



Mapping Thematic Trends in Product Customisation Within the Digital Era: A Comprehensive Bibliometric Analysis

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Abstract

Advances in digital technologies, particularly artificial intelligence and big data analytics, have significantly transformed the landscape of product customization. Although research in this domain has expanded over the past decade, it remains fragmented across disciplines, limiting a clear understanding of its intellectual evolution. This study addresses this gap by systematically mapping the thematic development and knowledge structure of product customization in the digital era through a comprehensive bibliometric analysis. Data were retrieved from Web of Science and Scopus using structured search strings combining product customization and digital transformation-related terms. The analysis was restricted to English-language publications in the business and social science domains published between 2010 and 2025. From an initial pool of 660 records, 591 documents were retained after removing duplicates and irrelevant entries. Bibliometric techniques such as annual publication analysis, citation analysis, three-field plots, co-occurrence networks, co-citation analysis, bibliographic coupling, and thematic mapping were applied. The results indicate a steady rise in research output, particularly after 2018, reflecting growing academic and industrial interest. While foundational studies continue to exert strong influence, emerging themes increasingly focus on additive manufacturing, AI-enabled configuration systems, product customization, digital design, and data-driven optimization. Overall, the field is evolving toward digitally integrated and intelligent production ecosystems, offering strategic insights for future research and practice.

Keywords: *Product Customization, Mass Customization, Tailored product offerings, Digital Transformation, Artificial Intelligence, Bibliometric Analysis.*



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1. INTRODUCTION

Product customization has evolved from a niche manufacturing strategy to a central competitive paradigm in digitally enabled markets. Initially, mass customization was defined as the ability to provide personalized products with efficiency similar to mass production, balancing variety with economies of scale (Pine, 1993). Subsequent theoretical refinements by Piller, Frank T., and Salvador, Fabrizio operationalized this logic through modular product architectures, solution space development, and choice navigation mechanisms. These foundational contributions established product customization as an interdisciplinary domain spanning operations management, marketing, and innovation studies. Product customization intensity significantly promotes servitization, highlighting customization as a strategic antecedent of service expansion in manufacturing firms (Pallant et al., 2020). Success in product customization depends on integrating customer interaction, choice navigation, and value co-creation into marketing strategies (Franke & Schreier, 2008) rather than focusing solely on flexible manufacturing systems, the authors emphasize customer-centric solution spaces, configuration toolkits, and relationship management mechanisms (Piller & Müller, 2004).

Despite the rapid proliferation of research, the literature remains conceptually dispersed across production economics, information systems, marketing strategy, sustainability, and technology management. The lack of an integrative mapping limits clarity about the field's intellectual structure, dominant research streams, collaborative networks, and emerging trajectories. While individual empirical and conceptual studies provide depth, a systematic synthesis is needed to capture the cumulative evolution of knowledge in the context of digital transformation (Chen et al., 2005).

Bibliometric analysis offers a rigorous methodological approach to address this gap. By applying quantitative techniques such as co-citation analysis, bibliographic coupling, keyword co-occurrence mapping, and thematic evolution analysis, it becomes possible to identify core knowledge bases, influential

contributors, structural clusters, and transitional paradigms. In rapidly expanding and multidisciplinary domains, bibliometric mapping enables the detection of consolidation phases, shifts in research fronts, and underexplored thematic niches.

Accordingly, this study systematically maps the thematic trends and intellectual architecture of product customization research in the digital era from 2010 to 2025, using data from Web of Science and Scopus. By examining publication growth, citation dynamics, collaborative structures, and thematic clusters, the study aims to provide a comprehensive, longitudinal perspective on how digitally enabled product customization has matured into a structurally cohesive and strategically significant research domain.

2. IMPORTANCE OF PRODUCT CUSTOMIZATION

Product customization enables firms to satisfy individual customer needs by allowing consumers to tailor products according to their specific preferences, resulting in greater customer satisfaction and a higher likelihood of purchase (Kaiser et al., 2017; Moreau & Herd, 2010).

Product customization creates value by improving the fit between customer preferences and product attributes while enhancing perceptions of uniqueness, thereby increasing consumers' willingness to pay and the perceived value of customized products (Franke & Schreier, 2008).

Product customization serves as a strategic source of competitive advantage by offering individualized products that strengthen customer relationships and deliver superior value compared with standardized offerings (Piller & Müller, 2004; Pine, 1993; Salvador et al., 2009).

Product customization has become a fundamental differentiation strategy that enables firms to strengthen brand identity, facilitate customer self-expression, and create meaningful consumer experiences that foster long-term relationships (Miceli et al., 2013).

