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Mass customization as a driver of national consumption: Linking flexible operations and co-creation

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Abstract

National Economy Model (NEM) posits that consumption capacity is the most critical driver of economic growth, challenging the traditional supply-side focus on production alone. Traditional economic policies often emphasize the mass production of standardized goods, which frequently leads to excess inventory, market saturation, and the waste of national resources. To support the NEM's thesis of "consumption-led growth", this study proposes an Industry 4.0-based Mass Customization strategy as a solution to align production capabilities with specific consumer demands. The study aims to demonstrate that a system incorporating consumers into the production process (co-creation) maximizes both the desire to consume and resource efficiency. On the operational dimension, this study discusses how Flexible Manufacturing Systems (FMS) allow to produce personalized goods at near-mass production costs, thereby minimizing inventory waste and optimizing national resource usage. On the marketing dimension, it analyzes how the sense of "psychological ownership" derived from co-creation accelerates purchasing behavior and stimulates money circulation within the national economy. In conclusion, it is argued that this integrated model—where the consumer acts not as a passive buyer but as an active producer—provides a robust operational and behavioral foundation for the "continuous growth" balance foreseen by the National Economy Model.

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1. Introduction

Production-oriented paradigms, which have guided economic thought since the Industrial Revolution and assume that "supply will create its own demand" (Kates, 2005), have started to lose their functionality in today's hyper-competitive market conditions. Traditional "Make-to-Stock" models, in which standardized products are produced in large batches with the concern of economies of scale, face market saturation and increasing inventory costs (Gupta & Benjaafar, 2004). This situation leads to inefficient use of national resources and the formation of "waste" (muda). In terms of effective management of resources and economic sustainability, it has become necessary to transform production processes from a purely cost-oriented structure to a demand-driven structure (Mourtzis et al., 2021; Ivanov, 2022; Ptak & Smith, 2016; Olhager, 2003; Christopher, 2000; Fisher, 1997; Pine, 1993).

In this context, the National Economy Model (NEM) put forward by Baş (2005) offers a different perspective to the literature by defining the main driving force of economic growth through "consumption ability" rather than production constraints. According to the model, the main reason for the bottlenecks in the economy is not the lack of supply, but the inadequacy of the desire and ability to consume. Motivation of the national economy has been made dependent on ensuring the active participation of the consumer in the system and keeping the consumption motivation alive. However, achieving this goal makes it imperative to meet heterogeneous consumer expectations without compromising operational efficiency.

In this study, the 'Mass Customization' strategy supported by Industry 4.0 technologies is proposed as the solution to this dilemma. With this strategy, which is positioned at the intersection of production management and marketing disciplines, it is aimed at producing personalized products with an efficiency close to mass production costs (Pine, 1993). Within the scope of the study, it was technically examined how Flexible Production Systems (FMS) and modular design processes prevent resource waste by minimizing stock risks in the operational dimension. In the marketing dimension, the sense of 'psychological ownership' (Pierce et al., 2001) created by 'co-creation' practices, in which the consumer is included in the design process, and its effect on purchasing behavior were analyzed. Finally, the operational and behavioral contributions of this integrated model to the 'continuous growth' balance envisaged by the National Economy Model (Baş, 2005) are discussed.

2. Theoretical framework

The interdisciplinary nature of this study and the multidimensional structure of the proposed integrated model have made it necessary to consider the literature on three different axes: macroeconomic, operational and behavioral. In this direction, the conceptual framework;

The consumption approach of the National Economy Model, which forms the theoretical basis of the study, is systematized under three sub-headings: Mass Personalization strategies that make this approach technically possible, and Co-Creation dynamics that complete the process in the context of consumer psychology.

2.1. The central role of consumption in the national economy model

Contrary to traditional economic theories, in the National Economy Model (NEM) literature, the "consumption" factor is positioned as the driving force of the economy, not production. In Baş's theses, the assumption of limited resources and unlimited needs was rejected; instead, a paradigm has been proposed in which resources are unlimited and needs are limited (Baş, 2005). According to this approach, no matter how high the production capability is, economic equilibrium cannot be achieved unless consumption power (effective demand-Keynes) is created to meet this production.

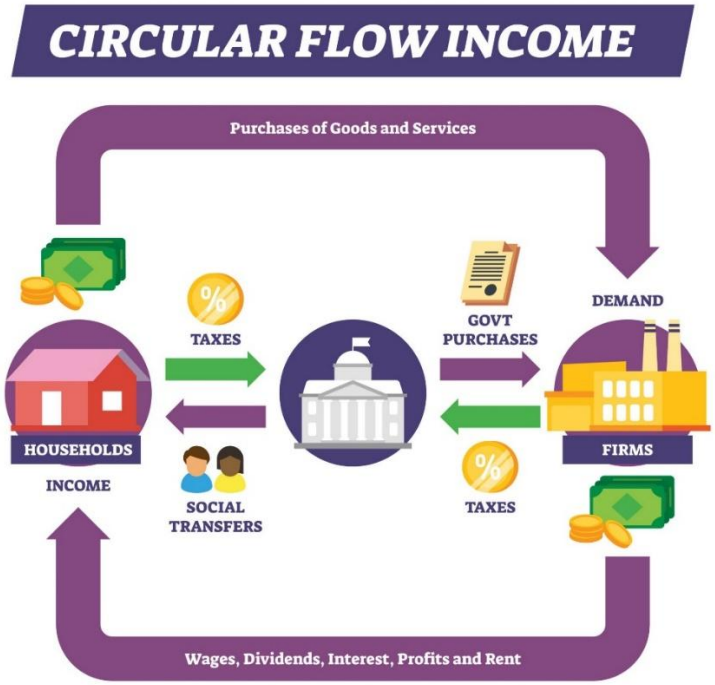

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Figure 1. The proposed demand-driven integrated production model supporting the Consumption-Led Growth thesis of NEM

