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Article

A study on the competitive sustainability of innovative design thinking and ceramic art brands

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Abstract: This study examines how the convergence of design thinking, innovation, and sustainability enhances competitive sustainability in the global ceramic industry. Grounded in the Resource-Based View, Dynamic Capabilities, and Triple Bottom Line frameworks, the study conceptualizes design thinking as a strategic capability that transforms innovation and sustainability resources into sustained competitive advantage. Using quantitative data from 90 ceramic brands across seven countries, the analysis employs descriptive statistics, regression, fixed-effects, and mediation tests. Based on the quantitative panel data on 90 ceramic art brands and 7 countries over the time span 2019–2021, the quantitative analysis will use the descriptive statistics, ordinary least squares, fixed-effects, mediation, and structural equation modeling. Results show that design thinking has a strong and stable positive effect on competitive sustainability ($b = 1.29$, $p < 0.05$), alongside market share and brand awareness, explaining about 51% of the variance. However, design thinking does not mediate the relationship between innovation and competitive sustainability, indicating that design thinking and innovation function as parallel strategic capabilities. The findings integrate RBV and Dynamic Capabilities with TBL logic, demonstrating how creativity-based intangible capabilities support both economic and sustainability goals in traditional manufacturing sectors.

Keywords: design thinking; competitive sustainability; resource-based view; dynamic capabilities; triple bottom line; innovation; ceramic industry; sustainable competitive advantage

1. Introduction

1.1. Conceptual background of competitive sustainability

Competitive sustainability is no longer a dreamy rhetoric exercise by managers as it has now become a complex strategic imperative which is encompassed within the corporate ecosystems that must now balance the twin imperative of profitability and environmental accountability. Ceramic art brands occupy a fairly special position in this dichotomy, as they are not only bound to the ideals of heritage-driven craft, but have to serve the needs of design markets of the contemporary era [1]. The process of mobilizing design thinking as a strategic thinking process is what makes such brands be able to transform creative intuition into systematic innovation cycles to result in the creation of a long-term competitive advantage without breaking socially responsible and environmentally sustainable practices [2,3].

Although the resources of knowledge, creativity, and innovations play an imperative role in competitive positioning, they do not suffice on their own to guarantee long-term competitiveness under Triple Bottom Line (TBL) conditions.

These resources need to be reconfigured and converted into responsive organizational practices on a continuous basis. In this respect, design thinking functions as a dynamic capability that facilitates continuous transformation of knowledge and creative resources into sustainable competitive advantages that can achieve economic, environmental, and social requirements at the same time.

Here, the Resource-Based View of the Firm (RBV) [4] offers the analytical syntax in terms of which internal intangible resources, including creativity, brand narrative, and artisanal knowledge can be re-conceptualized in terms of the single-sustained differentiation as provided by the distinctive competencies. These resource endowments gain a larger evaluative aspect that includes the environmental integrity, social equity, and economic viability when they are connected with the Triple Bottom Line (TBL) sustainability paradigm. The interchange of these theoretical constructs is the foundation of the conceptual scaffolding of this study. **Figure 1** illustrates the Resource-Based View framework underpinning the theoretical foundation of this study.

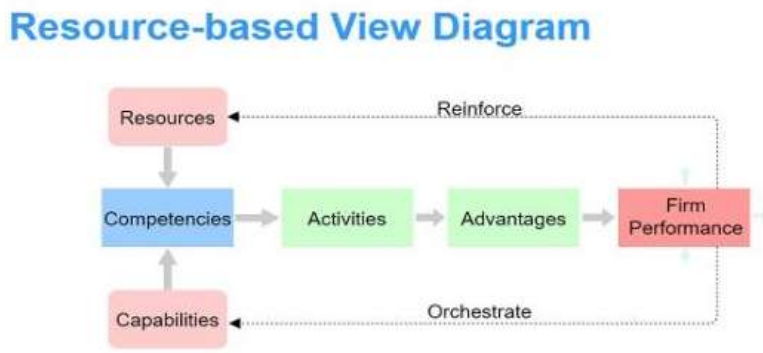

Figure 1. Resource-based view of the firm.

1.2. Design thinking as a strategic integrator

Design thinking has transformed itself into a metamorphosis of a user-based creative approach to a full-scale epistemological perspective of organizational renewal. It is commonly proclaimed a reconciliatory mechanism, as the needs of innovation velocity and sustainability require appear not only to be opposed but also to be mutually exclusive [5,6]. Design thinking is a thinking practice within the domain of ceramic art enterprises that serves as a cognitive practice and also a cultural code, rewriting the materiality narratives, re-organizing production practices and engaging stakeholders in the artistic, technological and environmental dimensions.

According to empirical studies carried out over the past few years, those firms that institutionalize design-led innovation have a higher adaptive capacity and stakeholder legitimacy, which are intangible assets that are important in the long run [7,8]. This means that the current study places design thinking not only as a methodological approach but as a dynamic capability which intermediates the influence between orchestration of creative resources and sustainability of competitive results.

1.3. The ceramic art brand environment

During the last ten years, the ceramic art industry is no longer a niche craft sector and is now a globally networked art industry that is integrated into design economies, tourist networks, and lifestyle brands [9]. This shift has brought about greater arguments on cultural sustainability, digital fabrication and material circularity. The strategic dilemma faced by brands of ceramic art is how to maintain cultural specificity and at the same time achieve a certain level of competitiveness by innovation in a scalable manner. The data used in this paper, which underpins the analysis, is a rich source of empirical data, the temporal panel data of the ninety ceramic art brands over three fiscal years.

Based on the analytical synergy of the Resource-Based View (RBV), the Triple Bottom Line (TBL), and design-thinking models, the research intends to discover how these brands structure creative resources in an attempt to internalize sustainability as a strategic capacity and not as a compliance mandate.

The research is also the immediate answer to recent demands in the sustainable competitiveness literature to provide the empirical and longitudinal evidence that can relate the design-led capabilities to quantifiable sustainability performance. The current study bridges a gap in the methodological and theoretical base, as it combines RBV, Dynamic Capabilities, and TBL in one design-thinking perspective, which fits the strategic intelligence theme that JSCI focuses on.

1.4. Research gap

Although the discussion of sustainable innovation has expanded, available literature is still divide in both methodological and theoretical aspects. The RBV literature presupposes firm-internalization of assets and neglects systemic ecological externality; TBL-oriented studies, in their turn, state sustainability demands without considering how micro-level resource orchestration. Besides, despite the broad theoretical acknowledgment of design thinking as an innovation concept, there is empirical evidence that its mediating effect of the relationship between the use of creative resources and sustainability performance in art-based brands has not been fully explored [10–12].