3. OBJECTIVES OF THE STUDY

- To examine the publication growth and citation dynamics of product

customization research in the digital era (2010–2025)

- To identify the intellectual structure and foundational knowledge base of the field by analyzing highly cited documents, core journals, influential authors, and co-citation networks.
- To map the thematic evolution and emerging research trends through keyword co-occurrence, thematic mapping, and bibliographic coupling, thereby revealing dominant, evolving, and nascent research clusters.
- To analyze global research collaboration patterns and geographical influence, identifying leading countries, institutional

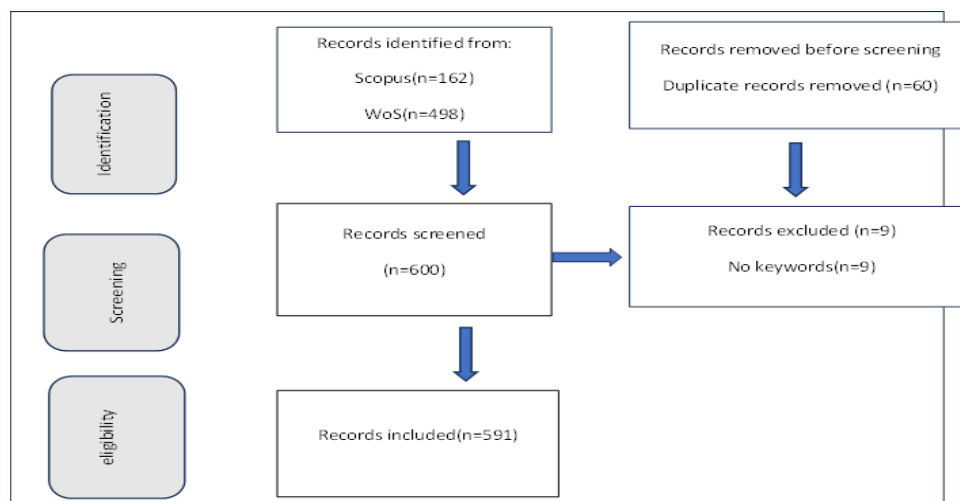
linkages, and cross-national knowledge integration shaping the domain of digitally enabled product customization.

4. MATERIALS AND METHODS

In this bibliometric analysis, we defined the search keywords by combining the terms and related terms for “product customization” and “digital era.” First, we searched the most widely used and renowned research databases: Web of Science (WoS) and Scopus (Rovira et al., 2019). The following table 1 shows the search string used, which exported 162 papers from the Scopus database in csv format and 498 papers from the Web of Science database in Bib Tex format

Table 1: Document search query and the search string

Database	Query
SCOPUS	(TITLE-ABS-KEY ("product customisation" OR "mass customisation" OR "product personalisation" OR "tailored product offerings" OR "custom driven customisation" OR "adaptive product configuration" OR "custom fit product design") AND TITLE-ABS-KEY ("digital" OR "digital era" OR "AI" OR "artificial intelligence" OR "technology" OR "online" OR "e-commerce" OR "big data" OR "machine learning")) AND PUBYEAR > 2009 AND PUBYEAR < 2026 AND (LIMIT-TO (SUBJAREA , "BUSI") OR LIMIT-TO (SUBJAREA , "SOCI")) AND (LIMIT-TO (DOCTYPE , "ar") OR LIMIT-TO (DOCTYPE , "cp") OR LIMIT-TO (DOCTYPE , "ch")) AND (LIMIT-TO (LANGUAGE , "English")) AND (LIMIT-TO (OA , "all"))
WoS	((ALL=("product customisation" OR "product customization" OR "mass customisation" OR "mass customization" OR "product personalisation" OR "product personalization" OR "customized products")) AND ALL=("digital" OR "digital era" OR "AI" OR "artificial intelligence" OR "technology" OR "online" OR "e-commerce" OR "big data" OR "machine learning")) AND LA=(English)) AND DT=(Article OR Book Chapter OR Review)