In the model, encouraging consumption is defined not as increasing waste, but as a "circulation mechanism" that ensures the continuity of production. Increasing the purchasing power and spending willingness

of the consumer increases the turnover rate of money in the markets (Keynes et al., 2017) and this situation is directly reflected in the capacity utilization rates of the producer companies. Therefore, from the perspective of NEM, transforming the consumer from a passive buyer into an active 'prosumer' (Lang et al., 2020) who directs the market and ensures value circulation is considered a prerequisite for macroeconomic stability (Vargo & Lusch, 2012; Baş, 2005; Prahalad & Ramaswamy, 2004).

2.2. Mass customization and operational flexibility

The production logic that prevailed after the Industrial Revolution focused on high-volume production of standardized products (Economies of Scale) to reduce unit costs. In today's markets, the heterogeneity of consumer demands has necessitated the evolution of this idea into "Economies of Scope" (Koren et al., 2018). In this context, the concept of Mass Customization; It is defined as a hybrid strategy that combines the efficiency advantages of mass production with the value proposition of craft production in a single pot (Mourtzis, 2021; Pine, 1993). In this approach, products are not just considered as final outputs, but as "solution packages" that can be configured according to the specific needs of the customer (Rasmussen et al., 2020).

From an operational point of view, the success of this strategy depends on the extent to which the principle of "modularity" is integrated into the design and production processes. The modular design allows the final product to consist of independent sub-components that can be combined in different combinations (Wang et al., 2018; Tang et al., 2017). In this way, while the production of standard parts (platform) continues most of the production line, infinite variations can be created according to customer demand during the assembly phase. In this way, it maximizes product diversity while keeping operational complexity at a manageable level (Hvam et al., 2013; ElMaraghy et al., 2013).

Industry 4.0 technologies, particularly Cyber-Physical Systems (CPS) and the Internet of Things (IoT), have transformed the flexibility in production systems from a static structure to a dynamic and autonomous structure (Ghobakhloo, 2020; Tao et al., 2018). In smart factories, as soon as the customer order is placed in the Enterprise Resource Planning (ERP) system, this data is transmitted directly to the machines (M2M) in the production area; CNC machines, robotic arms, and assembly lines can readjust themselves to the specifications of that order without human intervention (Leng et al., 2022; Grabowska, 2020).

In this process, the sustainability of the cost advantage is ensured by the transition from the traditional "Economies of Scale" paradigm to the principle of "Economies of Scope" (Yin et al., 2018). In traditional manufacturing, the physical apparatus changes, mold settings and

machine changeovers required for each product change are the most important factors that increase unit costs; In the proposed cyber-physical infrastructure, these processes are managed through soft reconfiguration. Transitions between product variations are carried out with parametric software updates instead of physical hardware changes, reducing setup costs to a marginal level and enabling profitable production even at a "batch size of one" (Aheleroff et al., 2019; Wang et al., 2017). On the other hand, simulating production processes in a virtual environment using "Digital Twin" technology and conducting virtual commissioning tests bring physical prototype costs and raw material waste (scrap rate) caused by faulty production to zero (Wu & Li, 2022; Tao et al., 2018).

The shortening of the speed factor and lead time is explained by the data flow rate provided by the vertical and horizontal integration in the production system (Dalenogare et al., 2018; Frank et al., 2019). Bureaucratic and operational delays (information latency) that occur during the transfer of order data from the planning department to the production line can be eliminated thanks to the Internet of Things. From the entry of raw materials into the factory to the shipment of the final product, Autonomous Guided Vehicles (AGVs) and smart conveyor systems dynamically optimize routing based on instant capacity availability (Winkelhaus & Grosse, 2020; Fragapane et al., 2021). As a result, the total cycle time of a personalized product is reduced to levels that are competitive with the production time of a standard product; By minimizing the time difference between demand and delivery, operational support is provided to the "fast and fluid market" structure envisaged by the National Economy Model (Baş, 2005).

From a supply chain management perspective, Mass Personalization refers to the reduction of the Customer Order Decoupling Point (CODP) to the earlier stages of the production process (Saad et al., 2021; Olhager, 2010). In the traditional "Push System", production is made based on demand forecasts and this creates the risk of idle stock (waste); In the proposed model, production turns into a "Pull System" triggered by a real customer order (Tortorella et al., 2021b; Cifone et al., 2021). This approach, also known as the Postponement strategy, allows the final product to be held until the customer's demand is finalized (Chaudhuri et al., 2024). In this way, the principle of "preventing waste of resources", which is one of the main goals of the National Economy Model, is implemented on an operational basis by not producing products that will not be sold and eliminating stock costs (Baş, 2005; Kamble et al., 2020).

2.3. Co-creation and IKEA effect in marketing

In the marketing literature, the participation of consumers in the value creation process by collaborating with companies is called "Co-creation" (Prahalad & Ramaswamy, 2004). The consumer's

involvement in the design or configuration phase of the product to be purchased changes the nature of the bond they establish with the product.

In the research, it has been observed that individuals attribute a higher value to the objects to which they contribute their own labor or ideas; this situation is explained in the literature by the "IKEA Effect" or "Psychological Ownership" theory (Pierce et al., 2001). The consumer perceives the product not only as a commodity but also as an "extension of himself", which increases his willingness to pay and brand loyalty (Norton et al., 2012). Supporting the "live market" structure targeted by the National Economy Model with this psychological motivation of the consumer forms the micro basis of the consumption-based growth model.

