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Research Article

Additive manufacturing in premium brands: The potential for competitive differentiation and strategic marketing management

Premium markalarda katmanlı üretim: Rekabetçi fark yaratma potansiyeli ve stratejik pazarlama yönetimi

Savaş Gökalp Karamık[1]

[1] Dr., Manisa Celal Bayar University, Köprübaşı Vocational School, Business Management, Manisa, Türkiye, gokalpkaramik@gmail.com

ORCID: 0009-0004-0621-7507

Abstract

Although additive manufacturing technologies have attracted considerable attention within the broader Industry 4.0 ecosystem, existing literature predominantly examines them through operational and engineering-oriented perspectives, leaving their strategic marketing implications comparatively underexplored. This study addresses that gap by examining how additive manufacturing technologies are integrated into competitive differentiation and strategic positioning processes within premium industries. A qualitative multiple case study design was adopted, and corporate and independent industry documents related to Porsche, Bugatti, and Chanel were analyzed through thematic coding interpreted within the VRIO framework. The findings indicate that additive manufacturing contributes to differentiation-oriented positioning through personalization, engineering prestige, aesthetic innovation, and agile value creation, whereas sustainability-related narratives remain largely aspirational rather than empirically substantiated in the analyzed materials. Strategic significance does not emerge from technological infrastructure alone, but from how firms organizationally embed these capabilities within broader branding and value creation systems. The study contributes a conceptual framework explaining how digitally integrated production technologies may support competitive differentiation within premium market environments.

Keywords: Strategic Marketing, Competitive Differentiation, Additive Manufacturing

JEL Codes: M31, O33, L21

Öz

Katmanlı üretim teknolojileri, daha geniş Endüstri 4.0 ekosistemi içerisinde önemli ölçüde ilgi görmesine rağmen, mevcut literatürde ağırlıklı olarak operasyonel ve mühendislik odaklı perspektiflerle ele alınmakta; stratejik pazarlama açısından taşıdığı etkiler ise görece sınırlı biçimde incelenmektedir. Bu çalışma, katmanlı üretim teknolojilerinin premium sektörlerde rekabetçi farklılaşma ve stratejik konumlandırma süreçlerine nasıl entegre edildiğini inceleyerek söz konusu boşluğu doldurmayı amaçlamaktadır. Araştırmada niteliksel çoklu vaka çalışması deseni benimsenmiş; Porsche, Bugatti ve Chanel'e ilişkin kurumsal ve bağımsız sektör dokümanları, VRIO çerçevesi doğrultusunda yorumlanan tematik kodlama yöntemiyle analiz edilmiştir. Bulgular, katmanlı üretimin kişiselleştirme, mühendislik prestiji, estetik inovasyon ve çevik değer yaratımı aracılığıyla farklılaşma odaklı konumlandırmaya katkı sağladığını; sürdürülebilirlik anlatılarının ise büyük ölçüde iddia düzeyinde kaldığını göstermektedir. Stratejik önemin yalnızca teknolojik altyapıdan değil, firmaların bu yetenekleri daha geniş markalaşma ve değer yaratma sistemleriyle örgütsel düzeyde nasıl bütünleştirdiğinden kaynaklandığı ortaya konulmuştur. Çalışma, dijital olarak entegre edilmiş üretim teknolojilerinin premium pazar ortamlarında rekabetçi farklılaşmayı nasıl destekleyebileceğini açıklayan kavramsal bir çerçeve sunmaktadır.

Anahtar Kelimeler: Stratejik Pazarlama, Rekabetçi Farklılaşma, Katmanlı Üretim

JEL Kodları: M31, O33, L21

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Introduction

Additive manufacturing technologies have attracted growing scholarly and managerial attention as digitally integrated production systems capable of reshaping competitive structures, organizational capabilities, and value creation processes across industries (Kotler & Keller, 2016; Pine & Gilmore, 1999; Porter, 1980). Within the broader Industry 4.0 ecosystem, these technologies have emerged as particularly relevant due to their flexibility, rapid prototyping capacity, and digitally enabled production capabilities (Schwab, 2017; Gibson et al., 2015). Unlike conventional subtractive manufacturing systems, additive manufacturing enables layer-by-layer production through digitally controlled processes, thereby supporting customized production, reduced lead times, and more flexible manufacturing structures (Gibson et al., 2015; Chua et al., 2010).

The growing diffusion of additive manufacturing technologies has expanded their application areas across automotive, aerospace, healthcare, luxury fashion, and consumer product industries (Schwab, 2017; Chua et al., 2010). Existing literature predominantly examines 3D printing technologies from operational and engineering-oriented perspectives, focusing primarily on technical efficiency, material performance, manufacturing optimization, and production system integration (Chua et al., 2010; Piller & Tseng, 2010; Devito et al., 2024). Although these studies provide valuable technological insights, comparatively limited attention has been devoted to understanding how firms strategically integrate additive manufacturing technologies into broader differentiation-oriented positioning narratives, symbolic value creation processes, and organizational capability structures within premium market environments (Gao et al., 2015).

This limitation becomes particularly significant when examined through strategic management and competitive positioning perspectives. Porter's differentiation framework emphasizes that firms may achieve stronger market positions by developing distinctive value propositions capable of reducing direct imitation pressures within saturated markets (Porter, 1980). Similarly, the Resource-Based View (RBV) suggests that sustainable strategic potential emerges when organizational resources are valuable, difficult to imitate, and effectively embedded within broader organizational systems (Barney, 1991). The dynamic capabilities perspective further highlights firms' capacities to adapt, reconfigure, and strategically deploy organizational resources in rapidly changing competitive environments (Teece et al., 1997). Within this context, additive manufacturing technologies may be interpreted not merely as technical production systems but as organizationally embedded capabilities potentially supporting personalization, flexibility, innovation signaling, and symbolic differentiation processes.

The Value, Rarity, Inimitability, and Organization (VRIO) framework provides an additional interpretive perspective for evaluating whether additive manufacturing-related capabilities demonstrate characteristics associated with differentiation-oriented strategic potential (Barney & Hesterly, 2015). However, existing literature rarely examines additive manufacturing technologies through an integrated framework combining strategic positioning, organizational capability interpretation, and premium branding narratives. More specifically, limited attention has been devoted to how firms utilize additive manufacturing technologies as part of broader communicative and symbolic positioning mechanisms rather than solely operational manufacturing infrastructures.

A further dimension concerns sustainability-oriented strategic positioning. Contemporary firms increasingly integrate sustainability narratives into innovation and branding processes in response to evolving stakeholder expectations and environmental concerns (Elkington, 1997). Additive manufacturing technologies are frequently associated with reduced material waste, flexible inventory systems, decentralized production structures, and on-demand manufacturing capabilities. Nevertheless, the relationship between additive manufacturing and sustainability-oriented differentiation narratives remains conceptually fragmented and methodologically underexplored within strategic marketing literature.

Accordingly, this study examines how premium brands strategically position additive manufacturing technologies within broader narratives of personalization, innovation, sustainability, and symbolic differentiation. Rather than claiming that additive manufacturing directly generates measurable competitive advantage, the study focuses on how firms discursively and strategically integrate additive manufacturing capabilities into differentiation-oriented positioning processes. In this respect, the research approaches additive manufacturing as a strategic and organizational capability embedded within broader value creation and branding systems. Methodologically, the study adopts a qualitative multiple case study design grounded in thematic document analysis (Creswell & Poth, 2018; Merriam & Tisdell, 2016; Yin, 2018). The analysis specifically focuses on strategic corporate discourses concerning additive manufacturing technologies within premium market contexts. Corporate reports, product

launch materials, sustainability disclosures, investor presentations, and independent industry analyses constituted the document types initially considered by the study; as described in the Methodology, the final analytical corpus consisted of four documents meeting the study's inclusion criteria. Porsche, Bugatti, and Chanel were selected through theoretical sampling logic due to their differentiated strategic approaches toward additive manufacturing applications and their analytical relevance for comparative interpretation within premium industries (Yin, 2018).