5. RESULTS

Key information with interpretation

5.1. Annual scientific production

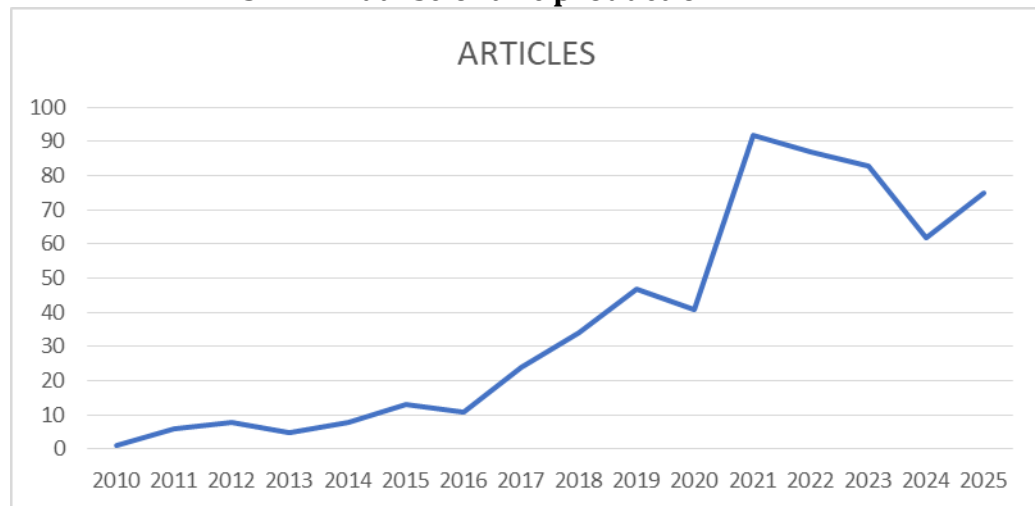


Figure 1: Year-wise publication trends

Fig. 1 shows the annual publication output from 2010 to 2025, indicating a steady increase in the number of articles, which reflects growing academic interest and the expanding significance of product customization research in the digital era. A low volume of publications in the early years typically reflects the field's emergence or conceptual infancy, with research

exploratory and limited to foundational studies. The number of articles appears to have peaked around 2020-2021 and then leveled off toward the end. As awareness increases and theoretical and methodological frameworks become established, the field often experiences a gradual rise in publications.

5.2. AVERAGE CITATION PER YEAR

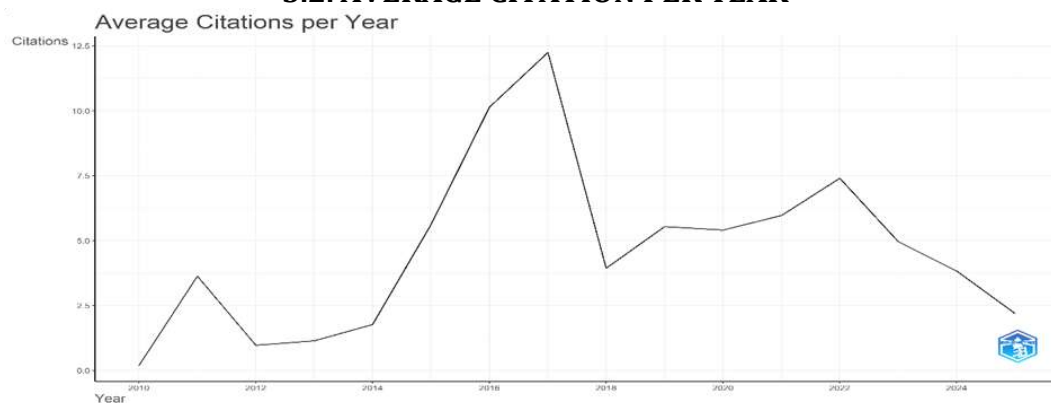


Figure 2: Average citation per year

Figure 2 shows that the average citations per year have fluctuated over time, with a noticeable peak in the middle of the period (2014-2015), followed by a decline and a slight recovery toward the end of the period. The overall trend is quite volatile, suggesting a

period of high citation impact followed by a slight improvement. The peak around 2014 represents a period of high visibility and influence, followed by recent improvement. This could be important for performance evaluation or publication strategy.

5.3. THREE-FIELD PLOT

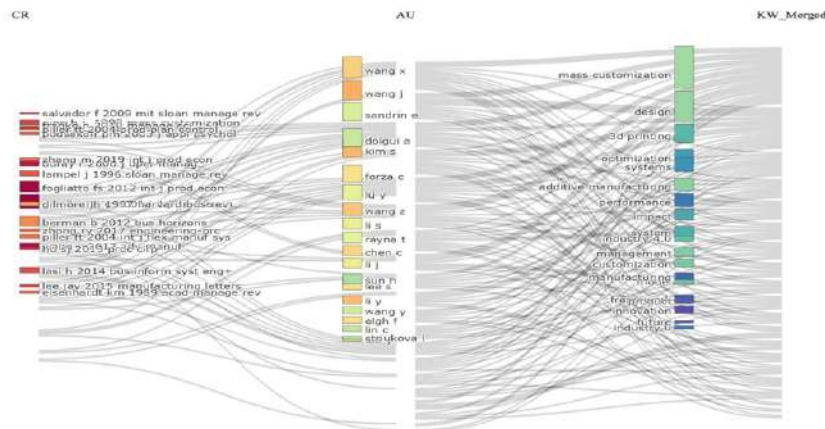


Figure 3: Three-field plot relationships between Cited Reference, Authors and Keywords

Fig. 3 illustrates the thematic evolution and intellectual structure of the mapping of relationships among cited references (CR), authors (AU), and keywords (KW-merged). The flows reveal that foundational works, such as [Salvador \(2009\)](#) and [Piller \(2004\)](#), serve as the primary intellectual base, heavily influencing a core group of prolific researchers, including Wang X and Wang J. These authors act as central bridges, connecting classic theories of mass customization to modern, emerging research

fronts. The rightward expansion of the plot highlights a strong contemporary focus on mass customization and Industry 4.0, suggesting that the field is transitioning from general manufacturing management toward highly digitized, additive production systems. The thickness of the connecting lines specifically identifies which authors are most instrumental in applying foundational concepts to these technological trends.