2.3.1. Co-creation

Consumers today have more choices of products and services than ever before; however, they often remain dissatisfied. Firms invest in expanding product variety, yet their ability to differentiate themselves has diminished. Growth and value creation have therefore become dominant concerns for managers. The concept of value and the process of value creation are undergoing a rapid shift from a product- and firm-centric perspective toward personalized consumer experiences. Informed, networked, empowered, and active consumers increasingly participate in value co-creation with firms (Prahalad & Ramaswamy, 2004).

Co-creation has become a widely used term describing a shift in perspective from the organization as the sole definer of value toward a more participatory process in which individuals and organizations jointly generate and develop meaning. In business contexts, it has informed approaches to insight generation, new product and service development, and marketing. However, much of the research in this field has focused on consumers and marketers rather than on other stakeholder groups (Hatch & Schultz, 2010).

Piller, Ihl and Vossen (2010) proposed three characteristics that form the conceptual dimensions of a typology of possible settings for cocreation with customers:

- **The stage in the innovation process** refers to the point in time at which customer input derived from co-creation activities is integrated into the new product development process; that is, whether customer input is incorporated early in the front-end stages (idea generation and concept development) or later in the back-end stages (product design and testing).
- **The degree of collaboration** refers to the structure of the underlying relationships within an open innovation setting; that is, whether collaboration occurs in a dyadic form between a firm and an individual customer, or whether it involves networks of

customers who collaborate with one another more or less independently of the firm.

- **The degrees of freedom** refer to the nature of the task assigned to customers; that is, whether the task is narrowly defined and predetermined with limited degrees of freedom, or whether it is an open and creative task for which solutions are difficult to foresee due to a high degree of freedom.

a) Customer centralisation

Today, the ability to manage the value chain from the customers' perspective, rather than that of the provider, determines the competitiveness of many organizations. The concept of a customer-centric enterprise focuses all company operations on serving customers and delivering unique value by treating customers as individuals (Tseng & Piller, 2003; Piller et al., 2006). Customers are increasingly empowered and exercise this power by "voting" with their payment individually, rather than as a group. They make judgments based on the value they perceive at the moment of the transaction.

For firms, the advent of computing and communication technologies enables pervasive connectivity and direct interaction, both among individual customers and between customers and suppliers. This connectivity provides substantial additional flexibility. Beyond "listening into the customer domain" (Dahan & Hauser, 2002) to address specific needs more effectively and with shorter response times, manufacturers can integrate the capabilities of different suppliers to offer customers the best economic value.

Considering customers as individuals and proactively developing products to meet their preferences—at prices they are willing to pay and schedules they are willing to accept—is by no means a straightforward task. Customer centralisation implies that the organization, as a whole, is committed to meeting the needs of all relevant customers. At the strategic level, this translates into a firm's orientation and mindset to share interdependencies and values with customers over the long term. At the tactical level, companies must align their processes with customers' convenience as the highest priority, rather than focusing on operational convenience. Achieving this requires sufficient infrastructural systems and mechanisms. These changes include adopting a customer-centric organizational structure. Traditionally separate functions, such as sales, marketing (communications), and customer service, must become integrated into a single customer-centered activity (Sheth et al., 2000). At the operational level, mass customization and personalization have emerged over the past decade as key strategies for achieving this objective (Pine, 1993; Salvador et al., 2009).

As a result, customer centralisation shifts the marketing perspective from demand management to supply responsiveness. Traditionally,

marketing management has been viewed as demand-oriented, focusing on the product or market and stabilizing demand through promotional activities, incentives, or pricing policies. The customer-centric enterprise, however, places the individual customer at the starting point for all activities. Rather than attempting to create and stabilize demand—i.e., influencing what, when, and how much customers buy—firms should adjust their capabilities, including product design, production, and supply chains, to respond to actual customer demand (Piller et al., 2010).

The concept of customer centralisation emphasizes managing the value chain from the customer's perspective, prioritizing individualized value creation over traditional provider-focused approaches. Advances in computing and communication technologies enable firms to interact directly with customers and integrate supplier capabilities, increasing flexibility and responsiveness. Achieving customer centricity requires organizational alignment across strategic, tactical, and operational levels, including integrated functions, mass customization, and personalization. Consequently, marketing shifts from demand management to supply responsiveness, with firms adapting their processes and offerings to meet actual customer needs in real time.

2.3.2. Co-creation and value

The recent literature on value creation suggests that viewing co-creation solely from the perspective of the production process is no longer tenable. An understanding of value creation in the context of the customer's purchasing and consumption activities is essential. In line with this perspective, customers are not passive recipients of marketing actions but active resources participating in the value creation process. Considering the various approaches to the concept of value co-creation, and from the perspective of dominant logic, the service is the fundamental unit of exchange. Customers' skills and knowledge influence the process of value creation. Accordingly, value is a joint function of the actions of both the supplier and the customer, and it always results from co-creation (Cossío-Silva et al., 2016).

The perspective on value creation is extended as both firms and customers are inventing new and innovative ways to support each other's value-creating processes. These mechanisms shift the focus beyond the traditional exchange. Value co-creation as a business concept strives to capture this critically important and topical evolution, where the boundaries between firms and customers become more blurred owing to the continuous redefinition of their roles.

