The Role of Design Thinking and Technology in Innovation: A Bibliometric Analysis to Enhance Property Business Development

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Abstract. The property sector has experienced transformative innovation, driven by technology and the convergence with design thinking. This paper presents a bibliometric analysis, examining the integration of strategic frameworks and design thinking approaches within the property sector, with a focus on technological applications. The study explores the structural development of the property sector to enhance customer value and synthesizes data on current innovation trends, best practices, challenges, and future projections. By assessing patterns and academic contributions in this area, the study provides insights into varying applications of technology-driven design thinking across different business scopes, particularly in terms of aesthetic and functional improvements. The findings aim to inspire stakeholders to adapt and meet evolving industry demands sustainably. Through a bibliometric perspective, the study highlights design thinking and technology as pivotal tools for advancing the property sector.

Keywords: Design Thinking, Technology Integration, Innovation, Property Development, Bibliometric Analysis.

Introduction

Housing is one of the needs of everyone, each residence certainly has a different motive, some are used for residence and some are used for investment only. In today's digital era, housing is not only seen as a primary need, but also as an investment opportunity that is increasingly in demand. The presence of digital technology has changed the way people search, choose and buy homes. Through online platforms, prospective buyers can easily explore a wide selection of properties from various locations without having to come directly to the location.

The integration of Design Thinking and technology plays an important role in driving innovation, especially in the property business sector. Innovation is seen as bold and creative new solutions to problems. Often, these innovative solutions require a clear understanding of the problem that needs to be solved from the user's perspective. This approach to driving innovation called Design Thinking requires discipline and is often different from the way most people do traditional problem solving. Traditionally, innovation projects result from teams coming together, creating specifications for innovation, and meeting those specifications within the allocated budget (Gallanis, Tony 2020).

However, while many innovations have been implemented, the structural development of the property sector to enhance customer value still faces challenges. Utilizing the right technology and strategically integrating design thinking are key in dealing with these changes. This is where the importance of bibliometric studies, which can identify trends, best practices, and key challenges in property sector innovation, comes in. With this approach, bibliometric studies not only reveal academic patterns and contributions in the literature, but also provide comprehensive insights into the application of technology and design thinking in the property sector.

This research aims to provide an overview of how the property sector is evolving through the integration of technology and design thinking, and identify the opportunities and challenges that exist. Through bibliometric analysis, this study also evaluates current trends and projects how technology-driven innovation and design approaches can inspire stakeholders to adapt to dynamic market demands. The results of this study are expected to contribute to understanding the critical role of technology and design thinking as strategic tools to enhance the competitiveness and sustainability of the property sector in the future. This bibliometric analysis explores how these methodologies enhance property development by encouraging user-centered solutions and leveraging technological advancements.

Methods

This study uses a bibliometric approach to analyze the development of several topics in the field of design and product development related to the property sector and technological innovation during the period 2001-2024.Data were collected from international journals indexed in the Scopus database using keywords such as *design thinking, product development, innovation,* and *technology-based design*.The data were managed using VOSviewer and Biblio Shiny which will produce thematic visualizations. Strategic diagrams are used to group themes based on relevance centrality and density, while Sankey diagrams are used to map theme transitions between periods. This approach provides an overview of trends, inter-theme relationships, and innovation opportunities, with quantitative-descriptive analysis to address the challenges and needs of the property sector.

Result and Discussion

This section describes the findings derived from the bibliometric and thematic analysis conducted, in that it illustrates the evolution and trends in research themes over two decades. The visualizations provided, including thematic networks and strategic diagrams, serve as a basis for discussing the relevance, centrality, and density of emerging and established themes in the design and innovation domain.