5.4. MOST RELEVANT SOURCE

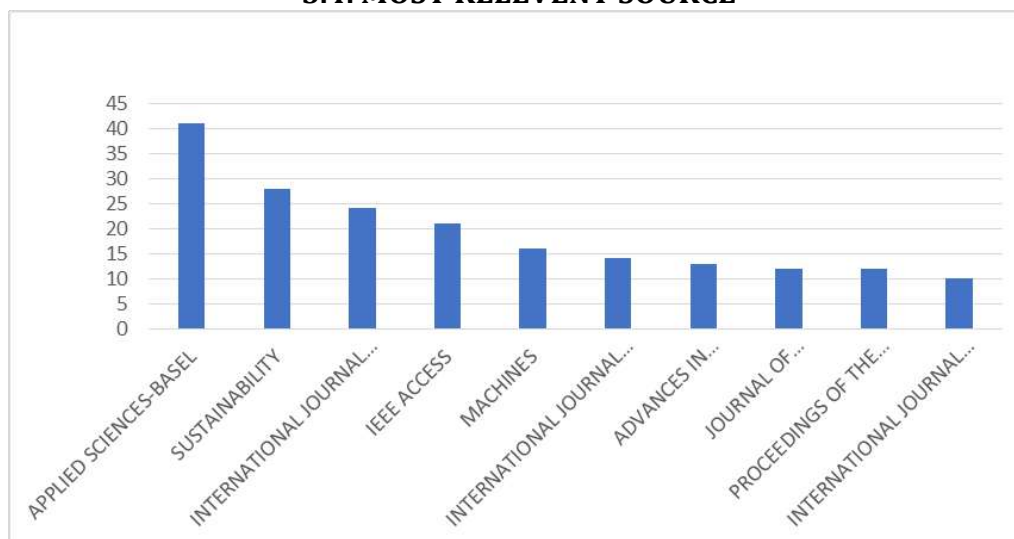


Figure 4

The fig. 4 shows that Applied Sciences-Basel publishes the most studies on product customization, followed by Sustainability and other international journals. Overall, the

research mainly appears in technology and sustainability-focused outlets, highlighting the field's strong interdisciplinary and innovation-driven character.

5.5. MOST LOCAL CITED SOURCES

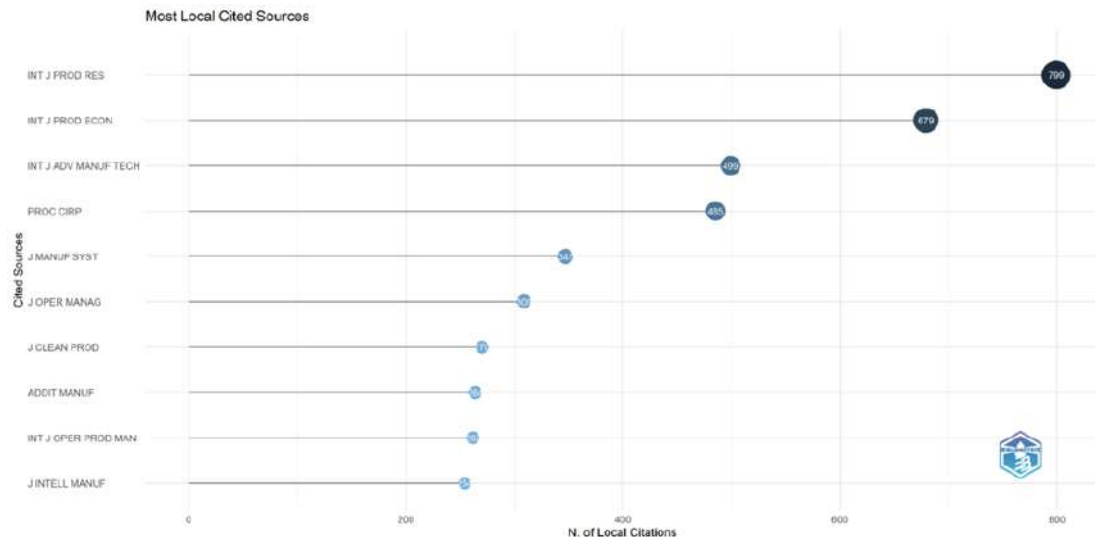


Figure 5 Most Local Cited Source

The citation analysis shows that International Journal of Production Research and International Journal of Production Economics dominate the field, forming its core knowledge base. Strong contributions from

manufacturing, operations, and technology-oriented journals indicate that the domain is firmly rooted in production systems, advanced manufacturing, and sustainability research.

