al. (2018)

4.6.3 Content Adequacy Assessment

The first step in assessing validity is to test for face validity (Schlegelmilch et al., 1993). “Content validity is established by showing that the test items are a sample of a universe in which the investigator is interested” (Cronbach and Meehl, 1955, p282), and “if the sample is appropriate and the items ‘look right’, the measure is said to have face or content validity” (Churchill, 1979, p69). In order to establish face validity, the research involved three panels for their feedback.

The first panel includes 6 academics whose work on UK higher education, with expertise in areas such as marketing, branding, strategy, management or related areas. The second group includes 5 practitioners with backgrounds such as brand manager, marketing manager, operational manager or senior management in related areas. The third group included 6 academics who held the position of PhD candidate.

According to the suggestions by the panels, some items were dropped, and the wording of some items was optimized. Several experts commented that the items ‘we can reduce the time required to deliver customized products’ are duplicated with the previous item (i.e., the item ‘we can reorganize production process quickly in response to customization products’). Thus it was dropped. The majority of experts commented on items of ‘product has a high degree of component carry over’ as unclear and difficult to understand. Accordingly, this item was dropped. In addition, some experts commented on the item ‘We automate the control activities of directing physical equipment’ as hard to understand. Thus, this item was deleted from the item pool.

Finally, a total of 43 items were retained. The following table (Table 4.6) depicts the items for relevant constructs after content validity (face validity).

Table 4.6 Measurement items after face validity

Component	**Measurements**	**Source**
E-Mass Customization	We have the ability to produce highly differentiated products without increasing costs, significantly	EMC1
	We have the ability to increase product variety without diminishing production volume	EMC2
	We have the ability to reorganising production process quickly in response to customization products	EMC3
	We have the ability to support user-friendly co-design activity for customer to identify their own products	EMC4

Product Modularity	Product can be decomposed into separate modules that can be re-combined into new designs We can make changes in the key components without redesigning others Product components can be reused in various products We have a high degree of component between different products	PdM1 PdM2 PdM3 PdM4
Process Modularity	Our process can be adjusted by adding new process modules Process modules can be adjusted for changing production needs Our process can be broken down into standard sub-processes that produce standard base units and customization sub-processes that further customize the base units Process modules can be rearranged so that customization sub-processes occur last	PcM1 PcM2 PcM3 PcM4
Production Automation	We automate production scheduling in our company We automate operational management in our company We automate the release of production orders We automate order progress controlling We automate real-time order status We automate activities controlling the physical equipment in the shop floor We automate the execution of production operations	PA1 PA2 PA3 PA4 PA5 PA6 PA7
Innovation	We actively engage in wide search for new idea We carefully think through how new ideas need to be adapted for our business We have good system of identifying, selecting and implementing innovation on a regular basis Compared with competitors, we have a high rate of product/service innovation Compared with competitors, we have a high rate of process/organization improvement Over time, we have been successful with overall innovation in recent years	Innov1 Innov2 Innov3 Innov4 Innov5 Innov6
Supply Chain Integration	Our company exchanges information about various supply chain activities with channel partners	SCI1

	Our company collaborates with channel partners in designing plans	SCI2
	Our company streamlines and automates its supply chain processes with channel partners	SCI3
	Our company establishes long-term relationships with channel partners to achieve strategic goals	SCI4
Machine Learning	We adopt machine learning to help optimise production from a fundamental level	ML1
	We adopt machine learning to help find solutions to difficult question	ML2
	We adopt machine learning to help obtain and present solutions	ML3
	We apply machine learning system to optimise scheduling of machine time for production line operations	ML4
	We apply machine learning to help manage produced diagnostic and prognostic knowledge at all levels of the manufacturing system	ML5
	We apply machine learning to help extend the life of manufacturing equipment	ML6
	We adopt machine learning to support to address the administration of large amount of data	ML7
	We adopt machine learning to support the storing of large amounts of critical data in the cloud	ML8
	We adopt machine learning to support the real time access of resources	ML9
Brand Performance	Relative to our competitors, our customers are willing to pay more in order to do business with us	BP1
	Our customers expect to continue the business relationship, with us for a long time	BP2
	Our brand has built strong customer brand loyalty	BP3
	Our brand is advantageous position in competition	BP4
	Our brand is successful in retaining current customers.	BP5

4.6.4 Survey

4.6.4.1 Targeted Population

Identifying the target popularly is a key step in social research to identify “who should and should not be included in the sample” (Malhotra and Birks, 2003, p358). Zikmund (2003, p369) pointed out that a population is “a complete group of entities sharing some common set of characteristics”, and the term ‘group’ can refer to people, companies, industries or nations etc. (Zikmund, 2003). This study aims to explore the meaning and implications of e-mass customization and how e-mass customization can be implemented from a resource orchestration perspective. As mentioned in the previous section, the theme of e-mass customization appears to be more relevant in the clothing and footwear industries, and these companies are ahead of the curve in implementing e-mass customization. Consequently, companies in China’s clothing and footwear industries are selected as the targeted population.

Unlike professional suppliers, associations in the clothing and footwear industries, such as China National Garment Association and China’s Apparel Industry Alliance, provide a variety of company listings. This research uses a company listing provided by China’s National Garment Association. The researcher contacted the head of this association and explained the research intentions. Based on the explanation provided, the researcher of this study was granted access to the database. Based on the retrieval of the database, the actual criteria for generating a sampling frame were 1) Business Pattern, 2) Business Platform, and 3) Job Function. Firstly, companies whose business pattern involves B2C (including companies conducting B2C business and conducting both B2C and B2B business) were selected; secondly, companies whose business involves e-mass customization business were selected; third, the following job functions were selected: Chairman, Chief Executive Communication Director, Assistant Chairman, Marketing Director, Brand Director, Product Director, Sales Director, Marketing Manager, E-marketing Manager, Brand Manager, Product Manager, Supply Chain Leader, Marketing Development Manager, Sales Manager, E-commerce Manager, Design Manager, and Head of Design. The final sampling frame contains 1283 individual contact from 561 companies.

4.6.4.2 Sampling Procedure

Probability Sampling refers to "each population element has a known, nonzero chance of being included in the sample" (Churchill Jr and Iacobucci, 2004, p324). As "the resulting sample is likely to provide a representative cross-section of a whole" (Denscombe, 2002, p12), probability sampling is the preferred technique. Probability sampling methods include simple random sampling, systematic sampling, cluster sampling and stratified random sampling (Bryman and Bell, 2007; Churchill Jr and Iacobucci, 2004)

The methods of simple random sampling were selected in this study, and the researcher contacted all 1283 individual contacts listed by email. The process of data collection procedure is presented in the following selection.

4.6.4.3 Data Collection Procedure

Academics have increasingly used web-based data collection, and web-based questionnaires have been highly recommended (Bryman, 2004). More specifically, online data collection is believed to reduce survey costs compared to traditional data collection methods significantly (Cobanoglu et al., 2001). In addition, online data collection has the advantage of being geographically unrestricted, i.e., it is convenient for respondents to answer the questions in the questionnaire at any time at a place (Mullarkey, 2004); thereby, online data collection is considered to greatly improve the response rate (Wygant and Lindorf, 1999; Cobanoglu et al., 2001) and speed of response (Kent and Lee,1999; Schuldt and Totten,1999; Sheehan and McMillan,1999; Cobanoglu et al., 2001). This data collection method effectively reduces missed data (Bryman, 2004; Bryman and Bell, 2007). Accordingly, a web-based questionnaire was selected to collect the original data.

4.6.4.4 Data Analysis Techniques

The quantitative data analysis was conducted in three phases. In the first phase of quantitative data analysis, sample characteristics followed by descriptive statistics were examined with the assistance of SPSS software package. When conducting descriptive statistics, the researcher of this study first investigated out-of-range values, missing values, and non-response biases, then examined univariate outliers by investigating Z-score and multivariate outliers by Cook's Distance. Following, the researcher inspected Q-Q Plot, Skewness and Kurtosis, and Kolmogorov-Smirnov and Shapiro-Wilks to examine univariate normality and VIF to assess multivariate normality.

The second phase of quantitative data analysis is mainly on data simplification. The researcher inspected Cronbach's Alpha and Corrected Item-total Correlation and Exploratory Factor Analysis (EFA). Following by, the researcher applied confirmation factor analysis (CFA) to finalize the measurement scale. The measurement scales were then subjected to a validation stage in this research.

The third main phase of data analysis involved the assessment of the measurement model and structural model. In this research, PLS-SEM is applied with the assistance of SmartPLS software to assess mentioned two models, as this technique can accommodate a small sample size compared to CB-SEM (Chin and Newsted, 1999); also, PLS-SEM is considered appropriate as an assessment technique, in particular when the model is in the early stage of development (Hemsley-Brown and Oplatka, 2006). The author inspected Cronbach's alpha, Composite value as well as Standard Out Factor Loading in order to assess the reliability of the measurement model. The researcher then examined Average Variance Extracted (AVE) and Fornell-Larcker Criterion to assess the measurement model's validity. Subsequently, the coefficient of determination (R2) and path coefficient (t-value) and predictive relevance (Q2) were inspected to assess the structural model.

4.7 Summary

In this chapter, the philosophical foundation of this research, as well as research methods, were thoroughly described. Also, the key issues related to data collection in qualitative research and quantitative research were presented, including research design and research settings were addressed. Moreover, the chapter presents procedures of scale purifying and methods and techniques used for inspection scale reliability and validity and structure models. The findings from qualitative data will be presented in the next chapter.

Chapter 5

Findings and Discussions

5.1 Introduction

This chapter presents qualitative and quantitative research findings and a comprehensive discussion of the findings. This chapter includes three main sections, i.e., Qualitative Findings, Quantitative Findings and Discussion of Findings. The first section presents the analysis and findings from qualitative research, starting with an overview of the qualitative data analysis procedure. The qualitative findings of each theme are identified in the proposed framework, followed by a summary of the main findings from qualitative research. The second section presents the analysis and findings from the qualitative research. In this section, firstly, the information about data characteristics, initial data examination, and data preparation are presented. Secondly, scale reliability and exploratory factor analysis (EFA) results are presented. Following by, the results of the confirmatory factor analysis are presented. Finally, the outcome of testing hypotheses used by PLS-SEM and the findings are presented. The third section provides a comparative discussion. In this section, quantitative and qualitative research findings are discussed in conjunction with previous findings from the literature.

5.2 Qualitative Findings

5.2.1 Overview of Qualitative Analysis Process

Qualitative data were collected from 15 semi-structured interviews; the interview guide contained 19 questions around the themes that emerged from the literature review above, including the concept of e-mass customization, its role for companies from a branding perspective, i.e., the possible outcomes of e-mass customization, and the possible factors that support e-mass customization. Qualitative data were collected from 15 semi-structured interviews; The interview guide consists of 19 questions on topics that emerged from the literature review, including the concept of e-mass customization, its role for companies from a branding perspective, its possible effects, and possible factors supporting e-mass customization.

Based on the suggestions of resource orchestration theory, the interviewees were set as CEO, president, general manager, marketing manager and supply chain person in China's garment and footwear industry. The interviewees were selected according to the China Garment and Footwear Industry Association list. Table 5.1 shows the profile of the respondents. All interviews were conducted in the respondents' offices in Mandarin, their mother tongue, to make it easier for them to express their views. The interviews lasted between 30 and 90 minutes, depending on the time available to the interviewee. Their names are kept confidential to preserve the brands and the interviewees' anonymity. All interviews were recorded digitally and transcribed verbatim in Mandarin. After, the transcripts were translated into English for thematic analysis. NVivo 12 was used for coding the qualitative data, followed by three phases: open coding, axial coding and selective coding.

Table 5.1 Participant profiles

Contributors	**Affiliation**	**Job role**	**Relevant work experience (years)**
Respondent 1	E-commerce department	E-marketing manager	7
Respondent 2	Operations department	Supply chain manager	7
Respondent 3	Supply chain center	Supply chain manager	10
Respondent 4	Entrepreneurship	Vice president	15
Respondent 5	Operations department	Executive deputy general manager	10
Respondent 6	Marketing department	Marketing manager	7
Respondent 7	Supply chain center	Supply chain manager	8
Respondent 8	Operations department	General manager	11
Respondent 9	E-commerce department	Marketing manager	9
Respondent 10	Operations department	General manager	10
Respondent 11	Operations department	Supply chain manager	9
Respondent 12	Marketing department	Marketing manager	10
Respondent 13	Entrepreneurship	Vice president	12
Respondent 14	Entrepreneurship	Acting vice president	8
Respondent 15	Operations department	General manager	13

The analysis is based on the conceptual framework, starting with the concept of e-mass customization and then the possible influence factors and implications of e-mass customization. These start list codes served as a reference to the quantitative data. The purpose of qualitative research is to discover the concept of e-mass customization, the outcomes of e-mass customization, and the alleged roles of product modularity, process modularity, innovativeness, supply chain integration, production automation, and machine learning in e-mass customization.

The author carried out open coding, axial coding and selective coding (Strauss and Corbin, 1998) of the interview transcripts in turn. The objective in the first phase is to search for information relevant to the conceptual framework developed based on the literature (Lincoln and Guba, 1985). The researchers subsequently connected categories using "axial coding" to discover and establish the relationships. In the selective coding phase, the research defined 'core categories' and specified relationships between constructs by integrating all the previous categories. The researcher of this study repeated the coding process more than once to increase the findings' credibility (Boejie, 2002).

5.2.2 Key Results of Qualitative Research

Overall, qualitative data provide valuable information concerning various aspects, such as the definition and the construct of e-mass customization and the antecedents and perceived consequences of e-mass customization.

5.2.2.1 Concept of E-mass Customization

Starting with the conceptualization of the construct of e-mass customization, which is defined in this research as a strategy that includes co-design activity and mass-custom production processes to bring customers a personalized experience and products at a reasonable price and within a short waiting time. (Kaplan and Haenlein,2006; Lee and Chang, 2011; Yoo and Park, 2016; Yan et al., 2019; Lang et al., 2020). The majority of interviewees agreed with the definition. For example, one respondent agreed with the definition, mentioning a characteristic of e-mass customization*, "balancing between mass and personalization":*

> *"It is different from haute couture. Haute couture is where the process is very complicated, targeted at both niche and high-end customers. The cost of haute couture is very high for us and our customers. E-mass customization brings customized products, services, experiences, and so on to many customers. Thus, we should balance personalization and costs as well as lead time. That is balancing between mass and personalization."* [Respondent 12]

Similarly, another interviewee agreed to the definition, mentioning 'large volume' and 'personalization' which are the characteristics of e-mass customization:

> *"The first is providing customized products and services, and the second we need to concern is large volume delivery of personalization."* [Respondent 7]

The interviewee continued:

> *"On one side, we design in the form of permutations and combinations to create hundreds of options. On the other side, we pay attention to improve the interaction*

> *with customers, by selecting and combining from the pre-designed options, customer can obtain products that better match their own needs"* [Respondent 7]

Mass-custom production is proposed as one dimension of e-mass customization, which is about low-cost, large-scale and quick production of differentiated products for each individual to obtain customized products at an affordable cost within a short waiting time (Tu et al.,2001; Tu et al., 2004; Wang et al., 2014). Several respondents agreed with the proposed definition of e-mass customization, mentioning the aspect of mass-custom production. For example, one respondent highlighted the characteristic of rapid and low-cost manufacturing of custom products:

> *"E-mass customization, first of all, including 'mass'... That is mass manufacturing custom products. It is worth noting that we must ensure the quality of the products and reasonable lead time; in addition, we must control costs during the process. Once we achieve these three points, customers can receive high-quality products quickly that meet their personalized needs, consequently, promoting customers' satisfaction with the brand will increase."* [Respondent 9]

Another interviewee agreed to the proposed definition, mentioning the characteristic of fast-speed manufacturing custom products:

> *"The first is to meet individual customer's needs, and the second is to deliver customized products to customers quickly. Now more and more young customers have personalized needs, so we must be able to meet the ever-changing needs of our customers. The second is about speed. When the customer places an order, we can ship it within 2 days and arrive in Australia within 7 days. This is called fast. The third is the high quality of the product."* [Respondent 5]

Similarly, one respondent agreed to the proposed definition, highlighting the features of fast speed and low-cost delivery of customized products:

> *"Delivering quality of mass-custom products is very important as well as meeting customers' needs regarding receiving goods quickly. Therefore, we stipulated lead time and set standards for product quality. In other words, we should ensure our ability to deliver custom products quickly and with high quality to the vast number of customers. In addition, customization means meeting individual needs, which means that we must ensure our ability to create and deliver products with very*

great variety. Only in this way can we bring a good sense of experience to customers." [Respondent 4]

One respondent agreed to the proposed definition, referring to e-mass customization including as being characterized by fast speed and high variety of production:

> *"There are several important indicators in production; the first is fast, the second is quality, and the third is variety."* [Respondent 1]

In addition, one respondent, in essence, agreed to the proposed definition, referring to e-mass customization as the brand's ability to deliver products that meet the personalized needs of customers:

> *"We can meet the different needs of each individual, facing the vast number of customers. This point is significant. Accordingly, we should ensure that the designed enough styles and options of the products for customers to select."* [Respondent 13]

Co-design activity is proposed as a constituent of e-mass customization. Co-design activity is related to using interactive, user-friendly interfaces for individual customers to define their own products through a collaborative design process (Lee and Chang, 2011; Aichner and Coletti, 2013). One interviewee agreed with the proposed definition of e-mass customization, mentioning the dimension of co-design activity. The interviewee highlighted the aspect of interaction, i.e., co-design activity, can deliver a personalized experience:

> *"We focus on the customer experience in the interaction. Online interaction is delivered by vision. On this basis, designers pay attention to designing online interfaces to make them more attractive. In addition, when customers participate in codesign, they define personalized products by selecting and combining various options in the menu. This is called 'one-click customization', and This method is easier for customers to operate."* [Respondent 10]

Similarly, one respondent supported the proposed definition of e-mass customization, mentioning the aspect of co-design activity:

> *"It is related to customers participating in product co-design. As we already pre-designed options, customers select and combine the options to define their products. While if the customer finds that his or her needs are not shown in the options, he or she can contact our online customer service. That's it. Humanized online*

interaction design and outstanding service can give customers a good experience." [Respondent 4]

Another interviewee agreed to the proposed definition, mentioning the aspect of co-design activity:

> *"Customization, for example, involves customer participation. Without customer participation in design, it is still standard production. Once a customer participates in the design, it is called personalization."* [Respondent 3]

The interviewee continued:

> *"Customers participate in co-design through the e-commerce platform. For example, we now have a parent-child activity. Customers can upload a photo with their child, or a customer can upload a painting they co-created with the child to make a personalized family t-shirt."* [Respondent 3]

Similarly, one respondent, in essence, agreed to the proposed definition and highlighted the character of customer participation in designing their product:

> *"Custom means personalization. The most important thing is that customers design their products by themselves. For example, if he [a customer] wants a certain collar, a certain cuff, a certain font, or he also wants to embroider his name on the collar, etc., he can define and design it for himself. Moreover, our design team is responsible for correctly setting the array of options. This is the core of mass customization."* [Respondent 6]

One interviewee, in essence, agreed with the proposed definition of e-mass customization, also emphasizing the dimension of co-design activity. In addition, the interviewee mentioned how companies could implement co-design activity:

> *"We use the principle of permutation and combination to design products. In this way, we can design various products; on the other side, customers can get products that align with their desires."* [Respondent 8]

The respondent continued:

> *"We engage customers in co-design and have an ongoing interactive flow to co-design; for example, customers can choose a collar combined with a colour contained in the array of optioned that we pre-set; or if the customer wants to add*

a specific pattern on the T-shirt, he or she can put the picture in the image box that we pre-set." [Respondent 8]

One respondent agreed to the proposed definition of e-mass customization, mentioning both proposed dimensions, i.e., co-design activity and mass-custom production:

> *"Our responsibility is to design and update basic modules. The focus is to involve customers to participate in the process of design of their products. For example, if she [a customer] wishes to get a cloth which has her own name on the collar, with a specific cuff, or front, we allow her to co-design for this personalised product. That is, a customer can combine pre-defined options with a collaborative design. From the brand side, we also need to be concerned with controlling cost and waiting time from the front-end, thus delivering the product with an acceptable price range for her." [Respondent 2]*

Overall, interviewed managers acknowledge the proposed definition of e-mass customization by pointing out its key aspects or characteristics.

5.2.2.2 Antecedents of E-mass Customization

- ***Product Modularity***

As presented in Chapter 3, this research links product modularity to e-mass customization. Results from interviews provide shreds of evidence for these linkages. For example, one interviewee first affirmed the importance of modularity for e-mass customization and, in particular, pointed out that the practice of using product modularity, i.e., the using of product modularity to reconfigure products, can improve flexibility when producing a large variety of products while reducing production costs simultaneously:

> *"Modularity-based management can certainly improve this."* [Respondent 7]

The interviewee continued:

> *"Using modularity in production can effectively reduce costs and improve efficiency. In other words, applying modularity in the production process can improve flexibility and production efficiency, thereby effectively reducing production costs."* [Respondent 7]

Similarly, one respondent pointed out that the use of product modularity helps to reduce the number of different parts to be delivered to the assembly plants, thus striking a balance between 'mass' and 'customization':

> *"The biggest challenge is building-up flexible systems. Fast production and cost control required us to re-adjust the design and manufacturing structure. We found that the more standard the front end, the more efficient the production and the lower the cost. In the design phase, we first define the functional modules, design the components in different functional modules, and concern how these can be combined into different products. In this case, we can balance cost, speed and customization."* [Respondent 1]

One interviewee pointed out the support for the use of the modularity principle for e-mass customization:

> *With programs and with modules, it may be easy for a brand to achieve that."* [Respondent 11]

Continually the respondent, in particular, mentioned the support of using product modularity in designing and configuring products for e-mass customization:

> *"At present, our company also applies modularity. When designing products, we divide the product into functional components and then set options in each functional component, for example, taking buttons, necklines, cuffs, and prints as modules. Then designers set details and variations in each module."* [Respondent 11]

Another interviewee agreed with the proposed linkage, mentioning that the application of product modularity helps to balance variety, cost and speed:

> *"This is very helpful and necessary. Sometimes standardization and personalization are contradictory, so we must consider the balance of cost, quality, speed and personalization. Through product modularity, we can help us define which parts allow customers to make personalized designs."* [Respondent 13]

The same interviewee also pointed out that the use of product modularity can facilitate user-friendly interaction and consequently helps with customer collaboration design of their products:

> *"In the web interface design, we also disassemble the product into components and input options in components for customers to choose and combine for their products. For example, in the button module, we set different submodules, such as button style and button colour, and each submodule includes various options. Customers can define their products by clicking on the content in different modules."* [Respondent 8]

Another interviewee agreed to the proposed linkage and highlighted the support of product modularity to the aspect of co-design activity:

> *"We allow consumers to participate in the design; then we need to make certain changes in design and development. We have added modules with options for patterns, embroidery, colours, and more for consumers to choose from."* [Respondent 2]

The same interviewee continued:

> *"In addition, we distinguish between the parts that consumers can co-design and the fixed foundations through modularity; for example, one piece of clothes is divided into 10 modules, 5 of which contain customization options for consumers to select and combine."* [Respondent 2]

Similarly, one interviewee agreed to the proposed linkage, highlighting the support of product modularity to the aspect of co-design activity in e-mass customization:

> *"Modularity in design conduce to reduce costs, improve work efficiency effectively. In the product design stage, we first arrange modules, then concern a variety of components in different modules. The components and modules that we arrange can be combined into different products. On this basis, the interface we finally present to the customer will contain many options. Thus, the customers can quickly assemble for their own product."* [Respondent 9]

In brief, the interviewed managers agreed to the proposed linkage and pointed out the possible support for e-mass customization using product modularity in configuring products.

- ***Process Modularity***

As presented in Chapter 3, this research links process modularity to e-mass customization. Although a few respondents supported the proposed relations, most interviewees expressed opposition. Starting from the respondents who support the proposed linkages, one of them commented:

> *"The more standard the front-end is, the more standard the manufacturing will be; consequently, the efficiency will be higher, and the c,ost will be lower."* [Respondent 1]

One respondent endorsed the proposed relation, detailing decomposing key activities, such as co-design activity, manufacturing process, and workflows process, into routines support key activities to be quickly and frequently reconfigured into new processes, which further improves flexibility and speed while reducing the cost of production, as well as assists customers to design their products:

> *"Remodelling processes, including manufacturing processes, workflows processes and online interaction processes to the principle of modularity. This helps to simplify the program and increase the speed."* [Respondent 3]

The interview continued:

> *"Using the modular principle in the manufacturing process facilitates the relative standardization of the process, thus helping to reduce production costs. In addition, we take into account the convenience of customer co-design, so we also use modular principle in interaction, for example, to break up options into the standard base and make it occur before the custom base, and add default choices, thus speeding up those customers who do not need customization"* [Respondent 3]

Respondents who held the opposite view to the above proponents offered their own insights. For instance, one respondent suggested that the relationship between process modularity and e-mass customization may depend on the length of the product cycle:

> *"If the product cycle is concise, then we must continually introduce new products or new types of products. Although process modularity is adopted, the workflow, production process, etc., may need to be completely redesigned rather than be accomplished by swapping or adding (or subtracting) pre-designed modular routines. In this case, the influence of product modularity is relatively weak."* [Respondent 10]

Another respondent who held the opposite view suggested that the relationship between process modularity and e-mass customization may depend on the degree of customization:

> *"It depends on the degree of personalization and the complexity of the customization part. If we allow consumers to select and combine pre-designed, for example, patterns and embroidery, to be their products, then the manufacturing process is only about adding a few steps. Process modularity can help reduce time and cost. While if a customer wants to add complex elements to clothes, the difficulty of manufacturing will also increase. In this case, changing the processing modules may take time and cost."* [Respondent 2]

Similarly, one respondent commented that:

> *"It depends on the complexity of the process involved in the customization part. Suppose customization only involves common processes in production. In that case, modularity in the process can help control costs and reduce time. In contrast, if a component involves unique and complex procedures, the impact of modularity in process on controlling costs and reducing time may be relatively weak."* [Respondent 15]

Another respondent suggested that the relationship between process modularity and e-mass customization depends on the complexity of customization, as he mentioned:

> *"We adopt process modularity. We split the process into modules that can be combined and divided, and new modules can be added. However, the cost of mass customization depends on the degree of customization. If we allow customers to personalize, such as very complex embroidery, printing, or using expensive materials, the production process may become more complicated, increasing the cost of materials."* [Respondent 12]

Similarly, one respondent mentioned:

> *"In other words, if the customization part only involves typical craft, the manufacturing cost will not change much. Suppose the customization part involves a relatively complex craft. In that case, the cost may increase even in the case of process modularity because it may involve increased workers and procedures, especially for manufacturing parts of complex processes."* [Respondent 10]

Another interviewee pointed out that process modularity involves substantial investments in renovating processes and, therefore, may affect overall costs and final pricing:

> *"This is the hard part. We need to invest in the manufacturing sector to match the current system. The money invested in the renovation is substantial, yes… including personnel turnover and module design, et cetera. That means we need to make a big adjustment. After the transformation, our mass customization ability has been greatly improved. However, due to our relatively significant investment in the renovation, these costs should be included in the clothing pricing. In other words, the cost and the price have not been greatly reduced."* [Respondent 9]

Similarly, one respondent commented:

> *"Achieving mass customization requires us to enhance the flexibility and agility of the production process. That means we need to make significant changes. Previously, the process is fixed and standard when large-scale production of the same product. However, we now have to make the process flexible, which requires us to invest substantial cost and effort in adjusting the manufacturing process, production personnel and production system."* [Respondent 1]

In brief, although a few of the respondents agreed to the proposed linkages regarding process modularity and e-mass customization, several respondents put forward a different point of view, considering that the linkage between process modularization and e-mass customization may depend on some other factors, such as the length of the product cycle, or the degree of customization etc.