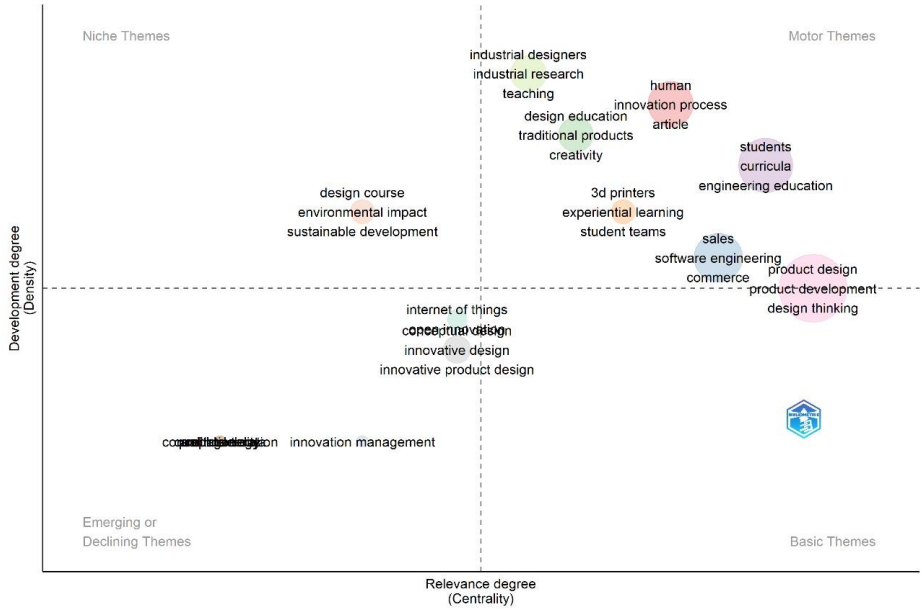

Figure 1. Bibliometric thematic map

Figure 1 is a Strategic Diagram that maps research themes based on the level of relevance (centrality) and the level of development (density) consisting of four quadrants.The motor themes quadrant identifies key themes with high relevance and development, such as product development, design thinking, and software engineering. The quadrant of niche themes includes topics such as sustainable development and environmental impact, which have a high level of development but limited relevance to specific areas. This suggests that these themes are specific in nature but have the potential to have a significant impact in their context.

Meanwhile, the basic themes quadrant displays basic themes such as conceptual design and innovative product design, which provide an important foundation for further research. The emerging or

declining themes quadrant shows themes with declining relevance and development, such as innovation management. These themes reflect emerging or fading potential, requiring special attention in future research strategies. This analysis provides strategic guidance in directing research focus, especially on themes that have great potential for further development.

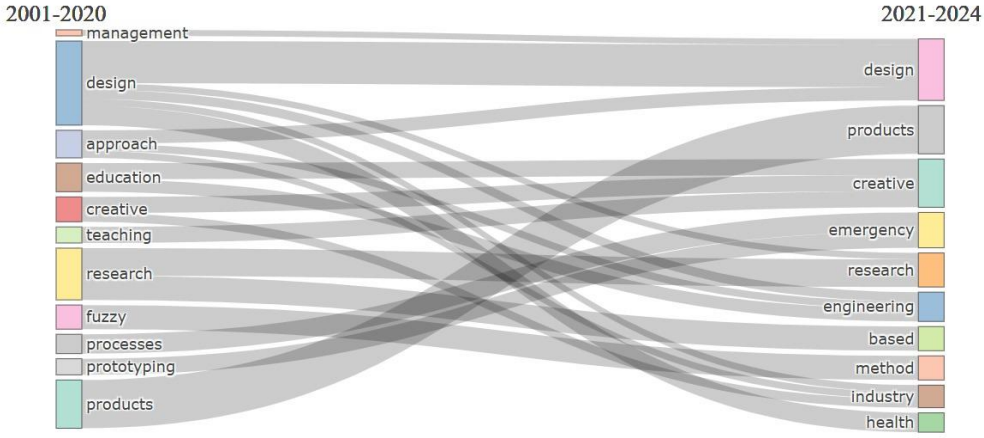

Figure 2. Bibliometric thematic evolution

Figure 2 shows an analysis of the evolution of research themes from the 2001-2020 period to the 2021-2024 period, visualized in the form of a thematic flowchart. This diagram connects the main topics that evolved from one period to the next, providing an overview of the changing focus of research in the field of design and innovation.In the 2001-2020 period, dominant themes included "management," "design," "education," "research," and "prototyping." However, the 2021-2024 period saw a shift towards more specific and applicable themes, such as "products," "creative," "emergency," "engineering," and "health." Some themes such as "design" and "research" remained as the main focus in both periods, showing the relevance and importance of these topics in related research fields.

In addition, the emergence of new themes such as "emergency," "based," and "health" in the 2021-2024 period reflects responses to evolving global needs, including emergencies and technology- or health-based approaches. This indicates that research in design and innovation is increasingly adapting to contemporary challenges, such as pandemics and digitalization. The diagram also highlights strong connections between old and new themes, such as how "education" and "teaching" from the 2001-2020 period connect with the "engineering" and "method" themes in the most recent period, showing a transformation of approaches in design and innovation education. As such, it reveals the dynamic evolution of research that reflects the trends and needs of the times.