High-quality interactions that allow individual customers to co-create unique experiences with the company are key to unlocking new sources of competitive advantage. Value must be jointly created by both the firm and the consumer. In the traditional system, where firms decide which products and services to offer, they implicitly determine what is

valuable to the customer. Consumers, in this model, have little or no role in value creation.

Over the past two decades, managers have found ways to delegate some of the work traditionally performed by the firm to consumers—examples include self-checkout (e.g., gas pumps, ATMs, supermarket checkouts), involving select customers in product development (e.g., industrial clients assisting in designing products they need, as airlines do with Boeing), and various intermediate forms. Some consumers perceive these arrangements as beneficial. Companies such as Disney and Ritz-Carlton have devised innovative methods to stage experiences for their customers. Across all forms of consumer involvement—from self-checkout to participation in staged experiences—the firm remains responsible for orchestrating the overall experience.

While these approaches emphasize the consumer experience, customers are still largely treated as passive participants. Such firms exert significant control over the nature of the experience and remain primarily product-centric, service-centric, and company-centric. The focus is clearly on connecting the customer to the company's offerings (Prahalad & Ramaswamy, 2004).

Recent research emphasizes that value creation cannot be understood solely from a production perspective; instead, it emerges through customers' active participation in purchasing and consumption activities. Value co-creation positions the service as the primary unit of exchange, where both customers' knowledge and firms' capabilities jointly determine value. Contemporary approaches highlight the evolving interaction between firms and customers, blurring traditional boundaries and enabling innovative ways to support mutual value creation. Despite efforts to enhance customer experiences through mechanisms such as self-service, co-design, and staged experiences, firms often retain control over the overall process, maintaining a primarily product- or service-centric focus.

2.3.3. IKEA effect

Existing views on the impact of work on evaluations suggest that asking customers to take production costs into account when assessing a product's value should lead to a higher willingness to pay, as customers subtract the value of their own labor from the product's total value. An opposing view posits that when individuals exert effort by performing the work themselves, this effort can increase the value they attribute to the resulting product.

Although work can be enjoyable (e.g., building a teddy bear with one's nephew) and can enable product customization (e.g., creating a bear bearing the logo of one's alma mater)—both of which may enhance evaluations—we propose that the act of working itself may be sufficient to generate greater attachment to the outcome. Even assembling a standard dresser, a challenging and solitary task, can lead

individuals to overvalue their (often imperfectly constructed) creations. Consumers also place a higher value on products they constructed themselves compared to identical items they did not construct – a bias termed the 'IKEA effect' named after the Swedish manufacturer whose products typically require self-assembly (Nortton et al., 2012).

Goods are rarely valued objectively; factors such as who made an object, how it was produced, or who previously owned it have a profound influence on its perceived value. This phenomenon is captured by the IKEA effect, whereby consumers assign higher value to objects they have created themselves. Although this bias appears intuitive in contexts involving product customization (e.g., arts and crafts), it also extends to utilitarian goods that involve little or no creative input, such as modular furniture. Notably, individuals often value their own poorly constructed creations more highly than expertly made alternatives (Marsh et al., 2018). The IKEA effect has been shown to generalize across a wide range of creation contexts, including food preparation and online product customization (Franke et al., 2010).

Despite extensive empirical support for the IKEA effect, the psychological mechanisms underlying this phenomenon remain debated. Three primary explanations have been proposed: (1) competence signaling, (2) effort justification, and (3) ownership. According to the competence-signaling account, individuals value their creations because these objects signal personal competence, akin to a trophy (Bühren & Pleßner, 2013; Mochon et al., 2012). Mochon et al. (2012) demonstrated that feelings of competence mediated participants' willingness to pay for self-assembled products. In contrast, the effort-justification account posits that increased valuation reflects the effort invested rather than perceived competence. From this perspective, rewards are valued more when they are associated with substantial effort, whereas minimal effort leads to diminished valuation. Thus, heightened valuation may arise from the effort expended during creation.

A third explanation emphasizes ownership. The act of creating an object foster claims of ownership (Kanngiesser et al., 2010; Kanngiesser & Hood, 2014) and enhances subjective feelings of ownership. Increased psychological ownership, in turn, leads to higher valuation of the object (Marsh et al., 2018).

More generally, adults tend to value their own possessions more highly than equivalent unowned objects, likely due to feelings of psychological ownership. Consequently, increased ownership may underlie the elevated valuation of handmade objects. However, empirical evidence distinguishing between these explanatory accounts remains limited (ibid).

Prior research indicates that engaging consumers in the production process can systematically increase the value they attribute to a product, a phenomenon known as the IKEA effect. This bias reflects the

tendency to overvalue self-created objects, even when they are imperfect or lack creative input, and has been demonstrated across diverse contexts including furniture assembly, food preparation, and product customization. Although initially attributed to enjoyment or customization, evidence suggests that the mere act of labor is sufficient to enhance attachment and valuation. The underlying mechanisms remain contested, with competence signaling, effort justification, and psychological ownership proposed as the primary explanatory accounts.