Based on this, the study fills a threefold gap: (1) lack of cross-theoretical synthesis between RBV, TBL, and design thinking; (2) lack of quantitative and longitudinal research in creative manufacturing industries; and (3) lack of comprehension of how the aesthetic-minded companies implement sustainable differentiation via design-led cognition.

1.5. Research objectives

1) To conceptualize design thinking as a dynamic capability that can facilitate sustainable competitive advantage in the ceramic art brands.
2) To develop an integrative model that portrays the interconnection between creative and material sustainability to create a sustainable brand competitiveness.
3) To add the theoretical synthesis to the Resource-Based View (RBV), the Triple Bottom Line (TBL) and design thinking frameworks to provide the applicability to the wider creative industries.

1.6. Research questions

1) What is the relationship between the internal creative resources and the competitive sustainability outcomes of ceramic art brands mediated by design thinking?
2) How can creative design solutions be converted into quantifiable environmental, social and economic performance measurements?
3) What is the operationalization of the interaction between the RBV and the TBL theories in art based organizations to increase strategic resiliency?

1.7. Significance of the study

In academia, the research develops the literature of sustainability to advance the limits of the field by setting design thinking as a theoretically connecting approach instead of a tool. In practice, it empowers the entrepreneurs of ceramic art and design managers with evidence-based information to balance creativity with ecological and social responsibility. The research will contribute to the development of the discussion of cultural and creative industries as drivers of sustainable development in line with the Sustainable development Goals (SDGs) of the United Nations. This study highlights the ability of creative industries to act as models, rather than imitators, of postindustrial innovation patterns based on responsibility, resilience and regenerative development by explaining how conceptual design intelligence can be developed into sustainable competitiveness.

2. Materials and methods

The research design used in this study is the integrative explanatory research design which is a theory that integrates the tenets of three theoretical pillars, which include Design Thinking Theory, Resource-Based View of the Firm, and Triple Bottom Line Sustainability. These will elaborate how a new design approach will serve as a channel to the competitive sustainability of the ceramic art brand.

Although the RBV-TBL-DT integration is conceptually lush, the extant research does not quantitatively model the causal pathways. This is the weakness that constrains the generalizability of the previous work and highlights the necessity of evidence-based models that can explain sustainable competitiveness of material-intensive creative industries. **Figure 2** presents the Triple Bottom Line framework used to operationalize sustainability dimensions.

Design Thinking Theory provides the cognitive and procedural lens through which creative ideation, prototyping, and empathic user insight are translated into organizational innovation capabilities. RBV offers the ontological premise that distinctive internal resources-material, human, and symbolic-are the primary engines of sustainable competitive advantage. TBL contributes the evaluative dimension, establishing ecological, social, and economic performance criteria through which sustainability outcomes are assessed. The cognitive and procedural foundations of design thinking that inform the analytical framework of this study are illustrated in **Figure 3**.

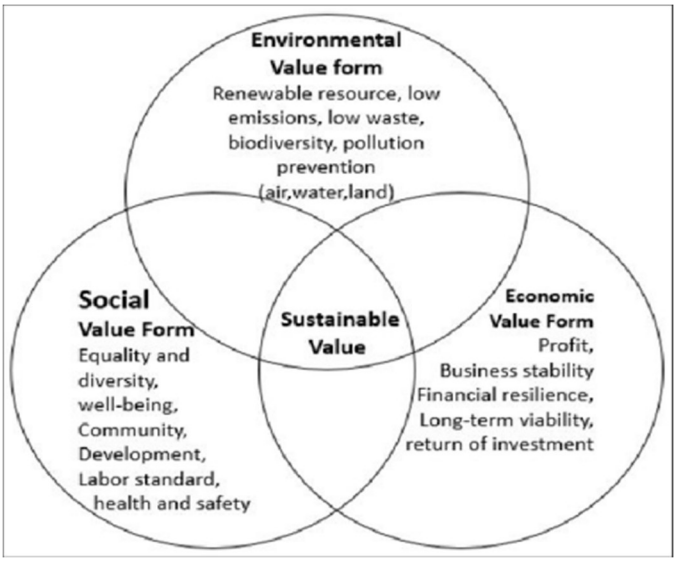

Figure 2. Triple bottom line sustainability.

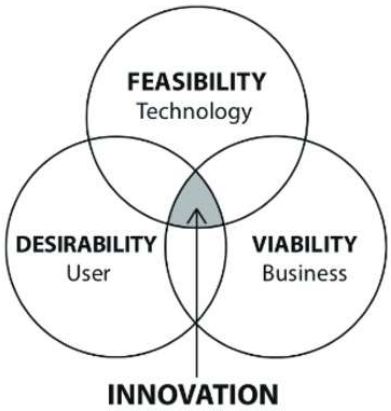

Figure 3. Design thinking theory.

The triad is dialectic in methodological synthesis as design thinking is the transformational process; the input conditions are represented by resource-based assets; and the evaluative output is represented by triple-bottom-line sustainability. This makes theoretical integration operationalized in the research design in an empirical architecture. The key components of the Resource-Based View and their relevance to intangible capabilities in creative industries are depicted in **Figure 4**.

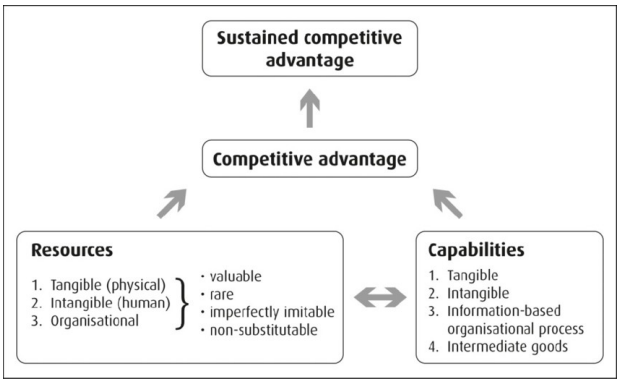

Figure 4. Resource-based view.

Conceptual framework is shown in **Figure 5** below which interprets that the intangible assets of the RBV lens are converted into sustainability results (economic, social, and environmental) through the use of design-thinking capabilities, which subsequently lead to competitive sustainability. The model as well enables the possibility of feedback effects and direct effect of resources on competitive sustainability. The integrated conceptual framework linking Resource-Based View, Design Thinking, and Triple Bottom Line sustainability is presented in **Figure 5**.