Table 1.Theme Frequency or Weight (2002-2020 and 2021-2024)

Theme(2001-2020)	Frequency	Theme(2021-2024)	Frequency
Design	120	Design	80
Education	90	Product	70
Research	85	Creative	65

Table 1 shows the number of occurrences (frequency) of the various relevant themes in the two time periods, 2001-2020 and 2021-2024. The design theme remains the main focus in both time periods, although it experienced a slight decrease in frequency from 120 to 80. The education theme, which was widely discussed in the first time period, is no longer a top priority in the second time period, replaced by themes such as products and creative. This change reflects the shift in attention from design education to real product

development and creativity as the core of innovation. Overall, this table provides a snapshot of the changing academic and industry focus in design over the past two decades.

Table 2.Theme Relationship Based on Sankey Diagram

Initial Theme	Main Relationship	Final Theme
Design	45%	Product
Education	30%	Engineering
Management	25%	Health

The third table summarizes the flow of relationships between themes in the 2001-2020 and 2021-2024 periods, based on Sankey diagrams. For example, the design theme has a strong relationship (45%) with products, reflecting the continuity of attention to product development-oriented design. The education theme is connected to engineering at 30%, indicating a shift in attention from educational theory to the application of engineering in design. The management theme, which relates to process management in design, shifts to health at 25%, reflecting the renewed attention to design that supports health. This table provides a more detailed explanation of how the key themes interconnect and change over time.

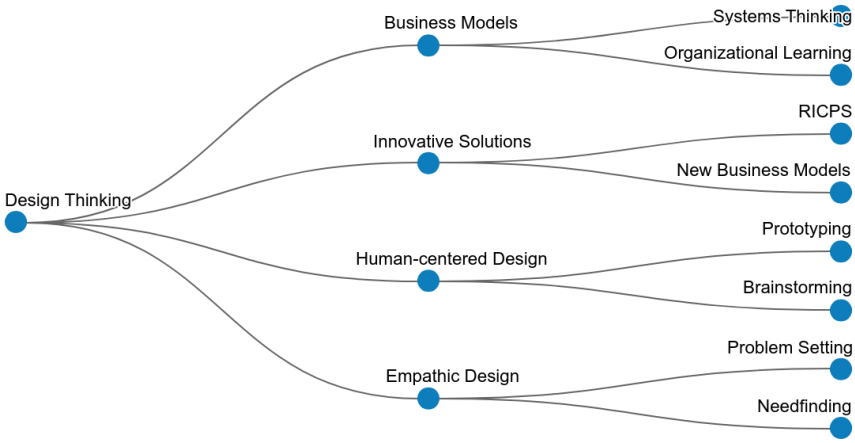

Figure 3. concept linkage map with Design Thinking main themes

Figure 3 shows a concept relationship map with the main theme of Design thinking as the core that branches out into various sub-themes and derived concepts. This theme reflects how Design Thinking has evolved and been applied in various research and practice contexts. One of its branches is **Business Models**, which highlights the role of Design Thinking in the development of innovative business models. This branch extends to sub-concepts such as **Systems Thinking**, which manages complexity in business models, and Organizational Learning, which focuses on continuous **organizational learning**.Furthermore, the I**nnovative Solutions** theme emphasizes the use of Design Thinking to create new solutions. Sub-themes include **RICPS (Rapid Iterative Cycles of Prototyping and Sharing**), which describes prototype-based iterative methodologies, and **New Business Models**, which highlights the development of new business models through design innovation. Another important theme is **Human-Centered Design**, which focuses on user needs with sub-concepts such as **Prototyping**, which explores ideas through prototype iterations, and **Brainstorming**, which involves creative collaboration to generate ideas according to user needs.

Finally, the Empathic Design branch emphasizes the importance of understanding user needs and emotions. This branch includes Problem Setting, which is the process of identifying problems with an empathetic approach, as well as Needfinding, which looks for unmet user needs. This concept map continues

the pattern from the previous figure, where Design Thinking becomes a central theme associated with creativity, research, and cross-disciplinary design processes. It shows the role of Design Thinking as a strategic approach in developing innovative solutions, business models, and user-oriented designs.

Conclusion

The conclusion of the analysis shows that Design Thinking is the main approach in the integration of innovation, creativity, and human needs-based solutions. The transformation of research themes over the period 2001-2024 indicates a shift in focus from educational aspects, theory-based approaches, and product development towards more applicable themes such as innovation, health, industry, and technology-based methods. This reflects the relevance of Design Thinking as a cross-disciplinary approach in facing the challenges of the times.The link between Design Thinking and concepts such as Business Models, Innovative Solutions, Human-Centered Design, and Empathic Design shows its important role in creating innovative solutions, developing new business models, and understanding human needs through an empathy-based approach. Based on the classification of internal and external factors, it was found that internal factors focus more on themes such as prototyping, process, and creativity, while external factors include more industry, method, health, and technology themes. This distribution shows a balance between internal development (product design and innovation) and external needs (industry and technology).

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