The study contributes to literature in several respects. First, it extends additive manufacturing literature beyond predominantly engineering-oriented discussions by providing a strategic marketing and organizational interpretation of additive manufacturing technologies. Second, the study conceptually connects additive manufacturing with Resource-Based View logic, dynamic capabilities theory, and VRIO-oriented strategic interpretation. Specifically, the study extends this perspective by examining how different additive manufacturing applications are incorporated into distinct brand positioning narratives— personalization, engineering prestige, aesthetic innovation, and agile value creation — thereby shifting the analytical focus from additive manufacturing and business models in general terms (e.g., Devito et al., 2024) toward their role within brand positioning. Third, the research provides a mechanism-oriented perspective explaining how personalization, engineering prestige, aesthetic innovation, and agile value creation may collectively support differentiation-oriented positioning processes within digitally transforming premium industries. Finally, the study contributes to the broader discussion surrounding Industry 4.0 by emphasizing the symbolic and communicative dimensions of digitally integrated production technologies in contemporary market environments. Building on this objective, and in order to guide the empirical investigation reported in the following sections, the study addresses the following research questions:

RQ1: How do premium brands strategically integrate additive manufacturing technologies into competitive differentiation and strategic positioning processes?

RQ2: Through which organizational capabilities and value creation mechanisms do additive manufacturing technologies contribute to differentiation-oriented strategic marketing?

RQ3: How can the VRIO framework be used to interpret the strategic potential of additive manufacturing technologies within premium industries?

The remainder of this paper is organized as follows. The following section presents the conceptual and theoretical foundations related to additive manufacturing and strategic management. This is followed by the methodology, which details the case selection strategy, data sources, and analytical procedures. Findings from the cross-case analysis and VRIO-oriented interpretation are then reported. Finally, the discussion, implications, limitations, and conclusion summarize the theoretical and managerial contributions of the study.

Conceptual and theoretical frameworks related to strategic management and additive manufacturing

3D printing technologies and digital transformation

The rapid expansion of digital transformation processes has significantly reshaped production systems and competitive structures across industries (Verhoef et al., 2021; Xu et al., 2018). Within the broader Industry 4.0 ecosystem, additive manufacturing technologies have increasingly attracted attention due to their flexibility, rapid prototyping capacity, and digitally integrated production capabilities (Chua et al., 2010). Unlike traditional subtractive production systems, additive manufacturing enables products to be manufactured layer by layer through digital design processes, allowing firms to produce customized and low-volume products more efficiently (Chua et al., 2010; Gibson et al., 2015).

Initially associated primarily with engineering and prototyping applications, 3D printing technologies are now utilized in industries where innovation, personalization, and customer experience possess strategic importance (Berman, 2012). Existing literature largely emphasizes operational advantages such as manufacturing flexibility, reduced lead times, and production optimization (Gao et al., 2015). However, recent studies suggest that digital manufacturing technologies may also influence broader strategic positioning and value creation processes (Rayna & Striukova, 2014). In premium industries especially, technological capabilities frequently function not only as operational assets but also as symbolic indicators of innovation, exclusivity, and brand prestige (Gilmore & Pine, 2007). Consequently, additive manufacturing technologies should be interpreted not merely as production tools but also as strategic resources capable of supporting differentiation-oriented positioning mechanisms in digitally transforming markets.

Competitive differentiation and strategic positioning

Competitive differentiation represents one of the primary strategic mechanisms through which firms attempt to establish distinctive market positions and reduce direct price competition pressures (Porter, 1980). In highly saturated markets characterized by product similarity and rapid technological imitation, firms increasingly rely on symbolic value creation, customer experience, and innovation-oriented positioning strategies (Ko et al., 2019). Porter's differentiation perspective emphasizes that firms may achieve stronger market positions by offering unique attributes perceived as valuable by customers (Porter, 1980). Within premium industries, differentiation often emerges through exclusivity, design, innovation, and experiential value rather than solely through functional superiority (Keller, 2013). Therefore, technological capabilities may become integrated into broader strategic narratives associated with prestige, authenticity, and customer engagement.

Additive manufacturing technologies are particularly relevant within this context because they support personalization and flexible production systems (Piller & Tseng, 2010). The ability to produce individualized products may strengthen firms' capacities to create unique customer experiences and reinforce premium positioning strategies. In addition, digitally enabled customization processes may support co-creation mechanisms by integrating customers more directly into product development and configuration processes (Prahalad & Ramaswamy, 2004). Accordingly, the strategic importance of additive manufacturing extends beyond operational efficiency alone. The technology may also contribute to competitive differentiation potential by supporting innovation-oriented positioning and symbolic value creation processes within contemporary digital markets.

RBV, dynamic capabilities, and VRIO framework

The Resource-Based View (RBV) argues that resources can generate sustained competitive advantage when they are valuable, rare, imperfectly imitable, and non-substitutable (Barney, 1991). The Organization dimension, which concerns whether a firm is organized to exploit such resources, is incorporated in the later VRIO formulation of the framework (Barney & Hesterly, 2015). From this perspective, sustainable differentiation depends not only on market conditions but also on firm-specific capabilities supporting long-term value creation. The dynamic capabilities perspective further emphasizes organizational adaptability and the ability to reconfigure strategic resources in rapidly changing environments (Teece et al., 1997). Within digitally transforming industries, technologies supporting agility, responsiveness, and innovation may therefore function as strategically significant organizational capabilities rather than merely technical systems.

The VRIO framework provides an analytical structure for evaluating whether organizational resources possess strategic differentiation potential (Barney & Hesterly, 2015). According to this model, a capability must create value, demonstrate relative rarity, resist imitation, and be effectively integrated into organizational structures in order to support sustainable strategic positioning. In the context of additive manufacturing, personalization capacity, technological prestige, agile production, and innovation signaling may potentially strengthen these dimensions under certain organizational conditions. Building on this scope, this study conceptualizes 3D printing technologies as strategic capabilities that may support differentiation-oriented positioning mechanisms through flexibility, personalization, innovation, and symbolic value creation.

Personalization, sustainability, and strategic value creation

Contemporary marketing approaches increasingly emphasize personalization, customer experience, and co-created value as central dimensions of strategic value creation (Kotler & Keller, 2016; Pine & Gilmore, 1999). Particularly within premium markets, consumers increasingly seek individualized products and experiences associated with uniqueness, authenticity, and symbolic meaning (Ko et al., 2019). Additive manufacturing technologies support these dynamics by enabling more flexible and customized production systems (Piller & Tseng, 2010). Unlike traditional mass production models, 3D printing technologies allow firms to produce individualized products without substantial modifications in manufacturing infrastructure. This flexibility may strengthen experiential differentiation mechanisms and reinforce exclusivity-oriented positioning strategies.

In addition to personalization, sustainability has become an increasingly central component of strategic positioning and brand communication processes (Elkington, 1997). Existing literature has discussed additive manufacturing as having the potential to support more distributed and resource-efficient production configurations, while also highlighting its possible contribution to circular economy objectives (Despeisse et al., 2017). Consequently, sustainability may function not only as an

environmental concern but also as a strategic differentiation mechanism, jointly with personalization and innovation signaling, within broader value creation processes in digitally transforming industries.

The theoretical foundations outlined above can be further extended by two complementary perspectives: the value creation perspective and strategic marketing orientation. From a value creation perspective, digitally integrated production technologies enable firms to co-create customer value through personalization, flexibility, and innovation (Prahalad & Ramaswamy, 2004). Likewise, strategic marketing orientation emphasizes that sustainable competitive differentiation depends not only on technological capabilities but also on firms' ability to communicate and transform these capabilities into meaningful customer value propositions (Kotler & Keller, 2016). Read together, these two perspectives suggest that additive manufacturing operates simultaneously as a technological resource, an organizational capability, and a marketing communication tool.

