Quantitative Research on Hotspots and Frontiers of Mass Customization Research

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Abstract: Mass customization (MC) has become an important means for enterprises to gain competitiveness, but there is a lack of systematic analysis of recent research on MC. The study conducts quantitative research on 1018 valid documents in the Web of Science database in the past ten years using bibliometric analysis and the CiteSpace software to understand MC's research hotspots and frontiers. Firstly, the data results show that keywords such as mass customization and design appear the most frequently, representing the high attention paid to them by academia. Secondly, keywords such as big data and information technology have the highest centrality value, indicating their relatively important position in MC. Finally, keywords such as industry 4.0, smart manufacturing and 3d printing are the keywords of recent MC research. This study will provide some reference for researchers to comprehensively understand the hotspots and frontiers of MC research.

Keywords: Mass Customization; Bibliometric Analysis; Quantitative Research

1.Introduction

With the diversity of consumer demand and the increase of enterprise costs, it is difficult to adapt to market changes by mass production of standardized products. Meanwhile, customization increases enterprise costs and is not beneficial to developing in the market competition environment. Therefore, mass customization (MC) was proposed in the 1980s. MC was first described by Davist and has since evolved into the ability to provide individually designed products and services to each customer through high process agility, flexibility, and integration (Fogliatto et al., 2012; Maalouf et al., 2022; Pine et al., 1993).

Through the development of the new generation of information technology (such as big data, 3d printing, Internet of Things), MC is one of the important means to integrate consumer demand, corporate profits and competitiveness (Brahami et al., 2022; Sheng et al., 2021; Wacker & Samson, 2021). The MC research in the past ten years (2013-2022) shows that MC research mainly experienced two stages. First, from 2013 to 2018, MC mainly focused on additive manufacturing (e.g., technology, value network, supply chain management), product platform (e.g., postponement strategy, construction industry), innovation (e.g., dynamic capability, personalization), modular design (e.g., flexibility, business performance), need for uniqueness (e.g., simultaneous configuration, perceived usefulness), cloud manufacturing (e.g., sensory

evaluation, 3d printing service), cost estimation (e.g., quality function deployment, requirements management), manufacturing systems (e.g., product-service system, integrated product) and other subject areas. For example, Wacker and Samson (2021) integrate supply chain optimization methods to conceptualize and model the balance between supply chain strategy and marketing decisions from the design, pricing and positioning of products and their features to obtain enterprise competitiveness.

Second, from 2019 to the present, MC has mainly around industry 4.0 (e.g., sustainable manufacturing, design science research), quality management (e.g., neural network, demand uncertainty), model innovation (e.g., product life cycle, business service), genetic algorithms (e.g., optimization algorithm, smart factory) and other subject areas. For example, from the perspective of smart manufacturing, Maalouf et al. (2022) proposed a distributed method of smart manufacturing management for cellular manufacturing systems for batch-customized products, which covers smart manufacturing planning, scheduling and material handling and distribution.

Currently, systematic studies on MC are relatively lacking, and few bibliometric methods are used to systematically sort out and analyze a large number of MC literature from quantitative research. Therefore, the main contribution of this study is to analyze the hotspots and frontiers of large-scale MC research in the past ten years, which will provide a reference for researchers to understand this field comprehensively.

2.Research Methods and Data Collections

Bibliometric analysis is a quantitative method using mathematics, statistics and other methods. Compared with qualitative literature analysis, it is more objective. This study is based on the bibliometric analysis method. Firstly, the study searched the Web of Science (WoS) database for "mass customization" literature. By October 2022, 1,018 valid documents included in SSCI/SCI have been extracted. Secondly, the study used CiteSpace software to analyze the science mapping of keyword co-occurrence to understand the research hotspots and used Burstness technology to conduct burst analysis of keywords to understand the research frontier in MC.

3.Research Hotspot of Mass Customization

The research uses CiteSpace to analyze co-occurrence keywords of MC research. Keywords are the core content of the article, and the frequency of keywords can represent the degree of attention it gets in a certain knowledge field. In terms of the frequency of keywords, the top 20 keywords include mass customization (670), design (238), system (149), management (145), model (118), impact (114), performance (108), supply chain (83), innovation (76), optimization (73), product (72), framework (68), architecture (61), integration (59), additive manufacturing (59), variety (56), technology (53), strategy (52), genetic algorithm (50), 3d printing (48) are that scholars have paid more attention to over the years.