3. Discussion: An integrated model for consumption-led growth

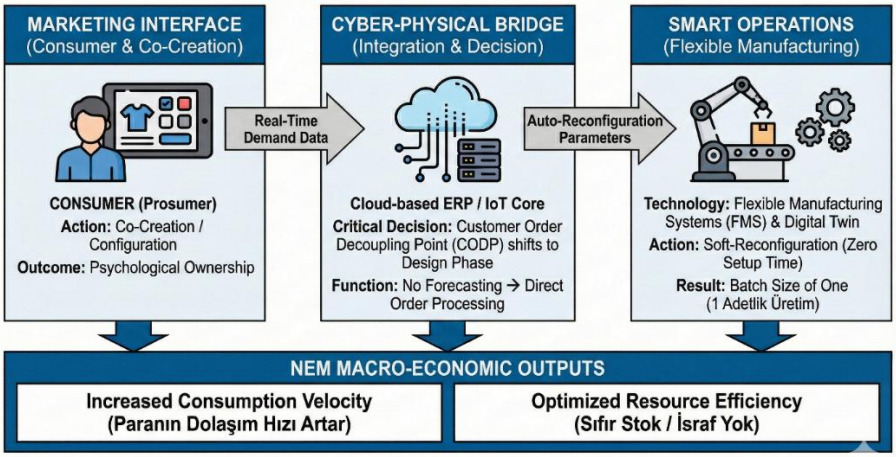
The concepts of operational flexibility and consumer participation examined in the literature review were synthesized in line with the goal of "consumption-driven growth", which is the main thesis of the National Economy Model (NEM), and the Demand-Driven Integrated Production Model was proposed in this study (Baş, 2005). Unlike traditional approaches, marketing and production departments do not work as silos are isolated from each other; On the contrary, this model, in which the data flow is real-time and bidirectional, is designed as the micro-level carrier of macroeconomic equilibrium (Tortorella et al., 2021a; Garrido-Vega et al., 2016).

The operating mechanism of the proposed model (Figure 2) starts with the "preference data" that the consumer enters into the system through digital configurators (Hvam et al., 2013; Mourtzis et al., 2021). This raw data obtained from the marketing interface is directly converted into production orders and transferred to cyber-physical systems without the need for any demand forecasting. This integration solves the "supply glut" crises that NEM criticizes at the source. Because production is triggered only for pre-sold products; Thus, the national wealth is prevented from melting in dead stocks (Nascimento et al., 2019; Olhager & Prajogo, 2012).

The economic output of the model should be discussed through the concept of "velocity of money". In NEM, the vitality of the economy is linked to the frequency with which money changes hands. The consumer's ownership of the product through the Co-Creation process and the minimization of lead time through operational flexibility accelerate purchasing decisions (Cambra-Fierro et al., 2017; Prahalad & Ramaswamy, 2004). This acceleration in the consumption cycle regulates the cash flow of producer companies and creates advantages such as capital accumulation for new investments (Badakhshan & Ivanov, 2025; Grosse-Ruyken et al., 2011).

From a holistic perspective, the proposed Mass Personalization strategy supports NEM's "unlimited resources" approach with the principle of "efficient use of resources". In standard production, raw materials and energy spent on features that the consumer does not fully want are wasted; In personalized production, only the features that "the

customer attributes value to" are manufactured. This situation overlaps the concept of "Value" in the Lean Production philosophy with NEM's understanding of social welfare; as a result, a sustainable economic ecosystem is created in which both consumer satisfaction (micro level) and national resource efficiency (macro level) are maximized simultaneously (Zhang et al., 2019; Bocken et al., 2014).



Source: The authors

Figure 2. The proposed Deman-Driven Integrated Production Model supporting NEM goals

4. Conclusion

This study examined how the “consumption-oriented growth” thesis, which constitutes the core of the National Economy Model (NEM), can be translated into actionable practices at the micro-enterprise level. In contrast to traditional supply-side paradigms, the analysis emphasized that sustainable growth in contemporary economies depends on the active involvement of consumers and on positioning demand as the primary driver of production processes.

Based on the theoretical analyses and the proposed integrated framework (Figure 2), the findings suggest that an Industry 4.0-based “mass personalization” strategy can be operationalized as a practical mechanism to reconcile the traditional divide between production and marketing. Through the implementation of cyber-physical systems, firms can achieve operational flexibility that enables product variety without increasing unit costs. Simultaneously, the integration of co-creation practices into marketing processes strengthens consumer engagement, enhances perceived ownership, and increases purchase motivation. In practical terms, micro-enterprises can adopt modular production systems, digital configuration tools, and customer feedback loops to align output more closely with real demand. This dual mechanism contributes both to accelerating the velocity of money at the

macroeconomic level and to improving resource efficiency by minimizing the production of non-demanded goods.

The study further highlights the practical implications of the co-creation paradigm for value generation in modern markets. Increasing product variety alone does not ensure higher consumer satisfaction; therefore, firms should transition from product-centric approaches toward personalized, experience-based value creation. In practice, this involves integrating consumers into product design, testing, and refinement processes through digital platforms and interactive tools. Co-creation should be structured across varying levels of participation and creative freedom, allowing firms to systematically incorporate customer input into innovation and marketing strategies.

A key operational principle underpinning this shift is customer centralization. This requires firms to manage the value chain from the customer's perspective by aligning organizational structures, workflows, and capabilities with individual customer needs. Digital technologies play a critical enabling role by facilitating direct interaction, real-time data collection, and adaptive production systems. As a result, marketing evolves from a function focused on demand stimulation to one centered on responsive supply configuration. Customers thus become active contributors to value creation, providing knowledge and competencies that firms can leverage in product development.

The "IKEA effect" provides additional insight into the psychological mechanisms supporting co-creation strategies. Empirical evidence indicates that consumers tend to assign higher value to products they have helped create. This phenomenon can be practically leveraged by designing participation mechanisms that allow customers to invest effort in the creation process, thereby fostering psychological ownership, signaling competence, and strengthening emotional attachment to the product.