Porter's (1980) competitive strategy perspective further complements the theoretical foundations of this study by emphasizing differentiation as a primary source of sustainable competitive advantage. From this perspective, additive manufacturing technologies should not be viewed merely as process innovations but as strategic resources capable of supporting product uniqueness, customer value creation, and long-term competitive positioning. Furthermore, strategic marketing theory argues that technological capabilities generate sustainable competitive value only when they are effectively transformed into meaningful customer benefits (Kotler & Keller, 2016) and distinctive brand positioning (Keller, 2013). Taken together with the value creation and RBV-based perspectives discussed above, this positions additive manufacturing as a capability that spans production, organizational, and market-facing dimensions rather than a single-purpose manufacturing tool. Figure 1 depicts how these theoretical perspectives connect to one another and to the strategic outcomes examined in this study.

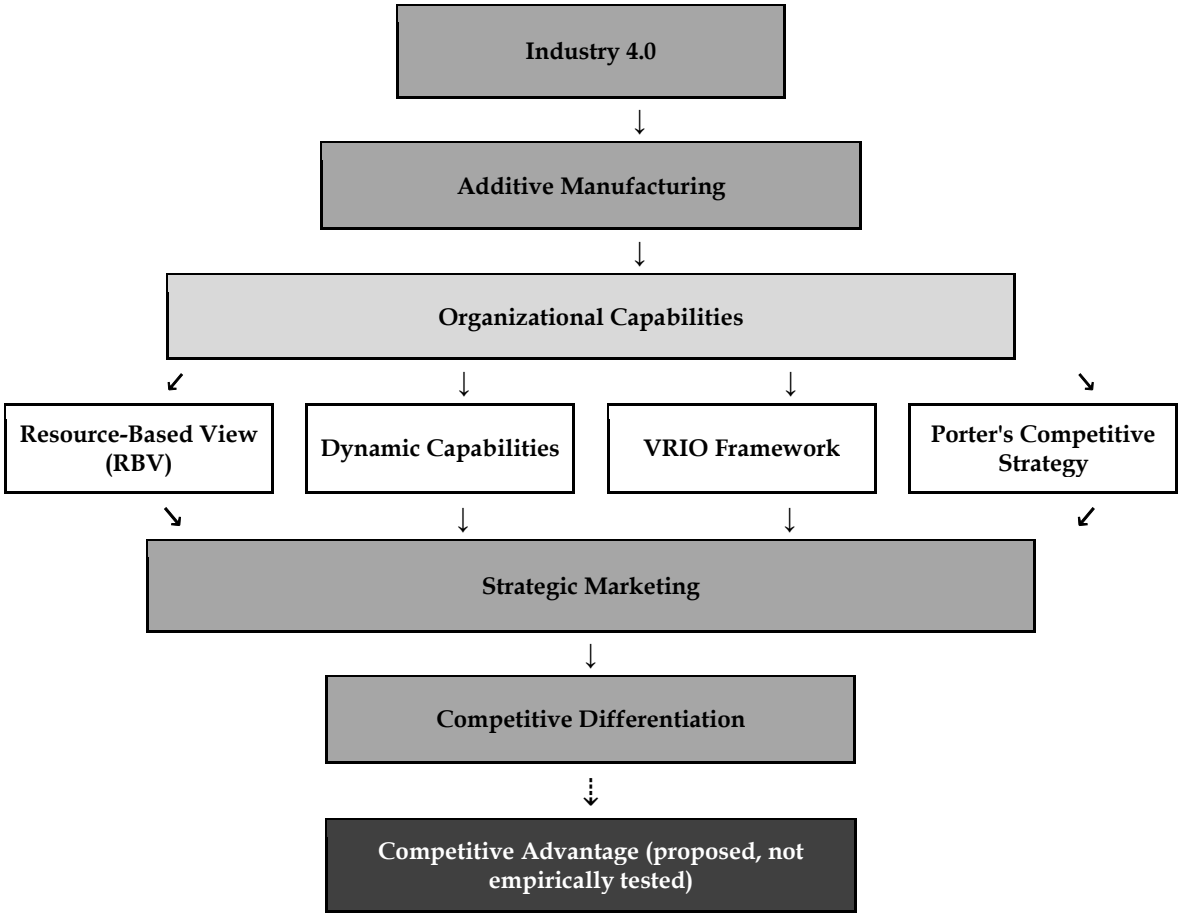

Figure 1: Strategic Positioning of Additive Manufacturing within Strategic Management Perspectives

Note: This figure was developed by the author. The final outcome box is labeled "(proposed, not empirically tested)" to indicate that this relationship represents a conceptual proposition rather than an empirically tested causal effect.

Figure 1 illustrates the theoretical integration adopted in this study. Industry 4.0 constitutes the broader digital transformation context within which additive manufacturing operates. Organizational capabilities enabled by additive manufacturing are interpreted through the Resource-Based View (RBV), Dynamic Capabilities, the VRIO framework, and Porter's competitive strategy perspective.

Together, these perspectives explain how capabilities based on additive manufacturing strengthen strategic marketing activities and facilitate competitive differentiation.

Methodology

Research design

This study adopts a qualitative multiple case study design grounded in thematic document analysis. A qualitative interpretive approach was considered appropriate because the research focuses on how firms strategically position additive manufacturing technologies within broader narratives of differentiation, innovation, personalization, and symbolic value creation rather than measuring direct financial or quantitative performance outcomes (Creswell & Poth, 2018; Merriam & Tisdell, 2016). The primary unit of analysis consists of strategic corporate discourses concerning additive manufacturing capabilities within premium market contexts. More specifically, the study examines how firms communicate, frame, and integrate additive manufacturing technologies into broader strategic positioning narratives associated with innovation, exclusivity, agility, sustainability, and customer-oriented value creation. A multiple case study structure was preferred because it enables comparative interpretation across different organizational contexts and strategic positioning approaches (Yin, 2018). Rather than attempting statistical generalization, the study aims to identify recurring strategic mechanisms and interpretive patterns associated with additive manufacturing technologies across premium industries.

Case selection strategy

The cases were selected through theoretical sampling logic in order to provide analytical variation regarding the strategic use of additive manufacturing technologies. Porsche, Bugatti, and Chanel were specifically selected because they represent differentiated premium positioning logics associated with personalization, engineering prestige, and symbolic luxury innovation. Porsche was included due to its emphasis on customer-specific production and personalization-oriented additive manufacturing applications. Bugatti represents a technologically intensive case emphasizing lightweight production systems, engineering precision, and innovation signaling. Chanel was selected as a contrasting premium case in which additive manufacturing technologies are integrated into both aesthetic innovation and symbolic exclusivity narratives on the one hand and functional, industrial-scale production applications on the other. The objective of the case selection process was not to compare market performance outcomes, but to explore how additive manufacturing technologies are strategically embedded into different premium branding and positioning structures. Although two cases originate from the premium automotive industry, they represent fundamentally different strategic applications of additive manufacturing. Porsche primarily emphasizes customer-oriented personalization and flexible production systems, whereas Bugatti focuses on engineering prestige and technological exclusivity. Chanel was deliberately included to introduce an analytically contrasting luxury fashion perspective. Accordingly, the selection was guided by theoretical replication logic rather than sectoral representativeness, aiming to maximize variation in strategic positioning rather than numerical balance across industries. The unit of analysis in each case is the brand's public corporate discourse, not the sector as a whole. Within Chanel, the cosmetics application and the haute couture application are treated as two analytically distinct sub-units.

Data sources and dataset

The case evidence consists of documents published between 2015 and 2020 (Hipolite, 2015; Bugatti Automobiles S.A.S., 2018; Porsche AG, 2020; Saunders, 2018), separate from the broader literature search and source verification process, which was updated through September 2026. These documents constitute the analyzed corpus itself, not contextual background, and are cited by publication year in their respective case sections. The 2015–2020 period was considered appropriate for capturing developments associated with Industry 4.0 integration, digital manufacturing transformation, and additive manufacturing adoption across premium industries. The primary data sources include corporate press releases, sustainability reports, investor presentations, executive statements, product launch materials, and independent industry analyses. Each document was independently reviewed according to a predefined document evaluation protocol that considered relevance to additive manufacturing, strategic content, publication source, and analytical contribution. Documents that focused exclusively on technical specifications without strategic implications were excluded from the final analytical dataset. Coding and thematic clustering were carried out manually using a structured Excel-based coding matrix, in which each document was tagged against the predefined thematic categories. The initial set of categories was derived from the theoretical framework presented above and subsequently refined through a first pass over the dataset, after which the matrix was applied

consistently across all three cases. However, the study does not treat all document categories as analytically equivalent. Different document types were interpreted according to their relative evidentiary strength and strategic relevance. In order to reduce excessive dependence on corporate self-representation narratives, independent industry analyses and sectoral reports were considered as higher-weight contextual sources where available; corporate claims were not treated as independently verified solely on the basis of these materials. In addition, contradictory evidence, implementation limitations, and scalability challenges associated with additive manufacturing adoption were also considered in order to reduce confirmation bias and improve interpretive balance. Table 1 operationalizes this differentiated evidentiary weighting by summarizing the document categories used in the dataset, together with the analytical weight assigned to each category and its primary purpose in the analysis.