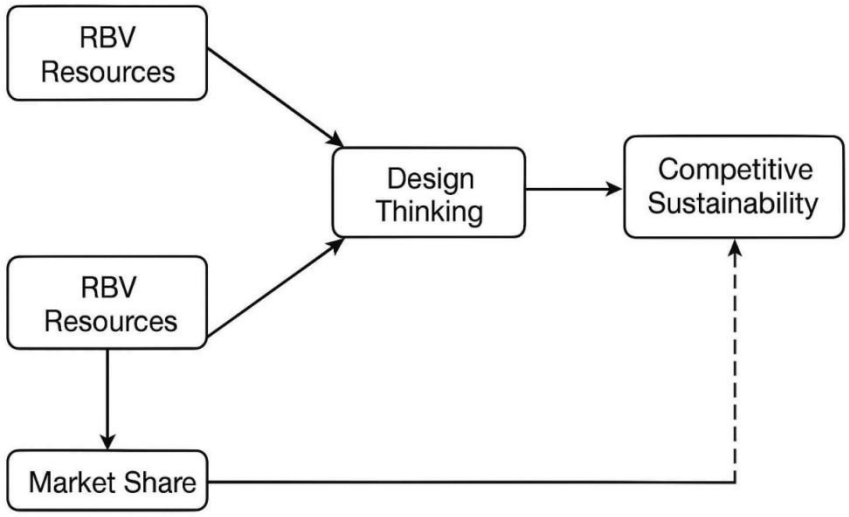

Figure 5. Integrated RBV–TBL–design thinking model for competitive sustainability.

2.1. Variable operationalization

The constructs used in this study resulted in empirical model, which is based on the tripartite theoretical background of the study. The operational definitions, indicator variables, and theoretical anchors for all study constructs are presented in **Table 1**.

Table 1. Variable operationalization.

Construct	Indicator variables	Theoretical anchor
Design thinking intensity (DTI)	Frequency of design iterations; number of humans-centered innovation initiatives; training in empathic design methods	Design Thinking Theory (Brown, 2008)
Resource-based capabilities (RBC)	R&D expenditure ratio; artisan skill index; brand heritage score; collaboration network density	Resource-Based View (Barney, 1991)
Sustainability performance (SP)	Environmental efficiency (energy use, material recycling); social responsibility index; net financial stability across years	Triple Bottom Line
Competitive sustainability (CS)	Composite index integrating market share growth, innovation effectiveness, and brand reputation for sustainability	Synthesized construct (DTI × RBC → SP = CS)

2.2. Index construction and operationalization

The operationalization of all key constructs was in the form of composite indices based on the publicly available financial, sustainability and design documentation. Design thinking Intensity (DTI) is determined by a weighted index involving (i) frequency of reported design iterations, (ii) disclosed number of human-centered design initiatives and (iii) official investment on design training programs.

Normalized scales of resource spending intensity on research and development, artisan skill level, brand heritage, and network density of collaboration were used to operationalize Resource- Based Capabilities (RBC). Sustainability Performance (SP) incorporated environmental efficiency measures (reduction of energy consumption and recycling of material), social responsibility measures, and inter-year financial stability. To achieve cross-country comparability of all indices and minimize scale bias, *z*-scores were used to standardize all indices.

Continuous variables were standardized for cross-country comparability, and categorical variables (region, firm size) served as control factors. Earlier work in strategic management viewed environmental responsibility as a constraint [13]; more recent literature frames it as a generative engine of innovation and differentiation [14,15]. In the field of creative industries-design, architecture, crafts and culture, the introduction of sustainability logic has given rise to new hybrid identities, what scholars' term eco-aesthetic entrepreneurship [16].

The empirical mapping of [17] demonstrates that aesthetic industries direct the consumer aspiration into the ethical expression and transform sustainability into symbolical capital. Several studies in Scandinavia, East Asia and Southern Europe creative clusters also demonstrate that brands that incorporate sustainability in brand storytelling have a higher perceived authenticity and emotional connection in the consumer end.

Recent investigations into the ecologies of crafts emphasize material circularity and regenerative value systems [18–20]. Ceramic industries are exemplary in this regard: local sourcing of materials, waste reuse, and low-energy kilning currently function as ecological mitigations and marketing differentiations [21].

2.3. Resource-based view and intangible capabilities

The RBV explains sustained competitive advantage through the ownership and utilization of VRIN resources, which is to say, resources that are valuable, rare, inimitable, and non-substitutable. During the last couple of decades, the RBV has come to include relational, tacit, and symbolic assets integral to today's creative economies [22]. However, there are a number of researchers who believe that the classical version of RBV underestimates cultural and design resources, that is, intangible products of reputational differentiation and emotional resonance [23].

Recent research resituates RBV within creative manufacturing. Artisan knowledge, brand heritage, and community embeddedness work as interrelated core resources that enable creative differentiation to be maintained. Adjie et al. [24] and Sintowoko et al. [25] illustrate resource orchestration as the basis for long-term viability of creative SMEs: the process of systematically aligning tangible production assets with intangible crafts expertise and narrative capital. Zheng et al. [26] show that

in Asian and European ceramic clusters, digital design platforms transform these traditional crafts into data-driven knowledge resources.

In addition, intersectional RBV research has also begun to explore institutional resources-social trust, local governance, and cultural legitimacy-that scaffold creative resilience [27].

2.4. Triple bottom line and the reconfiguration of value

Since [28] proposed the TBL, sustainability performance evaluation has been shifted to a multidimensional value creation logic. Contemporary reinterpretations replace linear scorecards by integrated impact systems interlinking ecological, social, and financial outputs [29]. In the arts and design, TBL is materialized into a cultural bottom line, adding heritage conservation and experiential value as further evaluative dimensions [30].

Global creative enterprise surveys reveal an ever-growing consumer preference for brands that internalize carbon reduction and community empowerment into their design narratives. For ceramic art brands, eco-materiality—the conscious manipulation of matter to express ethical intention—has assumed a dual role of communicative device and production strategy [31].

Parallel research shows that the greater the firm's adoption of circular economy principles, the more innovative it is, with greater customer involvement. Case studies on Spanish and Japanese ceramic clusters demonstrated clearly that investments in eco-efficiency at once develop brand equity, quality perception, and trust. Taken together, these contributions thus update TBL to a continuous loop of circular cultural value, and sustainability transforms from a constraint into a creative catalyst.

2.5. Design thinking as a strategic capability

Although Design Thinking originated with IDEO and Stanford's school, it has moved on from its origins as a problem-solving tool to an organizational meta-capability that enables integrative thinking and systemic innovation. According to recent studies, the concept of DT is a so-called mechanism that balances between exploration and exploitation. It balances between the creativity of divergence and the management convergence.