The primary contribution of this study lies in reframing the NEM as not only a macroeconomic framework but also a practical guide for industrial transformation at the firm level. The proposed "Demand-Driven Integrated Production Model" demonstrates that enterprises should eliminate rigid separations between marketing and operations and utilize technology not solely for cost efficiency but also as a tool for collaborative value creation with consumers. This approach repositions human participation as a central element of production systems.

As a conceptual contribution, the study is based on theoretical synthesis and literature review. Future research should focus on empirically validating the proposed model across different sectors, particularly among small and medium-sized enterprises. Case studies, survey-based research, and quantitative analyses are recommended to assess the model's applicability and to measure its impact on industrial performance within the framework of the National Economy Model.

Conflict of interest
The authors declared no conflicts of interest.

Authors' contributions
All authors contributed to the original idea, study design.

Ethical considerations
The authors have completely considered ethical issues, including informed consent, plagiarism, data fabrication, misconduct, and/or falsification, double publication and/or redundancy, submission, etc. This article was not authored by artificial intelligence.

Data availability
The dataset generated and analyzed during the current study is available from the corresponding author on reasonable request.

References
Aheleroff S, Philip R, Zhong RY, Xu X. (2019). "The degree of mass personalisation under industry 4.0". *Procedia CIRP.* 81: 1394-1399. https://doi.org/10.1016/j.procir.2019.04.050.

Badakhshan E, Ivanov D. (2025). "Integrating digital twin and blockchain for responsive working capital management in supply chains facing financial disruptions". *International Journal of Production Research.* 63(21): 1-35. https://doi.org/10.1080/00207543.2025.2507112.

Baş H. (2005). *Milli Ekonomi Modeli*. İcmal Yayıncılık, İstanbul. [in Turkish]

Bocken NM, Short SW, Rana P, Evans S. (2014). "A literature and practice review to develop sustainable business model archetypes". *Journal of Cleaner Production.* 65: 42-56. https://doi.org/10.1016/j.jclepro.2013.11.039.

Bühren C, Pleßner M. (2013). "The trophy effect". *Journal of Behavioral Decision Making*. 377(December): 363-377. https://doi.org/10.1002/bdm.1812.

Cambra-Fierro J, Perez L, Grott E. (2017). "Towards a co-creation framework in the retail banking services industry: do demographics influence?". *Journal of Retailing and Consumer Services*. 34: 219-228. https://doi.org/10.1016/j.jretconser.2016.10.007.

Chaudhuri A, Bhatia MS, Subramanian N, Kayikci Y, Dora M. (2024). "Socio-technical capabilities for blockchain implementation by service providers: multiple case study of projects with transaction time reduction and quality improvement objectives". *Production Planning & Control*. 35(9): 978-991. https://doi.org/10.1080/09537287.2022.2128865.

Christopher M. (2000). "The agile supply chain: competing in volatile markets". *Industrial Marketing Management*. 29(1): 37-44. https://doi.org/10.1016/S0019-8501(99)00110-8.

Cifone FD, Hoberg K, Holweg M, Staudacher AP. (2021). "'Lean 4.0': How can digital technologies support lean practices?". *International Journal of Production Economics*. 241. https://dx.doi.org/10.1016/j.ijpe.2021.108258.

Cossío-Silva FJ, Revilla-Camacho MÁ, Vega-Vázquez M, Palacios-Florencio B. (2016). "Value co-creation and customer loyalty". *Journal of Business Research.* 69(5): 1621-1625. https://doi.org/10.1016/j.jbusres.2015.10.028.

Dahan E, Hauser JR. (2002). "The virtual customer". *Journal of Product Innovation Management*. 19(5): 332-353. https://stuff.mit.edu/~hauser/Papers/Dahan%20Hauser%20Virtual%20Customer%20JPIM%2002.pdf.

Dalenogare LS, Benitez GB, Ayala NF, Frank AG. (2018). "The expected contribution of Industry 4.0 technologies for industrial performance". *International Journal of Production Economics.* 204(C): 383-394. https://doi.org/10.1016/j.ijpe.2018.08.019.

ElMaraghy H, Schuh G, ElMaraghy W, Piller F, Schönsleben P, Tseng M, Bernard A. (2013). "Product variety management". *Cirp Annals*. 62(2): 629-652. https://doi.org/10.1016/j.cirp.2013.05.007.

Fisher ML. (1997). "What is the right supply chain for your product?". *Harvard Business Review.* 75(2): 105-116. https://hbr.org/1997/03/what-is-the-right-supply-chain-for-your-product.

Fragapane G, de Koster R, Sgarbossa F, Strandhagen JO. (2021). "Planning and control of autonomous mobile robots for intralogistics: Literature review and research agenda". *European Journal of Operational Research.* 294(2): 405-426. https://doi.org/10.1016/j.ejor.2021.01.019.

Frank AG, Dalenogare LS, Ayala NF. (2019). "Industry 4.0 technologies: Implementation patterns in manufacturing companies". *International Journal of Production Economics.* 210: 15-26. https://doi.org/10.1016/j.ijpe.2019.01.004.

Franke N, Schreier M, Kaiser U. (2010). "The 'I Designed It Myself' effect in mass customization". *Management Science*. 56(1): 125-140. http://dx.doi.org/10.1287/mnsc.1090.1077.

Garrido-Vega P, Sacristán-Díaz M, Magaña-Ramírez LM. (2016). *Six Sigma in SMES with Low Production Volumes; A Successful Experience in Aeronautics*. Universia Business Review. 51: 52-71. https://www.redalyc.org/pdf/433/43347130003.pdf.