Table 1: Document Categories and Analytical Weighting

Document Type	Analytical Weight	Primary Purpose
Independent industry reports	High	External validation and triangulation
Investor presentations	Medium-High	Strategic direction and organizational priorities
Sustainability reports	Medium	Sustainability-oriented positioning narratives
Product launch materials	Medium	Innovation and personalization discourse
Press releases	Low	Strategic communication narratives

As Table 1 shows, independent industry reports were assigned the highest analytical weight; investor presentations, while strategically informative, were not treated as independently verified sources. Press releases, by contrast, were treated as contextual or descriptive evidence rather than as primary support for analytical claims, since these documents are produced directly by the firms under study and are more likely to emphasize favorable narratives. Product launch materials were assigned a somewhat higher (Medium) weight in Table 1 and were used descriptively to support innovation and personalization narratives. Table 1 reflects a general weighting principle rather than the composition of the final corpus; the four case-anchoring documents themselves fall only under the 'Press releases' and 'Independent industry reports' categories. Beyond this weighting scheme, the dataset was also subject to a set of explicit inclusion criteria: (i) direct reference to additive manufacturing technologies, (ii) strategic relevance to branding and positioning narratives, (iii) accessibility through publicly available sources, and (iv) analytical relevance to differentiation-oriented positioning mechanisms. The analysis draws on four publicly available corporate and independent industry documents (Porsche AG, 2020; Bugatti Automobiles S.A.S., 2018; Hipolite, 2015; Saunders, 2018), each providing case-specific, traceable evidence directly relevant to the research objectives. A formal screening record of all documents initially considered and subsequently excluded during the search and selection process was not systematically retained. Consequently, the total number of documents considered and excluded cannot be retrospectively reported with sufficient documentary certainty. This gap in the documentation of the selection process is acknowledged as a limitation of the study.

Data analysis process

The collected documents were analyzed through thematic content analysis (Braun & Clarke, 2006). The terms "thematic document analysis," "thematic content analysis," and "thematic coding" are used interchangeably throughout this study to refer to the same procedure, which adapts Braun and Clarke's (2006) six-phase approach into a four-stage process suited to document-based data. Specifically, "initial coding" combines Braun and Clarke's familiarization and initial-coding phases; "category clustering" corresponds to their theme-searching phase; "thematic synthesis" merges their theme-reviewing and theme-defining phases; and "cross-case comparison" is an additional stage, not present in the original single-dataset model, added to compare codes and themes across the three cases. The analytical process proceeded through four stages: initial coding, category clustering, thematic synthesis, and cross-case comparison. During the first stage, recurring statements associated with additive manufacturing technologies were identified directly from the documents. These statements were coded according to their strategic emphasis and interpretive meaning. Expressions emphasizing customer-specific production, flexible manufacturing, rapid prototyping, innovation signaling, sustainability, and exclusivity were repeatedly identified across the dataset. For example, statements emphasizing customer-oriented manufacturing flexibility were initially coded under concepts such as “customization” and “rapid response.” Subsequently, these codes were grouped into broader interpretive categories including “personalization” and “agility,” which were later synthesized under

higher-order themes associated with differentiation-oriented strategic positioning. As new documents were reviewed, each coding decision was checked against the categories already in use. Codes were not required to appear in every case: case-specific codes were permitted and retained where a theme was particular to one brand or application, and consistency was assessed at the theme level during cross-case comparison rather than requiring every code to recur across all three cases. Documents were reviewed in publication order (Hipolite, 2015; Bugatti Automobiles S.A.S., 2018; Saunders, 2018; Porsche AG, 2020); each newly reviewed document was coded against the existing category set before new codes were introduced, and every coding decision and category-definition change was logged, providing a revision trail. Coding was considered complete once the last document reviewed, Porsche AG (2020), produced no new categories and required no definition changes. Table 2 illustrates this coding process through four representative examples drawn from the three cases, showing how raw statements from the documents were progressively abstracted first into initial codes, then into broader categories, and finally into the higher-order themes used in the cross-case analysis.

Table 2: Sample Coding and Theme Generation Structure

Raw Statement	Initial Code	Category	Main Theme
(Porsche, Porsche AG, 2020) customer-specific seat components	customization	personalization	differentiation
(Porsche, Porsche AG, 2020) rapid adaptation to design demands	rapid response	agility	strategic flexibility
(Bugatti, Bugatti Automobiles S.A.S., 2018) lightweight titanium production	engineering precision	innovation signaling	technological prestige
(Chanel, Saunders, 2018) first mascara brush manufactured on an industrial scale	industrial-scale application	functional integration	strategic value creation

Note: All entries are paraphrased excerpts from the source documents.

As Table 2 illustrates, statements referring to concrete operational details, such as seat components or titanium production, were consistently traced through to broader strategic themes such as differentiation and strategic flexibility. This four-row structure was repeated across the full dataset, so that the same category and theme labels could be compared across Porsche, Bugatti, and Chanel during the cross-case stage described below. Theme generation was conducted through iterative interpretive comparison rather than automated keyword grouping. Codes were grouped according to semantic similarity, repeated strategic emphasis, and conceptual proximity across documents. Following within-case analysis, cross-case comparison procedures were conducted in order to identify recurring patterns and strategic differences across the selected cases.

Trustworthiness and research limitations

Several methodological strategies were adopted to strengthen the trustworthiness of the study. First, data triangulation was utilized by integrating both corporate and independent industry sources. Second, document categories were analytically differentiated according to evidentiary weight and interpretive purpose. Third, iterative recoding and thematic refinement procedures were applied in order to improve coding consistency and reduce interpretive instability. Finally, contradictory evidence and implementation limitations associated with additive manufacturing adoption were considered throughout the analysis in order to minimize confirmation bias. Coding was performed by a single researcher; consequently, no inter-coder reliability statistic is reported, and the coded categories reflect one researcher's interpretive judgment. Coding decisions and category definitions were logged and revisited throughout the analysis as new documents were reviewed; as the sole researcher, the author's background in strategic marketing and management is acknowledged as a source of interpretive influence on category definitions.

Counter-evidence was assessed and documented case by case, as follows. For Chanel, the industrially scaled mascara-brush production (50,000 units per day) initially appeared to contradict the selective-integration theme; it was coded as specific to the cosmetics sub-unit and was not generalized to the haute couture findings. For Bugatti, the cost, complexity, and scale constraints of titanium-based additive manufacturing were addressed in the Discussion as a widely reported implementation challenge, presented as a sector-level limitation rather than a brand-specific claim. For Porsche, the concept-study application limited to 40 seat prototypes was coded as a low-volume, trial-stage application and was not presented as evidence of series-production implementation.

Nevertheless, the study possesses certain limitations. The study does not attempt to establish direct causality between additive manufacturing adoption and competitive advantage outcomes; instead, the

analysis focuses on how firms strategically frame and integrate additive manufacturing capabilities within broader differentiation-oriented positioning narratives. Accordingly, the findings should be interpreted as mechanism-oriented strategic interpretations rather than causal performance claims.