5.6. MOST RELEVANT AUTHORS

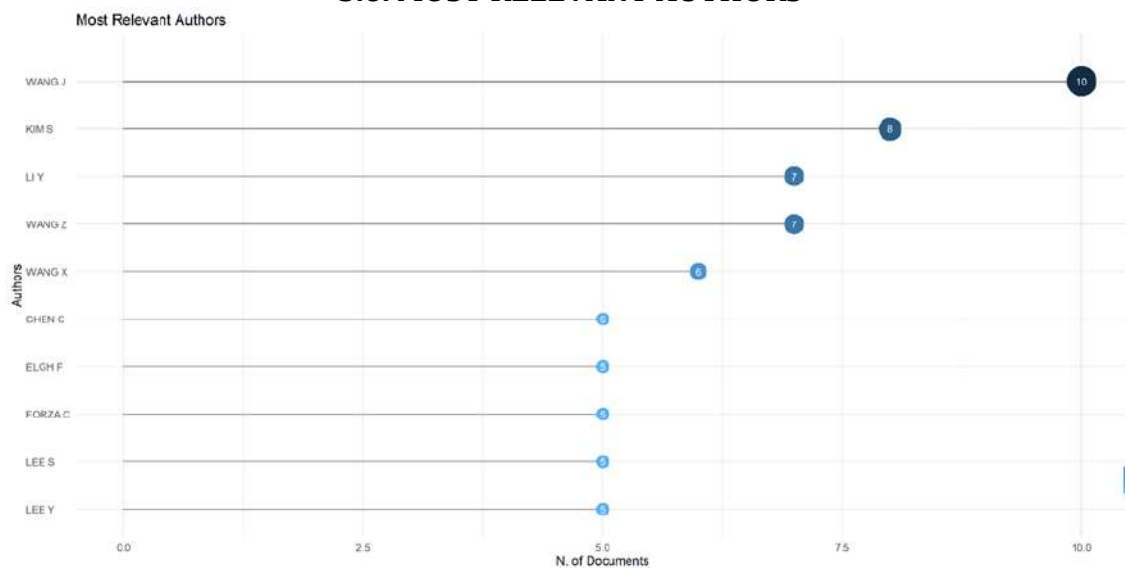


Figure 6: Most Relevant Authors

The figure highlights Wang J as the most productive contributor with nine publications, followed by Kim S (8 papers), and Li Y and Wang Z (7 each). Other authors have five to six publications. The relatively small differences in

output suggest a distributed authorship pattern, indicating collaborative research networks and the absence of a single dominant scholar in the field.

5.7. MOST CITED COUNTRIES

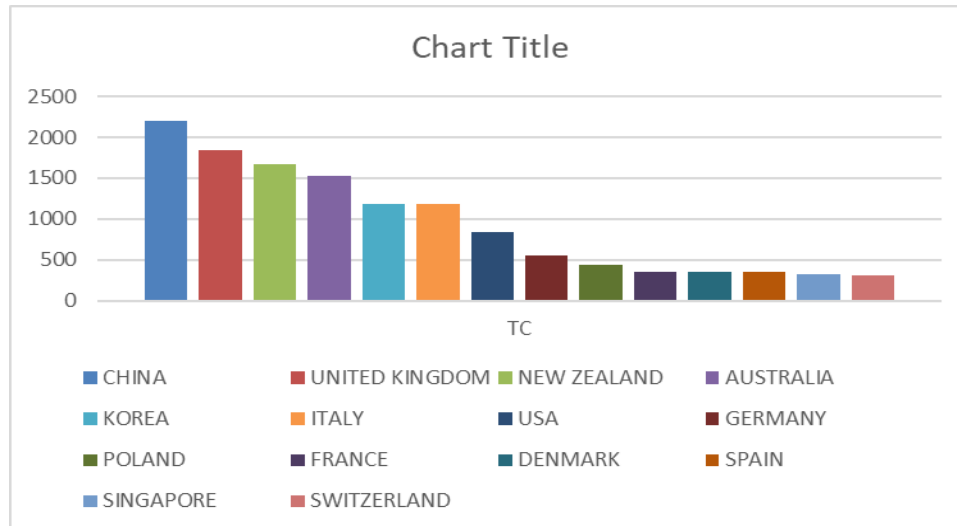
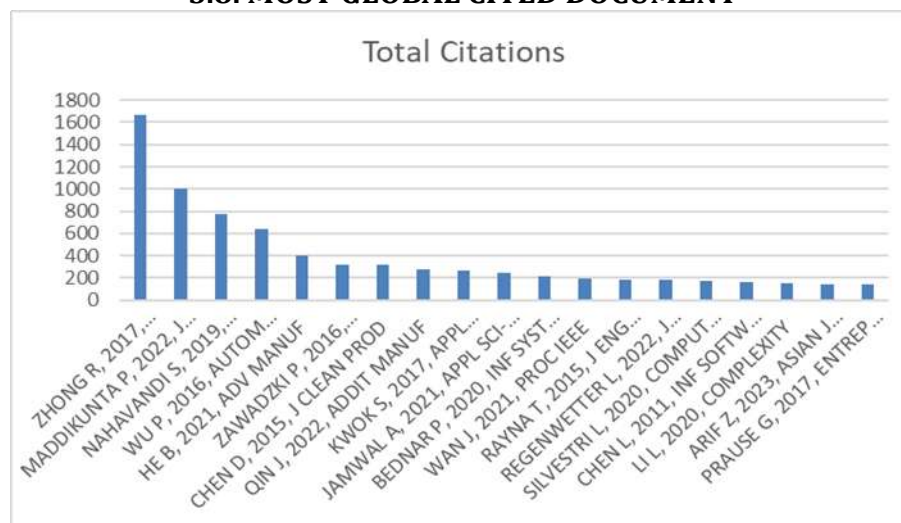