Ghobakhloo M. (2020). "Industry 4.0, digitization, and opportunities for sustainability". *Journal of Cleaner Production.* 252. https://doi.org/10.1016/j.jclepro.2019.119869.

Grabowska S. (2020). "Personalisation of production in the era of Industry 4.0 as a challenge for inventory management in small and medium-sized production enterprises". *Operations Research and Decisions*. 30(2): 29-37. https://doi.org/10.37190/ord200201.

Grosse-Ruyken PT, Wagner SM, Jönke R. (2011). "What is the right cash conversion cycle for your supply chain?". *International Journal of Services and Operations Management*. 10(1): 13-29. https://doi.org/10.1504/IJSOM.2011.041987.

Gupta D, Benjaafar S. (2004). "Make-to-order, make-to-stock, or delay product differentiation? A common framework for modeling and analysis". *IIE Transactions.* 36(6): 529-546. https://doi.org/10.1080/07408170490438519.

Hatch MJ, Schultz M. (2010), "Toward a theory of brand co-creation with implications for brand governance". *Journal of Brand Management*. 17(8). https://doi.org/10.1057/bm.2010.14.

Hvam L, Haug A, Mortensen NH, Thuesen C. (2013). "Observed benefits from product configuration systems". *International Journal of Industrial Engineering (Online)*. 20(5-6): 329-338. https://doi.org/10.23055/ijietap.2013.20.5-6.890.

Ivanov D. (2022). "Viable supply chain model: integrating agility, resilience and sustainability perspectives—lessons from and thinking beyond the COVID-19 pandemic". *Annals of Operations Research.* 319: 1411-1431. https://doi.org/10.1007/s10479-020-03640-6.

Kamble SS, Gunasekaran A, Gawankar SA. (2020). "Achieving sustainable performance in a data-driven agriculture supply chain: A review for research and applications". *International Journal of Production Economics.* 219: 179-194. https://doi.org/10.1016/j.ijpe.2019.05.022.

Kanngiesser P, Gjersoe N, Hood BM. (2010). "The effect of creative labor on property-ownership transfer by preschool children and adults". *Psychological Science*. 21(9): 1236-1241. https://psycnet.apa.org/doi/10.1177/0956797610380701.

Kanngiesser P, Hood BM. (2014). "Young children's understanding of ownership

rights for newly made objects". *Cognitive Development*. 29: 30-40. https://psycnet.apa.org/doi/10.1016/j.cogdev.2013.09.003.

Kates S. (2005). "'Supply Creates its Own Demand': A discussion of the origins of the phrase and of its adequacy as an interpretation of Say's law of markets". *History of Economics Review.* 41(1): 49-60. https://doi.org/10.1080/18386318.2005.11681202.

Keynes JM, CB FBA, Maynard J. (2017). *The General Theory of Employment, Interest, and Money*. Wordsworth Editions, 576 s., ISBN 9781840227475

Koren Y, Gu X, Guo W. (2018). "Reconfigurable manufacturing systems: Principles, design, and future trends". *Frontiers of Mechanical Engineering*. 13: 121-136. https://doi.org/10.1007/s11465-018-0483-0.

Lang B, Botha E, Robertson J, Kemper JA, Dolan R, Kietzmann J. (2020). "How to grow the sharing economy? Create prosumers!". *Australasian Marketing Journal*. 28(3): 58-66. https://doi.org/10.1016/j.ausmj.2020.06.012.

Leng J, Sha W, Wang B, Zheng P, Zhuang C, Liu Q, Wuest Th, Mourtzis D, Wang L. (2022). "Industry 5.0: Prospect and retrospect". *Journal of Manufacturing Systems.* 65: 279-295. https://doi.org/10.1016/j.jmsy.2022.09.017.

Marsh LE, Kanngiesser P, Hood B. (2018). "When and how does labour lead to love? The ontogeny and mechanisms of the IKEA effect". *Cognition*. 170: 245-253. https://doi.org/10.1016/j.cognition.2017.10.012.

Mochon D, Norton MI, Ariely D. (2012). "Bolstering and restoring feelings of competence via the IKEA effect". *International Journal of Research in Marketing*. 29: 363-369. https://doi.org/10.1016/j.ijresmar.2012.05.001.

Mourtzis D. (ed.). (2021). *Design and Operation of Production Networks for Mass Personalization in the Era of Cloud Technology*. Elsevier.

Mourtzis D, Angelopoulos J, Panopoulos N. (2021). "Collaborative manufacturing design: a mixed reality and cloud-based framework for part design". *Procedia CIRP.* 100: 97-102. https://doi.org/10.1016/j.procir.2021.05.016.

Nascimento DLM, Alencastro V, Quelhas OLG, Caiado RGG, Garza-Reyes JA, Lona LR, Tortorella G. (2019). "Exploring Industry 4.0 technologies to enable circular economy practices in a manufacturing context: A business model proposal". *Journal of Manufacturing Technology Management.* 30: 607–627. https://www.doi.org/10.1108/JMTM-03-2018-0071.

Norton MI, Mochon D, Ariely D. (2012). "The IKEA effect: When labor leads to love". *Journal of Consumer Psychology.* 22(3): 453-460. https://psycnet.apa.org/doi/10.1016/j.jcps.2011.08.002.

Olhager J. (2010). "The role of the customer order decoupling point in production and supply chain management". *Computers in Industry.* 61(9): 863-868. https://doi.org/10.1016/j.compind.2010.07.011.

----------. (2003). "Strategic positioning of the order penetration point". *International Journal of Production Economics.* 85(3): 319-329. https://doi.org/10.1016/S0925-5273(03)00119-1.