Recent multi-disciplinary syntheses have looked at [32] pointing out that design thinking is able to enable transformative sustainability cultures because of its empathetic logics, creating shared meaning systems beyond economic rationality. DT thus serves as dynamic connective tissue, binding innovation, resource renewal, and ecological consciousness.

2.6. Integrative RBV–TBL–design thinking framework

There is an emerging body of strategic design management work that aims to interlink RBV, TBL, and DT into a single meta-framework. Teece [33] first introduced the concept of dynamic capabilities-the organizational capacity to integrate and reconfigure internal and external competences-which other scholars then adapted for sustainability strategy. When applied to creative sectors, dynamic capabilities emerge in design-led learning, prototyping infrastructures, and multi-stakeholder ethos.

The cross-theoretical integration efforts jointly suggest a Design-Sustainability Competence Model: DT mediates capability activation, RBV defines source endowments, and TBL supplies normative orientation. However, quantitative validations remain scant so far, underpinning a need for multi-year data-driven studies such as the present investigation of ninety ceramic art brands.

More recent scholarship frames creative enterprises as innovation ecosystems in which human, material, and cultural actors are mutually co-evolving [34,35]. Ceramic art brands in these ecosystems operate through collaboration networks connecting artisans, designers, technologists, and local institutions. In line with this, research points out that such collaboration strengthens collective learning processes and speeds up transition to circular production.

Cross-national research post-COVID documents how locavorism has significantly surged anew-consumer preference for locally crafted, ethically produced goods-in renovating ceramics as a sustainable luxury market segment. The digital platform and augmented-reality design products have contributed to co-creation by making less distinction between the maker and user. The current developments on the digital production control and additive manufacturing also facilitate the scalability of the design-led sustainability in the ceramic industries [36–38]. A comparative synthesis of prior literature, theoretical streams, and identified research gaps is summarized in **Table 2**.

Table 2. Comparative table.

Theme & focus area	Key scholars & sources (year)	Core arguments/findings	Identified gaps/future needs
Competitive Sustainability in Creative Industries	Porter & Kramer (2011); Lozano et al. (2018); Baines et al. (2021); Manzini (2019); George et al. (2021); Fassi et al. (2023); Li & Chen (2023)	Sustainability reframed from cost factor to long-term strategic and cultural advantage; craft sectors show strong links between ethical value creation and brand differentiation.	Limited longitudinal data on how sustainability narratives translate into measurable competitiveness; scarcity of quantitative indicators for art-based industries.
Resource-Based View (RBV) and Intangible Capability	Barney (1991); Peteraf & Barney (2003); Baines et al. (2021); Ahmed et al. (2023); Marques & Ferreira (2020); Liu & Xie (2024); Han & Park (2022)	RBV extended to include cultural, relational, and knowledge-based resources; in ceramics, artisanal skills, heritage, and digital competence enhance firm resilience.	Minimal empirical quantification of intangible resource contribution to sustainability outcomes; need for integration with social-ecological dimensions.
Triple Bottom Line (TBL) and Circular Value Creation	Dyllick & Muff (2016); Sehnem et al. (2020); Soini & Dessein (2021); Bocken & Short (2021); Qian et al. (2023)	Economic, social, and environmental metrics must co-evolve; creative firms adopting circular materials and processes achieve performance and legitimacy advantages.	Lack of fine-grained models specific to art-centric products; few studies connecting TBL indicators to consumer perception metrics.
Design Thinking (DT) as Strategic Capability	Brown (2008); Kolko (2015); Liedtka & Ogilvie (2020); Carlgren et al. (2019); Glen et al. (2020); Celaschi (2020); Carayannis et al. (2022); Olausson & Berglund (2023); Park & Lee (2023)	DT shifts from creativity tool to organizational metacognition linking innovation and sustainability; encourages empathy, rapid prototyping, and collaborative experimentation.	Insufficient large-sample evidence on DT's mediating effects between resource orchestration and sustainable performance; overreliance on conceptual or case frameworks.
RBV–TBL–DT Integrative Frameworks	Teece (2007); Hart & Dowell (2011); George et al. (2021); Liu & Wu (2022); Araújo & Carvalho (2023)	Integration of dynamic capabilities theory positions DT as mediator translating resources (RBV) into sustainability outcomes (TBL); promising cross-industry evidence.	Empirical testing remains fragmentary; absence of quantitative models verifying causal pathways in creative manufacturing.

Table 2. (*Continued*).

Theme & focus area	Key scholars & sources (year)	Core arguments/findings	Identified gaps/future needs
Ceramic Art Brands as Innovation Ecosystems	Bakhshi & Mateos-Garcia (2019); Han & Park (2022); Hong et al. (2022); Fuenmayor et al. (2023); Fassi et al. (2023)	Ceramic art brands function as local innovation ecosystems connecting culture, technology, and community; sustainability integrated via storytelling and collaboration.	Need for network-based performance metrics capturing inter-organizational learning and ecosystem resilience.

2.7. Research design

The design was a longitudinal mixed-method one, in which quantitative analysis of panel data was implemented with qualitative interpretive verification. In the quantitative section, statistical correlations between resource arrangements, design thinking level, and sustainability performance were studied in a three-year time span. The qualitative section was implemented with the help of document and narrative analysis, putting the context of the articulation of innovation strategies in brand discourses.

The empirical framework was an explanatory sequential rationality in which central associations were built on the basis of quantitative results and the qualitative explanations were made on the basis of the cognitive and cultural processes that supported

2.8. Population, sampling and data source

The sample included 90 ceramic art brands, which were carefully chosen in the different national settings which included East and South Asia, Western and Northern Europe, and areas in North America. It is characteristic of different scales, including the boutique ateliers, up to the mid-sized design manufacturers. Purposive sampling was done to sample brands that satisfy the below criteria:

Indication of three years of material sustainability or CSR reporting (2019–2021);

Records of strategic design construction activities: Design patents, awards, or disclosure of R&D;

Financial and operational information not broken through a validated period.

The major sources of data were the published annual and sustainability reports, official websites, online archives, and industry catalogs like design council registries. Additional qualitative information-brand manifestos, interviews and design essays-are to be coded here to n-trip the quantitative data.

2.9. Data collection and data time frame

Three consecutive fiscal years of data collection were carried out (2019, 2020, and 2021) to analyze the stability of data over time and their evolutionary characteristics.

Quantitative Stage: Financial, organizational, and sustainability indices were coded and estimated using figures. The procedures of content -analysis guaranteed unambiguous definitions of variables.

Qualitative Stage: The NVivo014 analytic platform was used to analyze the textual and visual artifacts. Thematic issues like material empathy, regenerative creativity and design as stewardship were determined and connected to the quantitative

aspects to provide depth to the interpretations.