Figure 7 Most Cited Countries

Fig. 7 shows that China leads with approximately 2,200 total citations, followed by the United Kingdom (about 1,850), New Zealand (1,650), and Australia (1,500). Korea and Italy

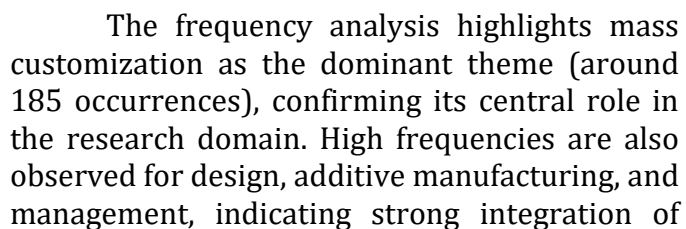
each record around 1,200, while the USA (800) and Germany (550) show comparatively moderate citation impact.

5.8. MOST GLOBAL CITED DOCUMENT



The most influential publication is **Zhong R. (2017)**, Engineering, with 1,688 global citations, underscoring its foundational role in the field. This is followed by **Maddikunta P. (2022)**, Journal of Industrial Information Integration (1,008 citations), and **Nahavandi S. (2019)**, Sustainability (772 citations), reflecting strong contributions to digital transformation and sustainability-oriented manufacturing. Earlier works, such as **Wu P. (2016)**, Automation in Construction (640 citations), and

He B. (2021), Advanced Manufacturing (~400+ citations), also demonstrate substantial academic influence. The distribution suggests that highly cited papers are concentrated between 2016 and 2022, indicating a rapid expansion and consolidation phase in this research domain. The steep citation gap between the top-ranked article and others highlights its exceptional intellectual dominance and centrality within the knowledge structure.

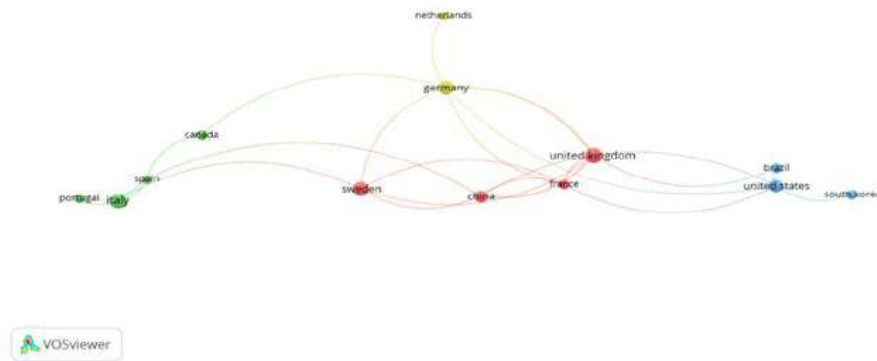


technological and operational perspectives. Moderate attention is given to modeling, digital twin, and machine learning, while Industry 5.0, dynamic capabilities, and uncertainty appear less frequently, reflecting emerging but still developing research streams.