- ***Innovativeness***

Chapter 3 proposes connections between innovativeness and e-mass customization, while interviewees offered two different opinions. Starting with the respondent who supports the proposed linkages, one respondent commented:

> *"Customers start to trust us then have some expectations to us. We must keep innovating and bringing new products."* [Respondent 15]

The interviewee continued:

> *"We not only need to consolidate the existing things but also innovate and reward our customers so as to continuously extend the brand effect."* [Respondent 15]

This interviewee stressed the need and importance of staying innovativeness, especially continuously bringing new products for e-mass customization. One respondent agreed to the relations, highlighting the support of keeping innovativeness in updating products and services:

> *"To make every product we develop better and more detailed. That is to upgrade products and services; customers can customize anything they want, which is the ideal state we want to achieve."* [Respondent 12]

Another respondent, in essence, agreed to the relations, referring to the values that keeping innovativeness in skills and products would bring:

> *"In my opinion, if we innovate in some aspects of the product, pay more attention to innovate in the brand, and innovate in the skills, the value may come out."* [Respondent 13]

In addition, an interviewee commented:

> *"If we keep innovating in skills and techniques, the chances of making mistakes decrease. Consequently, the production costs go down."* [Respondent 2]

However, several respondents held the opposite view of the proposed relations. For example, one respondent argued that:

> *"A brand needs to creation, maintain product quality, and keep bringing 'new' to customers. however, keeping innovation relates to higher research, development, and production costs."* [Respondent 9]

This respondent mentioned that innovativeness might lead to a significant increase in R&D costs and time rather than a reduction in advocacy costs and time. Similarly, another respondent commented:

> *"Understanding the environment and market changes and having resilience is the key to success. However, purchasing new equipment and adjusting systems require substantial effort, so in the early stage, it may not be able to reduce the overall cost."* [Respondent 2]

An interviewee also highlighted this point:

"Innovation is a prerequisite. However, on the whole, maintaining innovativeness, such as keeping R&D and improvement, requires a relatively significant investment; I mean time and cost." [Respondent 3]

In addition, one interviewee argued:

"Misprediction of the market or customer preferences may lead to unnecessary waste. For example, although the information may show that a product or a custom option is top-rated, they are not that popular after launch, affecting costs. Even innovating based on fashion trends and consumer habits, judgments can be wrong sometimes." [Respondent 8]

The manager continued:

"Since last year, we have introduced intelligent systems to help to analyze market and customer requirements more accurately, thus reducing the cost pressure." [Respondent 8]

This interviewee highlighted that the relationship between innovativeness and e-mass customization might be influenced by the degree of accuracy in predicting customer demands. Another interviewee also mentioned this point:

"The impact of innovativeness, for example, on products or technology, is still undetermined. Product sales may increase if we accurately capture the market and customers' needs. If we can not accurately capture the market and customers' needs while investing in manufacturing, sales and publicity costs, then sales will not increase and may even reduce. In addition, the input of innovation cost is related to profit. In other words, if we have high innovation costs, those costs should be added to the price of the final products." [Respondent 13]

Similarly, one interviewee commented:

"It depends on how well we predict future trends, such as the environment and demand. Then we can match staff to R&D and update systems and equipment. However, the accuracy of prediction simply by people could be higher. In other words, to keep innovativeness linked to a combination of cutting-edge technologies and techniques." [Respondent 7]

In brief, some interviewees agreed to the proposed linkages, emphasizing the importance of innovation. At the same time, several respondents argued that keeping innovativeness might only sometimes facilitate e-mass customization as frequent innovativeness can lead to increased costs and time. In addition, the relationship between innovativeness and e-mass customization may also depend on the degree of accuracy in predicting customer requirements.

- ***Supply Chain Integration***

In Chapter 3, the research proposes the relationship between supply chain integration and e-mass customization. Qualitative findings provide support for the linkages. One respondent highlighted the importance of supply chain integration, highlighting its outcomes, including increasing speed and reducing costs when producing a wide variety of products:

> *"Supply chain integration is critical. We should deliver customized products to customers as quickly as possible, and the relatively complete global supply network is conducive to the procurement of different materials; for example, if a customer requests a specific fabric, we can purchase it from an Italian supplier, or if a customer requests a specific button, we can source it from a UK supplier. On this basis, we can improve the speed, reducing costs but better meet customer needs." [Respondent 4]*

Similarly, one respondent agreed to the proposed linkage, mentioning that having a complete supply chain helps reduce production costs:

> *"There is another one, which is the model of regional cooperation; for example, we have partnerships with different cooperative bases and require one type of material with one certain cooperative base that helps to deduce the costs."* [Respondent 3]

Another interviewee also highlighted this point, as the interviewee commented:

> *"Supply chain is the most important part. The project can be realized only when the supplier can supply what we request quickly and control the cost within a reasonable range."* [Respondent 2]

Another respondent mentioned the importance of supply chain integration for e-mass customization, emphasizing that having a relatively complete supply chain can help companies obtain unique materials required by customers' orders to achieve substantial results:

"A complete supply chain is not about an individual, but an integration. When producing clothes, we corporate with different suppliers, including material suppliers, accessories suppliers and so on. For example, if a customer needs a certain type of zipper, we will contact the corresponding manufacturer to make it. In addition, fabrics, buttons, logos, tags, and packaging are made by our corresponding suppliers. Therefore, it is very important to establish a supply chain management system." [Respondent 15]

One interviewee agreed to the proposed linkages, mentioning that collaborating with channel partners helps firms to obtain information on customers and consequently catch the needs of customers:

"We should build a platform that integrates trusted supplier resources; that is, to add all upstream and downstream suppliers that meet the standards to the platform. On the one hand, we have relatively stable suppliers; on the other hand, it is more convenient for us to contact and communicate with suppliers. In addition, companies can share information on customers to understand customer needs better." [Respondent 10]

Similarly, another respondent suggested that sharing information with channel partners can help companies understand market and customer needs so they can act more accurately and quickly:

"Second, we cooperate with cross-border online platforms at home and abroad, such as Tmall, Amazon and eBay, on the one hand, to sell products, on the other hand, to share data. By working with these platforms, we know better what basic styles and custom- options are popular with customers quicker; through data sharing, we can also understand the speed of customer orders, customer comments and feedback. Thus we can update products and options and improve our service." [Respondent 5]

Another respondent agreed to the proposed relations, mentioning the following:

"For example, when I need a component, I will post my demand on the platform, and the manufacturers that can meet the demand can directly click to receive the order, produce, transport and so on. This greatly improves the efficiency of the entire process. [Respondent 6]

One respondent commented:

> "We are now working with a technology company in Shenzhen, as they are good at website design and operation. Cooperating with their aims to improve our serviceability to make the co-design process run smoother for the customers." [Respondent 2]

Similarly, another interviewee also agreed to the proposed linkages and pointed out that collaborating with channel partners helps improve efficiency and achieve customer-friendly interaction, allowing customers to obtain a better-personalized experience from cooperative design.

> *"We cooperate with a high-quality online operation company, and they carry out comprehensive design such as the vision and flow of our web so that customers can have visual enjoyment and good shopping experience"* [Respondent 11]

- ***Production Automation***

In Chapter 3, the study links production automation to e-mass customization. The qualitative results provide some evidence for the relations. For example, one respondent commented that an automated production process can help reduce the time and cost of production while increasing the flexibility required for the production of customized products:

> *"In production management, we have introduced an automatic production system. Through the computer control links in production processes, reduce the production time. Another benefit of the introduced system [automatic production system] is that it can reduce the error rate through computer control and monitoring, thereby reducing production costs. It is like this."* [Respondent 11]

Similarly, one interviewee agreed to the relations, referring that the automated production process helps to improve production flexibility and production efficiency:

> *"We use cloud system, automation system and equipment; with that, we can easily manage, for example, three thousand patterns. Also, making three thousand patterns involves the process of material cutting; and nowadays, cutting is completed by laser cutters which are controlled by the central system. The data will be transmitted to the cutting bed through the central system."* [Respondent 7]

Similarly, another respondent agreed to the relations, also mentioning the help of the automated production process in improving production flexibility and efficiency:

> *"Or to adjust the embroidery machine to be automatic, which can embroider 100 different patterns simultaneously."* [Respondent 2]

One respondent agreed with the proposed linkages, mentioning their firm using automated systems to control the production when implementing e-mass customization:

> *"The systems control each link and enable processes to run through automatically. (Production Automation)"* [Respondent 4]

Another respondent also agreed to the proposed relations, emphasizing the advantages brought by the automated production process as follows:

> *"The database can automatically calculate; For example, what kind of fabric is needed for making a piece of clothing; and once the business is scaled up, the system can help calculate how long it will take from the first to the last. The second is about the components; the system automatically calculates how long it will take to make a component from the first to the last step."* [Respondent 6]

In addition, one interviewee, when referring to the factors affecting the realization of e-mass customization, mentioned the concept of production automation:

> *"It is about using smart technologies to realize smart manufacturing factories. That is about smart and intelligence; since we receive an order from a customer, the system can automatically arrange it and run it through the production line."* [Respondent 5]

Similarly, one interviewee emphasized automated production processes when referring to the production process of mass customizing products, therefore illustrating the positive impact of production automation on e-mass customization:

> *"Once a customer places the order, our back-end system will automatedly transmit the relative information to the self-cutting system; then the cut materials will proceed to the next step."* [Respondent 9]

5.3.2.3The Role of Machine Learning

In Chapter 3, machine learning is proposed to enhance the relationship between each influence factors that proposed and e-mass customization. The results of the interviews provide some evidence regarding the role of machine learning. For example, one interview commented:

> *"Applying machine learning enables 'Made in China 2025'. More specifically, we apply machine learning to optimize planning, product designing, organization designing, cooperation and manufacturing, et cetera. For example, manufacturing includes material purchasing, cutting, sewing, packaging and delivering, and through machine learning algorithm we can decrease the error rate and costs but improve efficiency."* [Respondent 4]

The respondent continued:

> *"Also, applying machine learning to analyze heterogeneous data can enable us to adapt to the changing environment. For example, if a particular fabric is selected by customers 10 times a day, we store the corresponding amount. While for those colours of fabric that customers click once every 10 days, we do not prepare goods in advance but wait until customers order, then we place an order of material from upstream suppliers."* [Respondent 4]

The comments reveal that using machine learning algorithms gains insights into individual customer demands and market changes and helps to quickly and effectively arranges and adjust modules that can be configured to the products to meet customer needs. Similarly, one respondent comments:

> "It analyses your [customer] personal history, including shopping habits, choices made, etc., to predict your [customer] aesthetics, and it will actively recommend you [customer] styles that match your body and aesthetics; on this basis, you can then choose and combine from various modules, such as detailed decoration and so on. "[Respondent 9]

One respondent mentioned that machine learning could help to optimize and adjusts process modularity in arranging key activities by providing insights and solutions, which would cut cost and time on producing customized products:

> *"The garment production involves designing, purchasing, cutting, sewing, packaging, and delivery. We use machine learning algorithms and other software to control and optimize the process, which is to use machine learning algorithms to optimize the time and control the processing between links; this is it. So, it is related to the application of software. In China, we call it intelligent production."* [Respondent 4]

One comment respondent pointed out the possible role of machine learning in the relations between innovativeness and e-mass customization:

> *"Success depends on the accuracy of market forecasts. Accurate prediction of market and customer preferences leads to their [customers'] satisfaction. Under the influences, including personalized demands, and market trends, forecast accuracy becomes an important task for us. We use machine learning to apply intelligent analysis before production; in doing so, the accuracy of developing products and services increases. It also prevents us from entering the erroneous zone and causing production pressure."* [Respondent 14]

One comment respondent pointed out the possible role of machine learning in the relations between supply chain integration and e-mass customization:

> *"The machine learning system can store individual customer's shopping history, analyze customer's purchasing habits, and then make a corresponding recommendation. it [machine learning system] first recommends the basic style, and then the customer can make a personalized choice after the basic style is determined, such as details such as colours, collar, button, etc."* [Respondent 9]

The manager continued:

> *"In the online sales platform, for example, a basic style and a personalized option are purchased by Tens of millions a day, which means that these orders are the same, and their production process is the same. Our intelligent system can group the same orders and put them into the most suitable partner for production. After production is completed, logistics distribution is carried out. This is intelligent production…very high efficiency"* [Respondent 9]

Mentioning the role of machine learning in the relations between production automation and e-mass customization, respondents also provided some evidence. For instance, one respondent comments:

> *"With the introduction of the system …the production operation process and system are very mature. The flow of information from online to the production, machine, and equipment is very rapid and precise."* [Respondent 6]

The manager further detailed:

For example, we introduce machine learning, and in the future, we will introduce intelligent robots. In the case of such increasingly intelligent development, we will be able to complete the whole process faster and with higher quality in the future. For example, it only takes 3 days to teach you to receive the clothes when you [customer] place an order." [Respondent 6]

The qualitative research revealed that machine learning provides insights which can superior the use of modularity (i.e., product modularity and process modularity), innovation, production automation and supply chain for e-mass customization.

5.2.2.4 Consequences E-mass Customization

One aim of the qualitative research also is to shed light on the role of e-mass customization for company in 4.0 branding stage. The interview results indicate that e-mass customization is an important branding strategy. For example, one interview commented:

"The 4.0 era is an inevitable development trend, and in China, we call 4.0 "Made in China 2025." Looking at home and abroad, including Australia, the UK, and the United States, for example, for a company or a firm to obtain an advantage in the new era, it must capture the needs and mentality of customers, even for well-known brands such as Nike. Suppose a brand adheres to the traditional approach. In that case, its profits will become thinner and thinner because the brand and its competitors have not formed a differentiation, which is when our firm can accomplish a task, and our competitors can also accomplish it. In this way, we will not be competitive. Moreover, if we stick to the tradition, we will not be able to make a profit if something unexpected happens. In order to seek long-term development, our brand has received more orders and turned to focus on customization services for the audiences. We opened an online platform to interact with customers." [Respondent 5]

The respondent continued:

"E-mass customization is not a future trend but an ongoing trend. For companies, developing an e-mass customization strategy can save costs and time more than traditional customization and provide customers with more added value. Our [e-mass customization] aims to provide more personalized options for customers to select, combine, and better meet their personalized needs. When we build a more

personal and deeper connection with our customers, their preference for our brand is created" [Respondent 5]

Similarly, one interviewee mentioned the changes in customer attitudes and needs in the new era and pointed out that implementing e-mass customization is an effective way to cope with the change:

> *"More and more customers feel that: I want to be different; I need to be different; even if I wear the same clothes as others, at least the things embroidered on my sleeves should be unique. What we provide is like to meet their demands like these. On this basis, we launched an E-mass customization program."* [Respondent 8]

Also, one interviewee agreed with the important role of e-mass customization for companies, highlighting that e-mass customization can bring customers personalized products and experiences, which is the core of the 4.0 stage of branding.

> *"Our goal is to meet the personalized needs of users in detail. Accordingly, we need to improve our service. That is to make the clothing shape, color, and printing closer to the real needs of individual users, and make customers truly experience customized services"* [Respondent 7]

At outlined in Chapter 3, this research proposes the possible consequences of e-mass customization. That is, e-mass customization is positively influence a company's brand performance. Findings from the qualitative research reveal that most interviewees support these propositions. Numerous interviewees characterized the consequences of implementing an e-mass customization strategy, such as 'brand reorganization', 'customer loyalty', 'customer stickiness' and 'increasing of profits' and 'increasing the sales of product' etc. For example, one interviewee mentioned:

> *"As customers choose customization, and once they recognize you [the company] as a special brand and are attached to you, they will be loyal or stick to you, then the customer will keep paying attention to product information from you; in terms of profit, as long as you sell more and customers recognize you, your profit will increase, that is for sure."* [Respondent 6]

This view is consistent with the proposed main points of brand performance. Similarly, another respondent supported the proposed linkage, also highlighting that e-mass customization strategy contributes to 'higher profits, 'customer loyalty, 'customer stickiness', and sales volume, which can also be linked to the points of brand performance:

> *"The added values are higher, which contributes to higher profits. These are the returns to our company; it will also increase he/she loyalty towards the brand and make the brand more deeply entrenched. It enhances customer stickiness, as it is more experienced for customers. Our product sales are increasing 30% to 40% annually."* [Respondent 5]

One respondent pointed out the outcomes of implementing an e-mass customization strategy by highlighting the increase in profits, which can be linked to the customer's willingness to pay more in order to do business with us, and the firm gaining of advantageous position in the competition:

> *"And our profits increased from 5% to 15% [...] the profits are 3 times higher them before."* [Respondent 15]

In addition, one interviewee pointed out the points of 'brand recognition and 'customer stickiness' as the positive outcomes of e-mass customization:

> *"In this way, you [customer] will recognize our products more, compared to others compared to other products; and you will feel this brand is more congruent with you. In that case, you will remember our brand and we [the brand] will root deeper in your heart. While in the future, customer stickiness will be higher. Also, it will contribute to brand value, including customer reliability etc."* [Respondent 3]

One interviewee agreed to the proposed linkages, pointing out that brand recognition is the result of implementing an e-mass customization strategy:

> *"Just as he [a customer] was involved in designing his product, he gave emotion, so he had a more emotional connection to the product and the brand. Then we [the brand] is more easily accepted and recognized."* [Respondent 3]

Moreover, another respondent also noted the consequences of implementing e-mass customization, including enhancing ''brand recognition and 'customer loyalty, as well as 'brand differentiation'':

> *"The brand reputation will be improved, and brand recognition will be deeper, which is a plus for the brand. If a brand can achieve personalization, it will certainly make customers more loyal to the brand"* [Respondent 1]

The same interviewee continued pointing out the consequences of it also, including generating brand differentiation, which can be linked to the point of 'firm is an advantageous position in competition':

"If the brand can personalize, brand differentiation will be formed." [Respondent 1]

Similarly, another interviewee, in addition, mentioned that the outcomes of e-mass customization include increased sales volume and also mentioned the points of 'brand differentiation:

"We get a more positive brand impression. Brand differentiation is generating. Sales volume is increasing, which is the basic return." [Respondent 8]

One interview supported the proposed linkage and, in addition to mentioning 'brand recognition, also highlighted the points of customer willingness to make recommendations, which can be linked to

"They recognize the company for sure; he/she [customers] will spread, and recommend his/her friend" [Respondent 12]

Another respondent also, in essence, agreed that e-mass customization has a significant impact on brand performance for branding, emphasizing that the implementation of e-mass customization enhances brand awareness and brand recognition:

Another respondent also, in essence, agreed that e-mass customization has a significant impact on brand performance for branding, emphasizing that the implementation of e-mass customization enhances brand awareness and brand recognition:

"Branding is human-centered. The goal of personalized programs is your [customer] brand recognition. In addition to bringing you affordable products, we consider your emotional and spiritual needs. When you join the design, to define your product, you engage your emotions. When you also approve the final customized product we delivered, compared to other brands, you will be more identified with us. You will feel more attuned to our brand so that you will remember our brand. "[Respondent 13]

One interviewee agreed to the proposed linkages, mentioning the following:

"Branding is human-centered. The goal of personalized programs is your [customer's] brand recognition. In addition to bringing affordable products to you, we consider your emotional and even spiritual needs. You engage your emotions when you join in design to identify your product. When you also approve the final

customized product we deliver, compared to other brands, you will be more identified with us. You will feel more attuned to our brand so that you will remember our brand." [Respondent 7]

In addition, one interviewee commented:

"When the collaborative process brings personalized experience to him [customer], and we deliver high-quality customized products, his impression of the brand is positive. In other words, we give our customer a personalized experience so that the next time he wants to buy a product, he will think of our brand first; In addition, our profit and market share will also increase." [Respondent 4]

Finally, another interviewee mentioned the outcomes, including establishing long-term relationships with customers, and customer willingness to make recommendations, which can be linked to the points of retaining current customers and gaining an advantageous position in the competition, consequently can be linked to positive brand performance:

"Customers will more often interact with us; For example, a customer might ask what we are going to launch the next quarter; after this quarter is over, you [customer] may recommend our brand to friends; then the reputation of our brand will be passed on from one to ten, and ten to one hundred." [Respondent 13]

The primary data analysis clearly supports the relationship between e-mass customization and brand performance. In addition to the finding that is directly linked to the proposed antecedent factors and consequences of e-mass customization, the results of qualitative research provide further findings regarding the contextual factors, including government policy, talents, and international conflict, which are presented in the following sections.

5.2.2.5 Contextual Factors

- ***Government Policy***

In Chapter 2, the research concerned the influences of government policy orientation on enterprises management, strategy and performance. Respondents also revealed this information; for example, one response emphasized government policy support when asked about other factors that could influence e-mass customization:

> *"Yes. Government policy support, including technical support and the firms' attention, is also important. This will attract consumers' attention. This will be easier to handle once consumers pay attention to it."* [Respondent 4]

The same respondent elaborated:

> *"Yes. Government policies support including technical support, and attention from firms themselves are also important. This will attract consumers' attention. Once consumers pay attention to it, this thing will be easier to handle."* [Respondent 4]

The research considers the orientation of government policy to an industry; each company could influence companies' management, strategy formulation as well as achievement. The qualitative data provide supportive evidence for this. One interviewee details the ways that could give support for business after mentioning the importance of government policy support:

> *"We need the government to provide policy support to make our business environment more open. While if central and local governments provide policy support, it will be very beneficial to enterprise, and help enterprise avoid the possible risks of international political instability; Instability of government policies, as well as the instability of the international situation and currency instability, will adversely affect the business."* [Respondent 15]

The interviewee continued with the second way that could give business support:

> *"The government would provide corresponding assistance according to the needs of different enterprises, provide further assistance to some enterprises in specific difficulties, and give these enterprises substantive support. These enable the continuous development of business. For example, in response to the talent shortage problem in enterprises, the government can provide targeted support after understanding each enterprise, like knowing which type of talent in each enterprise is insufficient and how many people are in shortage. The government can classify enterprises according to their scales and needs and provide corresponding support. On the whole, enterprises in Shishi [a city in China] are basically facing the problem of a lack of talent, especially high-level management personnel. From the current point of view, the government's policy support is active and is constantly improving. However, providing support to help a company solve the talent shortage issue is crucial; for example, helping the enterprise retain*

talent is important for companies. Also, government must understand that small and medium-sized enterprises and large enterprises have different talent needs. We need the government to assist in enterprise standardization, modularization, customer information collection and talents; for example, the government supports constructing a comprehensive information platform so that each enterprise can find needed human resources through the platform." [Respondent 15]

- ***Talent***

Talent is proposed as a factor that could influence management, strategy implementation, and firms' performance. The results of interviews provide some evidence for this proposition. For example, one interviewee, when asked about influence factors on e-mass customization, highlighted the point of talent:

> *"We keep looking for more high-tech talents. Moreover, I believe every company needs and is looking for high-tech talents."* [Respondent 14]

Similarly, another interviewee mentioned talent as the influential factor in achieving the principle and the goals of e-mass customization:

> *"Whether a company has capabilities and talents. It needs enterprises to have the capabilities and talents; if an enterprise does not have the capabilities and talents, the company may not be able to carry out this field. So not all companies can do this, you know?"* [Respondent 11]

One respondent emphasized that talent is the key to dealing with technique-related issues in the process, such as design, manufacturing, operation etc., during the implementation of e-mass customization.

> *"Talents, especially professionals, that can provide us with innovation, technical, or management support are what we need."* [Respondent 15]

The interview continued:

> *"Professional, experienced, and supportive Talents are what we keep hunting. These relevant talents will continue consolidating our electronic modules [This brand focuses on smart heating-cooling clothing, adding electronic temperature control equipment to the clothing]. In the second module — electronics production,*

we need to find some senior engineers to work with the experts. Talents are needed in the processes of development and production." [Respondent 15]

- ***International Conflict***

This study proposes that under the influence of international conflict, the execution and effectiveness of the allocated strategy (i.e., e-mass customization) will be hindered. Respondents also raised this point. Managers mentioned that in the conflict situation, cooperation, and import and export, in particular, raw material and customized products, would be greatly hampered, further impacting brand performance negatively. For example, one interviewee mentioned that under the situation of the China-US trade war, the company's strategy execution, operations and performance had been negatively affected:

> *"We worry about the changes in international situations, for example, the trade war between China and America. Many places in the world, like the middle east, are in an unstable situation or facing the problem of currency instability. These will cause negative influences on business."* [Respondent 15]

Another respondent proposed that in an environment of international peace, regional cooperation of enterprises is conducive to reducing production costs on custom products:

> *"There is another one, which is the model of regional cooperation; for example, we have partnerships with different co-operative bases and require one type of material with one certain co-operative base that helps to deduce the costs."* [Respondent 3]

Numerous findings have been extracted from qualitative data. Interviewees largely agreed with the definition of e-mass customization. Most respondents see the concept of e-mass customization as a potent branding strategy for companies the 4.0 branding stage. Supportive evidence for the number of factors (i.e., antecedents) to affect e-mass customization has been found. Moreover, the proposition that e-mass customization is expected to offer beneficial outcomes, specifically to brand performance, is agreed upon by interviewed managers. The fact that machine learning was proposed as a moderator positively affected the relations of the proposed antecedents, and the interviewed manager widely supports e-mass customization.

5.2.3 Summary

This section presents qualitative research findings. First, the qualitative findings provide insights into the theme of e-mass customization, clarifying its concept, construct and role of e-mass customization for companies in branding. In addition, qualitative findings provide insights for links between proposed influence factors and e-mass customization. Overall, the qualitative results reveal the connection between product modularity, supply chain integration, and production automation in e-mass customization. On the other hand, respondents to the qualitative research provide new observations on the linkages between process modularity and e-mass customization and the linkage between innovation and e-mass customization. Also, the qualitative results highlight the importance of machine learning in improving the potential ability of each proposed influence factor to e-mass customization. These findings from qualitative research support the study's feasibility and provide a richer interpretation of the overall results.

5.3 Quantitative Data Analysis

The following section presents the analysis and findings from the main study. In brief, this section comprises 7 parts. Firstly, the information about data characteristics, initial data examination, as well as data preparation are presented. Secondly, scale reliability and exploratory factor analysis (EFA) results are presented. Following by, the results of the confirmatory factor analysis are presented. Finally, the outcome of testing hypotheses used by PLS-SEM and the findings are presented.

5.3.1 Data Set

In the main survey, 1283 questionnaires were sent out, and a total of 129 were returned. The raw data were then imputed into SPSS. After the preliminary confirmation of the quality and completeness of the samples, the respondent's profiles were counted, including their relevant working experience, the degree of their participation in e-mass customization, and the number of employees in their companies (Table 7.1 survey data profile).

In detail, company size was defined in this research based on the number of employees. All types of company sizes are represented in the sample, with 41% for '51-250' employees, 22% for '251-500' employees, and 15% for '10-50'number of employees; in addition, companies with 1,001-3,000 employees accounted for 9%, and companies with less than 10 employees, companies with 3,000-5,000 employees, and companies with more than 5,000 employees accounted for 2%-3%.

Respondents were first asked about working experience in the fashion industry, and the results shows that all respondents have at least one year of work experience. Moreover, most of them have more than three years of working experience relevant to fashion. 19% of respondents have 10 or more years of relevant work experience, the highest proportion among the categories.

Also, the respondents were asked if they had any subordinates, and the results shows that, except for two samples that did not fill in this item, all respondents indicated they have subordinates. More importantly, when asked whether they often participate in the management of e-mass customization, none of the respondents chose "somewhat disagree" or below.

Demographic questions were also sent to respondents on gender, age and education. In general, the sample contains all the categories involved. A full list of the descriptions of sampling data is presented in the following table (Table 5.2).

Table 5.2 Survey data profile

Variable	Subgroup	N	%
Gender			
Male		82	0.64
Female		40	0.31
Do not wish to disclose		7	0.05
Age			
under 25		1	0.01
25-35		33	0.26
35-45		44	0.34
45-55		40	0.31
55 and above		9	0.07
Missing		2	0.02
Years of working on fashion-relevant area			
Less than 1 year		0	0.00
1-3years		10	0.08
3-5years		23	0.18
5-7years		20	0.16
7-10years		20	0.16
10-13years		22	0.17

12-15years		9	0.07
Over 10years		24	0.19
Missing		1	0.01
Years of working on company, currently			
Less than 1 years		4	0.03
1-3years		15	0.12
3-5years		25	0.19
5-7years		27	0.21
7-10years		24	0.19
Over 10 years		32	0.25
Missing		2	0.02
Numbers of employees in the company at the moment			
Less than 10		3	0.02
10--50		19	0.15
51-250		53	0.41
251-500		28	0.22
501-1000		8	0.06
1001-3000		11	0.09
3001-5000		2	0.02
More than 5000		4	0.03
Missing		1	0.01
Subordinates you have			
Yes		127	0.98
No		0	0.00
Missing		2	0.02
Regularly involved in the management of e-mass customization program			
Strongly disagree		0	0.00
Disagree		0	0.00
Somewhat disagree		0	0.00
Neutral		15	0.12
Somewhat agree		41	0.32
Agree		44	0.34
Strongly agree		27	0.21

Missing		2	0.02
Level of education			
Below Undergraduate Level		31	0.24
Undergraduate		72	0.56
Master		10	0.08
MBA		2	0.02
PhD		10	0.08
Missing		4	0.03
Total		129	100.00

5.3.2 Data Cleansing

Before further multivariate analysis, initially exanimating data is crucial and necessary, which can help examine and identify potential violations of underlying assumptions associated with applying multivariate techniques (Neale, 2006; Hair et al., 2007). This paper examines the collected data in several ways. Outliers and non-response bias were examined first, followed by normality, outliers, and multicollinearity were evaluated.