Olhager J, Prajogo DI. (2012). "The impact of manufacturing and supply chain improvement initiatives: A survey comparing make-to-order and make-to-stock firms". *Omega*. 40(2): 159-165. https://doi.org/10.1016/j.omega.2011.05.001.

Pierce JL, Kostova T, Dirks KT. (2001). "Toward a theory of psychological ownership in organizations". *Academy of Management Review.* 26(2): 298-310. https://doi.org/10.2307/259124.

Piller FT, Ihl C, Vossen A. (2010). "A typology of customer co-creation in the innovation process". *SSRN*. https://doi.org/10.2139/ssrn.1732127.

Piller FT, Reichwald R Tseng M. (2006). Competitive advantage through customer centric enterprises". *International Journal of Mass Customization*. 1(2-3): 157-165.

Pine BJ. (1993). *Mass Customization: The New Frontier in Business Competition*. Harvard Business School Press.

Prahalad CK, Ramaswamy V. (2004). "Co-creation experiences: The next practice in

value creation". *Journal of Interactive Marketing.* 18(3): 5-14. https://doi.org/10.1002/dir.20015.

Ptak C, Smith C. (2016). *Demand Driven Material Requirements Planning (DDMRP)*. Industrial Press.

Rasmussen JB, Hvam L, Kristjansdottir K, Mortensen NH. (2020). "Guidelines for structuring object-oriented product configuration models in standard configuration software". *Journal of Universal Computer Science.* 26(3): 374-401. https://doi.org/10.3897/jucs.2020.020.

Saad SM, Bahadori R, Jafarnejad H, Putra MF. (2021). "Smart production planning and control: Technology readiness assessment". *Procedia Computer Science.* 180: 618-627. https://doi.org/10.1016/j.procs.2021.01.284.

Salvador F, de Holan M, Piller FT. (2009). "Cracking the Code of Mass Customization". *MIT Sloan Management Review*. 50(3): 71-78. https://sloanreview.mit.edu/article/cracking-the-code-of-mass-customization/.

Sheth JN, Sisodia RS, Sharma A. (2000). "The antecedents and consequences of customer-centric marketing". *Journal of the Academy of Marketing Science.* 28(1): 55-66. https://www.proquest.com/docview/224872040/fulltextPDF/FE0C9C7E37ED49B7PQ/1?accountid=32244&sourcetype=Scholarly%20Journals.

Tang M, Qi Y, Zhang M. (2017). "Impact of product modularity on mass customization capability: An exploratory study of contextual factors". *International Journal of Information Technology & Decision Making.* 16(04): 939-959. https://doi.org/10.1142/S0219622017410012.

Tao F, Cheng J, Qi Q, Zhang M, Zhang H, Sui F. (2018). "Digital twin-driven product design, manufacturing and service with big data". *The International Journal of Advanced Manufacturing Technology*. 94(9): 3563-3576. https://doi.org/10.1007/s00170-017-0233-1.

Tortorella GL, Rossini M, Costa F, Portioli Staudacher A, Sawhney R. (2021a). "A comparison on Industry 4.0 and Lean Production between manufacturers from emerging and developed economies". *Total Quality Management & Business Excellence.* 32(11-12): 1249-1270. https://re.public.polimi.it/handle/11311/1150597.

Tortorella GL, Fogliatto FS, Saurin TA, Tonetto LM, McFarlane D. (2021b). "Contributions of Healthcare 4.0 digital applications to the resilience of healthcare organizations during the COVID-19 outbreak". *Technovation*. 111. https://doi.org/10.1016/j.technovation.2021.102379.

Tseng MM, Piller FT. (2003)." The customer centric enterprise". In Tseng MM, Piller FT. (eds.). *The Customer Centric Enterprise: Advances in Mass Customization and Personalization*. pp. 1-18. New York, NY Springer.

Vargo SL, Lusch RF. (2012). "The nature and understanding of value: A service-dominant logic perspective". In *Special Issue–Toward a Better Understanding of the Role of Value in Markets and Marketing*. pp. 1-12. Emerald Group Publishing Limited.

Wang S, Li J, Song J, Li Y, Sherk, M. (2018). "Institutional pressures and product modularity: do supply chain coordination and functional coordination matter?". *International Journal of Production Research.* 56(20): 6644-6657. https://doi.org/10.1080/00207543.2018.1444807.

Wang Y, Ma HS, Yang JH, Wang KS. (2017). "Industry 4.0: A way from mass customization to mass personalization production". *Advances in Manufacturing.* 5(4): 311-320. https://doi.org/10.1007/s40436-017-0204-7.

Winkelhaus S, Grosse EH. (2020). "Logistics 4.0: a systematic review towards a new logistics system". *International Journal of Production Research.* 58(1): 18-43. https://doi.org/10.1080/00207543.2019.1612964.

Wu Y, Li Y. (2022). "Digital twin-driven performance optimization for hazardous waste landfill systems". *Mathematical Problems in Engineering.* 2022(1).

https://doi.org/10.1155/2022/7778952.

Yin Y, Stecke KE, Li D. (2018). "The evolution of production systems from Industry 2.0 through Industry 4.0". *International Journal of Production Research.* 56(1-2): 848-861. https://doi.org/10.1080/00207543.2017.1403664.

Zhang A, Venkatesh VG, Liu Y, Wan M, Qu T, Huisingh D. (2019). "Barriers to smart waste management for a circular economy in China". *Journal of Cleaner Production.* 240, 118198. https://doi.org/10.1016/j.jclepro.2019.118198.