

Research on the Relationship Between Design and Technology in the Design-driven Innovation Model Based on the Case Analysis of Apple

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Abstract: In the research of cutting-edge design, it has been increasingly recognized that the relationship between design and technology is no longer limited to mutual reinforcement and promotion. In the current era of development, the boundaries of the design industry are constantly expanding, shifting its focus from individuals to industries, and evolving into an interdisciplinary field that integrates systematic research from various sectors. Design is fundamentally driven by innovation, characterized by the trends of the times, and requires systemic innovation that merges various technological services. It necessitates resource integration, consideration of user needs, and a fusion of fields such as technology, culture, and business. Moreover, it must comprehensively assess economic, social, ecological, and cultural impacts, while exploring potential paths for future innovation and development. Therefore, this paper aims to explore the evolving relationship between design and technology from the perspective of current trends. By analyzing the driving forces behind innovation and the changes in the relationship between design and technology, using Apple Inc. as a case study of a frontier company, this paper focuses on the design-driven model, analyzing its successes and methodologies. The goal is to explore the prospects and development potential of innovative design in the new era and propose possible suggestions for driving industrial revolutions, economic transformations, and societal progress in the future.

Keywords: Innovation design, Design and technology, Design-driven model, Apple Inc.

1. Introduction

Design is the process of conceptualizing, planning, and calculating, an act of creativity undertaken by humans to achieve a specific goal. With the evolution of techniques, materials, and tools, technology has a direct impact on the creators of design.

The relationship between technology and design is clear: they complement and promote each other. Furthermore, good design represents a harmonious unity of art and science. Technology provides design with new materials and methods. More importantly, since the design is focused on real users, it becomes a means of media between technology and the public, guiding users and providing feedback to the tech, facilitating its iterative improvement.

At the highly anticipated WWDC 2023, Apple unveiled its much-discussed mixed-reality headset, the Apple Vision Pro. The technology behind it is highly advanced, featuring Apple's M2 and R1 chips, along with numerous sensors and cameras. This device offers a new experience that preserves a sense of the real world while allowing users to seamlessly transition into a fully virtual space [1]. Vision Pro blends virtual and real elements in a unique way, with the experience centered around the user's interaction in space, defining a new interaction logic. This design concept represents a revolution in research that aids human social development [2].

As demonstrated by this example, both design and technology are indispensable in the creation of new products. However, analyzing only from individual products and their development processes leads to narrow conclusions and fails to explore the fundamental relationship between design and technology from a broader perspective.

Therefore, expanding the research scope, this paper shifts focus from the individual product to the macro enterprise market which manufactures products. It moves beyond analyzing the outcomes of specific stages to examine the essential goals of product iteration and development. Products represent each phase of the design process, while the macro perspective of the enterprise market encompasses research and development, manufacturing, and application services, all of which need to integrate considerations of economic, social, and ecological factors under new modes of design. The fundamental goal of the ongoing evolution of design and technology that brings transformative change to society is, in fact, innovation.

Based on this reasoning, this paper expands the research object from the "design phase" to the "design goal" from the designer's perspective. The core research objective is to analyze how design and technology lead innovation in the current information era. By exploring the process of technological and design innovation, this paper aims to discuss the prospects and potential development of innovative design in the new era and offer possible suggestions for advancing industrial revolutions, economic transformation, and even societal progress in the future.

2. Innovation-Driven Models

2.1. Concepts of Innovation

Innovation comes in many forms and is applied across various industries and fields. To classify different types of innovation, industry professionals categorize innovation from the perspective of products and services into two main types: incremental innovation and Radical Innovation [3].

Incremental innovation is the traditional form of innovation, characterized by small, continuous changes and improvements. It has a larger market and lower risks, so as to make straightforward profitability. On the other hand, radical innovation is radical and groundbreaking. According to the theory proposed by Kristina B. Dahlin and Dean M. Behrens, Radical Innovation must meet three criteria: novelty (different from the past), uniqueness (different from the present), and practicality (successfully adopted) [4]. The innovation of shared bicycles, which popularized the idea of public-sharing products, conveyed the concept to users that services could be shared publicly, allowing them to enjoy the service without the need for ownership and addressing short-distance travel issues [3].

Successful radical innovations are rare, typically occurring every five to ten years, but their impact is often profound, that could disrupted one or more industries and created new consumer markets.

2.2. Limitations of the Incremental Innovation-Driven Model

The market-driven model follows the current social and cultural paradigm, focusing on meeting user needs or highlighting unique product features to attract users. It primarily manifests as the incremental optimization of the practicality and applicability of existing products. Consequently, this type of innovation is prone to imitation and often ends up in a passive position.