5.3.2.1 Out-of-Range Values

The first step of examining data is checking out-of-range values to avoid data entry errors. All samples were entered in SPSS, and frequencies were obtained. The results showed there were no out-of-range values occurred in the dataset.

5.3.2.2 Missing Data

Hair et al. (2007) mentioned that the number of missing values and possible patterns of missing values could threaten the generalizability of research findings; thereby, the missing values should be evaluated first.

However, the technical aspect of the online-based questionnaires enabled no missing values. When designing the questionnaire, the 'Save' option can only be validated when the respondent has completed all the relevant questions.

5.3.2.3 Non-response Bias

Non-response bias can limit the generalizability of data to the population (Churchill Jr and Iacobucci, 2004). Researchers assess whether non-response bias occurs through, for instance, whether there is a substantial difference between respondents and non-respondents or a difference between early respondents and late respondents. The main survey for this study lasted 4 months; therefore, the samples were divided into two groups, i.e., 'early respondent' (69 samples in total) within the first 2 months and 'late responders' (61 samples in total) within in later 2 months. SPSS performed T-test, and the results p-value of 0.236 reveals no significant errors between early and late respondents. Secondly, cold-calling was given to those who did not respond. The reasons for not participating are on a hectic schedule but not because of non-intertest to the survey. In brief, the results indicated that non-response bias did not occur. The table below (table 5.2) shows the results of the t-tests.

5.3 Results of non-response bias

time	mean	Standardized deviation	*t*	*p*	Cohen d
Early	5.53	0.75	1.192	0.236	0.210
Late	5.37	0.75	1.192	0.236	0.210

5.3.2.4 Normality Tests and Outliers

To further cleanse the collected data, the author assessed outliers (by examining standard scores and Cook's Distance) as well as normality (by observing Q-Q Plots and examining Skewness and Kurtosis, Kolmogorov-Smirnov and Shapiro-Wilks).

- ***Outliers***

Outliers are the observations that differ from most observations (Churchill Jr. and Iacobacci, 2004). Investigating special cases is important for initial data examination because they may distort the statistical tests (Hair et al., 2007). In this research, standard scores (Z-scores), as well as Cook's Distance, are tested in order to identify univariate outliers and multivariate outliers.

Firstly, frequency tables were first tabulated for all variables to analyse values outside the range for each variable initially; no values outside the range were identified. All data values were converted into Standard Scores, i.e., Z-scores. It is suggested that in the case of samples with 80 or more, the value of Z-scores greater than ± 3.26 may be considered outliers (Hair et al., 2007). Moreover, the performed Z-score shows two potential univariant outliers with results of -4.40 and -3.39. As the results of the Z-scores of these two cases are not exceedingly distant from the standard ± 3.26, the boxplots are checked in order to observe these two cases further; it is found that the two identified cases are represented by circles in boxplots, indicating that there is no sufficient to prove these two observations are truly aberrant (Pallant, 2006; Hair et al., 1998). Accordingly, these two cases were retained.

Cook's Distance was checked as it reflects the effect of each sample on the regression model. It is mentioned that the sample would greatly influence the model when the value of Cook's Distance is large. When the critical value of Cook' Distance is more significant than 0.5, the sample could be considered an outlier. In this research, the value of Cook's Distance is 0.12, under the critical threshold of 0.5, indicating that no sample is identified as an outlier in the collected data.

- ***Normality***

Normality refers to "an individual metric variable and its correspondence to the normal distribution" (Hair et al., 2007). In this research, both visual technique and statistical techniques are used to check univariate normality and multivariate.

In the first stage, univariate normality was checked. The graphics — histogram and normal probability plot (Q-Q Plots) were performed, and by comparing the observations with the expected data of normal distribution, no deviations in the variable were found. Secondly, to further assess possible deviation from univariate normality, Skewness and Kurtosis were performed. The scores of Skewness and Kurtosis exceeding a critical value of ±2.58 (0.01 significance level) are the deviation from a normal distribution (Hair et al., 2007). The result of Skewness and Kurtosis at the item and construct levels are within the critical value (Table 5.4.1 and Table 5.4.2), indicating that the observed data are normally distributed.

Table 5.4.1 Results of Skeweness and Kurtosis results at the item level

Item	N	Minimum	Maximum	Mean	Std. Deviation	Skewness	Kurtosis
PdM1	129	2	7	5.50	1.10	-0.69	-0.23
PdM2	129	2	7	5.57	1.03	-0.75	0.10
PdM3	129	3	7	5.62	0.99	-0.63	-0.16
PdM4	129	3	7	5.71	0.96	-0.60	-0.34
PcM1	129	4	7	5.60	0.96	-0.42	-0.78
PcM2	129	2	7	5.71	0.98	-0.97	1.01
PcM3	129	2	7	5.62	0.99	-0.87	0.56
PcM4	129	2	7	5.52	1.09	-0.60	-0.27
PA1	129	1	7	5.32	1.11	-0.49	0.29
PA2	129	1	7	5.40	1.14	-0.91	0.97
PA3	129	1	7	5.37	1.19	-0.95	1.30
PA4	129	1	7	5.41	1.07	-0.61	0.90

PA5	129	1	7	5.44	1.17	-0.59	0.21
PA6	129	1	7	5.26	1.18	-0.73	1.03
PA7	129	1	7	5.39	1.14	-0.49	0.21
Innov1	129	3	7	5.62	0.99	-0.49	-0.64
Innov2	129	4	7	5.67	0.98	-0.48	-0.74
Innov3	129	4	7	5.59	0.99	-0.33	-0.92
Innov4	129	3	7	5.60	0.98	-0.50	-0.59
Innov5	129	2	7	5.55	0.99	-0.80	0.15
Innov6	129	4	7	5.45	0.99	-0.27	-1.09
SCI1	129	2	7	5.49	1.18	-0.51	-0.40
SCI2	129	3	7	5.59	1.15	-0.33	-1.13
SCI3	129	3	7	5.80	1.00	-0.62	-0.43
SCI4	129	4	7	5.94	0.99	-0.81	-0.29
ML1	129	2	7	5.05	1.15	0.04	-0.57
ML2	129	2	7	4.91	1.10	0.01	-0.30
ML3	129	2	7	4.97	1.02	0.15	-0.62
ML4	129	3	7	5.24	1.09	0.02	-1.07
ML5	129	2	7	5.12	1.08	-0.17	-0.39
ML6	129	1	7	4.98	1.05	-0.24	0.69
ML7	129	2	7	5.36	1.11	-0.24	-0.75
ML8	129	2	7	5.29	1.18	-0.28	-0.62
ML9	129	2	7	5.33	1.14	-0.14	-0.89
EMC1	129	2	7	5.16	1.30	-0.49	-0.44
EMC2	129	2	7	5.46	1.15	-0.69	0.01
EMC3	129	2	7	5.28	1.08	-0.17	-0.72
EMC4	129	2	7	5.30	1.08	-0.37	-0.52
BP1	129	2	7	5.16	1.07	-0.28	-0.69
BP2	129	3	7	5.66	0.93	-0.68	-0.20
BP3	129	4	7	5.66	0.91	-0.55	-0.46
BP4	129	4	7	5.59	0.96	-0.34	-0.82
BP5	129	3	7	5.57	1.01	-0.50	-0.78

Table 5.4.2 Results of Skeweness and Kurtosis results at the construct level

variable	N	Minimum	Maximum	Mean	Std. Deviation	Skewness	Kurtosis
PdM	129	2.750	7.000	5.597	0.876	-0.473	0.011
PcM	129	3.000	7.000	5.612	0.892	-0.490	-0.171
PA	129	1.000	7.000	5.371	0.992	-0.664	1.558
Innov	129	4.000	7.000	5.581	0.853	-0.301	-0.638
SCI	129	4.000	7.000	5.704	0.939	-0.236	-0.870
ML	129	2.000	7.000	5.140	0.926	-0.107	-0.052
EMC	129	3.000	7.000	5.298	0.948	-0.098	-0.750
BP	129	3.600	7.000	5.526	0.831	-0.427	-0.493

In addition, the Kolmogorov-Smirnov and Shapiro-Wilks tests were performed to evaluate the normality (Hair et al., 2007). The results of the Kolmogorov-Smirnov and Shapiro-Wilks statistical tests ($p < 0.05$) indicate that the variable violates the normal distribution. However, 'the statistical assumption will ever be met in a strict sense" (Bagozzi and Yi, 1988); more importantly, 'striking a balance between the need to satisfy the assumptions versus the robustness of the technique and research" (Hair et al., 2007) Appendix 3 shows the full results of Kolmogorov-Smirnov test and Shapiro-Wilks test.

- ***Multicollinearity***

Multicollinearity is the relationship between more than two independent variables (Hair et al., 2007). The existence of multicollinearity between variables can have a substantive effect on multivariate analysis (Hair, 2007). The high collinearity can confound the contribution of independent variables, and the result of the size of the correlation coefficient may be limited (Hair et al., 2007). In other words, the statistical results may become less credible if influenced by high collinearity (Tabachnick and Fidell, 2007).

In order to diagnose multicollinearity, the variance inflation factor (VIF) is examined by SPSS. The VIF, above the critical value of 10, indicates high collinearity. The results of VIF show that the highest VIF is 4.072, the value obtained for process modularity, which is still far below the threshold value of 10. This suggests that multicollinearity is not a severe problem in this research. The details of the results of VIF are shown in Table 5.5.

Table 5.5 Results of Variance inflation factor (VIF) test

	B	Std. Error	*β*	*t*	*p*	Tolerance	VIF
(Constant)	0.692	0.322		2.148	0.034		
PdM	0.063	0.092	0.067	0.688	0.493	0.288	3.472
PcM	0.000	0.098	0.000	-0.003	0.998	0.246	4.072
PA	-0.010	0.066	-0.012	-0.149	0.882	0.431	2.318
Innov	0.463	0.098	0.475	4.744	<.001	0.270	3.697
SCI	0.219	0.073	0.248	3.003	0.003	0.398	2.512
EMC	0.185	0.072	0.211	2.547	0.012	0.396	2.523
ML	0.080	0.076	0.089	1.053	0.294	0.378	2.645

Dependent variable: brand performance

5.3.3 Data Simplification

The sampling data were further purified after preliminary cleansing. The internal consistency was examined to assess the reliability, and then the unidimensionality of the measurement scale was tested by exploratory factor analysis (CFA) and confirmatory factor analysis.

5.3.3.1 Reliability Analysis

Scale reliability is a very important measurement, as it is necessary for validity (Hair et al., 2007; Hair et al., 2011). It is suggested to use multi-item scales to increase the reliability of scales by "allowing measurement errors to cancel out against each other" (Peter, 1979). In other words, measure items should share a common core and be distinctive to each other (Anderson and Gerbing, 1984; Netemeyer et al., 2003). The classic theory emphasizes rigor of scale reliability and internal consistency as one way to assess scale reliability (DeVellis, 2003); when the sample size is limited, testing internal consistency is suggested as an effective method to assess scale reliability (Hair et al., 2007).

Cronbach's Alpha and Corrected Item-Total Correlation were performed to assess internal consistency; and it is suggested that when Cronbach's Alpha value is greater than 0.7(Nunnally, 1978; Bryman and Cramer, 2012; Hair et al, 2007), and Corrected Item-Total Correlation exceeded than 0.35 (Bearden et al., 2001) should have satisfactory internal consistency.

In detail, regarding the construct of product modularity, the Cronbach's alpha value of 0.879 exceed the threshold of 0.8, and the value of Corrected-Item-Total Correlation is well above the threshold of

0.35, indicating a satisfactory internal consistency and the reliability of the listed multi-item scales.

Regarding the construct of process modularity, the result of Cronbach's alpha is 0.910, which is higher than the threshold of 0.8, and the results of the Corrected-Item-Total Correlation exceeded 0.35, reflecting an internal consistency and reliability of the listed multi-item scales.

The result of Cronbach's alpha for the construct of innovativeness is 0.932, which is well higher than the critical value of 0.8. In addition, the results of the Corrected-Item-Total Correlation all exceed the threshold of 0.35. Accordingly, the listed multi-item scales for innovativeness have internal consistency and reliability.

Regarding supply chain integration, the test result of Cronbach's alpha is 0.889, and the values of Corrected-Item-Total Correlation exceed 0.35, indicating that listed multi-item scales for supply chain integration have internal consistency hand reliability.

The results of Cronbach's alpha and Corrected Item-Total Correlation on production automation are all well-exceeded thresholds. Thereby, listed multi-item scales for production automation have internal consistency and reliability.

In terms of machine learning, the result of Cronbach's alpha is 0.948, which is way above the critical value of 0.8; in addition, the Corrected Item-Total Correlation exceed 0.35, reflecting an internal consistency and reliability of the listed multi-item scales.

Regarding e-mass customization, the test result of Cronbach alpha is 0.838, which exceeds the critical value of 0.8, and the results of Corrected Item-Total Correlation are above the critical value of 0.35, indicating that the listed multi-item scales for supply chain integration have internal consistency hand reliability.

Finally, the test result of Cronbach alpha for the construct of brand performance 4.0 is 0.904, over the threshold of 0.8, and the Corrected Item-Total Correlation all exceed the threshold of 0.35, reflecting an internal consistency and reliability of the listed multi-item scales.

Overall, results show that Cronbach alpha values for all the constructs exceed 0.8 (0.838 - 0.948); and Corrected-Item-Total Correlation is well above the threshold of 0.35. This demonstrates satisfactory internal consistency, also the reliability of the listed multi-item scales. Table 5.6 presents the results of Cronbach alpha and Corrected Item-Total Correlation of all constructs.

Table 5.6 The results of Cronbach alpha and Corrected Item-Total Correlation

Construct	Item	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted	Cronbach α
Product Modularity	PdM1	0.767	0.834	0.879
	PdM2	0.756	0.838	
	PdM3	0.741	0.844	
	PdM4	0.695	0.861	
Process Modularity	PcM1	0.805	0.880	0.910
	PcM2	0.771	0.891	
	PcM3	0.821	0.874	
	PcM4	0.791	0.886	
Innovation	Innov1	0.84	0.914	0.932
	Innov2	0.786	0.921	
	Innov3	0.783	0.922	
	Innov4	0.788	0.921	
	Innov5	0.828	0.916	
	Innov6	0.774	0.923	
Supply Chain Integration	SCI1	0.685	0.888	0.889
	SCI2	0.798	0.841	
	SCI3	0.780	0.850	
	SCI4	0.784	0.849	
Production Automation	PA1	0.835	0.935	0.945
	PA2	0.783	0.939	
	PA3	0.771	0.940	
	PA4	0.845	0.934	
	PA5	0.825	0.936	
	PA6	0.822	0.936	
	PA7	0.836	0.935	
Machine Learning	ML1	0.825	0.940	0.948
	ML2	0.808	0.941	
	ML3	0.814	0.941	
	ML4	0.822	0.940	
	ML5	0.802	0.941	

	ML6	0.720	0.945	
	ML7	0.814	0.941	
	ML8	0.746	0.945	
	ML9	0.801	0.941	
E-mass Customization	EMC1	0.678	0.795	0.838
	EMC2	0.648	0.805	
	EMC3	0.659	0.801	
	EMC4	0.709	0.780	
Brand Performance 4.0	BP1	0.589	0.923	0.904
	BP2	0.809	0.873	
	BP3	0.771	0.882	
	BP4	0.844	0.865	
	BP5	0.819	0.870	

5.3.3.2 Exploratory Factor Analysis (EFA)

Exploratory factor analysis (EFA) was employed as new measurement scales were developed through a qualitative phase of this research, as exploratory factor analysis helps to achieve unidimensionality of the constructs and to obtain a more manageable number of items (Netemeyer et al., 2003; Hair et al., 2007).

It is mentioned that exploratory factor analysis is usually divided into several steps: determining the appropriateness of the samples; determining the feasibility of factors; determining the factor extraction method; determining the factor rotation method; and performing exploratory factor analysis and evaluating the critical value, Cronbach's alpha to filtrate the factor (Netemeyer et al., 2003; Hair et al., 2007).

According to this, the basic assumption was checked at first. Nunnally (1994) suggested a minimum sample of 100. In this research, 129 samples were gained, which satisfied the requirement. Moreover, Nunnally (1994) recommended that the ratio of samples to observations was at least 10:1. In addition, it is mentioned that when the ratio of samples to the observation is large, the results tend to be stable (Hair et al., 2007; Netemeyer et al., 2003). In this research, each variable with its scales performs exploratory factor analysis, respectively, as the ratio between the samples to observations of each variable satisfy 10:1, which helps to gain relatively stable results.

Before performing exploratory factor analysis, Kaiser-Meyer-Olkin Measure of Sampling Adequacy (KMO), as well as Bartlett's Test of Sphericity (BTS), were exanimated in order to assess whether factor analysis is appropriate for data (Hair et al., 2007). It is suggested that when the value of KMO exceeded the threshold of 0.8, indicating the measurement scales are feasible for exploratory factor analysis, and on the other hand, when the value of BTS reaches a significant level ($p<0.05$), indicating the common factor is found among the measurement scales (Field 2009; Hair et al., 2007). When the value of KMO and BTS exceeds the critical value, performing factor analysis will be appropriate for the set factors (Hair et al., 2007).

Before performing exploratory factor analysis, the researcher has to decide which method to use to extract factors. There are three main factor extraction methods: Principal Component Analysis (PCA), Common Factor Analysis and Maximum Likelihood Estimation Method. Since the aim is to identify the minimum number of factors and to minimize the number of items, which is consistent with the principal component analysis that focuses on identifying underlying factors or dimensions that occurred in the measurements (Hair et al., 2007) and can reduce large numbers of variables to small numbers of component (Tabachnick and Fidell, 2007), Accordingly principal component analysis is adopted.

Subsequently, the type of factor rotation was decided since the objective of performing factor rotation is to implement simpler and theoretically more meaningful factor solutions (Hair et al., 2007). There are two types of factor rotation: orthogonal factor analysis and oblique factor analysis (Hair et al., 2007). In the case of oblique factor analysis, there is no overlap (unrelated) between factors when rotated (Hair et al., 2007). In addition, three methods are included in orthogonal factor rotation, including Varimax, Quartimax and Equamax. Varimax minimizes the number of variables with the highest load on each factor; Quartimax minimizes the number of factors to be interpreted in each variable, while Equamax maximizes the load variation in both factors and variables. Concerning oblique rotation, there are two methods included, Direct Oblimin and Promax. Direct Oblimin minimizes the cross-products of factors, while Promax takes the results of Varimax and then performs the oblique rotation axis to find the correlations between factors. In this research, since the underlying factors are not a priori considered to be related, the orthogonal factor rotation is applied, and the Varimax method is used.

Following by, EFA is performed using SPSS, and Cronbach's alpha as the critical value is checked. The items that have the value of Cronbach's alpha higher than 0.7 were kept (Hair et al., 2007; Bryman and Cramer, 2011). The details of factor scale for each variable will be discussed below.

Product Modularity: Firstly, Kaiser-Meyer-Olkin's sampling adequacy measure and Bartlett's Sphericity Test are examined. The result of KMO is 0.808, which is greater than the threshold of 0.8, and the result of KMO exceeded the threshold ($p<0.01$ for PdM), indicating that the scales are preferable to conduct exploratory factor analysis.

Concerning exploratory factor analysis for product modularity, the Cronbach alpha for each factor of product modularity is above the threshold of 0.7., (i.e., the results of Cronbach's alpha are 0.875, 0.867, 0.859, and 0.826 for PdM1, PdM2, PdM3, and PdM4), which indicate that the unidimensionality of set factors is identified in the variable of product modularity. Thereby, every factor is kept from the established scale. Table 6.6.1 shows the result of KMO, BTS, and EFA for Product Modularity. Firstly, both Kaiser-Meyer-Olkin measure of sampling adequacy and Bartlett's Test of Sphericity are examined. As The results of KMO is 0.808 which is greater than the threshold of 0.8, and the result of KMO exceeded the threshold ($p<0.01$ for PdM) indicating that the scales are preferable to conduct exploratory factor analysis.

With regard to exploratory factor analysis for product modularity, the Cronbach alpha for each factor of product modularity is above the threshold of 0.7., (i.e., the results of Cronbach's alpha are 0.875, 0.867, 0.859, and 0.826 for PdM1, PdM2, PdM3, and PdM4), which indicate that the unidimensionality of set factors are identified in the variable of product modularity. Thereby, no factor was dropped from the established scale. The Table 5.7.1 shows the result of KMO, BTS, and EFA for Product Modularity.

Table 5.7.1 Final KMO results, BTS results and EFA results for product modularity

Kaiser-Meyer-Olkin Measure of Sampling Adequacy		0.808
Bartlett's Test of Sphericity	Approx. Chi-Square	266.62
	df	6
	Sig.	<.001
Final EFA Results for PdM		
The use of interchangeable components or units which allow to be combined/arranged into different end-product		
PdM1 Product can be decomposed into separate modules that can be re-combined into new designs		0.875
PdM2 We can make changes in the key components without redesigning others		0.867
PdM3 Product components can be reused in various products		0.859

PdM4 We have a high degree of component between different products	0.826

Process Modularity:

The Kaiser-Meyer-Olkin Measure of Sampling Adequacy test result is 0.829, which exceed the suggested threshold. Conversely, Bartlett's Test of Sphericity value is less than 0.01, indicating that the factors analysis is appropriate for process modularity.

Regarding exploratory factor analysis, the value of Cronbach's alpha for PcM1 is 0.894; the value for PcM2 is 0.873; the value for PcM 3 and PcM4 is 0.902 and 0.884, respectively. According to this, the process modularity is determined to have 4 items scale after exploratory factor analysis. Table 5.7.2 shows the KMO, BTS, and EFA results for Product Modularity.

Table 5.7.2 The KMO results, BTS results and EFA results for process modularity

Kaiser-Meyer-Olkin Measure of Sampling Adequacy		0.829
Bartlett's Test of Sphericity	Approx. Chi-Square	344.394
	df	6
	Sig.	<.001
The EFA Results for PcM		
Decomposing key activities of the production process into modular routines which allow to be combined or frequent re-configuration		
PcM1 Our process can be adjusted by adding new process modules		0.894
PcM2 Process modules can be adjusted for changing production needs		0.873
PcM3 Our process can be broken down into standard sub-processes that produce standard base units and customization sub-processes that further customize the base units		0.902
PcM4 Process modules can be rearranged so that customization sub-processes occur last		0.884

Innovativeness: Concerning the variable of innovativeness, both the results of the Kaiser-Meyer-Olkin Measure of Sampling Adequacy (KMO=0.886) and the results of Bartlett's Test of Sphericity ($P<0.01$) reached the critical threshold.

Next, the factors are assessed by exploratory factor analysis; the results of Cronbach's alpha for each factor exceeds the threshold of 0.8, indicating the unidimensionality of the factor. The table below (Table 5.7.3) shows the results of KMO, BTS, and EFA for factors of innovativeness.

Table 5.7.3 Final KMO results, BTS results and EFA results for innovativeness

Kaiser-Meyer-Olkin Measure of Sampling Adequacy		0.886
Bartlett's Test of Sphericity	Approx. Chi-Square	612.098
	df	15
	Sig.	<.001
The EFA Results for Innovativeness		
Keep forward thinking on resource updating and creation		
Innov1 We actively engage in wide search for new idea		0.894
Innov2 We carefully think through how new ideas need to be adapted for our business		0.854
Innov3 We have a good system for identifying, selecting and implementing innovation on a regular basis		0.851
Innov4 Compared with competitors, we have a high rate of product/service innovation		0.855
Innov5 Compared with competitors, we have a high rate of process/organization improvement		0.884
Innov6 Over time, we have been successful with overall innovation in recent years		0.845

Production Automation: About the variable of production automation, both the results of Kaiser-Meyer-Olkin Measure of Sampling Adequacy (KMO=0.925) and Bartlett's Test of Sphericity ($p<0.01$) exceed the critical values, thereby the factors then get evaluated by exploratory factor analysis.

The results of Cronbach's Alpha for each factor of production automation are greater than the critical value of 0.8. they are indicating the unidimensionality of the factor. According to this, the seven-factor scale is kept. The table below (Table 5.7.4) present the result of the results of the KMO and BTS, and EFA for factors of production automation.

Table 5.7.4 Final KMO results, BTS results and EFA results for production automation

Kaiser-Meyer-Olkin Measure of Sampling Adequacy		0.925
Bartlett's Test of Sphericity	Approx. Chi-Square	775.444
	df	21
	Sig.	<.001
The EFA Results for Production Automation		

The application of mechanical, electronic and computer-based technology to production process	
PA1 We automate production scheduling in our company	0.884
PA2 We automate operational management in our company	0.842
PA3 We automate the release of production orders	0.831
PA4 We automate order progress controlling	0.891
PA5 We automate real-time order status	0.875
PA6 We automate activities controlling the physical equipment in the shop floor	0.87
PA7 We automate the execution of production operations	0.883

Supply Chain Integration: The variable of supply chain integration initially consists of a 4-factor scale. The 4-factor scale was first checked by Kaiser-Meyer-Olkin and Bartlett's Test of Sphericity. The results on both (KMO=0.812; P<0.01) exceed the critical threshold.

Following, the 4-factor scale is evaluated by exploratory factor analysis, and the results of Cronbach's alpha for SCI (0.81), SCI 2 (0.892), SCI 3 (0.887) and SCI 4 (0.889) are greater than the threshold of 0.8. According to this, no factor is dropped from this step. Table 5.7.5 shows the results of EFA for production Supply Chain integration.

Table 5.7.5 Final KMO results, BTS results and EFA results for supply chain integration

Kaiser-Meyer-Olkin Measure of Sampling Adequacy		0.812
Bartlett's Test of Sphericity	Approx. Chi-Square	308.314
	df	6
	Sig.	<.001
The EFA results for Supply Chain Integration		
Integration of upstream and downstream suppliers into the supply chain practices		
SCI1 Our company exchanges information with channel partners on various supply chain activities		0.811
SCI2 Our company collaborates with channel partners in designing plans		0.892
SCI3 Our company automates supply chain processes with channel partners		0.887

SCI4 Our company establishes long-term relationships with channel partners to achieve strategic goals	0.889

Machine Learning: First, the Kaiser-Meyer-Olkin Measure of Sampling Adequacy and Bartlett's Test of Sphericity were checked to evaluate whether the factors are appropriate for exploratory factor analysis. The result of KMO is 0.916, and the result of BTS is less than 0.01, which indicates that the factors are preferable for exploratory factor analysis.

The critical value of Cronbach's alpha was checked, and the test results all exceed the critical threshold, indicating that the 9-factor scale is appropriate for the variable of machine learning. Table 5.7.6 shows the KMO, BTS and EFA results for Machine Learning.