[illegible]

5.11. THEMATIC EVOLUTION

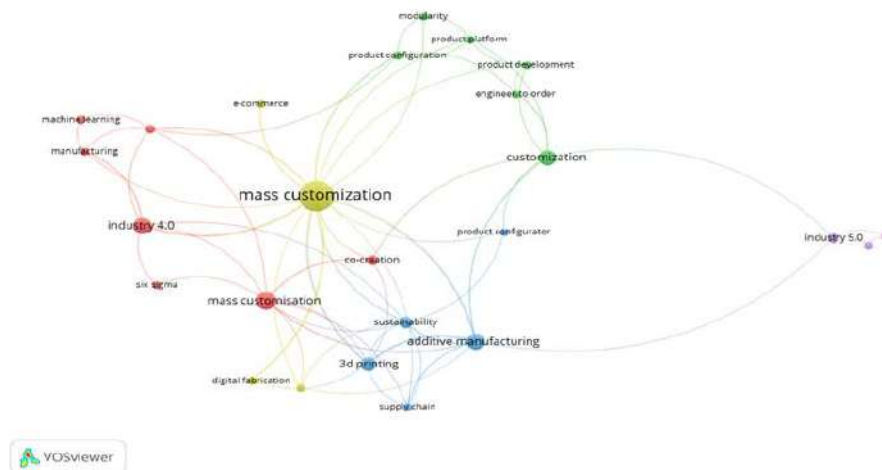
Visualization of country collaboration



The country collaboration network reveals distinct regional clusters with strong interconnections. The United States forms a central hub, collaborating closely with South Korea and Brazil. The United Kingdom, China, and France create another tightly linked cluster. Germany connects with European partners such

as the Netherlands and the UK. Meanwhile, Italy, Spain, Portugal, and Canada form a smaller collaborative group. Overall, the visualization indicates that the United States, United Kingdom, China, and Germany act as key bridging nations, facilitating international research integration across clusters.

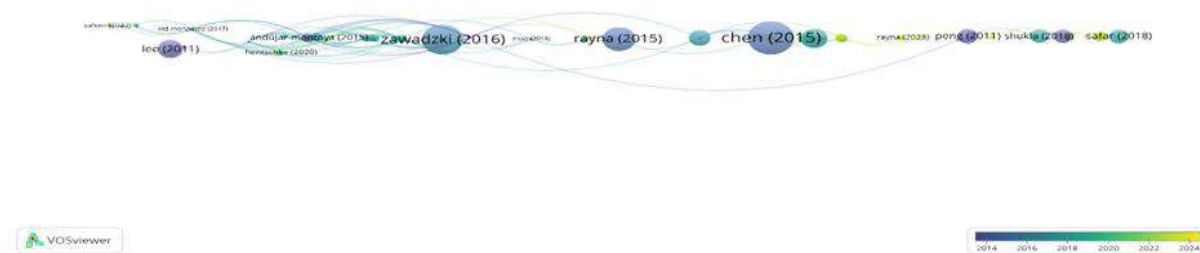
5.12. Visualization of Co-occurrence of keywords



The keyword co-occurrence network identifies mass customization as the central, most interconnected concept, underscoring its foundational role in the research domain. The map reveals four major thematic clusters: a technological cluster linking Industry 4.0, manufacturing, machine learning, and Six Sigma; a product development cluster emphasizing customization, modularity, product platforms,

and engineer-to-order strategies; an additive manufacturing cluster integrating 3D printing, supply chain, and sustainability; and an emerging Industry 5.0 theme. Overall, the visualization demonstrates strong convergence among digital technologies, advanced manufacturing systems, and strategic customization approaches.

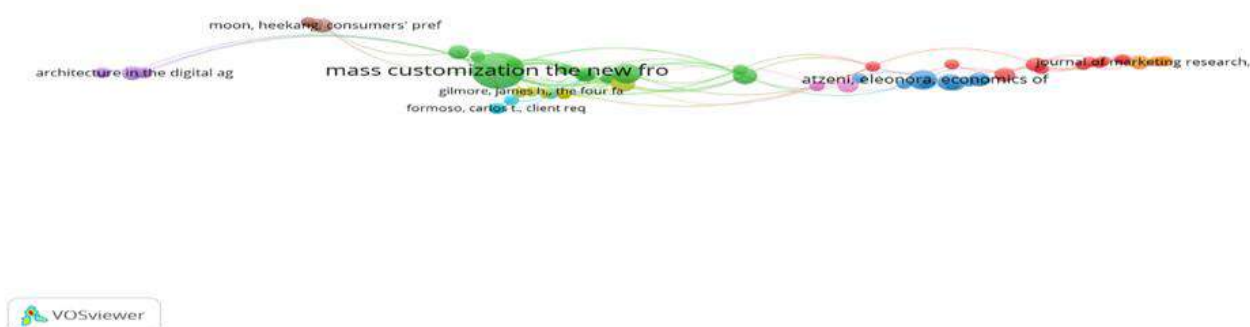
5.13. Visualization of Coupling of documents



The bibliographic coupling visualization illustrates the intellectual structure and thematic proximity of influential documents. Larger nodes, such as **Chen (2015)**, **Zawadzki (2016)**, and **Rayna (2015)**, indicate strong coupling strength, reflecting shared reference bases and foundational contributions. These works form the core cluster, suggesting a consolidated knowledge base established between 2014 and

2016. Subsequent publications are positioned around this core, showing progressive thematic extension and continuity. The color gradient (2014–2024) highlights temporal evolution, with more recent studies building on earlier seminal works. Overall, the network demonstrates a mature and interconnected research stream with clear foundational anchors and gradual expansion.