The technology-driven model emphasizes a technology-led approach, leveraging breakthroughs in technical fields to achieve radical innovation in product functionality. The invention of the Segway Personal Transporter employed "Dynamic Stabilization" tech and used embedded precision solid-state gyroscopes to allow motors to maintain balance [5].

Technological knowledge barriers can help enterprises establish a strong and exclusive competitive advantage [4]. However, achieving radical technological breakthroughs often requires high R&D investment within the industry or the organization. So implementing technology-led innovation is often challenging and, in most cases, remains in a reactive position.

2.3. Radical Innovation-Driven Model

Radical innovation is often characterized as radical or capability-destroying, or as a breakthrough. All these labels share a common concept: radical innovation signifies discontinuity with the past.

The current radical innovation-driven model is the design-driven model, regarded as a third strategic paradigm for innovation alongside technology-driven and market-driven models. This model posits that, beyond "technology" and "market," there is a critical body of knowledge that drives innovation—"meaning." The core objective of this model is to create new intrinsic meanings for products (the "product language"), requiring the redefinition of products and the assignment of new intrinsic attributes [4].

3. Design innovation-driven model

3.1. Typical Case of Design-Driven Innovation

Apple Inc. is regarded as "a beacon of design-driven enterprises" in the modern era. In its pursuit of creating radical products, the company has undergone various historical stages of "innovation power" struggles and transformations, eventually establishing an innovation culture centered on design as its core strategy. However, Apple did not embrace this idea at its inception. Through repeated setbacks and changes, the company ultimately presented a design-driven model to the public. This transition marked a significant shift from a "technology-first" geek mindset to a "human-centered" design philosophy [6].

Apple's transformation in company orientation highlights its adoption of design as an overarching driving force, achieving leapfrog innovation [7]. By embracing human-centered thinking, Apple redirected its design focus from purely technological solutions to user-oriented solutions. Leveraging existing technologies (or acquiring them) to enhance user experience and product performance exemplifies a method that balances technical and strategic feasibility to meet user needs.

3.2. Design-Driven Innovation Model

The design-driven innovation model is an innovation approach led by design activities. It does not focus on mastering a unique new technology, but rather on the creative integration and application of existing technological and social elements.

On the demand side, it goes beyond traditional market or customer categories urging innovators to pay attention to the development of broader social and cultural trends. This enables them to accurately grasp potential needs and subsequently guide market demand. On the technical side: it does not require companies to develop new tech but focuses on the application or secondary development of existing technologies to create new product functions [8].

Design-driven innovation emphasizes a dual approach—products-individuals and products-society—creating new concepts and visions while imbuing products with new intrinsic meanings. From a social perspective, meaning construction involves an "interpreter network" (talents from

various industries) to interact and integrate new product meanings and values that are co-created [1]. From an individual perspective, it is essential to embrace human-centered thinking.

3.2.1. Meaning Construction in Design-Driven Innovation

Art historian John Heskett stated that design is about "understanding objects," and the ways it shapes and creates objects fulfill our needs and imbue our lives with meaning [9]. In a sense, the essence of the logic of design lies in endowing products with new intrinsic meanings and creating new entities.

Design-driven innovation introduced firstly the product's "intrinsic meaning." It emphasizes the role of social and cultural contexts in the innovative design of intrinsic meanings, covering four aspects: economic significance, social significance, strategic significance, and future significance.

3.2.2. User Experience in Design-Driven Innovation

Recognizing and understanding new social and cultural paradigms also requires adopting a humanistic perspective to observe consumer and market demand trends. This approach elevates the goal from merely meeting to leading user needs and adheres to being human-centered and user-focused in market demand orientation.

The core logic of design-driven innovation is being people-oriented, employing a "user experience-centered" design mindset. As the definitions evolve, experience design has become the core competitive strength within the design-driven model [10].

3.3. Operational Process of the Design-Driven Model

As illustrated, the business process under the design-driven model follows three steps: defining the concept, analyzing user feedback, and integrating internal and external resources.

The first two steps can serve to reinforce the creation process of products within the design-driven model by connecting cultural and technological knowledge. In the process of innovative design, opening and cooperation are the most critical keywords. Companies establish mature cross-departmental collaboration practices and rules internally. Guided by this idea, leading experts across various fields will form interdisciplinary collaborative innovation platforms in future societies.

These platforms will facilitate the integration of diverse resources and establish an open co-creation model that combines internal management with external collaboration, which finally enables the realization of innovative visions into practical products and services.