Table 5.7.6 Final KMO results, BTS results and EFA results for machine learning

Kaiser-Meyer-Olkin Measure of Sampling Adequacy		0.916
Bartlett's Test of Sphericity	Approx. Chi-Square	1060.505
	df	36
	Sig.	<.001
The EFA results for Machine Learning		
An algorithm-based computer system systems capable of providing deep insights for performing tasks through autonomous learning		
ML1 We adopt machine learning to help optimize production from a fundamental level		0.869
ML2 We adopt machine learning to help find solutions to difficult question		0.855
ML3 We adopt machine learning to help obtain and present solutions		0.859
ML4 We apply machine learning system to optimize scheduling of machine time for production line operations		0.866
ML5 We apply machine learning to help manage produced diagnostic and prognostic knowledge at all levels of the manufacturing system		0.848
ML6 We apply machine learning to help extend the life of manufacturing equipment		0.777
ML7 We adopt machine learning to support to address the administration of large amount of data		0.853
ML8 We adopt machine learning to support the storing of large amounts of critical data in the cloud		0.797

ML9 We adopt machine learning to support the real time access of resources	0.843

E-mass customization: The factor scale for e-mass customization first were evaluated by the value of the Kaiser-Meyer-Olkin Measure of Sampling Adequacy and Bartlett's Test of Sphericity. The result of KMO is 0.752, which is close to 0.8. The result of KMO higher than 0.7 still indicates that performing factor analysis for the data is acceptable; moreover, the result of BTS is less than 0.01. suggesting that the correlation matrix is not an identity matrix (Hair et al., 2007; Bryman & Cramer, 2011)

The Cronbach's alpha for EMC1, EMC2, EMC3, and EMC4 are 0.824, 0.798, 0.818 and 0.850, respectively. The results show that the 4-factor analysis is appropriate for the variable mass-customized products. The table below (Table 5.7.7) presents the results of KMO, BTS and EFA for mass-custom production.

Table 5.7.7 Final KMO results, BTS results and EFA results for E-mass customization

Kaiser-Meyer-Olkin Measure of Sampling Adequacy		0.752
Bartlett's Test of Sphericity	Approx. Chi-Square	210.376
	df	6
	Sig.	<.001
The EFA results for Mass-Custom Production		
A strategy that includes processes of co-design activity and mass-custom production, in order to bring customers a personalized experience and products at a reasonable price and within a short waiting time		
EMC1 We have the ability to produce highly differentiated products without increasing costs, significantly		0.824
EMC2 We have the ability to increase product variety without diminishing production volume		0.798
EMC3 We have the ability to reorganising production process quickly in response to customization products		0.818
MCP4 We have the ability to support user-friendly co-design activity for customer to identify their own products		0.850

Branding performance: Firstly, the factors for brand performance pass the test of Kaiser-Meyer-Olkin Measure of Sampling Adequacy (i.e., the value of KMO is 0.862) and Bartlett's Test of

Sphericity ($p<0.01$), indicating that the factors are preferable for exploratory factor analysis.

Following, the items are evaluated by exploratory factor analysis. The results for BP1, BP2, BP3, BP4 and BP5 were 0.708, 0.899, 0.886, 0.911 and 0.896, respectively, indicating that the set five factors as measurements for brand performance are suitable. The table below (Table 5.7.8) presents the results of KMO, BTS and EFA for brand performance.

Table 5.7.8 Final KMO results, BTS results and EFA results for brand performance

Kaiser-Meyer-Olkin Measure of Sampling Adequacy		0.862
Bartlett's Test of Sphericity	Approx. Chi-Square	446.613
	df	10
	Sig.	<.001
The EFA results for Brand Performance		
The value that a company gains from its investments on branding, from which the company can maintain competitive positions in marketplace.		
BP1 Relative to our competitors, our customers are willing to pay more in order to do business with us		0.708
BP2 Our customers plan to continue the business relationship, with us for a long time		0.889
BP3 Our brand has built strong customer brand loyalty		0.866
BP4 Our brand is at an advantageous position in comparison to competition		0.911
BP5 Our brand is successful in retaining current customers		0.896

In brief, Kaiser-Meyer-Olkin test, Bartlett's Test of Sphericity test, and Exploratory Factor Analysis on the proposed structure of the scale were conducted, to evaluate the reliability of the proposed scale for its structure. The results indicate that the proposed item scales are reliable for their corresponding constructs. The next chapter mainly introduces the results of Confirmatory Factory analysis for the validity of the measurement scales to their corresponding constructs.

5.3.3.3 Confirmatory Factor Analysis (CFA)

Exploratory factor analysis (EFA) and confirmatory factor analysis is used to test the validity of scales. By finding common factors by observing the correlation coefficient or covariance between variables, both methods achieve dimensionality reduction (Churchill, 1979). EFA can develop relevant scales through data analysis, while CFA can determine the most effective scale structure with a theoretical basis (Churchill, 1979; Anderson et al., 1987). It is suggested to combine EFA with CFA to deepen the analysis for validating the measurement scale (Churchill, 1979). Although previous theoretical foundations support the scales for variables, some new measurements occur in a few variables from the face validity test. Although it is suggested to splitting the data into two parts and performing the EFA test on one and the CFA test on the other, in the face of smaller samples, it is feasible to analyze the same set of data in combination with EFA and CFA to evaluate the validity of the scale. Thereby, the EFA is used, followed by CFA is performed to test whether the number of factors is consistent with the expectations.

CFA is a technique usually used to "confirm an a priori hypothesis about the relationship between a set of measurement items and their respective factors" (Netemeyer et al., 2003, p148). Compared with EFA, CFA confirms the unidimensionality of constructs by detecting whether the measurement items have significant loading with respective factors while having no loading with other factors (Churchill, 1979). In this research, Mplus software was used for confirmatory factor analysis, including the ratio of chi-square (χ^2) to degrees of freedom (*df*), RMSEA (Root Mean Square Error of Approximation), CFI (comparative fit index), TLI (Tucker-Lewis Index) and SRMR (standard Root Mean-Square Residual) were performed to assess the validity of scales.

Firstly, the goodness-of-fit test measures the ratio of chi-square to the degree of freedom. Chi-square statistic reflects the degree of deviation between the actual value of observation and the expected value, while the degree of freedom reflects the complexity of the model (Churchill, 1979; Joreskog and Sorbom, 1996; Lee, 2001). Their ratio is used to evaluate the probability of the correctness of the measurement model (Lee, 2001). It is suggested that the value of χ^2/df is under 3, representing the measurement scales that 'fit well', and the value of χ^2/df is under 5, representing acceptable set measurement scales. In this study, the results of the χ^2/df are all under 5, and except for MCP (the value of χ^2/df is 4.193), all the values of χ^2/df are under 3. It indicates that all the set measurement scales are well fit.

Subsequently, RMSEA was performed. The closer the RMSEA is to 0, the better the measurement items fit the respective factor, and a value of RESEA less than 0.08 represents the set measurement scales is acceptable. In this research, the RMSEA values are less than 0.05, indicating a high degree of fit between measurement items and respective factors.

Following, CFI was tested by Mplus software. All the results of the CFI value are between the critical value, i.e., 0.9 to 1. Hair et al. (1998), Bentler (1990), and Hu and Bentler (1999) suggested that when the value of CFI is closer to 1, the better fit between measurement scales and the respective factor and the threshold of 'well fit' is 0.9. The results of CFI values exceed the threshold values, indicating that the established measurement scales for respective factors are feasible.

TLI index is also checked as one of the comparative fitting indexes. The closer the TLI value is to 1, the higher the fitting degree of the measurement scales to respective factors are (Hair et al., 1998). In this research, the results of TLI value are all greater than 0.9, which exceed the recommended threshold, and represents a 'good fit.

In addition, SRMR was also performed. It can be claimed that the construct is correct when the SRMR value is under 0.05 (Hair et al., 1998). In this study, the results of SRMR values are all less than the threshold of 0.05.

Overall, the unidimensional nature of the established scale was affirmed, as the performed value of χ^2/df, CMSEA, CFI, TLI, and SRMR all pass the threshold that represents a good fit between representative scales and measurement factors. The table below (Table 5.8) presents all the EFA results.

Table 5.8 Results of EFA

	χ^2/df	RMSEA	CFI	TLI	SRMR
PDM	0.713	0.001	1.000	1.006	0.008
PCM	1.362	0.053	0.999	0.994	0.007
PA	1.785	0.078	0.987	0.979	0.022
INNOV	1.239	0.043	0.997	0.994	0.017
SCI	0.272	0.001	1.000	1.014	0.004
ML	1.251	0.044	0.995	0.992	0.026
EMC	4.193	0.157	0.985	0.909	0.018
BP	1.256	0.044	0.998	0.994	0.013

5.3.3.4 Structural Equation Modelling-PLS

PLS-SEM (Partial Least Squares Structural Equation Modeling) in this research was used to assess the model. The PLS-SEM evaluation follows a sequential two-step approach: first, the reliability and construct validity (including convergent and discriminant validity) of outer models (i.e., measurement models) was assessed; subsequently, the inner model (i.e., structural model) was evaluated, including its reliability, and convergence validity and discriminant validity (Deal, 2006; Hair et al., 2007).

PLS-SEM technique was applied to assess the model mainly based on the following reasons： Firstly, owing to the small sample size-the total sample size of this study is 129, the traditional CB-SEM technique requires that the total number of observed samples should reach the minimum of 150, and the sample size should reach 10 times of the total number of questions, while PLS-SEM can be used for the analysis of small sample sizes, conditional on specific statistical power levels (Chin and Newsted,1999).

Secondly, the initial data examination, as described in section 3, chapter 6, has revealed some deviations; in other words, the data are not normally distributed. Traditional CB-SEM analysis is susceptible to violating the normal distribution assumption, while PLS-SEM is tolerant of multicollinearity and skewness kurtosis (Bollen, 1989; Werts et al., 1974; Jarvis et al., 2003).

Also, the focal construct of this study, e-mass customization, has only a limited theoretical basis. The PLS-SEM technique is more prediction-oriented and aims to explain the endogenous constructs (Hair et al., 2007; Henseler et al., 2009). Therefore, PLS-SEM is more appropriate for the path model analysis of this study than CB-SEM.

In addition, PLS-SEM is less restrictive to measurement scales than the CB-SEM technique. For example, PLS-SEM can be used to assess fewer items or even single-item scales; also, PLS-SEM can be used to assess reflective and formative measurements. In brief, due to the small sample size of this study and the non-normal distribution of the data, the measurement model and structural model were evaluated using PLS-SEM.

- ***Assessment of The Measurement Model***

According to Henseler et al. (2009), to the standard catalogue for evaluating model, namely reliability and validity analysis, this study successively measured the internal consistency reliability, convergent validity, and discriminant validity of the measurement model.

Firstly, internal consistency reliability is assessed, including Cronbach's alpha, Composite Reliability value, and Standard Out Factor Loading checked. Secondly, the validity of the outer model was assessed by testing Average Variance Extracted (AVE) and the Fornell-Larcker criterion.

Cronbach's alpha as a traditional criterion for internal consistency was tested. When Cronbach's alpha exceeds 0.7, the scales have considerable reliability, and when Cronbach's alpha is greater than 0.8, the scales have high reliability (Henseler et al., 2009). In this research, the results of Cronbach's alpha are all greater than the threshold of 0.8, indicating the 'high reliability' of the scales.

Following this, the composite reliability value was tested. The threshold of 0.7 indicates considerable reliability, and the threshold of 0.8 indicates high reliability (Werts et al., 1974; Nunnally and Bernstein, 1994). In this study, the results of the composite reliability value all exceeded the threshold of 0.8, which indicates that the set measurement items are adequately reliable.

In addition, Standard Outer Factor Loadings are tested, and all the results of Standard Outer Factor Loadings are greater than 0.7 (Fornell and Larcker, 1981), which exceeded the suggested value that indicates the reliability of the measurement model.

Apart from assessing internal reliability, the convergent validity of the outer model is assessed, and the Average Variance Extracted (AVE) was used as a criterion (Gotz et al., 2009). A value greater than 0.5 indicates adequate convergent validity (Ringle et al., 2006; Henseler et al., 2009; Hair et al., 2011). All the results of AVE in this research are more significant than the threshold of 0.5. Table 5.9 provides an overview of Cronbach's Alpha, Composite Reliability and AVE, and Table 5.10 shows the results of standard outer Factor Loadings.

Table 5.9 Overview of Cronbach's Alpha, Composite Reliability and AVE results

	Cronbach's Alpha	Composite Reliability	Average Variance Extracted (AVE)
BP	0.908	0.932	0.734
Innov	0.932	0.946	0.747
ML	0.948	0.956	0.707
EMC	0.841	0.893	0.677
PA	0.945	0.955	0.754
PcM	0.911	0.937	0.789
PdM	0.879	0.917	0.734
SCI	0.893	0.926	0.757

Table 5.10 Standard Outer Factor loadings

	BP	Innov	EMC	ML	PA	PcM	PdM	SCI
BP1	0.724							
BP2	0.888							
BP3	0.862							
BP4	0.909							
BP5	0.890							
Innov1		0.895						

Innov2		0.857						
Innov3		0.851						
Innov4		0.852						
Innov5		0.882						
Innov6		0.846						
EMC1			0.825					
EMC2			0.791					
EMC3			0.816					
EMC4			0.858					
ML1				0.861				
ML2				0.845				
ML3				0.851				
ML4				0.859				
ML5				0.839				
ML6				0.767				
ML7				0.866				
ML8				0.812				
ML9				0.860				
PA1					0.884			
PA2					0.848			
PA3					0.830			
PA4					0.886			
PA5					0.877			
PA6					0.868			
PA7					0.881			
PcM1						0.891		
PcM2						0.866		
PcM3						0.907		
PcM4						0.888		
PdM1							0.870	
PdM2							0.850	
PdM3							0.868	
PdM4							0.838	

SCI1								0.800
SCI2								0.885
SCI3								0.894
SCI4								0.897

Moreover, discriminant validity was evaluated, and Fornell-Larcker Criterion (Fornell and Larcker, 1981) was performed. When the Average Variance Extracted (AVE) value of each latent construct is higher than its highest squared correlation with any other latent construct, it indicates that measurement scales ism is distinct from items of other conceptually distinct latent constructs (Hair et al., 2007). The result shows that root AVE values exceed the corresponding off-diagonal correlations. Table 5.11 presents the results of the Fornell-Larcker Criterion.

Overall, the scale showed sufficient reliability and validity since all the values suggested to test the equivalents of the scale exceeded the recommended threshold.

Table 5.11 Latent variable correlations

	BP	Innov	ML	EMC	PA	PcM	PdM	SCI
BP	**0.8571**							
Innov	0.777	**0.864**						
ML	0.633	0.731	**0.841**					
EMC	0.641	0.648	0.612	**0.823**				
PA	0.539	0.633	0.676	0.638	**0.868**			
PcM	0.629	0.721	0.516	0.654	0.566	**0.888**		
PdM	0.614	0.664	0.511	0.662	0.498	0.807	**0.856**	
SCI	0.674	0.692	0.494	0.552	0.446	0.719	0.693	**0.87**

- ***Assessment of Structural Model***

Subsequently, the inner model was evaluated. The key criterion for the assessment of the inner model includes Coefficient of Determination (R^2), Path Coefficient (t-value) and Predictive Relevance (Q^2) (Chin, 1998; Hair et al., 2011). The Value of R^2 represents the percentage of construct in the model (Chin, 1998), and the R^2 that exceeds 0.33 indicate the model can be considered to predict the future outcome well (Chin, 1998; Hair et al., 2011). On the other hand, the t-value shows the strengths of relationships between constructs (Chin, 1998). The acceptable level of relationship between the two constructs requires a t-value of 1.96 ($p < 0.05$) (Chin, 1998). In other words, when the value of R^2

and *t*-values are significant in partial least squares, the null hypothesis with no effect can be rejected. Later, blindfolding was performed by testing of Q^2 value in order to evaluate whether the model could predict the latent constructs' indications. It is suggested that a Q^2 value exceeding 0.15 represents the latent constructs that explain the endogenous latent construct have predictive relevance; the results exceeded the threshold of 0.35 indicates the latent constructs that explain the endogenous latent construct have 'strong' predictive relevance (Hair et al., 2011; Tenenhaus et al., 2005).

First of all, R^2 was checked. The results show that all the values of R^2 were higher than the threshold of 0.33. The results of this criterion illustrate that the model can predict future outcomes well. The table below (Table 5.12) shows the results of $R^{2.}$

Table 5.12 The results of R^2

	R Square	R Square Adjusted
BP	0.444	0.435
EMC	0.584	0.567

Subsequently, the path coefficient *t-value* was performed to estimate the significance of relationships between constructs. The measurement process was divided into two steps: the relationship between the independent and dependent variables were assessed; then, the moderator (i.e., Machine Learning) was added to the measurement.

The bootstrap method was used to determine the confidence interval of path coefficients. Hypotheses from 1 to 5 as well as hypothesis 11 were assessed at first. Based on the significance level threshold of $p < 0.05$, the results show that the path coefficient of the focal construct to the consequence were significant. Also, PdM, PA and SCI to EMC were significant. However, PcM to EMC and Innov to EMC were not significant. The following table (Table 5.13) presents the results of the path coefficient including, *t* values and *p* values.

Table 5.13 Path Coefficient

	Original Sample (O)	Standard Deviation (STDEV)	*T* Statistics (|O/STDEV|)	*P* Values	2.50%	97.50%
Innov -> EMC	0.183	0.123	1.488	0.137	-0.060	0.412
EMC-> BP	0.474	0.102	4.662	0.000	0.254	0.654
PA -> EMC	0.323	0.078	4.139	0.000	0.160	0.465

PcM -> EMC	0.099	0.140	0.708	0.479	-0.173	0.361
PdM -> EMC	0.305	0.125	2.433	0.015	0.052	0.536
SCI -> EMC	0.273	0.101	2.935	0.038	0.175	0.224

In terms of H1, the results show that there is a significant relationship between product modularity (PdM) and e-mass customization (EMC) (t=2.433; p=0.015, $p < 0.05$), which indicates that applying product modularity to configure products has a positive impact on e-mass customization.

About H2, the results t-value equals 0.708; the p-value equals 0.478 (p>0.05), indicating that there is no significant relationship between process modularity (PcM) and e-mass customization (EMC) or whether the impact of process modularity to e-mass customization is positive/negative cannot be determined. On this basis, the second hypothesis, 'applying process modularity to arrange key activities of the production process has a positive effect on e-mass customization', is rejected.

About H3, the hypothesis of 'keeping innovativeness has a positive effect on e-mass customization' is rejected. The results t-value equals 1.488 regarding H3, which is under the critical threshold of 1.96, and the p-value (p=0.137) regarding H3, which is large than 0.05, indicating that innovativeness insignificantly affects e-mass customization. (i.e., whether the impact of innovativeness on e-mass customization is positive/negative cannot be determined).

About H4, the results indicate a significant relationship between supply chain integration (SCI) and e-mass customization. The results of the path from supply chain integration to e-mass customization are found to be t=2.935; p=0.038 (p<0.05). On this basis, the hypothesis of 'Integration of supply chain with upstream and downstream suppliers can facilitate e-mass customization' has been supported.

In terms of H5, the results indicate that production automation (PA) has a significant effect on e-mass customization; as results show the t-value equals 4.139 regarding H5, which exceeds the critical value, and the p-value equals 0.000 (p<0.05), thus indicate a significant relationship between production automation and e-mass customization. The fourth hypothesis, i.e., 'applying automation system to automate production process has a positive effect on e-mass customization, has been supported.

The proposed eleventh hypothesis, i.e., 'implementing e-mass customization as a branding strategy has a positive impact on the brand performance', is supported by statistical evidence. The results show that the t-value equals 4.662 and the p-value equals 0.000 (p<0.05) regarding H11, representing that e-mass customization significantly affects brand performance.

In brief, the results support that e-mass customization positively affects brand performance and support that the proposed antecedents, including product modularity, production automation and supply chain integration, have positively affected e-mass customization. At the same time, there is no significant relationship between process modularity and e-mass customization, as well as there is no significant relationship between innovation and e-mass customization. The table below (Table 5.14) shows the results of hypotheses testing from H1 to H5 and H11.

Table 5.14 Result of Hypotheses testing

H1	Applying product modules to configurate products has a positive effect on e-mass customization	**Supported**
H2	Applying process modularity to arrange key activities of the production process has a positive effect on e-mass customization	**Not significant**
H3	Keeping innovativeness has a positive effect on e-mass customization	**Not significant**
H4	Integration of supply chain with upstream and downstream suppliers has a positive impact on e-mass customization	**Supported**
H5	Applying automation systems to automate the production process can facilitate e-mass customization	**Supported**
H11	Implementing e-mass customization as a branding strategy has a positive impact on brand performance	**Supported**

Machine learning (ML) is proposed as a moderator between the proposed antecedents and e-mass customization. The proposed hypotheses (H6 to H10) regarding the effect of machine learning on the relationship between the antecedents and e-mass customization were evaluated. Overall, it is noticed from the results (Table 6.14) that machine learning strengthens the relationship between each of the proposed antecedents (i.e., product modularity, process modularity, innovativeness, production customization and supply chain integration) and each of the constructs of e-mass customization. The table below (Table 5.15) shows the results of hypotheses testing from H6 to H10.

Table 5.15 The results of hypotheses testing, H6 to H10

H6	Machine learning strengthens the relationship between product modularity and e-mass customization	**Supported**
H7	Machine learning strengthens the relationship between process modularity and e-mass customization	**Supported**

H8	Machine learning strengthens the relationship between innovativeness and e-mass customization	**Supported**
H9	Machine learning strengthens the relationship between supply chain integration and e-mass customization	**Supported**
H10	Machine learning strengthens the relationship between production automation and e-mass customization	**Supported**

The results indicate that the relationship between produce modularity and e-mass customization gets more robust underlying machine learning. The result of the *t*-value on H6a is 4.640, and the p-value is 0.000 (p<0.05). On this basis, the H6 hypothesis. i.e., 'machine learning strengthens the relationship between product modularity and e-mass customization' is supported.

Regarding H7, 'Machine learning strengthens the relationship between process modularity and e-mass customization' is supported by statistical results. In detail, the t-value in terms of H7 equals 2.602, and the *p*-value equals 0.009 (p<0.05), indicating a significant and positive relationship between process modularity and e-mass customization underlying the use of machine learning.

In terms of H8, i.e., 'machine learning strengthens the relationship between innovativeness and e-mass customization' is supported by statistical results. The result of the *t*-value is 2.351, and the *p*-value is 0.019 (p<0.05) regarding H8. The results indicated that innovation has a positive effect on e-mass customization when using machine learning.

H9, i.e., 'machine learning strengthens the relationship between supply chain integration and e-mass customization; is supported by statistical results. In more detail, the result of the *t*-value is 2.601, and the *p*-value is 0.009 ($p < 0.01$) in terms of H9. The results indicate that the relationship between supply chain integration and e-mass customization becomes stronger under the circumstance of using machine learning.

Regarding H10, the results show that using machine learning strengthens the relationship between production automation and e-mass customization as the result of the *t*-value is 3.262 *p*-value is 0.001 (p<0.05). Overall, H10, i.e., 'machine learning strengthens the relationship between production automation and e-mass customization,' is supported. The table below (Table 5.16) presents the statistical results between H6-H10.

Table 5.16 The results of path coefficient including t-values and p-values from H6-H10

	Original Sample (O)	Standard Deviation (STDEV)	*T* Statistics (|O/STDEV|)	*P* Values	2.50%	97.50%
SCI*ML -> EMC	0.247	0.095	2.601	0.009	0.067	0.437
Innov*ML -> EMC	0.295	0.125	2.351	0.019	0.028	0.521
PcM*ML -> EMC	0.239	0.092	2.602	0.009	0.065	0.429
PdM*ML -> EMC	0.475	0.102	4.640	0.000	0.263	0.669
PA*ML -> EMC	0.153	0.047	3.262	0.001	0.07	0.251

Finally, Stone-Geisser Criteria Q^2 was checked by a blindfolding procedure using Smart PLS to evaluate whether the model can predict the latent constructs' indicators (Hair et al., 2011; Tenenhaus et al., 2005). The researcher used the endogenous construct's cross-validated redundancy measure to form Q^2, and when the results of Q^2 exceeded the threshold of 0.15 indicates that the latent constructs that explain the endogenous latent construct have predictive relevance. Moreover, when the results exceeded the threshold of 0.35 indicates that the latent constructs that explain the endogenous latent construct have 'strong' predictive relevance.

The results show that all the values of Q^2 exceed the threshold of 0.15, even closer or exceed the threshold of 0.35, which indicates 'strong' predictive relevance (i.e., Q^2 on BP is 0.316, and Q^2 on EMC is 0.376). In other words, the results of the Q^2 criteria of this study illustrate that the model proposed can well predict future outcomes. The tables below (Table 5.17) show the results of Q^2.

Table 5.17 The results of Q^2

	SSO	SSE	Q^2
BP	0.444	0.435	0.316
MCP	0.584	0.567	0.376

Overall, steps, as well as results of data analysis, were delineated. Starting from the initial data examination, descriptive analysis, outliers, missing value analysis, reliability test, normal distribution assessment, exploratory factor analysis, and conformation factor analysis were conducted. In addition, measurement models and structural models by SEM-PLS were also evaluated. Table 5.14 and Table

5.15 reveal the results of whether the hypotheses proposed based on the model are supported or not. The results of the quantitative analysis are discussed in more detail in the next chapter.

5.4 Discussion of Findings

5.4.1 Overview of the study

The aim of this research is to investigate e-mass customization as a branding strategy, thereby broadening academic horizons and further developing knowledge in branding-, and marketing-related fields. Specifically, this research aims to conceptualize e-mass customization, and to develop a process model based on resource orchestration to explain the determinants of e-mass customization as well as its consequences. This research adopts a mixed method, i.e., the research first adopts qualitative research, and arranges interviews to investigate the concept of e-mass customization, and dimensions that can supports e-mass customization as well as the outcomes of e-mass customization; following by, this research adopts quantitative research through an online-based questionnaire survey. Exploratory facto analysis (EFA) and confirmatory factor analysis (CFA) were tested for the proposed measurement model. Moreover, the internal and external structures (the measurement model and the structural model) were tested by PLS-SEM. Qualitative results and quantitative results are discussed comprehensively in this paper, and based on the results, the researcher propose a two-tier orchestrating plan. And the companies relied on this plan can achieve the capability of e-mass customization. The following chapter attempts to delineate the findings.

5.4.2 E-Mass Customization

5.4.2.1 Focal Construct

This research aims to clarify the concept and construct of e-mass customization. Existing literature mentions e-mass customization as an ‘extension of mass customization’ (Yoo and Park, 2016, Yan et al., 2019) and pointed out that e-mass customization is associated with low-cost, large-volume, quick delivery of customized products (Pine, 1993; Tu et al., 2001; Tu et al., 2004), and allowing of customer to co-design their own products (Kaplan and Haenlein, 2006; Aichner and Coletti, 2013; Yoo and Park, 2016; Lang et al., 2019; Yan et al., 2019). Qualitative results support the proposed concept of e-mass customization and highlight that e-mass customization is a dual-core concept, which consists of co-design activity and mass-custom production, committing customers to personalized products and experiences in a short time at a reasonable price.

Beyond suggesting a dual-core concept of e-mass customization, our research develops a 4-item scale to measure e-mass customization appropriately. In particular, the author considers the scales proposed by Tu et al. (2001) and Tu et al. (2004) and the scales developed by Lee and Chang (2011) and Aichner and Coletti (2013) as the initial measurements of e-mass customization. Also, the author adds one initial item from qualitative research. After expert judgement, the EFA test and CFA test, a four-item scale for e-mass customization, are generated and showed satisfactory reliability and validity, thereby being the final measurement scale for e-mass customization. In brief, by qualitative research, this study explores the concept of e-mass customization as well as the measurement of e-mass customization. These findings may provide a basis for future research in related fields.

5.4.2.2 Consequences of E-mass Customization

The current literature implies possible outcomes of mass customization towards companies, such as improving productivity and profitability (Pine, 1993; Tu et al., 2004; Spaulding and Perry, 2013), competitiveness (Tu et al., Spaulding and Perry, 2013), and customers' loyalty (Totz and Riemer, 2000; Lee and Chang, 2011; Spaulding and Perry 2013). Accordingly, this research argues that e-mass customization is one essential branding strategy for companies in the 4.0 branding stage and hypothesizes that implementing e-mass customization as a branding strategy positively impacts brand performance. Quantitative findings support this hypothesis. Moreover, our results suggest that implementing e-mass customization as a branding strategy is forward-thinking and far-sighted; and companies that commit to e-mass customization have wider access to customers, acquire a loyal customer base, and achieve a competitive advantage. Specifically, our findings state that the ability to deliver highly differentiated products quickly and at low prices is an intense strength; by allowing a customer to co-design products, the companies can realize the emotional connection with their customers, i.e., the co-design process can bring the customers to express their personal feelings, and the final product they receive that can meet their needs for uniqueness and usefulness, which would improve their attitude towards brands tends to be positive, and this would trigger their customers' willingness to purchase products from the specific brands and their willingness to recommend products from the particular brands for the long-run.