Findings

The findings indicate that additive manufacturing technologies are strategically positioned not merely as operational manufacturing tools, but as organizationally embedded mechanisms supporting personalization, engineering prestige, aesthetic innovation, and agile value creation (sustainability-related narratives, discussed separately below, were not directly substantiated by the case evidence). Across the analyzed cases, additive manufacturing capabilities were repeatedly integrated into broader strategic positioning discourses associated with flexibility, customer responsiveness, technological prestige, and premium value creation. Rather than presenting additive manufacturing technologies solely through technical production efficiency narratives, the analyzed firms strategically framed these technologies within communicative structures emphasizing exclusivity, innovation, and differentiated customer experiences. However, the strategic mechanisms through which additive manufacturing was positioned varied significantly across the selected cases.

Personalization and strategic flexibility mechanisms: Porsche

The Porsche case demonstrates that additive manufacturing technologies were strategically integrated into personalization-oriented value creation narratives. Across the analyzed documents, the company repeatedly emphasized customer-specific production flexibility, individualized component development, and responsive manufacturing systems associated with premium customer experiences. One recurring strategic mechanism concerned experiential customization. Corporate materials repeatedly emphasized customer-specific bucket-seat production, including "seats adapted to the individual customer's specific body contour," and individualized interior production systems designed to support personalized driving experiences (Porsche AG, 2020). At the time of the source, this application remained at the concept-study stage, with an initial run limited to 40 seat prototypes rather than confirmed series production. Rather than functioning solely as technical production improvements, these applications were strategically framed as mechanisms reinforcing exclusivity and customer-centered differentiation.

The findings further indicate that personalization was consistently associated with organizational flexibility and rapid adaptation capabilities. Statements emphasizing rapid prototyping and customized low-volume manufacturing frequently appeared alongside broader narratives concerning innovation responsiveness and premium positioning. In this respect, additive manufacturing capabilities appeared to support what may be interpreted as differentiation-oriented strategic flexibility. Another observation concerns the communicative role of additive manufacturing within Porsche's strategic positioning discourse. Technological capability itself was repeatedly integrated into broader narratives of innovation leadership and premium exclusivity. Consequently, additive manufacturing technologies appeared to function simultaneously as operational systems and symbolic positioning mechanisms reinforcing customer-oriented value creation narratives.

Engineering prestige and technological exclusivity: Bugatti

Compared to Porsche's personalization-oriented positioning logic, the Bugatti case reflects a more engineering-centered strategic interpretation of additive manufacturing technologies. The analyzed materials repeatedly emphasized engineering precision, lightweight manufacturing systems, titanium-based additive production, and technological innovation signaling. One of the most visible strategic mechanisms identified in the Bugatti case concerned technological prestige construction. Corporate statements repeatedly highlighted the development of "the world's first brake caliper to be produced by 3-D printer," describing it as "the world's largest functional component produced from titanium" using additive manufacturing, and emphasized advanced engineering complexity associated with additive manufacturing systems (Bugatti Automobiles S.A.S., 2018). At the time of the source, the component was undergoing production testing, with series-vehicle integration announced as a future step rather than a completed outcome. These technological narratives appeared to function not merely as technical achievements but as symbolic indicators of exclusivity and innovation leadership.

The findings also demonstrate that additive manufacturing technologies were strategically associated with rarity-oriented positioning narratives. Unlike mass customization-focused manufacturing systems, Bugatti's discourse emphasized limited-production engineering sophistication and technological uniqueness. In this context, additive manufacturing capabilities appeared to reinforce perceptions of engineering exclusivity and premium technological distinction. However, the analyzed

materials also reflected certain operational limitations associated with additive manufacturing integration. Several documents emphasized the complexity, cost intensity, and scalability constraints of advanced titanium-based additive manufacturing systems. This observation suggests that additive manufacturing adoption may simultaneously generate both strategic opportunities and operational implementation challenges within technologically intensive premium industries. It should also be noted that the titanium brake caliper was developed jointly with Laser Zentrum Nord, an external research institute; the associated inimitability therefore reflects a collaborative engineering capability rather than a process developed solely within Bugatti (Bugatti Automobiles S.A.S., 2018).

Chanel: symbolic and industrial applications of additive manufacturing

The Chanel case demonstrates two distinct application patterns of additive manufacturing that should not be treated as analytically equivalent. The haute couture application reported by Hipolite (2015) represents a selective and primarily aesthetic use of additive manufacturing, supporting creative experimentation and symbolic differentiation. In contrast, the mascara brush application reported by Saunders (2018) demonstrates a functional and industrial application of the technology. The evidence indicates large-scale production capacity, the elimination of conventional mould requirements, and potential time and cost efficiencies. Accordingly, Chanel's use of additive manufacturing cannot be characterized solely as symbolic or selectively applied. Rather, the case combines symbolic and aesthetic applications with functional and operational uses, depending on the specific product and application context. This combination is consistent with the broader tension in luxury strategy between technological innovation and heritage-based identity (Beverland, 2009; Kapferer & Bastien, 2012).

One of the most documented applications concerns the development of the Le Volume Révolution mascara brush, produced in collaboration with Erpro 3D Factory. This represented the first mascara brush manufactured on an industrial scale through additive manufacturing, with production capacity reaching 50,000 units per day (Saunders, 2018). Chanel filed its initial patent for this application in 2007, and the resulting product was commercially launched in 2018 following more than a decade of collaborative development. The Director of Packaging Innovation at Chanel Parfums Beauté stated: "Together, we have taken up many technological challenges to push the boundaries of 3D printing and offer a revolutionary product" (Saunders, 2018). Critically, the brush's distinctive geometry — which enables homogeneous mascara distribution across lashes — would have been unachievable through conventional injection molding methods, illustrating how additive manufacturing expanded Chanel's design possibility space beyond traditional manufacturing constraints.

An earlier and symbolically significant application occurred at the Haute Couture Fall/Winter 2015–2016 collection at Paris Fashion Week, where Karl Lagerfeld unveiled a 3D printed version of the iconic Chanel suit produced using selective laser sintering technology. Lagerfeld described the project as follows: "The idea is to take the most iconic jacket of the 20th century and make a 21st century version, which technically was unimaginable in the period when it was born" (Hipolite, 2015). This statement exemplifies Chanel's strategic framing of additive manufacturing not as a production efficiency mechanism, but as an instrument for reinterpreting brand heritage through contemporary technological means. In this specific haute couture application, additive manufacturing functioned primarily as a symbolic and communicative resource rather than as an operational manufacturing system.

Across both applications, additive manufacturing serves different strategic purposes within Chanel. In haute couture, it supports symbolic reinterpretation of brand heritage and aesthetic differentiation, whereas in cosmetics it is associated with functional, industrial-scale production integration. This dual pattern suggests that Chanel does not manage additive manufacturing adoption uniformly; rather, the strategic role of the technology depends on the specific product category and application context. This is consistent with luxury branding arguments concerning heritage, authenticity, exclusivity, and experiential differentiation (Beverland, 2009; Gilmore & Pine, 2007; Kapferer & Bastien, 2012).

Sustainability and agile value creation mechanisms

Sustainability-related narratives were not observed with equal strength across the three cases. None of the four primary sources analyzed in this study (Porsche AG, 2020; Bugatti Automobiles S.A.S., 2018; Hipolite, 2015; Saunders, 2018) contains an explicit statement linking the featured additive manufacturing application to waste reduction, inventory flexibility, or decentralized production. Where a sustainability-oriented mechanism is discussed in this study, it draws on the broader additive manufacturing literature (Despeisse et al., 2017) rather than on brand-specific evidence, and this distinction is maintained throughout the analysis. On-demand or flexible production, where referenced in the case materials, is treated here strictly as an operational or strategic-flexibility mechanism; it is not, by itself, treated as evidence of an environmental or sustainability outcome. Accordingly, this study

does not claim that any of the three analyzed brands demonstrated a documented environmental benefit, and no life-cycle or comparative environmental data were available to support such a claim.