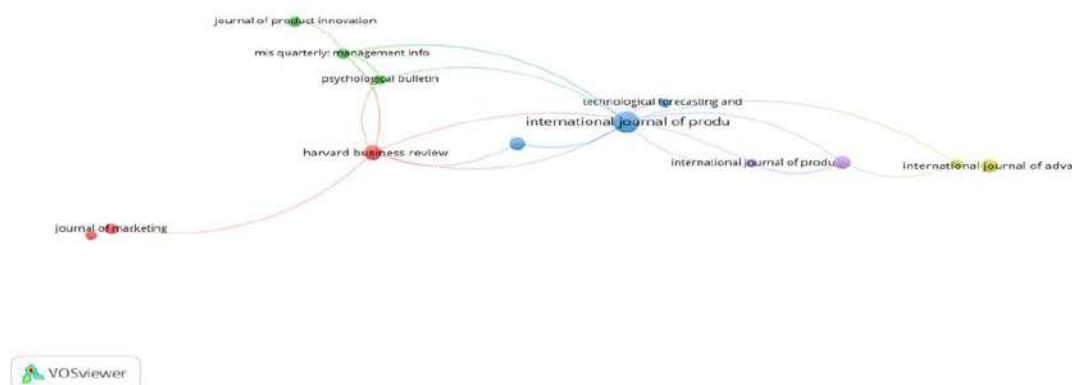
5.14. Visualisation of co-citation of reference



The network graph highlights "mass customization therapy" and "consumer pref" as central nodes with strong connections, indicating personalized therapeutic approaches driven by user preferences. "Digital agent" links to "forms" and "client," suggesting that AI tools

enable customized client interactions. Peripheral clusters such as "consumer research" and "archit" provide methodological and architectural context, emphasizing how digital facilitation enhances preference-based customization in therapy and design.

5.15. Visualization of co-citation of sources



This co-citation network graph illustrates connections among academic journals in consumer behavior, marketing, and innovation research. Central hubs such as "Harvard Business Review" (red) and "International Journal of Product" (blue/purple) show high influence, with strong links to "Journal of Marketing" (orange) and "JPIM" (Journal of Product Innovation Management). "Psychobiology" and "MS Quarterly Info" connect through psychology and IT lenses, while "International Journal of Research in Marketing" and others form clusters focused on product advancement. The graph reveals cross-disciplinary ties, emphasizing how marketing, psychobiology, and innovation journals co-cite in studies of consumer preferences and mass customization.

6. CONCLUSION

This bibliometric analysis of 591 publications indexed in Web of Science and Scopus provides a systematic, longitudinal overview of the intellectual structure and thematic evolution of product customization research in the digital era (2010–2025). The results show a sustained increase in scholarly output, particularly after 2018, reflecting intensified academic and industrial engagement driven by digital transformation, Industry 4.0 infrastructures, and AI-enabled production architectures.

Citation pattern analysis indicates that foundational contributions continue to exert

significant intellectual influence, while the concentration of highly cited works from 2016 to 2022 signals a phase of consolidation and accelerated theoretical and empirical development. Core outlets, notably the International Journal of Production Research and the International Journal of Production Economics, constitute the principal epistemic base of the domain, underscoring its firm anchorage in operations management, production economics, and advanced manufacturing systems. Concurrently, cross-disciplinary integration with marketing, sustainability, and innovation research highlights the field's expanding conceptual breadth.

Thematic mapping using keyword co-occurrence, bibliographic coupling, and co-citation analyses identifies mass customization as the enduring conceptual nucleus. However, the intellectual landscape is increasingly diversifying toward additive manufacturing, digital twins, AI-driven configurators, machine learning applications, and Industry 5.0 paradigms. This shift signals a transition from conventional manufacturing-centric paradigms to digitally integrated, data-driven, and intelligent production ecosystems. Emerging yet comparatively underdeveloped themes—such as dynamic capabilities and uncertainty management—point to promising avenues for theoretical advancement.

Geospatial analysis highlights the prominence of China, the United Kingdom, and

the United States in citation impact, alongside dense international collaboration networks, indicating growing global knowledge integration. Collectively, the findings affirm that product customization research has evolved into a mature, structurally cohesive, and thematically diverse domain with substantial academic and managerial relevance in digitally transformed production environments.

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