5.4.3 Resource Orchestration for E-mass Customization

Another aim of this study is to investigate how companies can achieve e-mass customization. The study proposes a multi-resource supported e-mass customization framework. Our data indicate that orchestrating these resources can optimize companies' e-mass customization capability. In other words, by combining resources of product modularity, process modularity, innovativeness, supply chain integration, and automated production resources by integrating machine learning into them, the superiority of these resources can be leveraged, optimizing the company e-mass customization capabilities. Combining the quantitative and qualitative findings, this study proposes a two-tier orchestration plan (Figure 5.1) that companies can use to address e-mass customization challenges to achieve the goals in branding 4.0.

Previous studies have shown that machine learning is a knowledge management tool that converts heterogeneous data into useful insight (Sharp, 2018) and can create and transfer knowledge between different applications (Lu et al., 2018). Companies use machine learning to develop plans, reach decisions and improve schedules that help them to achieve the best possible results (Ye et al., 2019). Machine learning treats information as an entirety and deeply analyzes similarities and commonalities, then generates knowledge, advice and solutions (Ye et al., 2022). However, our data show that machine learning's real strength emerges when used in conjunction with modularity, innovativeness, supply chain integration and production automation, as explained below.

The existing literature depicts product modularity as a key driver supporting e-mass customization (Pine, 1993; Sanchez, 1995; Meyer and Lehnerd, 1997; Swaminathan and Tayur, 1998; Warren et al., 2002). Companies using product modularity improve their flexibility and efficiency (Tu et al., 2004; Jacob, 2011; Wang et al., 2014; Seyoum, 2020). Our quantitative research supports that applying product modularity in configuring products positively affects e-mass customization. And our interviews further illustrate modularity in product strike a balance between 'mass' and 'customization' by reducing the number of different parts to be delivered to the assembly plants and applying modularity to a web interface improves the ease of use of co-design for customers, and hence improves the serviceability of brand-customer interactions. Most importantly, our findings highlight machine learning's critical role in this process. The quantitative results agree that machine learning strengthens the relationship between product modularity and e-mass customization. Managers and executives from companies in our sample use machine learning, providing knowledge to obtain optimal suggestions for quickly and cost-effectively scheduling modules in line with customer demands. Combining product modularity with machine learning maximizes design flexibility and enhances the company's ability to achieve its goals (Lee and Lapira, 2013; Lee et al., 2013; Wuest et al., 2016; Bajic, 2018).

Previous studies have shown process modularity enhances flexibility when producing customized products (Tu et al., 2004; Wang et al., 2014). And "Modularity in process design may speed new product manufacturing setup times, reduce costs, and enhance the profitability of the lower volumes that customization often entails" (Jacob et al., 2011, P123). The quantitative findings indicate that the linkage between process modularity and e-mass customization is insignificant (or the positive/negative effects of product modularity on e-mass customization are not determined).

Backtracking to the qualitative findings, the managers and executives explain that a product's lifecycle and complexity could affect the linkages: frequent rezoning of modules to fit the pace of new mass custom product launches can increase the time and cost, and when the production process of a mass custom product involves a time-consuming, costly and complex process, the impact of process modularity on e-mass customization. However, our statistical results show machine learning strengthens the relationship between innovativeness and e-mass customization; also, managers and executives in our interviews applied machine learning to obtain optimal suggestions for reducing time and costs in re-arranging modules through its ability to heterogeneous data analysis and problem-solving capabilities. In other words, machine learning optimizes process module arranges, enhancing the positive effect of process modularity on e-mass customization.

The current studies point out that organizations which remain innovativeness are more proactive in improving processes and systems (Cram, 1996; Wong and Merrilees, 2008), and these organizations are more proactive in acquiring market information and updating their products and services so as to attract their target customers (Barwise and Meehan, 2004; Wong and Merrilees, 2007; Wong and Merrilees, 2008). However, our statistical results reveal that the linkage between innovativeness and e-mass customization is insignificant. Managers and executives in our interviews express that the accuracy with which a company forecasts its customer demand could affect the cost and time, i.e., if a company can accurately predict demand or trends, innovation will be advantageous, and vice versa. Also, they propose staying innovative and constantly improving, like supporting equipment and processes to commit to e-mass customization may require significant investment, leading to higher costs. However, our findings highlight machine learning strengthens the relationship between innovativeness and e-mass customization. As mentioned, machine learning acquires valuable information through the results it derives from analyzing heterogeneous data (Wuest et al., 2016; Bajic et al., 2018); managers and executives in our interviews applied machine learning provides information to get superior suggestions on future trends for match innovations with trends and individual customer's personalized demands.

Previous studies have mentioned the help of supply chain integration to production flexibility; for example, Simatupang (2002, p292) pointed out that "the retailer and manufacturer share joint responsibility to implement the initiative of quick response as a strategy to cut lead times and increase the speed of product introduction to the market." The quantitative findings support the significant linkage between supply chain integration and e-mass customization, and managers and executives in our interviews express that they share information with channel partners to understand market and customer needs better and then take action more accurately and more quickly; these managers and executives collaborate with upstream and downstream suppliers and assigning tasks with these channel partners to complete production more effectively; also, these managers and executives. Notably, the quantitative findings support that machine learning strengthens the relationship between supply chain integration and e-mass customization. The interviews indicate that machine learning supports integrating data and information among upstream and downstream suppliers to enable knowledge sharing, which enhances collaboration and strategic partnerships between companies. Machine learning allows suitable supplier-product matching and transmits information, knowledge and suggestions to help deliver products to the corresponding clients. Those benefits, in turn, support companies to corporate more efficiently and effectively along with channel partners to produce diversified items in response to individual customer needs on a large scale.

This research also found production automation to be another critical factor in enhancing a company's capability for e-mass customization. Automation systems ensure "flexible and efficient production of a variety of personalized products simultaneously" (Lu et al., 2020, p318). Our study supports the notion that automation systems realize automatic planning, task allocation, process control, equipment control, and status checking in production and enable 24/7 production; these benefits accordingly increase the companies' speed and agility in the mass production of customized products co-designed with customers. Notably, the quantitative data support the critical role of machine learning in production automation. As mentioned, integrating machine learning into other systems improves systems performance by analyzing information and problem-solution abilities (Lee and Lapira, 2013; Lee et al., 2013; Bajic et al., 2018; Yan et al., 2022), managers and executives in our interviews implementing machine learning to detect processes and equipment commanded by automation system and optimize production schedules and operation. By combining machine learning into the automation system to control the production process, companies can reduce costs by reducing the production error rate and improving the efficiency of the production scheduling and operation to produce custom products with customer co-design on a large scale.

In summary, the synergies generated by the orchestration of these resources have an optimal impact on companies' implementation of online mass customization. Resource orchestration theory emphasizes that companies must take resource-related actions and highlight one or two actions, to create value. This research illustrates that companies should consider a combination of product modularity, process modularity, innovativeness, supply chain integration, and production automation when implementing e-mass customization. In addition, integrating machine learning into these tools and means to leverage their potential can help companies better deter the challenges of implementing e-mass customization.

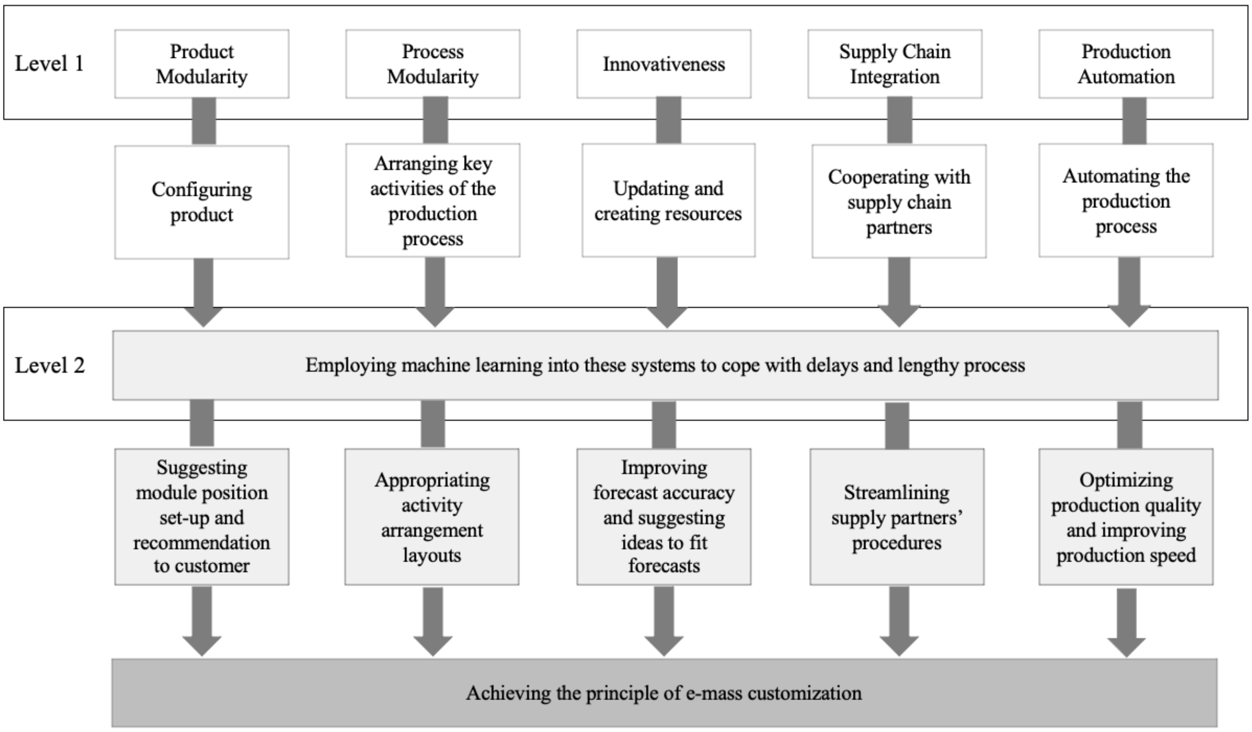

Figure 5.1 Two-tier Orchestration Plan

5.4.4 Summary

The findings suggest that the e-mass customization concept refers to a strategy that includes co-design activity and mass-custom production processes to bring customers a personalized experience and products at a reasonable price and within a short waiting time. Our findings indicate that companies committed to personalization have wider access to customers, better reputation, acquire a loyal customer base (Hedden, 2020), achieve competitive advantages (Santos et al., 2021), enhance brand identity, and strengthen customer relationships with the brand. On the other hand, our findings indicate that implementing e-mass customization poses multiple challenges and requires inevitable technical-, technological-, and operational-level adjustments. And companies relying on a two-tier orchestrating plan can achieve a superior e-mass customization capability. That is, companies can consider integrating machine learning in product modularity, process modularity, innovativeness, supply chain integration and production automation to leverage the strengths of these resources through data analysis, detection, diagnosis and problem-solving capabilities, then using these resources to superior efficiency and effective, hence to optimize their e-mass customization capability. We propose that theoretical plan as the main contribution of this study.

Chapter 6

Conclusion

6.1 Introduction

The development of commerce endows modern branding with new connotations and goals. Modern branding aims to establish a brand sign and symbol that can distinguish a company from its competitors and help the company to be recognized by its audiences. The ultimate goal of branding is to enable companies to obtain long-term benefits instead of short-term markup. Branding is considered to be divided into 4 phases. Branding 1.0 required managers to create iconic products and services, differentiating them from competing brands. In branding 2.0, in the context of increasingly alienated consumer markets, managers are required to focus on localizing products and services and ensure that the regional products and services remain authentic brand elements (Daye, 2020). Isarabhakdee, 2016). Branding 3.0 requires managers to address social needs through an international framework, such as corporate social responsibility and shared value, to establish a positive brand image. Managers are now trying to understand the branding 4.0 concept of brand–customer cooperation to view customers as a part of the brand; i.e., brands must concern with hyper-personalized experience to individual customers while ensuring the delivery of brand elements (Suthar, 2015; Wallace, 2018; Van and Hieu, 2020). Previous research has shown that companies successfully entering branding 4.0 can benefit from an enhanced performance from branding (Isarabhakdee, 2016; Hedden, 2020; Wallace, 2018, Chang et al., 2018; Odoom and Mensah, 2018). However, it is worth learning what branding strategies companies can apply to support themselves in achieving better performance.

To fill the gaps, our study starts from the literature stream of mass customization and e-mass customization to explore as a branding strategy; also, this study investigates the means and tools the companies can apply to deter the challenges when implementing e-mass customization. More importantly, this paper suggests a two-tier plan to e-mass customization challenges based on the orchestration of machine learning, product modularity, process modularity, innovativeness, supply chain integration and production automation. Overall, this study contributes to the management and branding literature.

6.2 Theoretical Implications

Although the term was coined in 1987, academics are still in discuss the concept of mass customization, and a nascent literature stream has started to conceptualize the term e-mass customization (Kaplan and Haenlein, 2006; Lee and Chang, 2011; Yoo and Park, 2016; Yan et al., 2019; Lang et al., 2020). However, to the best of our knowledge, the literature needs to be more specific regarding the meaning and implication of e-mass customization, with almost no academic work deliciated to the topic. Our research clarifies the emerging concept of e-mass customization and provides researchers with an analytical framework supported by empirical evidence for leading companies. More specifically, this research points out e-mass customization as a dual-core concept that includes co-design activity and mass-custom production processes to bring customers personalized products and experiences and offers a 4-item measurement for e-mass customization. This expands the earlier concept of e-mass customization proposed by Kaplan and Haenlein (2006), Lee and Chang (2011), Yoo and Park (2016), Yan et al. (2019) and Lang et al. (2020). Our analytical framework reveals plausible outcomes of e-mass customization from a branding perspective, such as customer brand identification, loyalty and long-term competitiveness; it illustrates the nexus of likely resources for e-mass customization. This opens a new avenue of academic research by placing e-mass customization on the theoretical map of branding.

Our strongest theoretical contribution stems from theoretical contribution stems from the use of scholarly work on e-mass customization, artificial intelligence, modularity, supply chain, innovation, and automation to inform a two-tier orchestration plan that highlights the joint effect and potential of machine learning, product modularity, process modularity, innovativeness, production automation and supply chain integration in supporting e-mass customization transitioning to an effective branding strategy. This framework provides a theoretical basis for 1) operationalizing e-mass customization; 2) using a resource orchestration lens to explore how brands can respond to e-mass customization challenges. More specifically, our findings show how machine learning's data analysis, knowledge conversion and transmission, and problem-solving capabilities benefit product modularity, process modularity, innovativeness, supply chain integration and production automation tasks to optimize the co-design process and mass-custom production process. Previous machine learning studies were mainly conceptual works which discussed the advantage of machine learning (Bajic et al., 2018; Sharp et al., 2018; Yan et al., 2022), while our findings could pave the way for future interdisciplinary machine learning application and research beyond the remits of technological fields, i.e., operations management. We contribute to the specific field of e-mass customization through modularity— Our finding shows the latter's advantages of product modularity beyond supporting flexibility in large-scale manufacturing (Duray et al., 2000; Tu et al., 2004; Jacob et al., 2011) and demonstrate it also benefits customer relationships and perceived brand serviceability, with direct implications for management and branding domain; also, our findings reveal the circumstances under which process modularity has greater potential to support e-mass customization, adding to the literature of Warren et al. (2002) and Tu et al. (2004), among others. This study also shows how innovativeness can support e-mass customization, i.e., by integrating machine learning to analyze future trends and customers' personalized needs and provide accurate information and effective suggestion on innovation. This finding contributes to the specific field of e-mass customization through innovativeness and extends Wong and Merrilees (2008) and Odoom and Mensah (2018) on the benefits of innovativeness from an interdisciplinary perspective. Furthermore, by integrating the supply chain integration into the e-mass customization nexus, we address management and branding academics' focus on the significant role of downstream and upstream partners in deterring the challenges of implementing e-mass customization beyond the more established information sharing, synchronized planning, and operational coordination functions currently mentioned in the literature (Liu et al., 2016). Finally, our study integrating production automation into the e-mass customization nexus prompted scholars' attention to the effect of applying automation systems in production (Shin et al., 2017) to the entire process of e-mass customization.

This study also has a contribution to resource orchestration theory. Previous studies have pointed out that possessing resources alone does not guarantee the development of competitive advantage; instead, resources must be managed effectively, i.e., accumulated, bundled, and leveraged, to realize the full value of resources for creating competitive advantages (Sirmon and Hitt, 2003; Sirmon et al., 2007). Fitting search/selection and configuration/deployment are argued to be critical for realizing the potential of the resources to facilitate the creation of competitive advantages (Helfat et al., 2007; Sirmon et al., 2007, Liu et al., 2016). Our study demonstrates how different types of resources contribute to performance and how firms manage, accumulate and allocate resources to achieve excellence through an analytical framework and a two-tier orchestration scheme. This completes the theoretical knowledge of the theory in terms of its application. In addition, this study provides evidence to support the importance of resource orchestration theory in the management and branding research stream by empirically mapping the nexus among multiple resources and e-mass customization and the optimized effects of orchestrating these resources.

In addition, this study used a mixed research method to investigate the topic of e-mass customization, which is rare in this field of research. Such an attempt should set a new benchmark for future research. In more detail, the qualitative study elucidates the concept of e-mass customization and provides a preliminary account of the seemingly possible relationship between the proposed resource and e-mass. In addition, the quantitative research provides empirical evidence for the determinants of e-mass customization. In turn, the article combines the results of the qualitative and quantitative studies to illustrate the deep, comprehensive relationship between the proposed resource and e-mass customization. Indeed, this study provides a reliable and valid measurement scale for all the results that scholars can use in further research.

Overall, this study is the first research considering e-mass customization as a branding strategy from a resource orchestrates perspective in the 4.0 branding era. This study explores the impacts of management means and technological tools on e-mass customization. It discusses the outcome of the successful implementation of e-mass customization on brand performance to build a casual-effect framework of e-mass customization. This study found that 1) e-mass customization is a dual-core concept and companies by implementing e-mass customization as a branding strategy can superior their performance; 2） machine learning helps other resource systems, thus enhancing their capability to address the challenges when companies implement e-mass customization; 3) Our findings highlight the joint effects of resources on enhancing companies e-mass customization capability. Admittedly, our research findings contribute to the theoretical literature and influence strategy development and execution for managers.

6.3 Managerial Implications

This study brings e-mass customization to managers' attention as a new branding stage. First, this study provides to take e-mass customization as an essential strategy in the 4.0 branding phase; more specifically, this study provides empirical evidence for the plausible benefits of e-mass customization, including long-term competitiveness, brand-customer relationship, and customer loyalty. This study refines the meaning of e-mass customization to two constituents 1) low-cost, large-scale and quick production of differentiated products for each individual to obtain customized products at an affordable cost within a short waiting time; 2) using interactive, user-friendly interfaces for individual customers to define their products through the collaborative design process. This can help brand managers understand how to achieve the goals of branding and thus formulate strategies, starting from the aspect of e-mass customization. Admittedly, the dual-core concept of e-mass customization that we give gives managers a more refined focus when considering this strategy of e-mass customization.

Our findings help brand managers and executives better understand the challenges associated with e-mass customization implementation and provide a plausible theoretical solution drawing on the resource orchestration perspective to support brands in implementing e-mass customization. The results show that; 1) coordinating technical, technological and managerial resources to enable the companies to obtain optimal e-mass customization capabilities; 2) machine learning by its data analysis, knowledge generation and problem-solving capacities to assist product modularity, process modularity, innovativeness, supply chain integration and production automation, enhance their performance so to help company deter challenges on implementing e-mass customization; in other words, embedding machine learning into management and original technology systems can better help brands arrange a co-design activity, which is the process of interacting with customers and can also improve company's ability of mass-custom production for low-cost, large-scale and fast production differentiated products. According to the results, it is proposed that managers can first pay attention to the interaction of machine learning with other systems, i.e., by embedding machine learning into product modularity, process modularity, innovativeness, supply chain integration, production automation, companies will be better able to assist customers in their co-design processes by providing more suitable components aligned with customers' diversified needs. At the same time, improve the overall efficiency of the production process. Our research suggests that relevant personnel use product modules that can be separated and combined in terms of integrated design to increase product diversity while reducing the number of different parts delivered to the assembly plant, thereby bringing more value to the customer and, at the same time reducing the time and price paid by customers waiting for their own products. Moreover, the researcher recommends managers applying of modular principles when managing their companies' key activities, in particular, arranging standardized module and customization modules, as well as sequencing these two modules when managing brand-customer interactions as well as production processes, in order that customers are easier to customize and update their own products. The companies can increase flexibility, thereby reducing production costs and production time. In addition, the researcher suggests that managers can establish an incentive mechanism to encourage internal personnel to proactively seek or adapt to new ideas, thus helping brands constantly optimize and innovate in products, services, processes, systems, etc. In addition, our research recommends that companies and brands move from a competitive perspective to a more collaborative approach with downstream and upstream partners, focusing on information sharing, simultaneous planning and operational coordination to strengthen their relationships. Our research also suggests that managers adopt automation systems to complement the original manual works, including using automated production systems and production supporting systems on production scheduling, operational management, placing production orders, controlling progress, controlling physical equipment, and executing production operations.

6.4 Limitation of the Study

This study explores the need to successfully implement e-mass customization from the perspective of new-era branding, i.e., branding 4.0. Simultaneously, this study extends the resources necessary for the successful implementation of e-mass customization and the positive outcomes of e-mass customization, especially for brand performance. However, this study has some limitations, which also provide directions for future research.

First of all, considering that the research time of this study is limited, the researchers chose companies in the Chinese clothing and footwear industry, which has a high level of e-mass customization, as the research background. In other words, the qualitative and quantitative research findings may only reflect managers' views on China's clothing and footwear industry. However, companies in other manufacturing industries, such as furniture and electronics, are known to be involved in e-mass customization-related businesses, and it is open to discussing whether the views of managers in these industries align with those of the managers in the industry that were researched in this study. Admittedly, the object of this study is currently limited to the manufacturing industry, and whether the research framework proposed in this study applies to the service industry still needs to be verified.

Secondly, due to the time limitation, this study only selects the geographical context of 'China'. However, other geographical contexts which as inferior or more robust managerially and (or) technologically advanced than China, have yet to be included in the discussion. Including technology and management level and brand development levels, which are inferior to or stronger than China's geographical environment, the ideas presented in this study on e-mass customization and the factors and consequences of e-mass success remain to be further studied. The views proposed in this study on e-mass customization as well as the determinants and consequences of successful implementation of e-mass customization in these regional contexts, need to be further researched.

At the time of this study, many technologies, such as automation and machine learning, are in their early but rapidly developing stages. Although this study confirms the impacts of the existing automation technology and machine learning technology on e-mass customization, it still needs to be discovered how the constantly developing cutting-edge technologies will bring e-mass customization.

This study empirically verifies the positive impact of e-mass customization on brand performance, focusing on exploring the effect of e-mass customization on intangible performance, including brand competitiveness, brand-customer relationship, and customer loyalty. However, it remains to be discussed that e-mass customization impacts brand tangible performance, such as return on investment (ROI), return on asset (ROA), and short-term as well as long-term profit margin.

Moreover, this study proposes three control variables, namely government policy, talent and international conflict, on their possible effects on e-mass customization and (or) the outcomes brought about by e-mass customization. Several interviewed managers support the possible linkages presented;

however, further exploration of the potential effects of these factors is required, combined with empirical evidence.

In addition, an obvious limitation of this study is related to the sample size of this study. This study collected data from a survey of 129 senior executives in the apparel and footwear industry over a limited time. However, a larger sample size is needed to verify the feasibility of the proposed technical framework (Hair et al., 2006). Accordingly, future studies can collect more data to verify the feasibility of the framework presented in this study.

6.5 Avenues for Future Research

The limitations of this study open up multiple avenues for future investigation. First of all, this study only reflects the views of representatives of enterprises in China's clothing and footwear industries that mainly engage in business-to-consumer. Researchers could consider collecting data from managers in the same industry involved in business-to-business; moreover, researchers may consider collecting data from different industry representatives to understand the role of e-mass customization as well as richer empirical evidence of e-mass customization in its implementation and outcomes. Companies in the furniture, electronics, and service industries have implemented or are experimenting with schemes related to mass customization. Researchers can collect data on managers from these industries to compare the framework and conclusions presented in this study.

Second, the geographic context of China was chosen for this study because many Chinese clothing and footwear companies have become better known in recent years by combining marketing with cutting-edge technological tools and multiple management tools. Further research may consider multiple geographic contexts, including other countries or regions less technologically advanced than China and(or) more advanced than China, for a more balanced view of the e-mass customization strategy and to compare (or) validate the proposed framework on e-mass customization.

This study investigates the influence of multiple factors, including management and technology, on e-mass customization and e-mass on brand performance, especially brand intangible performance. Researchers can explore the implementation of e-mass customization with more management, technical factors or other resources, or e-mass customization brings tangible performance (such as ROI, ROA, and short-term and long-term benefits) into the discussion to enrich the proposed framework.

In addition, in-depth research on the impacts of government policy, talent and international conflict on e-mass customization and(or) the results of e-mass customization, combined with empirical evidence, can also become the future research direction of researchers.

Admittedly, managers may use different strategies and solutions to achieve branding 4.0, while researchers can explore reasonable and feasible strategy from different perspectives and disciplines. In addition, due to the limited research time of this study, only limited sample data were collected. Researchers can collect more data in future studies to verify the framework proposed in this study.

6.6 Summary

This PhD thesis investigates e-mass customization as a part of branding strategy for companies in the 4.0 branding stage. A triangulated research approach, combining a qualitative study with a quantitative study, identifies the factors that determine e-mass customization as well as the likely consequences of e-mass customization towards brand performance.

Based on semi-structured interviews with decision-makers and top management managers in companies from China's clothing and footwear industry, the concept of e-mass customization as well as the outcomes of e-mass customization is generated. Statistical results support most of the proposed relationships, including possible determinants, moderators of e-mass customization extracts from management literature and technique and technological fields, and the plausible consequences of e-customized consequences extracted from branding literature. Combining qualitative and quantitative results, a two-tier orchestration plan is suggested, supporting the successfully implementing of e-mass customization

Based on the findings, the researcher strongly recommends that scholars in closely related fields consider the importance and potential of e- mass customization in their future thinking, concepts, and frameworks. Given the expected positive results of e-mass customization, the researchers strongly advise that decision-makers and top managements incorporate e-mass customization into their branding strategies for brand development.

Overall, this study significantly contributes to and advances existing knowledge on the concept of e-mass customization and its implication and application in the 4.0 stage of Branding. The researchers firmly believe it is encouraging for academics, managers and decision-makers who take an active interest in e- mass customization.

Reference

Aaker, D.A. and Joachimsthaler, E., 2012. *Brand leadership*. Simon and Schuster

Aaker, D.A., 1996. Building strong brands. *New York: The Free*.

Aarker,D., 1991. Brand Leadership. Simon & Schuster.

Abdul Rahman, H., Jarrar, M.T. and Omira, O.D., 2014. Leadership styles and performance of public sector organizations: The case of Saudi Arabia. *Journal of Business Management and Accounting (JBMA)*, *4*, pp.55-62.

Adler, P.S. and Borys, B., 1996. Two types of bureaucracy: Enabling and coercive. *Administrative science quarterly*, pp.61-89.

Adner, R. and Helfat, C. E., 2003. Corporate effects and dynamic managerial capabilities. *Strategic Management Journal*, 24(10), pp.1011-1025.

Aichner, T. and Coletti, P., 2013. Customers' online shopping preferences in mass customization. *Journal of Direct, Data and Digital Marketing Practice*, *15*(1), pp.20-35.

Aichner, T. and Coletti, P., 2013. Customers' online shopping preferences in mass customization. *Journal of Direct, Data and Digital Marketing Practice*, *15*(1), pp.20-35.

Aichner, T. and Coletti, P., 2013. Customers' online shopping preferences in mass customization. *Journal of Direct, Data and Digital Marketing Practice*, *15*(1), pp.20-35.

Anderson, J.C. and Gerbing, D.W., 1984. The effect of sampling error on convergence, improper solutions, and goodness-of-fit indices for maximum likelihood confirmatory factor analysis. *Psychometrika*, *49*(2), pp.155-173.