Table 3: Cross-Case Strategic Comparison

Brand	Dominant Strategic Mechanism	Strategic Emphasis	Positioning Orientation
Porsche	Personalization flexibility	Customer-specific production	Experiential exclusivity
Bugatti	Engineering prestige	Technological rarity	Innovation exclusivity
Chanel – Haute Couture	Symbolic and aesthetic differentiation	Collection-specific application	Symbolic luxury differentiation
Chanel - Cosmetics (mascara brush)	Functional and industrial-scale production	Large-scale production and operational efficiency	Functional and operational differentiation

Table 3 shows that additive manufacturing was integrated through distinct strategic mechanisms across the cases. Porsche emphasized personalization flexibility, Bugatti emphasized engineering prestige, while the Chanel case revealed two analytically distinct application patterns: symbolic and aesthetic differentiation in haute couture and functional, industrial-scale production integration in cosmetics. This comparison indicates that additive manufacturing was integrated into differentiation strategies in sector-specific and application-specific rather than uniform ways.

Reading this divergence alongside the case narratives above, four recurring patterns can be identified across the three cases. First, all firms employed additive manufacturing as a differentiation-supporting capability rather than merely a production technology, even though the specific mechanism differed by brand. Second, personalization, engineering prestige, aesthetic innovation, and agile value creation recurred as underlying strategic drivers behind these otherwise distinct mechanisms. Third, each organization integrated its chosen mechanism into a broader brand positioning narrative rather than presenting it as a standalone technical feature. Finally, the comparison suggests that the strategic value of additive manufacturing depends primarily on organizational integration rather than on technological sophistication alone.

Cross-case comparative interpretation

Building on the patterns identified above, the strategic significance of additive manufacturing appears to depend less on which specific mechanism a firm emphasizes and more on how effectively that mechanism is integrated into broader organizational narratives, customer experience systems, and premium positioning structures.

VRIO-Oriented Interpretive Evaluation

The VRIO-oriented interpretation suggests that additive manufacturing technologies demonstrate varying levels of differentiation-oriented strategic potential across the selected cases. However, the analysis does not evaluate VRIO dimensions through quantitative scoring logic. Instead, the interpretation is based on the consistency, recurrence, and strategic integration intensity observed across the analyzed documents. The four VRIO dimensions were assessed according to explicit interpretive criteria applied consistently across all cases. Value was rated high when the analyzed documents explicitly attributed strategic or operational value to the technology. Rarity was rated high when the documents stated or clearly implied that the capability, or its outcome, was held by few actors in the sector at the time of the claim. Where such rarity was asserted by the firm itself (e.g., "world's first") rather than independently confirmed by a third party, this is treated as a self-reported claim rather than independently verified evidence. Inimitability was rated high when the documents pointed to a specific barrier to imitation, such as a proprietary process, a patented development, or accumulated engineering know-how. Where external partners were involved, this was considered explicitly. Organizational Integration was rated high when the technology was embedded across multiple products, business units, or an extended period rather than a single isolated application. These interpretive levels were used as ordinal analytical categories rather than numerical scores, assigned comparatively across cases based on the evidence available.

Capabilities were interpreted as “high” when repeatedly embedded within multiple distinct strategic narratives and organizational positioning structures. Medium-level interpretations reflected partial or selectively integrated strategic usage patterns. Within this framework, Porsche demonstrated relatively strong strategic integration regarding personalization-oriented manufacturing flexibility and customer-centered differentiation narratives. Bugatti exhibited particularly strong technological prestige and innovation-signaling integration associated with engineering exclusivity. Chanel demonstrated a dual

pattern of strategic integration: selective and symbolic in its haute couture application, but operationally intensive and industrially scaled in its cosmetics application. Consequently, Chanel's overall VRIO profile should be interpreted in light of these two distinct application contexts rather than as a single uniform usage pattern. Table 4 reports this VRIO-oriented interpretation for each case.

Table 4: VRIO-Oriented Interpretive Evaluation

Brand	Value	Rarity	Inimitability	Organizational Integration
Porsche	High	Medium	High	High
Bugatti	High	High	Medium-High	Medium-High
Chanel – Cosmetics (mascara brush)	High	Medium	Medium-High	Medium-High
Chanel – Haute Couture	Medium-High	Medium	Medium	Low-Medium

As indicated in Table 4, the Value dimension was rated high across most cases and application contexts (medium-high for Chanel's haute couture sub-unit), whereas Rarity, Inimitability, and Organizational Integration varied according to organizational context, partner involvement, and strategic positioning priorities. The two Chanel rows illustrate this variation directly: the cosmetics application shows a higher degree of organizational integration, consistent with its ongoing, industrially embedded production status, whereas the haute couture application shows a comparatively lower degree of organizational integration, consistent with its collection-specific, non-recurring nature. Organizational integration appeared, within this interpretive analysis, to be an important factor associated with whether additive manufacturing capabilities could potentially contribute to sustainable differentiation, although this interpretation reflects coded corporate and industry discourse rather than an independently verified causal mechanism. Porsche's relatively lower Rarity reflects the absence of an explicit uniqueness claim in the source material; Bugatti's lower Inimitability reflects its joint development with Laser Zentrum Nord, while its lower Organizational Integration reflects that the caliper remains a single, still-experimental application rather than one embedded across multiple products. This finding reinforces the argument that technological resources alone are insufficient unless effectively embedded within broader organizational capabilities.

Discussion

The findings of this study suggest that additive manufacturing technologies should not be interpreted solely through operational efficiency or engineering-oriented manufacturing perspectives. Although existing literature predominantly emphasizes prototyping speed, technical optimization, production flexibility, and manufacturing integration (Chua et al., 2010; Gao et al., 2015), the present findings indicate that additive manufacturing technologies may also function as strategically embedded organizational capabilities associated with personalization, engineering prestige, aesthetic innovation, and agile value creation. Earlier studies examining additive manufacturing primarily through business model innovation and operational transformation perspectives similarly emphasize the growing strategic relevance of digitally integrated production systems (Rayna & Striukova, 2014). In this respect, the study extends the additive manufacturing literature beyond primarily engineering-centered interpretations toward a broader strategic marketing and organizational capability perspective.

One of the most significant findings concerns the multidimensional strategic role of additive manufacturing within premium industries. Across all analyzed cases, additive manufacturing technologies were integrated into broader positioning narratives emphasizing customer experience, innovation prestige, symbolic differentiation, and strategic flexibility. This finding supports recent arguments suggesting that digitally integrated production technologies increasingly influence not only operational manufacturing structures but also organizational identity construction, communicative positioning processes, and value creation narratives within digitally transforming markets (Verhoef et al., 2021). Furthermore, Industry 4.0 literature increasingly highlights the integration of digital manufacturing systems into broader strategic transformation processes involving organizational responsiveness and digitally enabled market adaptation (Schwab, 2017; Xu et al., 2018).

The Porsche case particularly demonstrates how additive manufacturing technologies may support experiential differentiation and customer-oriented strategic flexibility. Existing marketing literature emphasizes that personalization and customer participation increasingly function as central dimensions of strategic value creation in premium markets (Kotler & Keller, 2016; Rayna & Striukova, 2014). Similarly, co-creation theory suggests that firms increasingly strengthen differentiation-oriented

positioning by integrating customers more actively into production and experience formation processes (Prahalad & Ramaswamy, 2004). The findings of this study support these arguments by demonstrating that customization-oriented additive manufacturing applications were repeatedly framed through narratives of exclusivity, customer-specific production, and individualized experience creation. In this respect, additive manufacturing technologies appeared to support broader experiential differentiation mechanisms rather than merely improving production efficiency.

Similarly, the findings associated with Bugatti indicate that additive manufacturing technologies may contribute to engineering prestige construction and technological exclusivity narratives. Existing strategic branding literature suggests that technological sophistication and innovation signaling may strengthen premium positioning structures by reinforcing symbolic perceptions of rarity and expertise (Kapferer & Bastien, 2012; Ko et al., 2019), while also contributing to brand equity through innovation-oriented symbolic value (Keller, 2013). The Bugatti case reflects this mechanism particularly clearly, as additive manufacturing technologies were repeatedly associated with engineering precision, lightweight innovation, and technological distinction. However, the findings also demonstrate that technologically intensive additive manufacturing systems may simultaneously generate implementation complexity, cost intensity, and scalability limitations. This observation indicates that additive manufacturing adoption may involve both strategic opportunities and operational constraints within premium industries.