3.4. Co-Creation Based on Collaboration

3.4.1. Integrating the Co-Creation Concept

One of Apple's key innovation characteristics weakens and blurs organizational boundaries, promoting knowledge exchange and sharing between internal and external stakeholders. Ultimately, centered on the core objective of innovating intrinsic product meanings, design-driven innovation emphasizes leading innovation through internal management and achieving proprietary collaborative ecosystems through external collaboration. This enables the organic integration of societal culture with technical craftsmanship, achieving shared meaning creation and strategic product development goals [12]. The specific process can be outlined along two key threads [4]:

The interpreter network drives innovation based on societal and cultural knowledge. Through design narratives, cultural production forms new concepts and visions, which are then translated into product meanings. These meanings are communicated to consumers via a new and specific product language, fostering their perception of the new meaning.

The interpreter network facilitates technical and finishing innovations to form new functions. If a “Technology Epiphanies” occurs, consumer feedback can be integrated and optimized. This process culminates in the final product form and presents it through a specific product language and its physical manifestation.

4. Design-Driven and Innovation-Driven Approaches

The intersection of technology-driven innovation and design-driven innovation enables a dual disruptive transformation in product performance and intrinsic meaning, referred to as Technology Epiphanies [3]. Achieving breakthroughs in both technology-driven and design-driven innovation represents the pinnacle of many innovation endeavors.

The Apple Vision Pro exemplifies a product born from technological insight, and Apple has designed numerous successful products within this category. Renowned examples such as the iPhone 4 and the App Store are iconic technological insight-driven innovations.

There is a close relationship between the design-driven and technology-driven models. Only when technological breakthroughs are integrated with design-driven innovation can a product emerge with the ability to captivate and engage users.

Thus, design-driven innovation emphasizes constructing new concepts and visions while endowing products with fresh intrinsic meanings. It strives to achieve the ultimate goal of design: transforming the public and improving society.

Compared to previous design theories, the one of design-driven innovation suggests that technology is no longer the dominant element driving innovation. The dominance of technology and functionality in design, which prevailed since the industrial era, has been relegated to the background, giving way to the ideas and meanings embodied by products.

The fundamental reason for this shift lies in the advancement of the times. As society transitions from the industrial era to the information era, people's needs have evolved from basic necessities to higher-level demands and more immersive experiences. The rising standard of living among the general public also signifies that the foundational mindset in design must undergo iteration.

In the past, economic development was driven by market-oriented approaches. The rapid growth of internet and hardware technologies marked the technology-driven era. Now, design-driven has constructed a new paradigm of innovation suited to the current age. It not only adapts to the times but also leads to comprehensive industrial progress within this era.

5. The Relationship Between Design and Technology in the Development of the Times

In the 1970 definition of industrial design by the International Council of Societies of Industrial Design (ICSID), the focus was on economic efficiency driven by mass production, including aspects such as production line efficiency and market-driven industrial design.

In the 1980 definition by ICSID, the focus shifted to the inclusion of CMF and aesthetic design to attract consumer attention, marking a market differentiation-driven approach to industrial design aimed at increasing consumer demand.

The 2006 definition by ICSID expressed the shift to the information era, where technology had reached a global scale. In this context, technology-driven industrial design became the mediator between users and technology, playing an important role in providing experience design and development feedback for technology.

In 2015, the World Design Organization (WDO), which now maintains the current definition of industrial design, emphasized that design is driven by innovation (development goals). It introduced the concept of co-creation, which integrates interdisciplinary expertise, linking innovation,

technology, business, research, and consumers in creative activities that guide development and offer strategic advantages.

Clearly, the evolution of the definition of industrial design reflects the changing times. As industries mature, the shift in thinking among pioneers and innovators in the context of the era represents the most advanced ideas of the time. In the future, the changing definition of design will continually present a challenge that we, designers, must face: we need to be at the forefront of exploration and creation to solve the problems our generation of designers will inevitably confront.

6. Conclusion

This paper, from the perspective of a designer, focusing on the transition from technology to design, analyzes the evolution of the innovation-driven model around the innovation of intrinsic product meanings. The aim is to explore a more standardized innovation paradigm within innovative design in the new era, offering potential suggestions for advancing industrial revolutions, economic transformation, and even social progress in the future.

Design-driven innovation will continue to evolve and iterate with the times. This study has theoretical limitations due to the lack of real data and research that respond to current societal conditions. My future research will aim to incorporate actual sample surveys to enhance the representativeness and reliability of the results.

It is not difficult to foresee that in the future, designers will collaborate across industries to build more mature innovation frameworks. This paper hopes to provide a more contemporary perspective on the emerging career paths of designers by analyzing modern design trends, offering a reference for the future development of innovation-driven design, and presenting a more relevant vision for growth and potential pathways.

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