Anderson, M. 2002. Building products on-demand for e-comerce. Build-to-order consulting. [online] Build-to-Order. Available at: http://www.build-to-order-consulting.com/e-commerce.htm [Accessed 31 May 2018]

Armbruster, H., Bikfalvi, A., Kinkel, S. and Lay, G. (2008) "Organizational Innovation: The Challenge of Measuring Non-Technical Innovation in Large- Scale Surveys", *Technovation*, 28 (10), pp. 644-657.

Ashton, C. and Morton, L., 2005. Managing talent for competitive advantage: Taking a systemic approach to talent management. *Strategic HR review*, *4*(5), pp.28-31.

Bagozzi, R.P., Yi, Y. and Phillips, L.W., 1991. Assessing construct validity in organizational research. *Administrative science quarterly*, pp.421-458.

Baiman, S., Fischer, P.E. and Rajan, M.V., 2001. Performance measurement and design in supply chains. *Management science*, *47*(1), pp.173-188.

Bajic, B., Cosic, I., Lazarevic, M., Sremcev, N. and Rikalovic, A., 2018. Machine learning techniques for smart manufacturing: Applications and challenges in industry 4.0. *Department of Industrial Engineering and Management Novi Sad, Serbia*, *29*.

Baker, M.J. and Balmer, J.M., 1997. Visual identity: trappings or substance?. *European Journal of marketing*.

Baldwin, C. and Clark. K., 1997. Managing in an age of modularity. *Harvard Business Review* **75**(5), pp.84–93.

Baldwin, C.Y. and Clark, K.B., 2006. Modularity in the design of complex engineering systems. In *Complex engineered systems* (pp. 175-205). Springer, Berlin, Heidelberg.

Bardakci, A. and Whitelock, J., 2003. Mass‐customisation in marketing: the consumer perspective. *Journal of consumer marketing*, *20*(5), pp.463-479.

Barney JB., 1991. Firm resources and sustained competitive advantage. *Journal of Management, 17*(1), pp.99–120.

Barwise, P. and Meehan, S., 2004. Don't be unique, be better. *MIT Sloan Management Review*, *45*(4), p.23.

Bastos, W. and Levy, S.J., 2012. A history of the concept of branding: practice and theory. *Journal of Historical Research in Marketing*.

Bearden, W.O., Hardesty, D.M. and Rose, R.L., 2001. Consumer self-confidence: Refinements in conceptualization and measurement. *Journal of consumer research*, *28*(1), pp.121-134.

Bentler, P.M., 1990. Comparative fit indexes in structural models. *Psychological bulletin*, *107*(2), p.238.

Bhaskar, R., 1978. A Realist Theory of Science (Hassocks: Harvester).

Biklen, S.K., 1992. *Qualitative research for education: An introduction to theory and methods*. Allyn and Bacon.

Blecker, T. and Abdelkafi, N., 2006. Complexity and variety in mass customization systems: analysis and recommendations. *Management Decision*, *44*(7), pp.908-929.

Bloom, N. and Van Reenen, J., 2010. Why do management practices differ across firms and countries?. *Journal of economic perspectives*, *24*(1), pp.203-24.

Bollen, K.A., 1989. *Structural equations with latent variables*(Vol. 210). John Wiley & Sons.

Broekhuizen, T.L.J. and Alsem, K.J., 2002. Success factors for mass customization: a conceptual model. *Journal of Market-Focused Management*, *5*(4), pp.309-330.

Brown, T.J. and Dacin, P.A., 1997. The company and the product: Corporate associations and consumer product responses. *Journal of marketing*, *61*(1), pp.68-84.

Brown, T.J., 1998. Corporate associations in marketing: Antecedents and consequences. *Corporate Reputation Review*, *1*(3), pp.215-233.

Brown, T.J., 1998. Corporate associations in marketing: Antecedents and consequences. *Corporate Reputation Review*, *1*(3), pp.215-233.

Brück, T., Naudé, W. and Verwimp, P., 2013. Business under fire: Entrepreneurship and violent conflict in developing countries. *Journal of Conflict Resolution*, *57*(1), pp.3-19.

Bryman, A. and Bell, E., 2007. Business research methods second edition oxford university press uk.

Bryman, A. and Cramer, D., 2012. *Quantitative data analysis with IBM SPSS 17, 18 & 19: A guide for social scientists*. Routledge.

Burell, G. and Morgan, G., 1979. Sociological paradigms and organizational analysis. *Elements of the sociology of corporate life*.

Burnell, G. and Morgan, G., 1979. Sociological paradigms and organisational analysis, elements of the sociology of corporate life.

Burrell, G. and Morgan, G., 1979. Sociological Paradigms and Organisational Analysis Heinemann.

Camacho, A. and Rodriguez, C., 2013. Firm exit and armed conflict in Colombia. *Journal of Conflict Resolution*, *57*(1), pp.89-116.

Campagnolo, D. and Camuffo, A., 2010. The concept of modularity in management studies: a literature review. International journal of management reviews, 12(3), pp.259-283.

Campagnolo, D. and Camuffo, A., 2010. The concept of modularity in management studies: a literature review. *International journal of management reviews*, *12*(3), pp.259-283.

Campagnolo, D. and Camuffo, A., 2010. The concept of modularity in management studies: a literature review. *International journal of management reviews*, *12*(3), pp.259-283.

Cantor A.M., 2020. *A brief history of branding.* Available at: https://99designs.hk/blog/design-history-movements/history-of-branding/ (Accessed 2, Auguest, 2021).

Carson, D., Gilmore, A., Perry, C. and Gronhaug, K., 2001. *Qualitative marketing research*. Sage.

Cassell, C. and Symon, G., 1994. Qualitative methods in organizational research: A practical guide.

Cassell, C. and Symon, G., 1994. Qualitative research in work contexts. *Qualitative methods in organizational research*, pp.1-13.

Chadwick, C., Super, J.F. and Kwon, K., 2015. Resource orchestration in practice: CEO emphasis on SHRM, commitment - based HR systems, and firm performance. *Strategic Management Journal*, *36*(3), pp.360-376.

Chan-Olmsted, S.M. and Shay, R., 2015. Media branding 3.0: From Media brands to branded entertainment and information. In *Handbook of media branding* (pp. 11-32). Springer, Cham.

Chang, Y., Wang, X. and Arnett, D.B., 2018. Enhancing firm performance: The role of brand orientation in business-to-business marketing. *Industrial Marketing Management*.

Chang, Y., Wang, X. and Arnett, D.B., 2018. Enhancing firm performance: The role of brand orientation in business-to-business marketing. *Industrial Marketing Management*, *72*, pp.17-25.

Chin, W.W. and Newsted, P.R., 1999. Structural equation modeling analysis with small samples using partial least squares. *Statistical strategies for small sample research*, *1*(1), pp.307-341.

Chin, W.W. and Newsted, P.R., 1999. Structural equation modeling analysis with small samples using partial least squares. *Statistical strategies for small sample research*, *1*(1), pp.307-341.

Chin, W.W., 1998. The partial least squares approach to structural equation modeling. *Modern methods for business research*, *295*(2), pp.295-336.

Chinnaiah, P.S. and Kamarthi, S.V., 2000. Mass customization and manufacturing. In *Innovations in Competitive Manufacturing* (pp. 283-296). Springer, Boston, MA.

Chirico, F., Sirmon, D.G., Sciascia, S. and Mazzola, P., 2011. Resource orchestration in family firms: Investigating how entrepreneurial orientation, generational involvement, and participative strategy affect performance. *Strategic Entrepreneurship Journal*, *5*(4), pp.307-326.

Chowdhury, M., Prayag, G., Orchiston, C. and Spector, S., 2019. Postdisaster social capital, adaptive resilience and business performance of tourism organizations in Christchurch, New Zealand. *Journal of Travel Research*, *58*(7), pp.1209-1226.

Chulanova, Z.K., Satybaldin, A.A. and Koshanov, A.K., 2019. Methodology for assessing the state of human capital in the context of innovative development of the economy: A three-level approach. *The Journal of Asian Finance, Economics and Business*, *6*(1), pp.321-328.

Churchill Jr, G.A., 1979. A paradigm for developing better measures of marketing constructs. *Journal of marketing research*, *16*(1), pp.64-73.

Churchill, G.A. and Iacobucci, D., 2006. *Marketing research: methodological foundations* (Vol. 199, No. 1). New York: Dryden Press.

Cobanoglu, C., Moreo, P.J. and Warde, B., 2001. A comparison of mail, fax and web-based survey methods. *International journal of market research*, *43*(4), pp.1-15

Cobanoglu, C., Moreo, P.J. and Warde, B., 2001. A comparison of mail, fax and web-based survey methods. *International journal of market research*, *43*(4), pp.1-15.

Cobanoglu, C., Moreo, P.J. and Warde, B., 2001. A comparison of mail, fax and web-based survey methods. *International journal of market research*, *43*(4), pp.1-15.

Cohn, J.M., Khurana, R. and Reeves, L., 2005. Growing talent as if your business depended on it. *Harvard business review*, *83*(10), p.62.

Collier, P. and Duponchel, M., 2013. The economic legacy of civil war: firm-level evidence from Sierra Leone. *Journal of Conflict Resolution*, *57*(1), pp.65-88.

Collins, J. and Hussey, R., 2003. Business Research: a practical guide for undergraduate and postgraduate students. *New York: Paigrave Macmillan*.

Collins, J. and Hussey, R., 2003. Business Research: a practical guide for undergraduate and postgraduate students. *New York: Paigrave Macmillan*.

Collis, J. and Hussey, R., 2013. *Business research: A practical guide for undergraduate and postgraduate students*. Macmillan International Higher Education.

Cooper, E. and Raymond, M.K.,1999. Modular Assembly Lines Are Taking Over. *Machine Design, 71*(19), pp.97-101.

Cooper, I.I.I. and Raymond, M.K., 1999. Modular Assembly Lines Are Taking Over. *Machine Design*, *71*(19), pp.97-101.

Corbetta, P., 2003. *Social research: Theory, methods and techniques*. Sage.

Corbetta, P., 2003. *Social research: Theory, methods and techniques*. Sage.

Corbetta, P., 2003. *Social research: Theory, methods and techniques*. Sage.

Coronado, A.E., Lyons, A.C., Kehoe, D.F. and Coleman, J., 2004. Enabling mass customization: extending build-to-order concepts to supply chains. *Production Planning & Control*, *15*(4), pp.398-411.

Cram, T., 1996. A manager's guide to innovation. *Journal of Product & Brand Management*, *5*(5), pp.15-17.

Crawford, C. (2017). Online to Claim 40% of Apparel Market share in 2030s [online] Sourcing Journal. Available at: https://sourcingjournal.com/topics/retail/online-claim-40-apparel-market-share-2030s-69692/ [Accessed 24 Apr. 2018].

Creswell, J.W., Plano Clark, V.L., Gutmann, M.L. and Hanson, W.E., 2003. Advanced mixed methods research designs. *Handbook of mixed methods in social and behavioral research*, *209*(240), pp.209-240.

Cronbach, L.J. and Meehl, P.E., 1955. Construct validity in psychological tests. *Psychological bulletin*, *52*(4), p.281.

Crotty, M., 1998. *The foundations of social research: Meaning and perspective in the research process*. Sage.

Crotty, M., The foundations of social research 1998 Allen & Unwin St. *Leonards, Sydney*.

Da Silveira, G., Borenstein, D. and Fogliatto, F.S., 2001. Mass customization: Literature review and research directions. International journal of production economics, 72(1), pp.1-13.

Daft, R.L. and Weick, K.E., 1984. Toward a model of organizations as interpretation systems. *Academy of management review*, *9*(2), pp.284-295.

Damanpour, F., 1991. Organizational innovation: A meta-analysis of effects of determinants and moderators. *Academy of management journal*, *34*(3), pp.555-590.

Damanpour, F., 1991. Organizational innovation: A meta-analysis of effects of determinants and moderators. *Academy of management journal*, *34*(3), pp.555-590.

Danemark, B., Ekstrom, M., Jakobsen, L. and Karlsson, J.C., 2002. Theory in the methodology of social science. *Explaining society: critical realism in the social sciences. New York: Routledge*, pp.115-49.

Davis, S.M., 1989. From "future perfect": Mass customizing. *Planning review*, *17*(2), pp.16-21.

Davis, S.M., 1997. *Future perfect*. Basic Books.

Day, G.S., 1996. Using the Past as a Guide to the Future: Reflections on the History of the Journal of Marketing. *Journal of Marketing*, *60*(1), pp.14-16.

Daye, D.,2020. *The Branding 4.0 Business 4.0 Strategy Workshop.* Available at: https://www.brandingstrategyinsider.com/the-branding-4-0-business-4-0-strategy-workshop/amp/ (Accessed 30, January, 2021)

deBara, D, 2019. *Marketing vs. Branding: what's the difference?* Available at: https://99designs.hk/blog/marketing-advertising/marketing-vs-branding/ (Accessed 6, September, 2021).

Dellaert, B.G. and Dabholkar, P.A., 2009. Increasing the attractiveness of mass customization: The role of complementary on-line services and range of options. *International Journal of Electronic Commerce*, *13*(3), pp.43-70.

Denscombe, M., 2002. Ground rules for good research: A 10 point guide for social research.

Denzin, N.K., 1989. (1989b). The research act: A theoretical introduction to sociological methods . Englewood Cliffs, NJ: Prentice Hall.

Denzin, N.K., 1989. Denzin, Norman K., The Research Act: A Theoretical Introduction to Sociological Methods, Englewood Cliffs, NJ: Prentice-Hall, 1989.

Deshpande, R., 1983. "Paradigms lost": On theory and method in research in marketing. *Journal of marketing*, *47*(4), pp.101-110.

Deshpande, R., 1983. "Paradigms lost": On theory and method in research in marketing. *Journal of marketing*, *47*(4), pp.101-110.

Deshpande, R., 1983. "Paradigms lost": On theory and method in research in marketing. *Journal of marketing*, *47*(4), pp.101-110.

DeVellis, R.F. and Thorpe, C.T., 2021. *Scale development: Theory and applications*. Sage publications.

DeVellis, R.F. and Thorpe, C.T., 2021. *Scale development: Theory and applications*. Sage publications.

Dodd, R.W. and Whipple, T.W., 1976. Item selection: a practical tool in attitude research. *Journal of Marketing*, *40*(3), pp.87-89.

Drucker, P.F., 1998. The discipline of innovation. *Harvard business review*, *76*(6), pp.149-157.

Duncan, T.R. and Mulhern, F., 2004. A White Paper on the Status, Scope and Future of IMC (from IMC symposium sponsored by the IMC programs at Northwestern University and the University of Denver). *New York: McGraw-Hill*.

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

Duray, R., Ward, P.T., Milligan, G.W. and Berry, W.L., 2000. Approaches to mass customization: configurations and empirical validation. *Journal of operations management*, *18*(6), pp.605-625.

Dyer, J.H. and Singh, H., 1998. The relational view: Cooperative strategy and sources of interorganizational competitive advantage. *Academy of management review*, *23*(4), pp.660-679.

Dyer, J.H. and Singh, H., 1998. The relational view: Cooperative strategy and sources of interorganizational competitive advantage. *Academy of management review*, *23*(4), pp.660-679.

Easterby-Smith, M.T. and Thorpe, R., 2002. R. and Lowe, A.(2002). *Management research: An introduction*, *2*, p.342.

Easterby-Smith, M.T. and Thorpe, R., 2002. R. and lowe, a.(2002). *Management research: An introduction*, *2*, p.342.

El Naqa, I. & Murphy, M.J. (2015). What is machine learning? *In machine learning in radiation oncology*. Springer, Cham.

Eniola, A.A. and Entebang, H., 2015. Government policy and performance of small and medium business management. *International Journal of Academic Research in Business and Social Sciences*, *5*(2), pp.237-248.

Erlandson, D. Harris, E. Skipper, B. and Allen, S. (1993), Doing naturalistic inquiry, Newbury Park, CA, Sage.

Fabbe‐Costes, N. and Jahre, M., 2008. Supply chain integration and performance: a review of the evidence. *The International Journal of Logistics Management*.

Fawcett (2017) *The Future of Automation and Industry 4.0.* Available at: https://eandt.theiet.org/content/sponsored/essentra-the-future-of-automation-and-industry-40/ (Accessed, 20, May, 2021)

Fawcett, S., 2017. *The Future of Automation and Industry 4.0.* Available at: https://eandt.theiet.org/content/sponsored/essentra-the-future-of-automation-and-industry-40/ (Accessed 10, August, 2021).

Feitzinger and Lee (1997). Available at: https://hbr.org/1997/01/mass-customization-at-hewlett-packard-the-power-of-postponement (Accessed, 20, May, 2021)

Feitzinger, E. and Lee, H.L., 1997. Mass customization at Hewlett-Packard: the power of postponement. Harvard business review, 75, pp.116-123.

Feitzinger, E. and Lee, H.L., 1997. Mass customization at Hewlett-Packard: the power of postponement. *Harvard business review*, *75*, pp.116-123.

Fiore, A.M., Lee, S.E. and Kunz, G., 2004. Individual differences, motivations, and willingness to use a mass customization option for fashion products. *European Journal of marketing*, *38*(7), pp.835-849.

Fixson, S.K. and Park, J.K., 2008. The power of integrality: Linkages between product architecture, innovation, and industry structure. *Research Policy*, *37*(8), pp.1296-1316.

Fleetwood, S., 2005. Ontology in organization and management studies: A critical realist perspective. *Organization*, *12*(2), pp.197-222.

Flynn, B.B., Huo, B. and Zhao, X., 2010. The impact of supply chain integration on performance: A contingency and configuration approach. *Journal of operations management*, *28*(1), pp.58-71.

Fogliatto, F.S., Da Silveira, G.J. and Borenstein, D., 2012. The mass customization decade: An updated review of the literature. *International Journal of production economics*, *138*(1), pp.14-25.

Fogliatto, F.S., Da Silveira, G.J. and Royer, R., 2003. Flexibility-driven index for measuring mass customization feasibility on industrialized products. *International Journal of Production Research*, *41*(8), pp.1811-1829.

Fornell, C. and Larcker, D.F., 1981. Structural equation models with unobservable variables and measurement error: Algebra and statistics.

Fournier, S. and Avery, J., 2011. The uninvited brand. *Business horizons*, *54*(3), pp.193-207.

Franke, N. and Piller, F., 2003. Key research issues in user interaction with configuration toolkits in a mass customization system. *International Journal of Technology Management*, *26*(5/6), pp.578-599.

Franke, N. and Schreier, M., 2008. Product uniqueness as a driver of customer utility in mass customization. *Marketing Letters*, *19*(2), pp.93-107.

Franke, N., Schreier, M. and Kaiser, U., 2010. The "I designed it myself" effect in mass customization. *Management science*, *56*(1), pp.125-140.

Füller, J. and Bilgram, V., 2017. The moderating effect of personal features on the consequences of an enjoyable co-creation experience. *Journal of Product & Brand Management*, *26*(4), pp.386-401.

Giddens, A., 2013. *New rules of sociological method: A positive critique of interpretative sociologies*. John Wiley & Sons.

Giglio, S., Pantano, E., Bilotta, E. and Melewar, T.C., 2020. Branding luxury hotels: Evidence from the analysis of consumers'"big" visual data on TripAdvisor. *Journal of business research*, *119*, pp.495-501.

Gill, J. and Johnson, P., 2002. *Research methods for managers*. Sage.

GILL, J. and JOHNSON, P., 2005. Making Methodological Choices. *Developing Business Knowledge*, p.84.

Gilmore, J.H., 1997. The four faces of mass customization. *Harvard business review*, *75*(1), pp.91-101.

Glaser, B.G. and Strauss, A.L., 2017. *The discovery of grounded theory: Strategies for qualitative research*. Routledge.

Glasser, B.G. and Strauss, A.L., 1967. The development of grounded theory. *Chicago, IL: Alden*.

Glasser, B.G. and Strauss, A.L., 1967. The development of grounded theory. *Chicago, IL: Alden*.

Golder, P.N. (2000), "Insights from senior executives about innovation in international markets", Journal of Innovation Management, Vol. 17 No. 5, pp. 326-40.

Gomez-Uribe, C.A. and Hunt, N., 2015. The netflix recommender system: Algorithms, business value, and innovation. *ACM Transactions on Management Information Systems (TMIS)*, *6*(4), pp.1-19.

Götz, O., Liehr-Gobbers, K. and Krafft, M., 2010. Evaluation of structural equation models using the partial least squares (PLS) approach. In *Handbook of partial least squares* (pp. 691-711). Springer, Berlin, Heidelberg.

Gowa, J. and Mansfield, E.D., 1993. Power politics and international trade. *American political science review*, *87*(2), pp.408-420.

Grant RB., 1991. A resource-based theory of competitive advantage: implications for strategy formulation. *California Management Review, 33*(3), pp.114–135.

Groover, M.P., 2016. Automation, production systems, and computer-integrated manufacturing. Pearson Education India.

Gruber, M., Heinemann, F., Brettel M. and Hungeling, S., 2010. Configurations of Resources implications: an exploratory study on technology ventures. *Strategic management Journal, 31*(12), pp.1337-1356

Gualandris, J. and Kalchschmidt, M., 2013. Product and process modularity: improving flexibility and reducing supplier failure risk. *International Journal of Production Research*, *51*(19), pp.5757-5770.

Guba, E.G., 1985. Naturalistic inquiry. *Beverly Hills: Sage Publications*

Hair, J.F., Black, W.C., Babin, B.J., Anderson, R.E. and Tatham, R.L., 1998. Multivariate data analysis . Uppersaddle River. *Multivariate Data Analysis (5th ed) Upper Saddle River*, *5*(3), pp.207-219.

Hair, J.F., Ringle, C.M. and Sarstedt, M., 2011. PLS-SEM: Indeed a silver bullet. *Journal of Marketing theory and Practice*, *19*(2), pp.139-152.

Handfield, R., Petersen, K., Cousins, P. and Lawson, B., 2009. An organizational entrepreneurship model of supply management integration and performance outcomes. *International Journal of Operations & Production Management*.

Harash, E., Al-Tamimi, K. and Al-Timimi, S., 2014. The relationship between government policy and financial performance: A study on the SMEs in Iraq. *China-USA Business Review*, *13*(4).

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

Hedden, C., 2020. *Branding 4.0 For the 4th Industrial Revolution.* Available at: https://www.brandingstrategyinsider.com/branding-4-0-for-the-4th-industrial-revolution/ (Accessed 30, January, 2021)

Heinen, J.S. and O'Neill, C., 2004. Managing talent to maximize performance. *Employment Relations Today*, *31*(2), p.67.

Hemsley‐Brown, J. and Oplatka, I., 2006. Universities in a competitive global marketplace: A systematic review of the literature on higher education marketing. *International Journal of public sector management*.

Henisz, W.J., Mansfield, E.D. and Von Glinow, M.A., 2010. Conflict, security, and political risk: International business in challenging times. *Journal of International Business Studies*, *41*(5), pp.759-764.

Henseler, J., Ringle, C.M. and Sinkovics, R.R., 2009. The use of partial least squares path modeling in international marketing. In *New challenges to international marketing*. Emerald Group Publishing Limited.

Hibbard, J. 1999. The web is changing mass production into mass customization. Information Week, pp. 85-86

Hirschman, E.C., 1980. Innovativeness, novelty seeking, and consumer creativity. *Journal of consumer research*, *7*(3), pp.283-295.

Hirschman, E.C., 1986. Humanistic inquiry in marketing research: philosophy, method, and criteria. *Journal of marketing Research*, *23*(3), pp.237-249.

Hoek, R.I.V. and Weken, H.A., 1998. The impact of modular production on the dynamics of supply chains. *The International Journal of Logistics Management*, *9*(2), pp.35-50.

Holden, M.T. and Lynch, P., 2004. Choosing the appropriate methodology: Understanding research philosophy. *The marketing review*, *4*(4), pp.397-409.

Holland, T., 2017. *What Is Branding? A Brief History.* Available at: https://www.skyword.com/contentstandard/branding-brief-history/ (Accessed 5, August, 2021).

Hu, L.T. and Bentler, P.M., 1999. Cutoff criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives. *Structural equation modeling: a multidisciplinary journal*, *6*(1), pp.1-55.

Huang, X., Kristal, M.M. and Schroeder, R.G., 2008. Linking learning and effective process implementation to mass customization capability. *Journal of Operations Management*, *26*(6), pp.714-729.

Hughes, J.A., 1997. The philosophy of social research/John A. Hughes, Wesley W. Sharrock.

Hunt, S.D., 1993. Objectivity in marketing theory and research. *Journal of Marketing*, *57*(2), pp.76-91.

Hussey, J. and Hussey, R. (1997) *Business Research - A Practical Guide for Undergraduate and Postgraduate Students*, London: McMillan Business.

Ingham, J., 2006. Closing the talent management gap: Harnessing your employees' talent to deliver optimum business performance. *Strategic HR Review*.

Iranzo, S., Schivardi, F. and Tosetti, E., 2008. Skill dispersion and firm productivity: An analysis with employer-employee matched data. *Journal of Labor Economics*, *26*(2), pp.247-285.

Ireland, R. D., Hitt, M. A. and Sirmon, D. G., 2003. A model of strategic entrepreneurship: The construct and its dimensions. *Journal of Management, 29*(6), pp. 963-989.

Isarabhakdee, P., 2016. Branding 4.0: *From Human Spirit to Your Spirit.* Available at: https://www.linkedin.com/pulse/branding-40-from-human-spirit-your-piyachart-isarabhakdee (Accessed 30, January, 2021).

Jacobs, M., Droge, C., Vickery, S.K. and Calantone, R., 2011. Product and process modularity's effects on manufacturing agility and firm growth performance. *Journal of Product Innovation Management*, *28*(1), pp.123-137.

Jain, P., Garg, S. and Kansal, G., 2022. Implementation of mass customization for competitive advantage in Indian industries: an empirical investigation. *The International Journal of Advanced Manufacturing Technology*, pp.1-16.

Jarvis, C.B., MacKenzie, S.B. and Podsakoff, P.M., 2003. A critical review of construct indicators and measurement model misspecification in marketing and consumer research. *Journal of consumer research*, *30*(2), pp.199-218.

Jick, T.D., 1979. Mixing qualitative and quantitative methods: Triangulation in action. *Administrative science quarterly*, *24*(4), pp.602-611.

Jick, T.D., 1979. Mixing qualitative and quantitative methods: Triangulation in action. *Administrative science quarterly*, *24*(4), pp.602-611.

Joneja, A. and Lee, N.K., 1998. Automated configuration of parametric feeding tools for mass customization. *Computers & industrial engineering*, *35*(3-4), pp.463-466.

Jordan, M.I. and Mitchell, T.M., 2015. Machine learning: Trends, perspectives, and prospects. *Science*, *349*(6245), pp.255-260.

Kaiser, U., Schreier, M. and Chris, J., 2015. Nonfunctional Self-Customization Enhances Product Performance. ACR North American Advances.

Kamali, N. and Loker, S., 2002. Mass customization: On-line consumer involvement in product design. *Journal of Computer-Mediated Communication*, *7*(4), p.JCMC741.

Kamali, N. and Loker, S., 2002. Mass customization: On-line consumer involvement in product design. *Journal of Computer-Mediated Communication*, *7*(4), p.JCMC741.

Kanter, R.M., 1999. From spare change to real change: The social sector as beta site for business innovation. *Harvard business review*, *77*(3), pp.122-123.

Kapferer, J. N., 1992. *The brand - capital of the company*. Landsberg / Lech: Publisher Modern Industry

Kapferer, J.N., 2008. *The New Strategic Brand Management: Creating and Sustaining Brand Equity*.

Kaplan, A.M. and Haenlein, M., 2006. Toward a parsimonious definition of traditional and electronic mass customization. *Journal of product innovation management*, *23*(2), pp.168-182

Kay, M.J., 1993. Making mass customization happen: lessons for implementation. *Planning Review*, *21*(4), pp.14-18.

Kay, M.J., 1993. Making mass customization happen: Lessons for implementation. *Planning Review*.

Keller, K.L., 1993. Conceptualizing, measuring, and managing customer-based brand equity. *the Journal of Marketing*, pp.1-22.

Keller, K.L., 2003. Brand synthesis: The multidimensionality of brand knowledge. *Journal of consumer research*, *29*(4), pp.595-600.

Keller, K.L., 2009. Building strong brands in a modern marketing communications environment. *Journal of marketing communications*, *15*(2-3), pp.139-155.