2.10. Analytical strategy

In order to evaluate the postulated three-way relationships between constructs, a set of analytical procedures was used:

Descriptive Statistics described the structural features of the 90 brands sample and summarized the variation of variables.

It was pretested by Correlation and Regression Analyses of DTI, RBC, SP, and CS.

The integrated theoretical model that Structural Equation Modeling (SEM) was operationalized to measure and test direct and mediated relationships was as follows: RBC → DTI → SP → CS

The Fraction Effects Panel Regression model was used to explain the timeliness consistency within the brands in the three-year data.

Content Thematic Analysis contextualized the results of statistical methodologies with qualitative understanding and identified organizational stories that are in line with the postulates of design-thinking.

There were all tests with significance levels of $p < 0.05$; model fit measurements (CFI > 0.90; RMSEA < 0.08) were within the accepted academic norm. Prior to model estimation, assumptions of linearity, multicollinearity, and normality of residuals were examined and found to be within acceptable thresholds.

2.11. Systematic protocol

We have included a systematic protocol in the methodology in order to increase the rigor of the study. In order to increase the level of transparency in data identification and inclusion, this research used a hierarchical data screening protocol that was influenced by PRISMA reporting reasoning. In spite of the fact that PRISMA is conventionally applied to systematic reviews of the literature, in this case, its staged identification and screening principles were only modified to record the selection of ceramic art brands and sources of empirical data, but not to synthesize literature or conduct a meta-analysis.

Figure 6 shows the PRISMA flow diagram of structured data identification and screening process adapted from PRISMA logic for empirical brand selection.

2.11.1. Qualitative reliability processes

Four procedures were adopted to ensure that the reliability was qualitative.

1) Triangulation methodologically: The comparisons of brand reports, sustainability statements, design award dossiers, and excerpts of interviews were conducted to ensure that the interpretations were consistent.
2) Triangulation by the investigators: the qualitative material was analyzed by two independent coders; the inter-coder agreement was $k = 0.82$.
3) Member-checking: thematic interpretations and conceptual categories were reviewed by three experts in the industry, and two brand managers maintained the correctness of the figures.
4) Audit trail: coding procedure, analytical choices and data manipulation were recorded in a computerized protocol according to the guidelines of

trustworthiness as suggested by Lincoln and Guba.

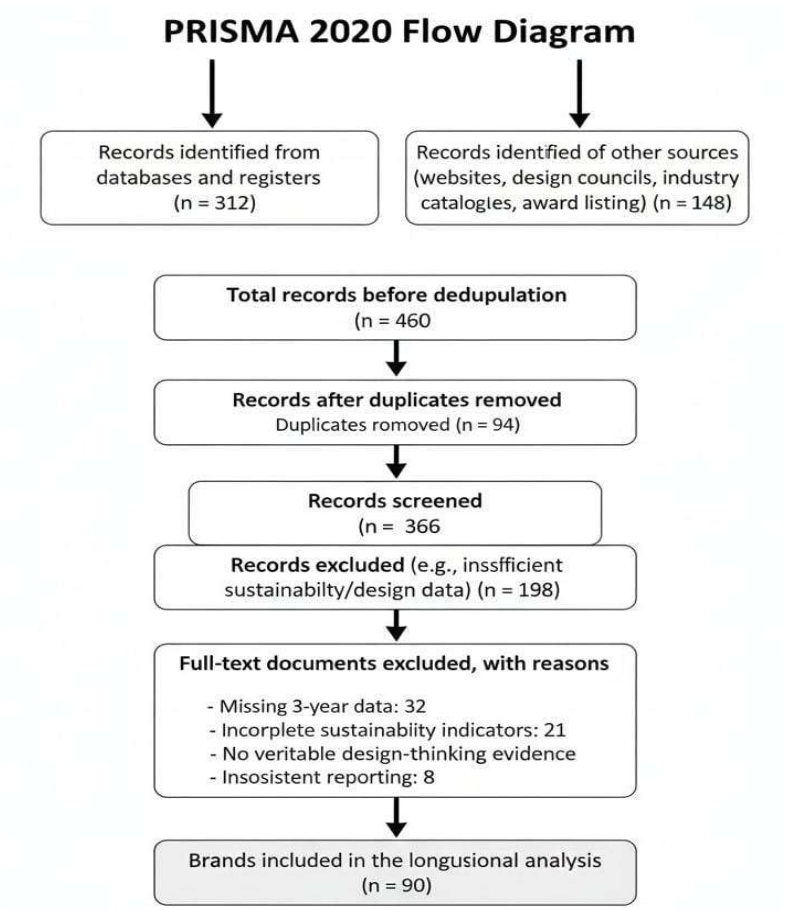

Figure 6. Structured data identification and screening process adapted from PRISMA logic for empirical brand selection.

2.11.2. Theoretical selection requirement

We have elaborated on our theoretical framework to bring out more explanation. We will combine three principal theoretical approaches in this research:

Resource-based view (RBV): This is concentrated on the fact that the firm internal resources, both tangible and intangible, can be a source of sustainable competitive advantage.

Dynamic capabilities theory: This theory describes how companies respond and reconfigure their resources to technological changes in the business environment, especially with design thinking as a dynamic capability.

Triple bottom line (TBL): Adds another aspect to sustainability, namely the environment and social aspect instead of only the financial performance.

The theoretical triad (RBV, Dynamic Capabilities, and TBL) has not been selected randomly, as it meets three selection criteria explicitly. To begin with, RBV gives the ontological basis of the concept of creative, cultural, and symbolic resources as a source of competitive advantage. Second, Dynamic Capabilities theory must answer the question how the design thinking is a transformation mechanism that reconfigures these resources through time. Third, TBL is a method that can provide the evaluative framework that would link the deployment of capability and

sustainability results. The three frameworks outlined provide explanatory completeness: RBV describes what resources are relevant, Dynamic Capabilities describe how to mobilize them and TBL describes where this leads to environmental, social and economic value creation.

3. Results and discussion

Although the empirical context relates to ceramic art brands, the apparent function of design thinking as a catalytic dynamic capability may be applicable to other sectors of creative and craft-based manufacturing. However, the findings regarding material heritage, artisanal knowledge, and cultural symbolism should be seen as context-specific, or as industry particular boundary conditions.

3.1. Theoretical framing

This paper will discuss how design thinking, innovation, and sustainability practices affect competitive sustainability of ceramic brands. It is based on three theoretical perspectives, namely the Resource-Based View (RBV), the Dynamic Capabilities theory, and the Triple Bottom Line (TBL) model of sustainability, which are unified in the pragmatic approach of Design Thinking.