The Chanel case further demonstrates that additive manufacturing technologies may serve different strategic functions depending on the specific product category and application context. Within the same brand, the haute couture application was associated primarily with aesthetic innovation and symbolic differentiation, whereas the cosmetics application involved functional and industrial-scale production integration. Existing luxury branding literature emphasizes that contemporary luxury firms increasingly attempt to balance innovation with heritage, authenticity, and symbolic refinement (Beverland, 2009; Gilmore & Pine, 2007). The findings suggest that additive manufacturing technologies may support innovation while being integrated into broader symbolic luxury identities **in some application contexts, while serving more directly functional and operational purposes in others**. This observation additionally aligns with previous literature emphasizing authenticity and symbolic consistency as central dimensions of luxury-oriented differentiation strategies (Beverland, 2009).

From a Resource-Based View perspective, the findings suggest that additive manufacturing technologies may acquire strategic significance when organizationally embedded within broader differentiation-oriented systems. Existing RBV literature argues that technological resources alone rarely generate strategic value unless effectively integrated into organizational capabilities and positioning structures (Barney, 1991). The present findings are consistent with this interpretation because additive manufacturing capabilities appeared strategically meaningful primarily when associated with personalization, engineering prestige, aesthetic innovation, and agile value creation. Moreover, the dynamic resource-based perspective suggests that organizational capabilities evolve through adaptation and capability lifecycle processes shaped by environmental change and strategic integration intensity (Helfat & Peteraf, 2003).

The findings also support the dynamic capabilities perspective emphasizing organizational adaptability and strategic responsiveness in rapidly changing environments (Teece et al., 1997). Across the analyzed cases, additive manufacturing technologies were repeatedly associated with flexibility, rapid adaptation, and innovation responsiveness. Particularly within premium industries characterized by rapid symbolic competition and evolving consumer expectations, digitally integrated manufacturing systems appeared to support broader strategic flexibility mechanisms rather than merely technical production processes. Previous research further suggests that organizational responsiveness and capability reconfiguration play increasingly prominent roles within digitally transforming industries (Helfat & Peteraf, 2003; Teece et al., 1997).

Another contribution concerns the symbolic and communicative dimensions of additive manufacturing technologies. Existing Industry 4.0 discussions frequently prioritize automation, operational integration, and digital manufacturing optimization (Schwab, 2017; Xu et al., 2018). However, the present findings suggest that additive manufacturing technologies may simultaneously function as communicative positioning mechanisms reinforcing innovation-oriented brand identity structures. Across the analyzed cases, technological capability itself frequently became integrated into broader narratives of exclusivity, creativity, innovation, and premium differentiation. Consequently, digital manufacturing technologies should be interpreted not solely as operational infrastructures but also as symbolic organizational resources embedded within strategic positioning processes. Existing literature concerning authenticity and symbolic value creation similarly suggests that consumers increasingly

evaluate brands through experiential and symbolic narratives extending beyond purely functional product characteristics (Gilmore & Pine, 2007; Ko et al., 2019).

The findings additionally contribute to discussions surrounding sustainability-oriented strategic positioning. Contemporary firms increasingly integrate sustainability narratives into broader innovation and branding structures (Elkington, 1997). Existing literature has discussed additive manufacturing as having the potential to support more distributed and resource-efficient production configurations, while also highlighting its possible contribution to circular economy objectives (Despeisse et al., 2017).

The findings of this study do not substantiate these environmental claims empirically; however, they do indicate that firms actively construct sustainability-oriented communication narratives around flexible and digitally coordinated manufacturing systems. Nevertheless, the analysis also demonstrated that sustainability-related claims were often framed aspirationally rather than through directly measurable environmental outcomes. This observation suggests that sustainability narratives surrounding additive manufacturing may partly function as symbolic positioning mechanisms within premium branding environments.

The study does not claim that additive manufacturing technologies automatically generate measurable competitive advantage or sustainable market superiority. Instead, the findings suggest that additive manufacturing technologies possess differentiation-oriented strategic potential when integrated into broader organizational capabilities, communicative positioning structures, and premium branding narratives. This distinction reflects the fact that the study focuses on organizational interpretation and strategic framing processes rather than causal performance measurement.

The VRIO-oriented interpretation further supports these conclusions. The findings suggest that additive manufacturing technologies may demonstrate strategic relevance through value creation, innovation signaling, personalization flexibility, and symbolic differentiation mechanisms. However, the rarity and inimitability dimensions appeared highly dependent on organizational integration intensity and sector-specific positioning structures. Consequently, the strategic significance of additive manufacturing technologies does not emerge solely from technological infrastructure itself but from how firms strategically embed these capabilities within broader organizational narratives and differentiation systems (Barney & Hesterly, 2015).

Limitations

Several limitations should nevertheless be acknowledged. Since the study relies entirely on secondary qualitative data, the findings primarily reflect organizational narratives and publicly communicated positioning discourses rather than direct consumer perceptions or measurable market outcomes. Furthermore, the selected cases are limited to premium industries characterized by strong symbolic competition and innovation-oriented branding structures. Therefore, the findings should not be generalized directly to mass-market manufacturing environments or purely operational production contexts. From a methodological perspective, qualitative interpretive studies inherently emphasize contextual depth rather than statistical generalizability (Creswell & Poth, 2018; Merriam & Tisdell, 2016). Similarly, document-based qualitative analyses reflect interpretive thematic structures emerging from available organizational narratives rather than experimentally verifiable causal relationships (Bowen, 2009; Yin, 2018).

Implications and future research

The present study contributes to the growing literature examining the strategic implications of digitally integrated manufacturing technologies. By integrating strategic management perspectives with additive manufacturing literature, the research provides a mechanism-oriented interpretive framework explaining how additive manufacturing technologies may support personalization, symbolic exclusivity, innovation signaling, sustainability-oriented positioning, and differentiation-oriented strategic narratives within contemporary premium industries. The interpretive multiple-case structure adopted in this study further aligns with broader qualitative strategy research traditions emphasizing analytical comparison, theoretical pattern recognition, and mechanism-oriented interpretation across organizational contexts (Braun & Clarke, 2006; Eisenhardt, 1989; Patton, 2015).

Future research may expand the present study through quantitative approaches examining consumer perceptions of additive manufacturing-supported personalization and innovation narratives. Comparative studies involving mass-market industries, emerging digital brands, or cross-cultural market environments may also provide additional insights regarding the strategic implications of additive manufacturing technologies across different organizational and sectoral contexts.

Furthermore, future research integrating consumer behavior analysis with organizational capability perspectives may contribute to a more comprehensive understanding of how digitally integrated manufacturing technologies influence contemporary strategic positioning processes.

Conclusion

This study investigated how additive manufacturing technologies are strategically embedded within competitive differentiation and premium brand positioning processes, analyzing corporate discourses from Porsche, Bugatti, and Chanel through a VRIO-oriented thematic framework. The central finding is that additive manufacturing technologies acquire strategic significance not through their technical capabilities alone, but through the organizational and communicative systems within which they are integrated. Across all three cases, additive manufacturing was consistently framed as a mechanism for constructing and reinforcing differentiation-oriented positioning narratives rather than solely optimizing operational manufacturing performance. The three cases collectively illustrate that the strategic integration of additive manufacturing is highly context-dependent. Personalization, engineering prestige, aesthetic innovation, and agile value creation emerged as distinct strategic pathways, each shaped by the specific positioning logic and brand identity structure of the firm in question. These findings challenge simplified interpretations that treat additive manufacturing as a uniformly applicable competitive tool, emphasizing instead the importance of organizational alignment between technological capability and broader strategic positioning intent. With respect to the three research questions, the findings demonstrate that premium firms integrate additive manufacturing into differentiation-oriented positioning through distinct organizational narratives; that personalization, engineering prestige, aesthetic innovation, and agile value creation emerged as the principal supporting mechanisms, while sustainability-related narratives remained aspirational rather than empirically substantiated; and that the VRIO framework proved useful in interpreting this strategic potential.