Ketchen Jr, D.J. and Hult, G.T.M., 2002. To be Modular or not to be? Some Answers to the Question. *Academy of Management Perspectives*, *16*(2), pp.166-168.

Ketchen Jr, D.J. and Hult, G.T.M., 2002. To be Modular or not to be? Some Answers to the Question. *Academy of Management Perspectives*, *16*(2), pp.166-168.

Kim, D.H., Kim, T.J., Wang, X., Kim, M., Quan, Y.J., Oh, J.W., Min, S.H., Kim, H., Bhandari, B., Yang, I. and Ahn, S.H., 2018. Smart machining process using machine learning: A review and perspective on machining industry. *International Journal of Precision Engineering and Manufacturing-Green Technology*, *5*(4), pp.555-568.
Kim, D.H., Kim, T.J., Wang, X., Kim, M., Quan, Y.J., Oh, J.W., Min, S.H., Kim, H., Bhandari, B., Yang, I. and Ahn, S.H., 2018. Smart machining process using machine learning: A review and perspective on machining industry. *International Journal of Precision Engineering and Manufacturing-Green Technology*, *5*(4), pp.555-568.
Kim, Y.K., 2002. Consumer value: an application to mall and Internet shopping. *International Journal of Retail & Distribution Management*, *30*(12), pp.595-602.

Kolberg, D. and Zühlke, D., 2015. Lean automation enabled by industry 4.0 technologies. *IFAC-PapersOnLine*, *48*(3), pp.1870-1875.
Kolberg, D. and Zühlke, D., 2015. Lean automation enabled by industry 4.0 technologies. *IFAC-PapersOnLine*, *48*(3), pp.1870-1875.
Kotabe, M., Parente, R. and Murray, J.Y., 2007. Antecedents and outcomes of modular production in the Brazilian automobile industry: a grounded theory approach. *Journal of International Business Studies*, *38*(1), pp.84-106.

Kotha, S., 1995. Mass customization: implementing the emerging paradigm for competitive advantage. *Strategic management journal*, *16*(S1), pp.21-42.

Kothari, C.R., 2004. *Research methodology: Methods and techniques*. New Age International.

Kotler, P., Kartajaya, H. and Setiawan, I., 2019. Marketing 3.0: From products to customers to the human spirit. In *Marketing wisdom* (pp. 139-156). Springer, Singapore.

KPMG., 2021. *Supply Chain: Digitize, Re-design and Optimize.* Available at https://home.kpmg/nl/en/home/services/advisory/strategy/supply-chain-digitize-re-design-and-optimize.html (Accessed 13, October, 2021)

Krawiec, T., 2018. *The Amazon Recommendations Secret to Selling More Online.* Rejoiner http://rejoiner.com/resources/amazon-recommendations-secret-selling-online/website (Accessed 20, October, 2021)

Kulp, S.C., Lee, H.L. and Ofek, E., 2004. Manufacturer benefits from information integration with retail customers. *Management science*, *50*(4), pp.431-444.

Lambert, D.M., Cooper, M.C. and Pagh, J.D., 1998. Supply chain management: implementation issues and research opportunities. *The international journal of logistics management*, *9*(2), pp.1-20.

Lang, C., Xia, S. and Liu, C., 2020. Style and fit customization: a web content mining approach to evaluate online mass customization experiences. *Journal of Fashion Marketing and Management: An International Journal*.

Lau, A.K., Yam, R.C. and Tang, E., 2011. The impact of product modularity on new product performance: Mediation by product innovativeness. *Journal of Product Innovation Management*, *28*(2), pp.270-284.

Lau, A.K., Yam, R.C. and Tang, E., 2011. The impact of product modularity on new product performance: Mediation by product innovativeness. *Journal of Product Innovation Management*, *28*(2), pp.270-284.

Lee, C.H.S., Barua, A. and Whinston, A.B., 2000. The complementarity of mass customization and electronic commerce. *Economics of Innovation and New Technology*, *9*(2), pp.81-110.

Lee, G., 2000. A future that fits: Mass customization of appeal looms large at the Bobbin show.

Lee, H.H. and Chang, E., 2011. Consumer attitudes toward online mass customization: An application of extended technology acceptance model. Journal of Computer-Mediated Communication, 16(2), pp.171-200.

Lee, H.L. and Whang, S., 2004. E-business and supply chain integration. In *The practice of supply chain management: Where theory and application converge* (pp. 123-138). Springer, Boston, MA.

Lee, J. and Lapira, E., 2013. Predictive factories: the next transformation. *Manufacturing Leadership Journal*, *20*(1), pp.13-24.

Lee, J., Davari, H., Singh, J. and Pandhare, V., 2018. Industrial Artificial Intelligence for industry 4.0-based manufacturing systems. *Manufacturing letters*, *18*, pp.20-23.

Lee, J., Davari, H., Singh, J. and Pandhare, V., 2018. Industrial Artificial Intelligence for industry 4.0-based manufacturing systems. *Manufacturing letters*, *18*, pp.20-23.

Lee, J., Lapira, E., Yang, S. and Kao, A., 2013. Predictive manufacturing system-Trends of next-generation production systems. *Ifac proceedings volumes*, *46*(7), pp.150-156.

Lee, M. and Kent, R., 1999. Using the Internet for market research: a study of private trading on the Internet. *Market Research Society. Journal.*, *41*(4), pp.1-10.

Lei, X., Ye, T. and Abimbola, T., 2013. The role of branding capability for innovative companies: Stock market reactions to new product announcement. *Nankai Business Review International*.

Leitão, P., Colombo, A.W. and Restivo, F.J., 2005. ADACOR: A collaborative production automation and control architecture. *IEEE Intelligent Systems*, *20*(1), pp.58-66.

Li, P., Chen, J. and Liu, Z., 2017. Consumer Perception and Behavioral Intention in Apparel E-Shopping: A Study on Chinese College Students. *Journal of Fashion Technology & Textile Engineering*, *2017*.

Li, X., Hui, E.C.M., Lang, W., Zheng, S. and Qin, X., 2020. Transition from factor-driven to innovation-driven urbanization in China: A study of manufacturing industry automation in Dongguan City. China Economic Review, 59, p.101382.

Li, X., Hui, E.C.M., Lang, W., Zheng, S. and Qin, X., 2020. Transition from factor-driven to innovation-driven urbanization in China: A study of manufacturing industry automation in Dongguan City. *China Economic Review*, *59*, p.101382.

Lincoln, Y.S. and Egon, E.G., 2000. Lincoln, Yvonna S., and Egan G. Egon," Paradigmatic Controversies, Contradictions, and Emerging Confluences," pp. 163-188 in Norman K. Denzin and Yvonna S. Lincoln, eds., The Handbook of Qualitative Research, Thousand Oaks, CA: Sage Publications, 2000.

Lincoln, Y.S. and Guba, E.G., 1985. Naturalistic inquiry. Newberry Park.

Lincoln, Y.S. and Guba, E.G., 1985. *Naturalistic inquiry*. sage.

Liu, G., Shah, R. and Schroeder, R.G., 2006. Linking work design to mass customization: a sociotechnical systems perspective. *Decision Sciences*, *37*(4), pp.519-545.

Liu, G., Shah, R. and Schroeder, R.G., 2010. Managing demand and supply uncertainties to achieve mass customization ability. *Journal of Manufacturing Technology Management*, *21*(8), pp.990-1012.

Liu, H., Wei, S., Ke, W., Wei, K.K. and Hua, Z., 2016. The configuration between supply chain integration and information technology competency: A resource orchestration perspective. *Journal of Operations Management*, *44*, pp.13-29.

Lu, Y. and Asghar, M.R., 2020. Semantic communications between distributed cyber-physical systems towards collaborative automation for smart manufacturing. *Journal of manufacturing systems*, *55*, pp.348-359.

Lu, Y. and Asghar, M.R., 2020. Semantic communications between distributed cyber-physical systems towards collaborative automation for smart manufacturing. *Journal of manufacturing systems*, *55*, pp.348-359.

Lu, Y. and Asghar, M.R., 2020. Semantic communications between distributed cyber-physical systems towards collaborative automation for smart manufacturing. *Journal of manufacturing systems*, *55*, pp.348-359.

Lu, Y., Xu, X. and Wang, L., 2020. Smart manufacturing process and system automation–a critical review of the standards and envisioned scenarios. *Journal of Manufacturing Systems*, *56*, pp.312-325.

Luxton, S., Reid, M. and Mavondo, F., 2015. Integrated marketing communication capability and brand performance. Journal of Advertising, 44(1), pp.37-46.

MacDuffie, J.P., 1997. The road to "root cause": Shop-floor problem-solving at three auto assembly plants. *Management Science*, *43*(4), pp.479-502.

Magnusson, M. and Pasche, M., 2014. A contingency‐based approach to the use of product platforms and modules in new product development. *Journal of Product Innovation Management*, *31*(3), pp.434-450.

Malhotra, N.K., Birks, D.F., Palmer, A. and Koenig-Lewis, N., 2003. Market research: an applied approach. *Journal of marketing management*, *27*, pp.1208-1213.

Malhotra, N.K., Birks, D.F., Palmer, A. and Koenig-Lewis, N., 2003. Market research: an applied approach. *Journal of marketing management*, *27*(1), pp.1208-1213.

Malhotra, N.K., Birks, D.F., Palmer, A. and Koenig-Lewis, N., 2003. Market research: an applied approach. *Journal of marketing management*, *27*(1), pp.1208-1213.

Mansfield, E.D., 1995. *Power, trade, and war*. Princeton University Press.

Marczyk, G. DeMatteo, and D. DeMatteo. "D. and Festinger, D, 2005. Essentials of Research Design and Methodology."

Masayuki, M.O.R.I.K.A.W.A., 2020. *Heterogeneous Relationships between Automation Technologies and Skilled Labor: Evidence from a Firm Survey* (No. 20004).

Masayuki, M.O.R.I.K.A.W.A., 2020. *Heterogeneous Relationships between Automation Technologies and Skilled Labor: Evidence from a Firm Survey* (No. 20004).

Maxwell, J.A., 2012. *Qualitative research design: An interactive approach* (Vol. 41). Sage publications.

McCarthy, I.P., 2004. Special issue editorial: the what, why and how of mass customization. *Production Planning & Control*, *15*(4), pp.347-351.

McCutcheon, D.M., Raturi, A.S. and Meredith, J.R., 1994. The customization-responsiveness squeeze. *MIT Sloan Management Review*, *35*(2), p.89.

McDermott, C.M. and O'Connor, G.C., 2002. Managing radical innovation: an overview of emergent strategy issues. *Journal of Product Innovation Management: an international publication of the product development & management association*, *19*(6), pp.424-438.

McKinsey.,2021. The state of fashion 2021. [Online] Available at https://www.mckinsey.com/~/media/mckinsey/industries/retail/our%20insights/state%20of%20fashion/2021/the-state-of-fashion-2021-vf.pdf (Accessed 13, October, 2021)

Merle, A., Chandon, J.L., Roux, E. and Alizon, F., 2010. Perceived value of the mass‐customized product and mass customization experience for individual consumers. *Production and Operations Management*, *19*(5), pp.503-514.

Merle, A., Chandon, J.L., Roux, E. and Alizon, F., 2010. Perceived value of the mass‐customized product and mass customization experience for individual consumers. *Production and operations management*, *19*(5), pp.503-514.

Merriam, S.B., 1988. *Case study research in education: A qualitative approach*. Jossey-Bass.

Meyer, M.H. and Lehnerd, A.P., 1997. *The power of product platforms*. Simon and Schuster.

Meyer, M.H. and Lehnerd, A.P., 1997. *The power of product platforms*. Simon and Schuster.

Midgley, D.F. and Dowling, G.R., 1978. Innovativeness: The concept and its measurement. *Journal of consumer research*, *4*(4), pp.229-242.

Miguel, P.A.C., 2005. Modularity in product development: a literature review towards a research agenda. *Product: Management and Development*, *3*(2), pp.165-174.

Milgrom, P. and Roberts, J., 1995. Complementarities and fit strategy, structure, and organizational change in manufacturing. *Journal of accounting and economics*, *19*(2-3), pp.179-208.

Mone, M.A., McKinley, W. and Barger, I. (1998), “Organizational decline and innovation: a contingency framework”, Academy of Management Review, Vol. 23 No. 1, pp. 115-32.

Mone, M.A., McKinley, W. and Barker III, V.L., 1998. Organizational decline and innovation: A contingency framework. *Academy of management review*, *23*(1), pp.115-132.

Moore, K. and Reid, S., 2008. The Birth of Brand: 4000 Years of Branding History, MPRA Paper No. 10169. *McGill University, Munich Personal RePEc Archive: Retrieved from https://mpra. ub. uni-muenchen. de/10169*.

Netemeyer, R.G., Bearden, W.O. and Sharma, S., 2003. *Scaling procedures: Issues and applications*. sage publications.

Neuman, W.L. and Kreuger, L., 2003. *Social work research methods: Qualitative and quantitative approaches*. Allyn and Bacon.

Nobeoka, K. and Cusumano, M.A., 1997. Multiproject strategy and sales growth: the benefits of rapid design transfer in new product development. *Strategic Management Journal*, *18*(3), pp.169-186.

Nunnally, J.C., 1978. An overview of psychological measurement. *Clinical diagnosis of mental disorders*, pp.97-146.

Nunnally, J.C., 1994. *Psychometric theory 3E*. Tata McGraw-hill education.

Nunnally, J.C., 1994. *Psychometric theory 3E*. Tata McGraw-hill education.

O’Neill, E, 2015; *History of Branding.* Available at: https://www.lcca.org.uk/blog/education/history-of-branding/ (Accessed 6, April, 2021).

Obaji, N.O. and Olugu, M.U., 2014. The role of government policy in entrepreneurship development. *Science Journal of Business and Management*, *2*(4), pp.109-115.

Odoom, R. and Mensah, P., 2018. Brand orientation and brand performance in SMEs: The moderating effects of social media and innovation capabilities. *Management Research Review*.

Parente, R. and Gu, J., 2005. Strategic modularisation and performance implications in the Brazilian automotive industry. *International journal of automotive technology and management*, *5*(4), pp.430-460.

Patton, M.Q. (2002) *Qualitative Evaluation and Research Methods*, 3rd ed., London: Sage.

Patton, M.Q., 1990. *Qualitative evaluation and research methods*. SAGE Publications, inc.

Payne, G. and Payne, J., 2004. *Key concepts in social research*. Sage.

Payne, G. and Payne, J., 2004. *Key concepts in social research*. sage.

Pekkarinen, S. and Ulkuniemi, P., 2008. Modularity in developing business services by platform approach. *The International Journal of Logistics Management*.

Persson, M. and Åhlström, P., 2006. Managerial issues in modularising complex products. *Technovation*, *26*(11), pp.1201-1209.

Peter, J.P., 1979. Reliability: A review of psychometric basics and recent marketing practices. *Journal of marketing research*, *16*(1), pp.6-17.

Peters, L. and Saidin, H., 2000. IT and the mass customization of services: the challenge of implementation. *International Journal of Information Management*, *20*(2), pp.103-119.

Petracco, C. and Schweiger, H., 2012. The Impact of Armed Conflict on Firms' Performance and Perceptions. *European Bank for Reconstruction and Development Working Paper*, *152*.

Petracco, C. and Schweiger, H., 2012. The Impact of Armed Conflict on Firms' Performance and Perceptions. *European Bank for Reconstruction and Development Working Paper*, *152*.

Piehler, R., Grace, D. and Burmann, C., 2018. Internal brand management: introduction to the special issue and directions for future research.

Piller, F., 2021. *Mass Customization* http://frankpiller.com/mass-customization/ (Accessed, 25, May, 2022)

Piller, F.T. and Müller, M., 2004. A new marketing approach to mass customisation. *International Journal of Computer Integrated Manufacturing*, *17*(7), pp.583-593.

Piller, F.T. and Müller, M., 2004. A new marketing approach to mass customisation. *International Journal of Computer Integrated Manufacturing*, *17*(7), pp.583-593.

Pine, B.J., 1993. *Mass customization: the new frontier in business competition*. Harvard Business Press.

Pine, B.J., 1993. Mass customizing products and services. *Planning Review*, *21*(4), pp.6-55.

Pine, B.J., 1999. *Mass customization: the new frontier in business competition*. Harvard Business Press.

Qi, Y., Boyer, K.K. and Zhao, X., 2009. Supply chain strategy, product characteristics, and performance impact: evidence from Chinese manufacturers. *Decision Sciences*, *40*(4), pp.667-695.

Raimondo, M.A. and Farace, S., 2013. Customer attitude and dispositions towards customized products: The interaction between customization model and brand. *Journal of Interactive Marketing*, *27*(3), pp.209-225.

Raimondo, M.A. and Farace, S., 2013. Customer attitude and dispositions towards customized products: The interaction between customization model and brand. *Journal of Interactive Marketing*, *27*(3), pp.209-225.

Ravichandran, T., 1999. Redefining organizational innovation: towards theoretical advancements. *The Journal of High Technology Management Research*, *10*(2), pp.243-274.

Reid, M., 2005. Performance auditing of integrated marketing communication (IMC) actions and outcomes. *Journal of Advertising*, *34*(4), pp.41-54.

Reid, M., Luxton, S. and Mavondo, F., 2005. The relationship between integrated marketing communication, market orientation, and brand orientation. Journal of advertising, 34(4), pp.11-23.

Remenyi, D., Williams, B., Money, A. and Swartz, E., 1998. *Doing research in business and management: an introduction to process and method*. Sage.

Reynolds, N., Diamantopoulos, A. and Schlegelmilch, B., 1993. Pre-testing in questionnaire design: A review of the literature and suggestions for further research. *Market Research Society. Journal.*, *35*(2), pp.1-11.

Rigdon, E.E., Ringle, C.M. and Sarstedt, M., 2010. Structural modeling of heterogeneous data with partial least squares. *Review of marketing research*.

Rikalovic, A., Cosic, I., Labati, R.D. and Piuri, V., 2017. Intelligent decision support system for industrial site classification: A GIS-based hierarchical neuro-fuzzy approach. *IEEE Systems Journal*, *12*(3), pp.2970-2981.

Risley, J., 2019. *Round up, personalization pushes Nike's online sales to grow 42%.* Available at: https://www.digitalcommerce360.com/2019/09/26/personalization-pushes-nike-online-sales/ (Accessed 6, April, 2021).

Rosenau, P.M., 1991. *Post-modernism and the social sciences: Insights, inroads, and intrusions*. Princeton University Press.

Roumeliotis, J.D (2015) *Mass Customization & Personalization: The Pinnacle of Differentiation and Brand Loyalty*. Available at https://www.linkedin.com/pulse/mass-customization-personalization-pinnacle-brand-roumeliotis (Accessed, 3, March, 2022)

Salvador, F., De Holan, P.M. and Piller, F.T., 2009. Cracking the code of mass customization. *MIT Sloan management review*, *50*(3), p.71.

Sanchez, R. and Collins, R.P., 2001. Competing—and learning—in modular markets. *Long Range Planning*, *34*(6), pp.645-667.

Sanchez, R. and Mahoney, J.T., 1996. Modularity, flexibility, and knowledge management in product and organization design. *Strategic management journal*, *17*(S2), pp.63-76.

Sanchez, R. and Mahoney, J.T., 1996. Modularity, flexibility, and knowledge management in product and organization design. *Strategic management journal*, *17*(S2), pp.63-76.

Sanchez, R. and Mahoney, J.T., 1996. Modularity, flexibility, and knowledge management in product and organization design. *Strategic management journal*, *17*(S2), pp.63-76.

Sanchez, R., 1995. Strategic flexibility in product competition. *Strategic management journal*, *16*(S1), pp.135-159.

Sanchez, R., 1995. Strategic flexibility in product competition. *Strategic management journal*, *16*(S1), pp.135-159.

Sanchez, R., 2000. Modular architectures, knowledge assets and organisational learning: new maSuzik, H.A., 1999. GM announces modularity project. *Quality*, *38*(5), p.14.nagement processes for product creation. International Journal of Technology Management, 19(6), pp.610-629.

Sanchez, R., 2000. Modular architectures, knowledge assets and organisational learning: new management processes for product creation. *International Journal of Technology Management*, *19*(6), pp.610-629.

Sangwan, A. 2004. Cross Cultural Training and Global Competencies – A Study of Indian MNC. IOSR Journal of Business and Management, pp. 20–24.

Santos, I., Seibel, S. and Silveira, I., 2021. Covid-19's Impact on Society, Fashion Trends and Consumption. *Strategic design research journal*, *14*(1), pp.92-101.

SANTOSA, M.G.S., SUPARTHA, W.G., RIANA, I.G. and SURYA, I., 2020. A contiguity of social capital, competence, and business performance moderating by government policy. *The Journal of Asian Finance, Economics and Business*, *7*(9), pp.727-736.

SANTOSA, M.G.S., SUPARTHA, W.G., RIANA, I.G. and SURYA, I., 2020. A contiguity of social capital, competence, and business performance moderating by government policy. *The Journal of Asian Finance, Economics and Business*, *7*(9), pp.727-736.

Saunders, M., Lewis, P. and Thornhill, A., 2009. *Research methods for business students*. Pearson education.

Schilling, M.A. and Steensma, H.K., 2001. The use of modular organizational forms: An industry-level analysis. *Academy of management journal*, *44*(6), pp.1149-1168.

Schilling, M.A. and Steensma, H.K., 2001. The use of modular organizational forms: An industry-level analysis. *Academy of management journal*, *44*(6), pp.1149-1168.

Schilling, M.A. and Steensma, H.K., 2001. The use of modular organizational forms: An industry-level analysis. *Academy of management journal*, *44*(6), pp.1149-1168.

Schilling, M.A., 2000. Toward a general modular systems theory and its application to interfirm product modularity. *Academy of management review*, *25*(2), pp.312-334.

Schreier, M., 2006. The value increment of mass - customized products: an empirical assessment. *Journal of Consumer Behaviour*, *5*(4), pp.317-327.

Schreier, M., 2006. The value increment of mass - customized products: an empirical assessment. *Journal of Consumer Behaviour*, *5*(4), pp.317-327.

Schuldt, B.A. and Totten, J., 1999. E-mail surveys: What we've learned thus far. *Quirk's Marketing Research Review*.

Seyoum, B., 2021. Product modularity and performance in the global auto industry in China: the mediating roles of supply chain integration and firm relative positional advantage. *Asia Pacific Business Review*, *27*(5), pp.651-676.

Sharp, M., Ak, R. and Hedberg Jr, T., 2018. A survey of the advancing use and development of machine learning in smart manufacturing. *Journal of manufacturing systems*, *48*, pp.170-179.

Sheehan, K.B. and McMillan, S.J., 1999. Response variation in e-mail surveys: An exploration. *Journal of advertising research*, *39*(4), pp.45-45.

Shin, M., Ryu, D., Han, J., Kim, K. and Son, Y.J., 2018. Preliminary design of a production automation framework for a pyroprocessing facility. *Nuclear Engineering and Technology*, *50*(3), pp.478-487.

Silveira, G.J.C.D., Fogliatto, F.S. and Fendyur, A., 2016. Demographics of mass customization: a global study of manufacturing plants. *Production*, *26*(1), pp.1-11.

Silverman, D., 2015. *Interpreting qualitative data*. Sage.

Simatupang, T.M., Wright, A.C. and Sridharan, R., 2002. The knowledge of coordination for supply chain integration. *Business process management journal*.

Simatupang, T.M., Wright, A.C. and Sridharan, R., 2002. The knowledge of coordination for supply chain integration. *Business process management journal*.

Sirmon, B.G., Hitt, M.A., Ireland R.D. and Gilbert B.A., 2011. Resource Orchestration to create competitive advantage: Breadth, depth, and life cycle effects. *Journal of management, 37*(5), pp.1390-1412

Sirmon, B.G., Hitt. M.A. and Ireland, R.D., 2007. Managing firm resources in dynamic environments to create value: Looking inside the black box. *Academy of management review, 32*(1), pp.273-292

Smith, H.L., Dickson, K. and Smith, S.L., 1991. "There are two sides to every story": Innovation and collaboration within networks of large and small firms. *Research Policy*, *20*(5), pp.457-468.

Spaulding, E. and Perry, C., 2013. Making it personal: Rules for success in product customization. Bain & Company Publication.

Spaulding, E. and Perry, C., 2013. Making it personal: Rules for success in product customization. *Bain & Company Publication*.

Squire, B., Brown, S., Readman, J. and Bessant, J., 2006. The impact of mass customisation on manufacturing trade‐offs. *Production and Operations Management*, *15*(1), pp.10-21.

Sriram, V. and Mersha, T., 2010. Stimulating entrepreneurship in Africa. *World Journal of Entrepreneurship, Management and Sustainable Development*.

Starr, M.K., 1965. Modular production, a new concept. *Harvard Business Review*, 43(6), pp. 131-142.

Sturgeon, T.J., 2002. Modular production networks: a new American model of industrial organization. *Industrial and corporate change*, *11*(3), pp.451-496.

Subramanian, A. and Nilakanta, S., 1996. Organizational innovativeness: Exploring the relationship between organizational determinants of innovation, types of innovations, and measures of organizational performance. *Omega*, *24*(6), pp.631-647.

Subramoniam, S. and Babu, S.R., 2010. Mass customising the tourism sector in Kerala. *International Journal of Leisure and Tourism Marketing*, *1*(4), pp.392-405.

Susarla, A., Barua, A. and Whinston, A.B., 2009. A transaction cost perspective of the" software as a service" business model. *Journal of Management Information Systems*, *26*(2), pp.205-240.

Suthar, S. (2015). *6 Reasons Why Customization Is the New Marketing Strategy*. Available at: https://thenextscoop.com/customization-is-the-new-marketing-strategy/ (Accessed 20 September, 2021)

Suzik, H.A., 1999. GM announces modularity project. *Quality*, *38*(5), p.14.

Suzik, H.A., 1999. GM announces modularity project. *Quality*, *38*(5), p.14.

Swaminathan, J.M., 2001. Enabling customization using standardized operations. *California Management Review*, *43*(3), pp.125-135.

Tabachnick, B.G., Fidell, L.S. and Ullman, J.B., 2007. *Using multivariate statistics* (Vol. 5, pp. 481-498). Boston, MA: pearson.

Teddlie, C. and Tashakkori, A., 2003. Major issues and controveries inthe use of mixed methods in the social and behvioral sciences. *Handbook of mixed methods in social & behavioral research*, pp.3-50.

Teddlie, C. and Tashakkori, A., 2003. Major issues and controversies in the use of mixed methods in the social and behavioral sciences. *Handbook of mixed methods in social and behavioral research*, *1*(1), pp.13-50.

Tellis, G.J., Prabhu, J.C. and Chandy, R.K., 2009. Radical innovation across nations: The preeminence of corporate culture. *Journal of marketing*, *73*(1), pp.3-23.

Tenenhaus, M., Vinzi, V.E., Chatelin, Y.M. and Lauro, C., 2005. PLS path modeling. *Computational statistics & data analysis*, *48*(1), pp.159-205.

Thompson, V.A. (1965) "Bureaucracy and Innovation", *Administrative Science Quarterly*, 10 (1), pp. 1-20.

Totz, C. and Riemer, K., 2001. The effect of interface quality on success-an integrative approach on mass customization design. In *Proceedings of the 1st World Congress on Mass Customization and Personalization, Hong-Kong*.

Trochim, W.M., 2002. Introduction to research design. *Retrieved December*, *2*, p.2006.

Troncoso, D.J., and Leonard, M., 2022 *Branding vs Marketing: What Is The Difference.* Available at: https://marketsplash.com/branding-vs-marketing/ ((Accessed 6, September, 2021).

Tu, Q., Vonderembse, M.A. and Ragu-Nathan, T.S., 2001. The impact of time-based manufacturing practices on mass customization and value to customer. *Journal of Operations management*, *19*(2), pp.201-217.

Tu, Q., Vonderembse, M.A., Ragu-Nathan, T.S. and Ragu-Nathan, B., 2004. Measuring modularity-based manufacturing practices and their impact on mass customization capability: a customer-driven perspective. *Decision Sciences*, *35*(2), pp.147-168.

Tuli, F., 2010. The basis of distinction between qualitative and quantitative research in social science: Reflection on ontological, epistemological and methodological perspectives. *Ethiopian Journal of Education and Sciences*, *6*(1).