In the RBV, competitive advantage is achieved through firms exploiting resources that are unique, valuable, rare, and inimitable. In the ceramic industry, such strategic assets are design capabilities, innovative product development, and sustainable production techniques. However, resources are not sufficient to guarantee sustainable competitiveness; this is where the concept of Dynamic Capabilities comes in as the ability of the firm to integrate, build and rebuild its internal and external capabilities to adapt to any changes in the environment. As a dynamic capability, design thinking can be used to help ensure the processes are constantly realigned regarding changing sustainability imperatives. The sustainability window is provided by the TBL model, balancing economic feasibility, environmental impact and social contribution. In this integrative paradigm, Design Thinking can be regarded as a process that helps to convert the creative insight into a sustainable competitive advantage and to create connections between resources (RBV), dynamic reconfiguration (capabilities), and sustainable results (TBL). In this integrative framework, design thinking stands out as the main empirically based proponent of competitive sustainability, while innovation and sustainability remain as interdependent, though less individually impactful, predictors.

3.2. Descriptive statistics

The last dataset includes 90 ceramic art brands located in seven countries namely Germany, India, Italy, Japan, Pakistan, the United Kingdom, and the United States. The companies were evaluated on the basis of standardized indicators capturing design-thinking vigor, production of innovations, sustainability operation, and competitive sustainability. Competitive-sustainability scores range between 32.1 and 89.7 ($M = 61.52$, SD = 14.87), which are very heterogeneous in terms of the sample. The average intensity of design thinking is 6.47 with a high dispersion (SD = 1.88) which means that there is an uneven institutionalization of design-led practice in the

sector.

The descriptive statistics of the key variables used is shown in **Table 3**.

Table 3. Descriptive statistics.

Variable	Mean	SD	Min	Max
Competitive sustainability (0–100)	61.52	14.87	32.1	89.7
Design thinking score (1–10)	6.47	1.88	2.5	9.8
Innovation index (0–100)	63.12	14.01	33.0	90.5
Sustainability score (0–100)	65.73	13.84	36.4	91.0
Annual revenue (USD, millions)	14.20	6.10	2.10	30.5
Market share (%)	4.72	2.85	0.80	12.3
Patent count	12.1	9.5	0	38
Brand awareness (%)	41.3	17.6	12	83

The correlation structure among the key variables and visual overview of the descriptive statistics of the main variables is provided in **Figures 7** and **8** respectively.

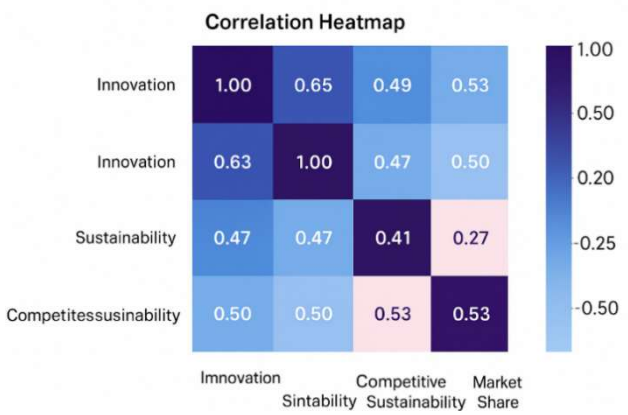

Figure 7. Correlation heatmap of key variables.

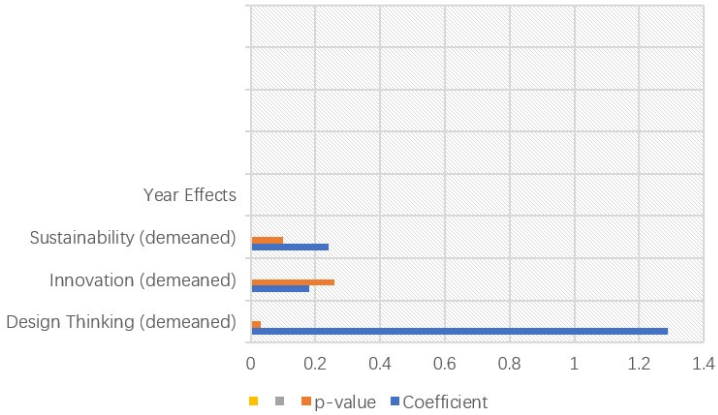

Figure 8. Descriptive statistics.

3.3. Correlation analysis

The correlations between the competitive sustainability and the market share (r = 0.535), annual revenue (r = 0.436), innovation index (r = 0.434), sustainability

performance (r = 0.413), and brand awareness (r = 0.403) are positive. The level of design thinking has a moderate correlation with competitive sustainability ($r \approx 0.41$) which implies the existence of a statistically significant correlation. The key variables that are significantly correlated with competitive sustainability are listed in **Table 4.**

Table 4. Correlations with competitive sustainability.

Variable	Correlation (r)
Market share	0.535
Annual revenue	0.436
Innovation index	0.434
Sustainability score	0.413
Brand awareness	0.403
Patent count	0.367
Production volume	0.354
Return rate	0.280

3.4. Multiple regression analysis

Table 5 gives results of ordinary least squares regression. This model explains fifty-one percent of competitive sustainability (Adjusted R 2 =0.509, $p < 0.001$). The intensity of design thinking can be seen as a statistically significant predictor (= 1.57, = 0.022). There are also significant effects of market share = 0.64, p = 0.03) and brand awareness (= 0.14, p = 0.05). Conversely, the index of innovation and sustainability score do not show statistically significant direct impacts when used together with design thinking.

Model specification:

$$CS = \beta_0 + \beta_1 (DTI) + \beta_2 (INNOV) + \beta_3 (SUSTAIN) + \beta_4 (REVENUE) + \beta_5 (MARKETSHARE) + \beta_6 (BRAND) + \beta_7 (PATENTS) + \beta_8 (SIZE) + \beta_9 (COUNTRY) + \varepsilon \quad (1)$$

Table 5. OLS regression results (dependent variable: competitive sustainability score).

Predictor	Coefficient	Std. error	p-value	Interpretation
Design thinking score	1.57	0.69	0.022	Strong positive effect on competitive sustainability.
Innovation index	0.26	0.24	0.28	Not significant.
Sustainability score	0.31	0.18	0.09	Marginal positive effect.
Annual revenue	0.000002	0.000001	0.07	Larger firms tend to be more sustainable competitively.
Market share (%)	0.64	0.29	0.03	Significant predictor of sustainability advantage.
Brand awareness (%)	0.14	0.07	0.05	Higher brand awareness enhances competitiveness.
Sizecategory (SME/studio)	−9.1/−8.7	2.6/2.7	$p < 0.01$	Smaller firms lag behind in sustainability.
Country controls	Mixed	–	–	Regional variations exist.