For example, in order to provide products or services that meet customer needs as accurately as possible, reduce costs, and improve market competitiveness, Wacker and Samson (2021) conduct a comprehensive modeling of supply chain strategy and marketing decisions based on theories related to marketing and resource operation, combined with the content of supply chain strategy and marketing decision; and they put forward the idea of integrating strategy with product and service design, optimize product and service design for enterprises to improve competitiveness. Supply chain network design is

considered to be one of the most important links in highly competitive environments such as market turbulence; by integrating capacity constraints of construction links and strategic decisions related to transport network design, Brahami et al. (2022) proposed a multi-objective model integrating different environmental impacts, transport activity costs and environmental impact control. Their model is used to solve the problem of sustainable supply chain network design. In addition, they also support their views by verifying data on a large number of actual operating platforms, providing some reference for future MC supply chain network design. For the question of whether (electronic) retailers adopt the MC strategy, Zhang and Zheng (2021) studied the optimal customization strategy and product variety decision of enterprises in different channels (online and offline) by comparing and analyzing four different scenarios, considering the influence of customization on company pricing decision, profit and consumer welfare; it also puts forward some management suggestions for e-retailers to provide customized products in online channels and standard products in offline stores, which can provide some reference for the retail industry.

The distribution and centrality of keyword occurrence frequency can explore the development research hotspot of a certain knowledge field, in which a value greater than 0.1 is considered to be of certain importance. The higher the value, the higher the importance of the keyword in this knowledge field. In this study, keywords with centrality greater than 0.1 are sorted out, the top 20 keywords with centrality value are big data (0.34), information technology (0.27), commonality (0.26), knowledge (0.24), supply chain management (0.19), integration (0.17), industry (0.16), service (0.15), methodology (0.15), competition (0.15), family design (0.14), trust (0.14), form postponement (0.13), supply chain (0.12), product platform (0.12), new product development (0.12), product variety (0.11), product development (0.11), cloud manufacturing (0.11), and operational performance (0.11). Among them, the centrality value of big data is the highest, with a centrality value of 0.34, representing the important position of big data in MC research.

For example, based on organizational information processing theory, Sheng et al. (2021) tested 277 Chinese enterprises in the face of market turbulence through big data analysis and MC using hierarchical regression analysis. The research results showed that supply chain agility completely mediates the influence of technical skills on product orientation and service orientation. Their research about the impact of a data-driven decision-making culture on service orientation provides some references for enterprises to cope with market turbulence. In order to understand the development of MC production information system in the housing industry, Zhang et al. (2022) use virtual reality technology to evaluate the feasibility of the system, and put forward a prototype production information system supported by three kinds of information technology to promote the implementation of MC in wood products production enterprises. Their research on the coordination and information flow between the modules of the system will provide a valuable reference for the development of the MC production system in the future housing industry. Using the modular theory and integration method, Shi et al. (2022) analyzed the relationship between the measurement accuracy of customer preference, manufacturing flexibility, customer participation and the quality of customized products through data in China's garment industry. They introduced the variable of customer participation to form a new adjustment effect; and proposed the management enlightenment of MC, which provides some references for improving the interaction between consumers and manufacturers.

In addition, mass customization is becoming more and more important in the service sector. In the face of severe market competition, in addition to the objective level (such as the application of technology, product iteration, intelligent recommendation, etc.), there is also the subjective level of influence, and service is one of the very important components of the subjective level. Service plays an increasingly significant role in promoting the economy, and customized service can bring core competitiveness to enterprises. More and more enterprises are paying more attention to issues related to service customization. For example, Xu et al. (2022) analyzed the demand response process of consumers and related characteristics, established an MC-oriented service platform of customer demand response by using cloud computing and Internet of Things technologies and calculated the efficiency and stability of the service platform by using the edge cloud collaboration method. This platform helps improve resource utilization efficiency and reduce operating costs and provides some reference for future service customization practices.