Tummala, V.M. and Schoenherr, T., 2008. Best practices for the implementation of Supply Chain Management initiatives. *Tummala, VM Rao, and Tobias Schoenherr."Best Practices for the Implementation of Supply Chain Management Initiatives," International Journal of Logistics Systems and Management*, *4*(4), pp.391-410.

Ulrich, K., 1995. The role of product architecture in the manufacturing firm. *Research policy*, *24*(3), pp.419-440.

Van Hoek, R.I. and Weken, H.A., 1998. The impact of modular production on the dynamics of supply chains. *The International Journal of Logistics Management*, *9*(2), pp.35-50.

Van, H.T. and Hieu, V.M., 2020. Travel branding in tourism 4.0: case study Vietnam travel. *Journal of Asian and African Studies*, *55*(6), pp.896-909.

Venkatraman, N. and Prescott, J.E., 1990. Environment-strategy coalignment: An empirical test of its performance implications. *Strategic management journal*, *11*(1), pp.1-23.

Venkatraman, N., 1990. Performance implications of strategic coalignment: a methodological perspective. *Journal of management studies*, *27*(1), pp.19-41.

Vladimir, K., Anton, D. and Hugo, G., 2017, September. Genetic programming application for features selection in task of arterial hypertension classification. In *2017 International Multi-Conference on Engineering, Computer and Information Sciences (SIBIRCON)* (pp. 561-565). IEEE.

Wallace, B., 2018. *Branding 4.0 and the Age of Hyper Customization.* Available at: https://www.experts.com/articles/branding-4-0-the-age-of-hyper-customization-by-rob-wallace (Accessed 30, January, 2021).

Wan, X., Wang, T., Zhang, W. and Cao, J., 2017. Perceived value of online customization experience in China: Concept, measurement, and consequences. *The Journal of High Technology Management Research*, *28*(1), pp.17-28.

Wang, C.L. and Ahmed, P.K., 2004. The development and validation of the organisational innovativeness construct using confirmatory factor analysis. *European journal of innovation management*.

Wang, Y., Ma, H.S., Yang, J.H. and Wang, K.S., 2017. Industry 4.0: a way from mass customization to mass personalization production. *Advances in manufacturing*, *5*(4), pp.311-320.

Wang, Z., Chen, L., Zhao, X. and Zhou, W., 2014. Modularity in building mass customization capability: The mediating effects of customization knowledge utilization and business process improvement. *Technovation*, *34*(11), pp.678-687.

Wang, Z., Chen, L., Zhao, X. and Zhou, W., 2014. Modularity in building mass customization capability: The mediating effects of customization knowledge utilization and business process improvement. *Technovation*, *34*(11), pp.678-687.

Welch, C. and Wilkinson, I., 2005. Network perspectives on interfirm conflict: reassessing a critical case in international business. *Journal of Business Research*, *58*(2), pp.205-213.

Werts, C.E., Linn, R.L. and Jöreskog, K.G., 1974. Intraclass reliability estimates: Testing structural assumptions. *Educational and Psychological measurement*, *34*(1), pp.25-33.

West, A., Clifford, J. and Atkinson, D., 2018. " Alexa, build me a brand" An Investigation into the impact of Artificial Intelligence on Branding. *The Business & Management Review*, *9*(3), pp.321-330.

Westrom (2020). *THE GROWING USE OF AUTOMATION IN MANUFACTURING.* Available at https://www.machinemetrics.com/blog/automation-in-manufacturing (Accessed, 15, May, 2021)

Whetten, D.A., 1997. Part II: Where do reputations come from?: Theory development and the study of corporate reputation. *Corporate Reputation Review*, *1*(1), pp.25-34.

Wilke, R. and Zaichkowsky, J.L., 1999. Brand imitation and its effects on innovation, competition, and brand equity. *Business Horizons*, *42*(6), pp.9-9.

Wind, J. and Mahajan, V., 1997. Issues and opportunities in new product development: An introduction to the special issue. *Journal of marketing research*, *34*(1), pp.1-12.

Wong, H.Y. and Merrilees, B., 2007. Multiple roles for branding in international marketing. *International Marketing Review*.

Wong, H.Y. and Merrilees, B., 2008. The performance benefits of being brand-orientated. *Journal of Product & Brand Management*.

Wong, H.Y. and Merrilees, B., 2008. The performance benefits of being brand-orientated. *Journal of Product & Brand Management*.

Worren, N., Moore, K. and Cardona, P., 2002. Modularity, strategic flexibility, and firm performance: a study of the home appliance industry. *Strategic management journal*, *23*(12), pp.1123-1140.

Wuest, T., Weimer, D., Irgens, C. and Thoben, K.D., 2016. Machine learning in manufacturing: advantages, challenges, and applications. *Production & Manufacturing Research*, *4*(1), pp.23-45.

Wygant, S. and Lindorf, R., 1999. Surveying collegiate Net surfers—Web methodology or mythology. *Quirk's Marketing Research Review*.

Yan, Y., Gupta, S., Licsandru, T.C. and Schoefer, K., 2022. Integrating machine learning, modularity and supply chain integration for Branding 4.0. *Industrial Marketing Management*, *104*, pp.136-149.

Yan, Y., Gupta, S., Schoefer, K. and Licsandru, T., 2020. A Review of E-mass Customization as a Branding Strategy. *Corporate Reputation Review*, *23*(3), pp.215-223.

Yin Wong, H. and Merrilees, B., 2008. The performance benefits of being brand-orientated. *Journal of Product & Brand Management*, *17*(6), pp.372-383.

Yoo, J. and Park, M., 2016. The effects of e-mass customization on consumer perceived value, satisfaction, and loyalty toward luxury brands. *Journal of Business Research*, *69*(12), pp.5775-5784.

Yoo, J. and Park, M., 2016. The effects of e-mass customization on consumer perceived value, satisfaction, and loyalty toward luxury brands. *Journal of business research*, *69*(12), pp.5775-5784.

Zaefarian, G., Henneberg, S.C. and Naudé, P., 2013. Assessing the strategic fit between business strategies and business relationships in knowledge-intensive business services. *Industrial Marketing Management*, *42*(2), pp.260-272.

Zikmund, W.G., Babin, B.J., Carr, J.C. and Griffin, M., 2003. Business research methods 7th ed. *Thomson/South-Western*.

Zorlu, K. and Hacıoğlu, Ü., 2012. The conflict issue in international business and the global leadership. *Procedia-Social and Behavioral Sciences*, *41*, pp.100-107.

Appendices

Appendix 1 Semi-structured Interview Guide

The aim of this interview: The purpose of this research is to investigate 'e-mass customization'; in particular, this study focuses on the concept of e-mass customization, the role of e-mass customization on branding, the plausible influence of e-mass customization towards the brands (specifically to brand performance), as well as the factors that may affect the implementation of e-mass customizationThe successful implementation of e-mass customization may be related with managerial and technological solutions, such as modularity, innovation, supply chain integration, production automation as well as machine learning. Accordingly, the relation in terms of these constructs to e-mass customization hence will be an important part of the study.

Thank you for voluntarily taking the time to participate in this research being conducted as part of my doctoral studies at Newcastle University. This interview will be helpful to understand the importance of e-mass customization, and how to support the firm to implement e-mass customization from operational perspective.

Please note the following about this interview:

• The interview will be audio recorded and transcribed for analysis purposes;

• You are free to withdraw from this process at any point during the interview or request that the recording be stopped;

• The data collected will be considered confidential and not be disseminated to any external sources;

• The data will be stored safely and securely (password protected where applicable) and will only be viewed or used by the researcher and his supervisors;

• The details of the participant will remain anonymous and not disclosed unless I am permitted to in agreement with you.

The results of this study maybe published in research articles and other formal research outputs.

By agreeing to participate in this interview you acknowledge the above information pertaining to the interview.

Participant Details

Title:

Position:

Name of the Company:

Duration of employment:

Interviewer:

Date:

Thank you again for your participation.

Interview Questions

Part 1. Respondent Information

1. How many years have you worked in the fashion-relevant area?
2. How many years have you worked for the company?
3. How many employees does your company have, currently?
4. Describe your role in the organization?
5. Have you ever been involved in managing e-mass customization program?

Part 2. The Concept of E-mass Customization

6. Can you please share your views on e-mass customization program for branding?
7. What are the dimensions of e-mass customization program?
   7.1 In your view, what is the role of co-design activity in e-mass customization?
   7.2. In your view, what is the role of mass-custom production in e-mass customization?

Part 3. The influence of E-mass Customization

8. What triggered the need for set up e-mass customization?
   (Or in your view, give at least <u>*three*</u> *reasons for the launching e-mass customization program)*
9. What were the changes after implementation of e-mass customization program?
   9.1. What were the key changes towards the brand after implementation of e-mass customization?
   (Or in your view, please tell three influences from brand value side)
   9.2. What were the changes towards brand performance after implementation of e-mass customization program?
   (Please tell the changes such as brand competitiveness, brand-customer relationship, customer loyalty)

Part 4. The influence factors on E-mass customization

10. What is the role of product modularity in pushing of e-mass customization?
    (Or, has product modularity helped in pushing e-mass customization program? If yes, how?)
11. What is the role of product modularity in pushing of e-mass customization?
    (Or, has process modularity helped in pushing e-mass customization program? If yes, how?)
12. Has modularity applied at other levels helped in pushing Branding 4.0? (If yes, can you detail which levels and how it helped?)

13. What is the role of innovation in pushing of e-mass customization?

13.1 How would you describe the role of innovation in implementation of Branding 4.0 principles?

14. What is the role of supply chain integration in pushing of e-mass customization?

 14.1. How would you describe the role of SCI in implementation of Branding 4.0 principles?

 14.2. Are there activities your brand applies for supply chain integration in terms of Branding 4.0? (If yes, can you detail them?)

15. What is the role of production automation in pushing of e-mass customization?

 15.1. How would you describe the role of innovation in implementation of Branding 4.0 principles?

 15.2. Are there systems and (or) activities that use e-mass customization when implement e-mass customization program? (If yes, can you detail them?)

16. What was the role of machine learning in the implementation of e-mass customization?

 16.1. Have you used machine learning for implementation of e-mass customization? (If yes/no, why?)

 16.2. How is machine learning employed for the implementation of e-mass customization?

 16.3. Is there a further plan to further adopt machine learning in pushing e-mass customization (If yes, can you describe the plan? If not, why?)

Part 5 Retrospectives and prospects

17. Looking back, what are the success and deficiencies in the progress of the project?

18. Looking forward, what do you think the organization could do to further enhance e-mass customization program?

19. Have you encountered any struggles during implementation of e-mass customization? (If yes, can you detail them? How did you solve the problem?)

Appendix 2-1 Questionnaire (English Version)

An Investigation into E-mass Customization in E-commerce: from A Brand Perspective

1. Introduction

This study's core theme is company branding strategy based on e-mass customization. This study investigates the impact of e-mass customization on branding companies and how companies use technological, technical and managerial tools and means to successfully deploy operations to implement e-mass customization. The ultimate goal of this study is to determine how a firm can achieve great success through branding strategies in an increasingly competitive business environment.

2 Demographic Information

1. Your Gender □ Male □ Female □Do not wish to disclose
2. Age □ Under 25 □ 25-35 □35-45 □45-55 □55and above
3. Please indicate years of working on fashion-relevant area □ Less than 1year □ 1-3years □ 3-5years

☐ 5-7 years
☐ 7-10years
☐ 10-13years
☐ 13-15 years
☐ Over15 years

4. Please indicate how old is this company you are working with, currently
☐Less than 1year
☐1-3 years
☐3-5years
☐5-7years
☐7-10years
☐over 10years

5. Please indicate the number of employees in your company at the moment:
☐ Less than 10
☐ 10-50
☐ 51-250
☐ 251-500
☐ 501-1000
☐ 1001-3000
☐ 3001-5000
☐ more than 5000

6. Do you have subordinates?
☐Yes
☐No

7. Please state your designation/ current position in the company: ………founder and manager………………………………

8. Which of the following best represents your current average income (including overtime, bonuses and other extras) received from the organization per month?
☐ Below 10,000 CNY
☐10,001-30,000CNY
☐30,001-50,000CNY
☐50,001-70,000CNY
☐70,001-90,000CNY
☐Above 90,000CNY

9. Level of your education
☐ Below Undergraduate level
☐Undergraduate
☐Master
☐ MBA
☐PhD
☐ Others: …………

10. I am regularly involved in the management of e-mass customization program in our company
☐ Strongly disagree
☐Disagree
☐Somewhat disagree
☐Neutral
☐Somewhat agree
☐Agree
☐Strongly agree

11. I would like to receive a summary of this study ☐ No
☐ Yes- PDF file to the following Email address …………
☐ Yes – Hard copy to the following address …………

12. Please use the space below to make any observations about the institution or the questionnaire itself: ………………………………………

3. E-mass customization

E-mass customization is a strategy that includes processes of co-design activity and mass-custom production in order to bring customers a personalized experience and products at a reasonable price and within a short waiting time; it can be measured as:

	1 Strongly disagree	2 Disagree	3 Somewhat disagree	4 Neutral	5 Somewhat agree	6 Agree	7 Strongly agree
We have the ability to produce highly differentiated products without increasing costs, significantly							
We have the ability to increase product variety without diminishing production volume							
We have the ability to reorganising production process quickly in response to customization products							
We have the ability to support user-friendly co-design activity for customer to identify their own products							

4. Product Modularity

Applying product modularity to configurate products has a positive effect on e-mass customization, when:

	1 Strongly disagree	2 Disagree	3 Somewhat disagree	4 Neutral	5 Somewhat agree	6 Agree	7 Strongly agree
Product can be decomposed into separate modules that can be re-combined into new designs							
We can make changes in the key components without redesigning others							
Product components can be reused in various products							
We have a high degree of component between different products							

5. Process Modularity

Applying process modularity to arrange key activities of the production process has a positive effect on e-mass customization, when:

	1 Strongly disagree	2 Disagree	3 Somewhat disagree	4 Neutral	5 Somewhat Agree	6 Agree	7 Strongly agree
Our process can be adjusted by adding new process modules							
Process modules can be adjusted for changing production need							
Our process can be broken down into standard sub-processes that produce standard base units and customization sub-processes that further customize the base units							
Process modules can be rearranged so that customization sub-processes occur last							

6. Innovativeness

Keeping innovativeness has a positive effect on e-mass customization, when:

	1 Strongly disagree	2 Disagree	3 Somewhat disagree	4 Neutral	5 Somewhat agree	6 Agree	7 Strongly agree
We actively engage in wide search for new idea							
We carefully think through how new ideas need to be adapted for our business							
We have a good system for identifying, selecting and implementing innovation on a regular basis							
Compared with competitors, we have a high rate of product/service innovation							
Compared with competitors, we have a high rate of process/organization improvement							
Over time, we have been successful with overall innovation in recent years							

7 Supply Chain Integration

Integration of supply chain with upstream and downstream suppliers has a positive impact on e-mass customization, when:

	1 Strongly disagree	2 Disagree	3 Somewhat disagree	4 Neutral	5 Somewhat agree	6 Agree	7 Strongly agree
Our company exchanges information with channel partners on various supply chain activities							
Our company collaborates with channel partners in designing plans							
Our company streamlines supply chain processes with channel partners							
Our company establishes long-term relationships with channel partners to achieve strategic goals							

8. Production Automation

Applying automation system to automate production process has a positive impact e-mass customization, when:

	1 Strongly disagree	2 Disagree	3 Somewhat disagree	4 Neutral	5 Somewhat agree	6 Agre e	7 Strongly agree
We automate production scheduling in our company							
We automate operational management in our company							
We automate the release of production orders							
We automate order progress controlling							
We automate real-time order status							

We automate activities controlling the physical equipment in the shop floor							
We automate the execution of production operations							

9. Moderator-Machine Learning

H6: Machine learning strengthens the relationship between product modularity and e-mass customization

H7: Machine learning strengthens the relationship between process modularity and e-mass customization

H8: Machine learning strengthen the relationship between innovation and e-mass customization

H9: Machine learning strengthen the relationship between supply chain integration and e-mass customization

H10: Machine learning strengthen the relationship between production automation and e-mass customization

Machine learning is algorithm-based computer systems capable of providing deep insights for performing tasks through autonomous learning; and by integrating machine learning systems into different systems we can gain optimal solutions, when:

	1 Strongly disagree	2 Disagree	3 Somewhat disagree	4 Neutral	5 Somewhat agree	6 Agree	7 Strongly agree
We adopt machine learning to help optimise production from a fundamental level							
We adopt machine learning to help find solutions to difficult question							
We adopt machine learning to help obtain and present solutions							
We apply machine learning system to optimise scheduling of machine time for production line operations							
We apply machine learning to help manage produced diagnostic and prognostic knowledge at all levels of the manufacturing system							
We apply machine learning to help extend the life of manufacturing equipment							
We adopt machine learning to support to address the administration of large amount of data							
We adopt machine learning to support the storing of large amounts of critical data in the cloud							
We adopt machine learning to support the real time access of resources							

10. Brand Performance

Implementing e-mass customization as a branding strategy has a positive impact on the brand performance, including:

	1 Strongly	2 Disagree	3 Somewhat	4 Neutral	5 Somewhat	6 Agree	7 Strongly

	disagree		disagree		agree		agree
Relative to our competitors, our customers are willing to pay more in order to do business with us							
Our customers plan to continue the business relationship, with us for a long time							
Our brand has built strong customer brand loyalty							
Our brand is at an advantageous position in comparison to competition							
Our brand is successful in retaining current customers							

Appendix 2-2 Questionnaire Chinese Version

Newcastle University

品牌视角下的大众线上定制策略研究

1. 研究介绍

本研究的核心是线上大众定制为基础的企业品牌化策略。该研究将调查企业实施线上大众定制为企业的品牌化带来的影响，以及企业如何运用科技，技术和管理方法进行操作部署从而保证线上大众定制策略的成功实施。本研究的最终目的是确定一个企业如何在竞争日益激烈的商业环境中通过品牌化策略获得巨大成功。

2 基本信息

1. 您的性别 □ 男 □ 女 □ 不愿透露
2. 您的年龄 □ 25 岁以下 □ 25-35 □35-45 □45-55

□55 岁以上
3. 请注明您在时尚相关领域工作多少年了 □ 少于 1 年 □ 1-3 年 □ 3-5 年 □ 5-7 年 □ 7-10 年 □ 10-13 年 □ 13-15 年 □ 15 年以上
4. 请注明您在目前的公司工作多少年了 □少于 1 年 □1-3 年 □3-5 年 □5-7 年 □7-10 年 □10 年以上
5. 请注明贵公司目前的员工人数: □ 少于 10 人 □ 10-50 人 □ 51-250 人 □ 251-500 人 □ 501-1000 人 □ 1001-3000 人 □ 3001-5000 人 □ 多于 5000 人
6. 您有下属吗? □有 □无
7. 请说明您目前在公司的职务或职位: …………………………………………
8. 以下哪项代表您目前每月从单位获得的收入(包括加班、奖金和其他额外收入)? □ 少于 10,000 元 □10,001-30,000 元 □30,001-50,000 元 □50,001-70,000 元 □70,001-90,000 元 □高于 90,000 元
9. 您的教育程度 □ 大学以下 □大学 □硕士 □MBA (工商管理硕士) □博士 □其它：…………
10. 您参与了公司大众线上定制项目的管理工作 □非常不同意

□不同意 □不太同意 □中立 □有些同意 □同意 □非常同意
11. 您想收到这份研究报告的摘要 □ 不需要 □ 需要- 请发送 PDF 文件至以下电邮地址………… □ 需要 – 请邮寄纸质文件到以下地址…………
12. 您对机构或问卷的意见： ………………………………………

3. 线上大众定制：

线上大众定制是一种策略，它包括‘共同设计活动’和‘大规模生产’两个方面，最终以合理的价格和较短的等待时间为客户带去个性化的体验和个性化的产品。线上大众定制可以用一下几个方面衡量：

（*请按照其公司的实际情况或按照经验进行填写）

	1 非常不同意	2 不同意	3 有些不同意	4 中立	5 有些同意	6 同意	7 非常同意
公司能够在不显著增加成本的情况下生产高度差异化的产品							
公司能够在不减少产量的情况下增加产品的种类							
公司能够迅速重组生产流程，以应对定制产品							
公司能够支持用户友好的协同设计活动，以让客户识别自己的产品							

4. 产品模块化：

在配置产品时使用产品模块化对线上大众定制有积极影响；也就是说：

（*请按照其公司的实际情况或按照经验进行填写）

	1 非常不同意	2 不同意	3 有些不同意	4 中立	5 有些同意	6 同意	7 非常同意
产品可以分解成单独的模块，这些模块可以重新组合成新的设计							
相关人员可以对关键组件进行更改，而无需重新设计其他组件							
产品组件可以在各种产品中重复使用							
我们的产品在很大程度上是由模块组合而成的							

5. 环节模块化：

在安排生产过程的关键活动时使用过程模块化对线上大众定制具有积极影响；也就是说：

（*请按照其公司的实际情况或按照经验进行填写）

	1 非常不同意	2 不同意	3 有些不同意	4 中立	5 有些同意	6 同意	7 非常同意
生产工艺可以通过增加新的工艺模块进行调整							
生产环节模块可以根据生产需求的变化进行调整							
生产环节可以分解为生产基本部件的环节和生产定制部件的环节							
生产环节可以重新安排，让定制环节过程最后发生，以此提升生产效率							

6. 创新突破：

保持对资源的更新并创造新的资源对线上大众定制有积极影响；也就是说：

（*请按照其公司的实际情况或按照经验进行填写）

	1 非常不同意	2 不同意	3 有些不同意	4 中立	5 有些同意	6 同意	7 非常同意
我们能积极探索并在业务中运用先进思想和方法							
我们能仔细考虑新思想方法与业务的适配性							
我们有较好的系统和机制来选择和应用创新思想或方法							
与竞争对手相比，我公司的产品/服务的创新率较高							
与竞争对手相比，我公司对流程/组织改进率较高							
公司近年来在全面创新方面取得了成功							

7. 供应链整合：。

整合上下游的供应商对线上大众定制有积极影响；也就是说：

（*请按照其公司的实际情况或按照经验进行填写）

	1 非常不同意	2 不同意	3 有些不同意	4 中立	5 有些同意	6 同意	7 非常同意
公司与渠道合作伙伴交流各种供应链活动信息							
公司与供应商合作设计方案							
公司与供应商对供应链流程进行简化							
公司与供应商建立长期合作关系，以实现战略目标							

8. 生产自动化：

运用自动化系统自动化生产过程会对线上大众定制产生积极影响；也就是说：

（*请按照其公司的实际情况或按照经验进行填写）

	1 非常不同意	2 不同意	3 有些不同意	4 中立	5 有些同意	6 同意	7 非常同意

公司运用自动化系统进行生产调度							
公司运用自动化系统进行运营管理							
公司运用自动化系统进行生产订单发布							
公司运用自动化系统进行生产进度控制							
公司采用自动化系统获取实时订单状态							
公司采用自动化系统控制车间的设备的运行							
公司运用自动化系统进行生产操作							

9. 调节变量-机器学习：

机器学习加强了产品模块化和线上大众定制之间的关系

机器学习加强了流程模块化和线上大众定制之间的关系

机器学习加强创新与线上大众定制之间的关系

机器学习加强了供应链整合与线上大众定制之间的关系

机器学习加强了生产自动化和线上大众定制之间的关系

机器学习是基于算法的计算机系统，能够通过自主学习为执行任务提供深入见解；将机器学习系统应用在生产中的不同系统中，我们可以获得最优的解决方案；也就是说：

（*请按照其公司的实际情况或按照经验进行填写）

	1 非常不同意	2 不同意	3 有些不同意	4 中立	5 有些同意	6 同意	7 非常同意
公司采用机器学习系统（人工智能系统）帮助优化生产							
公司采用机器学习系统来帮助找到难题的解决方案							
公司采用机器学习系统帮助获取解决方案							
公司应用机器学习系统优化生产时间							
公司应用机器学习系统帮助管理生产系统中各个层面产生的诊断和预测知识							
公司应用机器学习系统来帮助延长制造设备的寿命							
公司采用机器学习系统支持大量数据的管理							
公司采用采用机器学习来支持在云中存储大量关键数据							
公司采用机器学习来支持资源的实时访问							

10. 品牌绩效：

将线上大众定制作为品牌战略实施对品牌 4.0 的绩效产生积极影响；包括：

	1 非常不同意	2 不同意	3 有些不同意	4 中立	5 有些同意	6 同意	7 非常同意
相对于我们的竞争对手，我们的客户愿意为与我们开展业务而支付更多费用							

我们的客户希望与我们长期保持业务关系							
我们的品牌建立了强大的客户品牌忠诚度							
我们的品牌在竞争中处于优势地位							
我们的品牌成功地留住了现有客户。							

Appendix 3

The results of Kolmogorov-Smirnova and Shapiro-Wilk

	Kolmogorov-Smirnova			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
MCP	0.111	129	<.001	0.965	129	0.002
OCDA	0.186	129	<.001	0.922	129	<.001
PdM	0.189	129	<.001	0.923	129	<.001
PcM	0.195	129	<.001	0.930	129	<.001
PA	0.117	129	<.001	0.940	129	<.001
Innov	0.129	129	<.001	0.938	129	<.001
SCI	0.120	129	<.001	0.926	129	<.001
ML	0.095	129	0.006	0.959	129	<.001
BP	0.164	129	<.001	0.933	129	<.001

Appendix 4 KMO and Bartlett's Test of EMC

KMO and Bartlett's Test of MCP

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		0.752
Bartlett's Test of Sphericity	Approx. Chi-Square	210.376
	df	6
	Sig.	<.001

Appendix 5 EFA Test of EMC

Item	Component
EMC1	0.824
EMC2	0.798

EMC3	0.818
EMC4	0.850

Appendix 6 KMO and Bartlett's Test of PdM

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		0.808
Bartlett's Test of Sphericity	Approx. Chi-Square	266.62
	df	6
	Sig.	<.001

Appendix 7 EFA Test of PdM

Item	Component
PdM1	0.875
PdM2	0.867
PdM3	0.859
PdM4	0.826

Appendix 8 KMO and Bartlett's Test of PcM

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		0.829
Bartlett's Test of Sphericity	Approx. Chi-Square	344.394
	df	6
	Sig.	<.001

Appendix 9 EFA Test of PcM

Item	Component
PcM1	0.894
PcM2	0.873
PcM3	0.902
PcM4	0.884

Appendix 10 KMO and Bartlett's Test of PA

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		0.925
Bartlett's Test of Sphericity	Approx. Chi-Square	775.444

	df	21
	Sig.	<.001

Appendix 11 EFA Test of PA

Item	Component
PA1	0.884
PA2	0.842
PA3	0.831
PA4	0.891
PA5	0.875
PA6	0.87
PA7	0.883

Appendix 12 KMO and Bartlett's Test of Innov

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		0.886
Bartlett's Test of Sphericity	Approx. Chi-Square	612.098
	df	15
	Sig.	<.001

Appendix 13 EFA Test of Innov

Item	Component
Innov1	0.894
Innov2	0.854
Innov3	0.851
Innov4	0.855
Innov5	0.884
Innov6	0.845

Appendix 14 KMO and Bartlett's Test of SCI

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		0.812
Bartlett's Test of Sphericity	Approx. Chi-Square	308.314
	df	6
	Sig.	<.001

Appendix 15 EFA Test of SCI

Item	Component
SCI1	0.811
SCI2	0.892

SCI3	0.887
SCI4	0.889

Appendix 16 KMO and Bartlett's Test of Machine Learning

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		0.916
Bartlett's Test of Sphericity	Approx. Chi-Square	1060.505
	df	36
	Sig.	<.001

Appendix 17 EFA Test of Machine Learning

Item	Component
MC1	0.869
ML2	0.855
ML3	0.859
ML4	0.866
ML5	0.848
ML6	0.777
ML7	0.853
ML8	0.797
ML9	0.843

Appendix 18 KMO and Bartlett's Test of Brand Performance

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		0.862
Bartlett's Test of Sphericity	Approx. Chi-Square	446.613
	df	10
	Sig.	<.001

Appendix 19 EFA Test of Brand Performance

Item	Component
BP1	0.708
BP2	0.889
BP3	0.866
BP4	0.911
BP5	0.896