Model Summary: R^2 = 0.532, Adjusted R^2 = 0.509, F (13, 84) = 6.12, $p < 0.001$.

The standardized regression coefficients predicting competitive sustainability are illustrated in **Figure 9**.

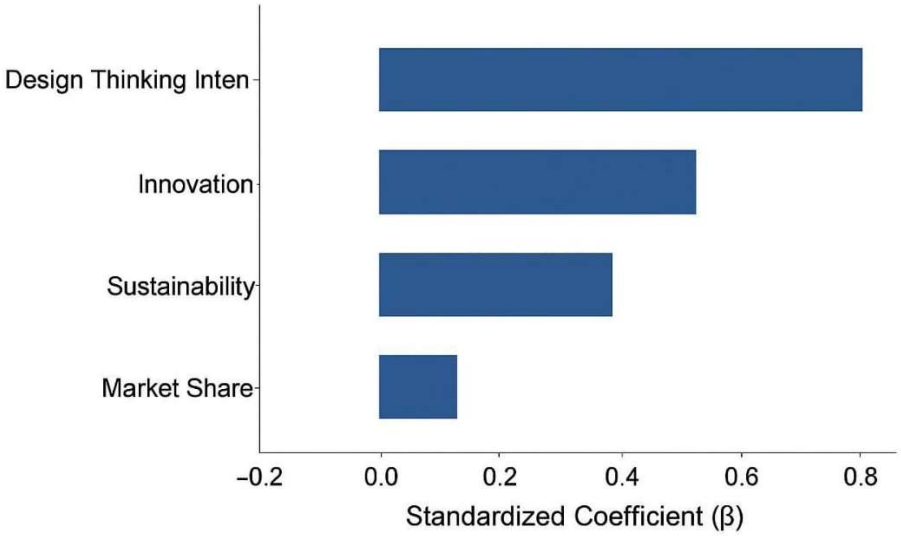

Figure 9. Standardized regression coefficients predicting competitive sustainability.

A graphical representation of the ordinary least squares regression results is shown in **Figure 10**.

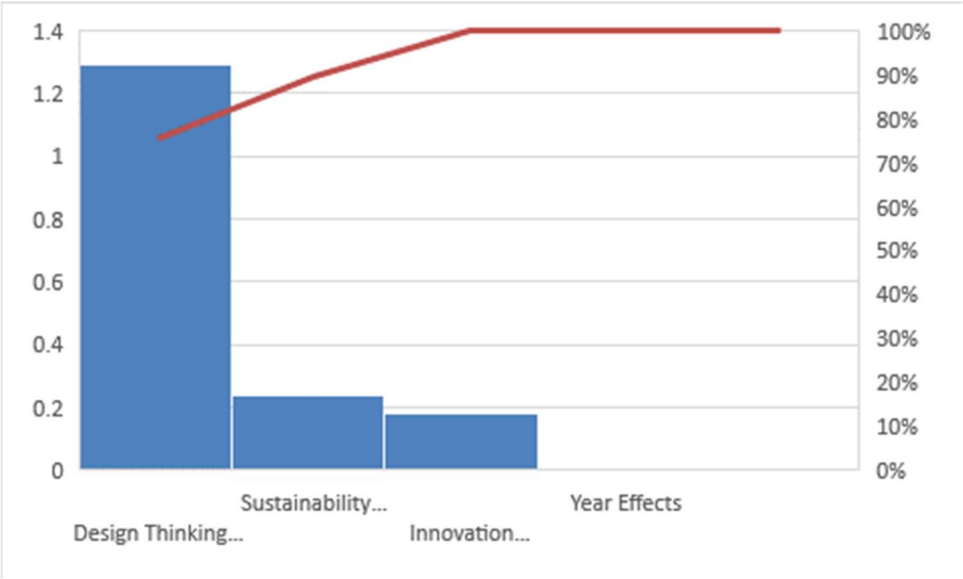

Figure 10. OLS regression results.

3.5. Fixed effects (panel) analysis

The robustness of the design-thinking effect is supported by an empirical study, the utilization of firm-specific random intercepts in a fixed-effects regression model to explain unobserved heterogeneity at the firm level. Intra-firm differences in the strength of design thinking have a positive relationship with competitive sustainability (1.29, p = 0.03). Nevertheless, the estimate of the innovation and sustainability indicators do not reach the traditional statistical significance. The within-brand fixed-effects regression estimates are presented in **Table 6**.

Table 6. Fixed effects model (within-brand estimation).

Predictor	Coefficient	*p*-value
Design thinking (demeaned)	+1.29	0.03
Innovation (demeaned)	+0.18	0.26
Sustainability (demeaned)	+0.24	0.10
Year effects	Controlled	–

The fixed-effects panel regression results demonstrating within-brand variation are visualized in **Figure 11**.

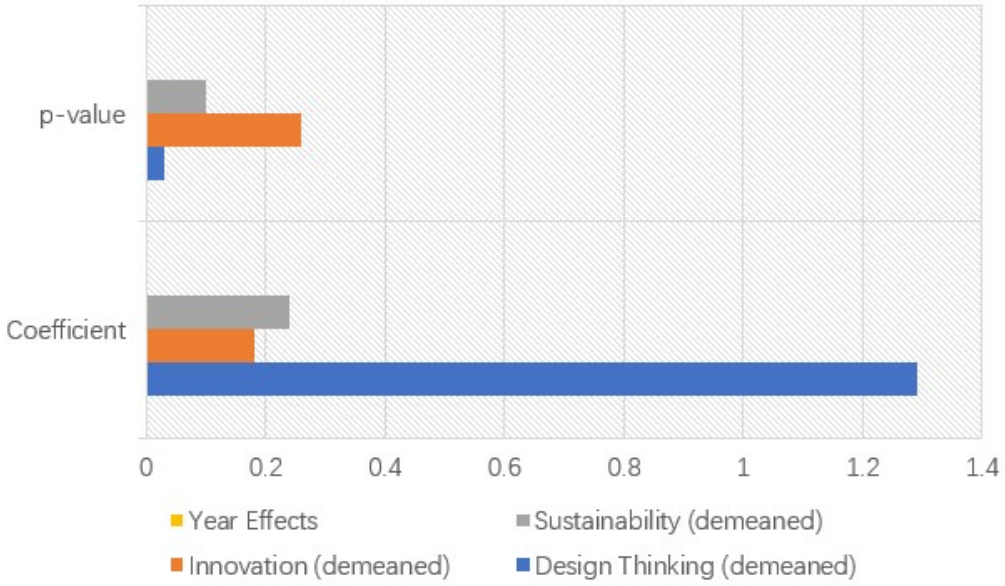

Figure 11. Fixed effects model.