From a theoretical perspective, the study contributes to additive manufacturing literature by reframing 3D printing technologies as organizational capabilities embedded within strategic management and premium branding systems rather than purely technical production assets. The integration of Resource-Based View logic, dynamic capabilities theory, and VRIO-oriented interpretation offers a mechanism-oriented framework for understanding how digitally integrated production technologies may support personalization, engineering prestige, aesthetic innovation, and agile value creation within premium industries. In addition, the study contributes to Industry 4.0 discussions by emphasizing the communicative and symbolic dimensions of these technologies, dimensions that operational efficiency-oriented perspectives have largely overlooked. Accordingly, the study suggests that additive manufacturing should not be interpreted merely as a production technology but as an organizational capability whose strategic value is highly context-dependent, shaped by the coherence between technological adoption, organizational integration, and sector-specific positioning priorities rather than technological capability alone.

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The data analyzed in this study consist of publicly available corporate and independent industry documents cited in the manuscript. No proprietary, confidential, or personally identifiable data were used.

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Generative artificial intelligence (ChatGPT) was used solely for language editing and grammatical proofreading during the preparation of the manuscript. The author reviewed and verified the final text and remains fully responsible for the content of the manuscript.

References

Barney, J. (1991). Firm resources and sustained competitive advantage. *Journal of Management*, *17*(1), 99–120. https://doi.org/10.1177/014920639101700108

Barney, J. B., & Hesterly, W. S. (2015). *Strategic management and competitive advantage: Concepts and cases*. Pearson Education.

Berman, B. (2012). 3-D printing: The new industrial revolution. *Business Horizons*, *55*(2), 155–162. https://doi.org/10.1016/j.bushor.2011.11.003

Beverland, M. B. (2009). *Building brand authenticity: 7 habits of iconic brands*. Palgrave Macmillan.

Bowen, G. A. (2009). Document analysis as a qualitative research method. *Qualitative Research Journal*, *9*(2), 27–40. https://doi.org/10.3316/QRJ0902027

Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology*, *3*(2), 77–101. https://doi.org/10.1191/1478088706qp063oa

Bugatti Automobiles S.A.S. (2018). *World premiere: Brake caliper from 3-D printer*. Bugatti Newsroom. https://newsroom.bugatti.com/en/press-releases/world-premiere-brake-caliper-from-3-d-printer

Chua, C. K., Leong, K. F., & Lim, C. S. (2010). *Rapid prototyping: Principles and applications* (3rd ed.). World Scientific Publishing.

Creswell, J. W., & Poth, C. N. (2018). *Qualitative inquiry and research design: Choosing among five approaches* (4th ed.). Sage Publications

Despeisse, M., Baumers, M., Brown, P., Charnley, F., Ford, S. J., Garmulewicz, A., Knowles, S., Minshall, T. H. W., Mortara, L., Reed-Tsochas, F. P., & Rowley, J. (2017). Unlocking value for a circular economy through 3D printing: A research agenda. *Technological Forecasting and Social Change*, *115*, 75–84. https://doi.org/10.1016/j.techfore.2016.09.021

Devito, F., Copani, G., Natalicchio, A., Alami, A. H., Lavecchia, F., Olabi, A.-G., & Dassisti, M. (2024). Business models and advanced additive manufacturing strategies for better sustainability. *Energy Nexus*, 16, Article 100337. https://doi.org/10.1016/j.nexus.2024.100337

Eisenhardt, K. M. (1989). Building theories from case study research. *Academy of Management Review*, *14*(4), 532–550. https://doi.org/10.2307/258557

Elkington, J. (1997). *Cannibals with forks: The triple bottom line of 21st century business*. Capstone Publishing.

Gao, W., Zhang, Y., Ramanujan, D., Ramani, K., Chen, Y., Williams, C. B., Wang, C. C. L., Shin, Y. C., Zhang, S., & Zavattieri, P. D. (2015). The status, challenges, and future of additive manufacturing in engineering. *Computer-Aided Design*, *69*, 65–89. https://doi.org/10.1016/j.cad.2015.04.001

Gibson, I., Rosen, D. W., & Stucker, B. (2015). *Additive manufacturing technologies: 3D printing, rapid prototyping, and direct digital manufacturing* (2nd ed.). Springer.

Gilmore, J. H., & Pine, B. J., II. (2007). *Authenticity: What consumers really want*. Harvard Business School Press.

Helfat, C. E., & Peteraf, M. A. (2003). The dynamic resource-based view: Capability lifecycles. *Strategic Management Journal*, *24*(10), 997–1010. https://doi.org/10.1002/smj.332

Hipolite, W. (2015). *Chanel's Karl Lagerfeld stuns the celebrities with 3D printed fashion design*. 3DPrint.com. https://3dprint.com/79654/chanel-lagerfeld-3d-printed/

Kapferer, J.-N., & Bastien, V. (2012). *The luxury strategy: Break the rules of marketing to build luxury brands* (2nd ed.). Kogan Page.

Keller, K. L. (2013). *Strategic brand management: Building, measuring, and managing brand equity* (4th ed.). Pearson Education.

Ko, E., Costello, J. P., & Taylor, C. R. (2019). What is a luxury brand? A new definition and review of the literature. *Journal of Business Research*, *99*, 405–413. https://doi.org/10.1016/j.jbusres.2017.08.023

Kotler, P., & Keller, K. L. (2016). *Marketing management* (15th global ed.). Pearson Education.

Merriam, S. B., & Tisdell, E. J. (2016). *Qualitative research: A guide to design and implementation* (4th ed.). Jossey-Bass.

Patton, M. Q. (2015). *Qualitative research & evaluation methods: Integrating theory and practice* (4th ed.). Sage Publications.

Piller, F. T., & Tseng, M. M. (Eds.). (2010). *Handbook of research in mass customization and personalization*. World Scientific Publishing.

Pine, B. J., II, & Gilmore, J. H. (1999). *The experience economy: Work is theatre and every business a stage*. Harvard Business School Press.

Porsche AG. (2020, March 17). *Porsche presents innovative 3D-printing technology for bucket seats*. Porsche Newsroom. https://newsroom.porsche.com/en/2020/products/porsche-3d-printed-bodyform-full-bucket-seat-concept-study-19996.html

Porter, M. E. (1980). *Competitive strategy: Techniques for analyzing industries and competitors*. Free Press.

Prahalad, C. K., & 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

Rayna, T., & Striukova, L. (2014). The impact of 3D printing technologies on business model innovation. In P.-J. Benghozi, D. Krob, A. Lonjon, & H. Panetto (Eds.), Digital Enterprise Design & Management (Advances in Intelligent Systems and Computing, Vol. 261, pp. 119–132). Springer. https://doi.org/10.1007/978-3-319-04313-5_11

Saunders, S. (2018, March 20). *Chanel turns to industrial 3D printing to develop the first 3D printed mascara brush*. 3DPrint.com. https://3dprint.com/207267/chanel-3d-printed-mascara-brush/

Schwab, K. (2017). *The fourth industrial revolution*. Crown Business.

Teece, D. J., Pisano, G., & Shuen, A. (1997). Dynamic capabilities and strategic management. *Strategic Management Journal*, *18*(7), 509–533. https://doi.org/10.1002/(SICI)1097-0266(199708)18:7<509::AID-SMJ882>3.0.CO;2-Z

Verhoef, P. C., Broekhuizen, T., Bart, Y., Bhattacharya, A., Dong, J. Q., Fabian, N., & Haenlein, M. (2021). Digital transformation: A multidisciplinary reflection and research agenda. *Journal of Business Research*, *122*, 889–901. https://doi.org/10.1016/j.jbusres.2019.09.022

Xu, L. D., Xu, E. L., & Li, L. (2018). Industry 4.0: State of the art and future trends. *International Journal of Production Research*, *56*(8), 2941–2962. https://doi.org/10.1080/00207543.2018.1444806

Yin, R. K. (2018). *Case study research and applications: Design and methods* (6th ed.). Sage Publications.