The increasingly fierce external market competition environment is bound to make enterprises seek solutions to cope with the severe situation. MC has become an effective method to reduce enterprise costs and improve profits and market competitiveness. To sum up, in the field of MC research in the past decade, it can be seen that keywords such as mass customization, design, system, management, and model have been paid the most attention by scholars over the years. At the same time, big data, information technology, commonality, knowledge, supply chain management, service and other keywords play an important role in MC research. The MC research not only focuses on the relevant issues at the objective level but also becomes increasingly important at the subjective level, especially in the field of service.

4.Research Frontier of Mass Customization

The study adopts the Burstness technology in CiteSpace to carry out burst analysis on the keywords to explore the inflection point of MC research. The top 17 keywords with the strongest citation bursts are choice, form postponement, product development, product development, product configuration, perspective, postponement, consumer, allocation, market, flexibility, uniqueness, industry 4.0, mechanical property, smart manufacturing, augmented reality, machine learning, and 3d printing. Some keywords in each research hotspot have a short duration, such as postponement, choice, flexibility, etc. Perspective and consumer studies are of longer duration. With the continuous expansion and deepening of MC research, firstly, MC research mainly focused on choice, form postponement, product development, product configuration, perspective, postponement, consumer and other keywords. Secondly, MC research has turned to the keywords such as allocation, market, flexibility and uniqueness. Finally, MC research mainly focuses on industry 4.0, mechanical property, smart manufacturing, augmented reality, machine learning and 3d printing.

For example, with the improvement of people's consumption power, more and more consumers tend to choose personalized and unique products or services. Based on the application of blockchain, the Internet of things, artificial intelligence and other technologies in MC, Yetis et al. (2022) put forward a reliable and optimized MC framework. The framework comprehensively considers the storage, tracking, transparency, reliability and other features of data, optimizes the whole process from ordering to production, and

improves the energy-saving effect of the whole process, providing a certain reference for supporting the personalized needs of customers. 3D printing is an effective response to changes in consumer preferences. Guo et al. (2022) studied the 3d printing of a car company and a furniture company, discussed the risk bias between MC manufacturers and consumers, and found that the high flexibility and other features of 3D printing can help MC manufacturers improve production efficiency and effect.

From the research frontier analysis, Current MC research has been from choice, form postponement, product development, product development, product configuration, perspective, postponement, consumer, allocation, market, flexibility, uniqueness to industry 4.0, mechanical property, smart manufacturing, augmented reality, machine learning, and 3d printing. In the context of big data-driven and intelligent production, for example, the use of emerging technologies (such as 3d printing, augmented reality, etc.) to connect the client and manufacturing side, the transformation to smart factories, and the realization of on-demand production. Suppose an enterprise wants to optimize the whole process through MC, which needs to pay attention not only to the objective level (such as emerging technologies and production) but also to the subjective level (such as the service of the whole process and consumers' feelings). In MC's market research, the design and production of products and services remain the core issues of the enterprise.

5. Discussion and Conclusion

With the improvement of people's living standards, more and more users tend to choose customized products and services. Enterprises are faced with a fierce market competition environment. MC has become one of the effective means to deal with market turbulence. In the past ten years, MC research has experienced two stages of development and is currently in a stable growth period of MC research. Based on the bibliometric analysis, the study conducted quantitative research on hotspots and frontiers of MC research. The co-occurrence and burst analysis of all keywords in MC research literature included in the WoS database platform were carried out. There are three main conclusions of this study. First, keywords such as mass customization, design, system, and management have the highest frequency, which means that academia pays more attention to them. Second, the centrality values of big data, information technology and commonality are the highest, indicating that they are in a relatively important position in MC. Finally, MC research has shifted from keywords such as form postponement and product development to industry 4.0, smart manufacturing, augmented reality, machine learning, 3d printing and other fields. There are major fields of recent academic attention that have certain pioneering characteristics. To sum up, this study analyzes the hotspots and frontiers of MC research from an objective and scientific quantitative research perspective, providing a scientific basis for researchers to comprehensively understand the MC knowledge field.

Funding

This work is financially supported by the Youth Innovative Talents Project of Higher Education of Guangdong [Grant number 2021WQNCX099].

Acknowledgment

Thanks to all the participants in this study.

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