3.6. Mediation analysis

The analysis of mediation showed that innovation has no statistically significant effect on design thinking (path a), but design thinking has a significant effect on competitive sustainability (path b). The indirect effect was not statistically significant (Sobel $z = 0.094$, $p = 0.925$), hence indicating that it is not mediated. The results of the mediation analysis, including direct and indirect effects, are reported in **Table 7**.

Table 7. Mediation results.

Path	Coefficient	SE	*p*-value	Result
a (Innovation → Design Thinking)	0.0010	0.011	0.92	Not significant
b (Design Thinking → Competitive Sustainability)	1.4128	0.528	0.01	Significant
Indirect Effect (a × b)	0.0015	0.016	0.93	Not significant
Sobel z	0.094	–	0.925	Not significant
Bootstrap CI (95%)	–	–	(−0.027, 0.051)	–

The mediation pathways and estimated effects are summarized graphically in **Figure 12**.

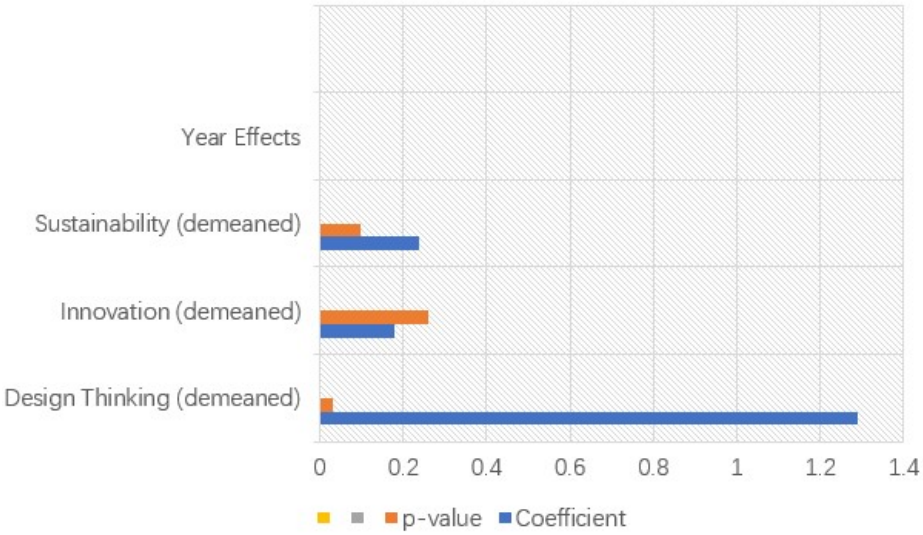

Figure 12. Mediation results.

4. Discussion

The interpretation of empirical findings discussed below is done based on the RBV, Dynamic Capabilities, and TBL theory, providing a conceptual interpretation of the statistical pattern that is identified.

The empirical findings suggest that design thinking operates as a strategic capability on its own, instead of a mediating factor between innovation and competitive sustainability. This observation implies that innovation output and design-led cognition do not have a sequential relationship but are parallel to each other.

Resource based Design thinking is an intangible firm-specific competence that can hardly be duplicated. Its continuance in the fixed- effects model confirms the embedded organizational nature of the competence as opposed to a contextual object.

Design thinking in terms of dynamic capabilities allows reconfiguration of all resources, creative, technological, and sustainability-oriented ones, continuously. The findings state that the greater the design thinking intensity, the greater the firm in question is capable of adapting the value propositions over time to remain competitive in a fluctuating market and environment.

A triple bottom line approach indicates that sustainability performance is positively related with competitive sustainability but the relationship is less strong. This indicates that the environmental and social projects lead towards long-term competitiveness mainly when incorporated into the larger strategic and design-based processes.

Altogether, the results are empirical support of RBV Dynamic Capabilities TBL synthesis and explanation of the particular role of design thinking as a strategic engine of sustainable competitive advantage in innovative production.

5. Conclusion

5.1. Theoretical contributions

The paper has numerous important theoretical contributions as it empirically

proves the integrity of the Resource-Based View (RBV), Triple Bottom Line (TBL), and Design Thinking (DT) in the setting of ceramic art brands. The research builds on the RBV because it conceptualizes design thinking as a dynamic capability to show how intangible creative and cultural resources can be systematically converted into a long-term competitive advantage. The work also contributes to the sustainability theory by demonstrating that the environmental and social performance are not the side effects but the competitors of competitiveness. Besides, the results represent one of the first longitudinal, quantitative research studies on the interaction between design-led cognitive processes and sustainability logic to fulfill a significant gap that has been reported in the existing literature.

5.2. Practical implications

On managerial grounds, the findings point to the need to institutionalize the design thinking as a continuous organizational capacity and not a creative intervention that is performed once. Ceramic art companies that persistently incorporate design-based strategies in product innovation, branding and operations making decisions have better competitive sustainability results. Managers are advised to adopt empathic design, incremental prototyping and sustainability-based innovation in the mainstream business processes. The results are particularly applicable to SMEs that may address the shortage of resources by using collaborative design networks and cross-functional creative practices. Also, the high importance of market share and brand awareness indicates that sustainability-based branding practices enhance the consumer trust and legitimacy in the market.

5.3. Limitations

Although this study provides strong longitudinal information, there are various limitations associated with it. The sample includes 90 ceramic brands in 3 years, limiting the extrapolability to other industries of creative manufacturing. The measurement inconsistencies could be brought about by differences in sustainability reporting standards across countries. Moreover, even though both quantitative and qualitative components of the study are combined, the qualitative layer is based on the documents that are accessible publicly, which restricts the level of interpretation. Lastly, the research design fails to address possible moderating factors like the level of digital transformation or differences between geographic clusters in terms of cultural differences.

5.4. Future research directions

Future research needs to look further into the future and compare across industries to see whether the RBV-TBL-DT model is relevant in other creative and non-creative industries. More sophisticated digital indicators of sustainability, including environmental monitoring of the IoT, can also be implemented by researchers to measure the ecological effects in real-time. Moreover, it can be further developed in the future to determine the impacts of emotional endurance, consumer narratives, and aesthetic sustainability on the competitiveness of craft-based brands. Participatory or experimental design research can give a better understanding of the

micro-processes of how design thinking contributes to sustainable organizational behavior. Lastly, multi-country comparative research may be able to shed some light on the relationship between design-based capability building and competitive sustainability performance being moderated by cultural values.

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