Design thinking as a catalyst for sustainable product innovation

Aayush Jain[1], Ananya Nagar[1], Diya Sarkar[1], Sidharth Sinha[1]

[1] *Indian Institute of Technology Kharagpur*

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Abstract— In the light of depleting resources and increasing waste, the world is becoming increasingly cognizant of the need for sustainable production methods and product design. Several established as well as upcoming firms are turning towards design thinking methods in order to make the green shift efficient and effective. Case studies based on various such firms have shown that the human-centered approach to product design, collaborative ideation process and iterative prototyping based on user feedback helps increase the quality of the product, while at the same time reducing costs. Crucially, design thinking helps reduce overall environmental impact leading to more sustainable solutions.

Keywords—Design Thinking, Sustainable Innovation, Innovation Thinking, Engineering Design Process, Design Thinking Models

I. INTRODUCTION

Product innovation refers to the creation and subsequent introduction of a goods or service that is either new, or an improved version of previous goods or services. It is a dynamic process that involves the development and introduction of new or improved products to meet the evolving needs and desires of consumers. It typically follows a structured approach, which may vary depending on the industry, company size, and specific goals. If one was to take a look at the process and analyze the same, the challenges present with regards to sustainability come into light. We take a look at the primary challenge faced at each step -

- **Ideation**: It requires creativity in finding solutions that not only meet consumer needs but also minimize environmental impact and promote social responsibility.
- **Concept Development**: Developing concepts that prioritize sustainability can be challenging, especially if there are conflicting priorities such as cost-effectiveness or technological feasibility.
- **Design and Prototyping**: Designing products with sustainable materials and manufacturing processes is essential but can be challenging due to limitations in available eco-friendly materials, cost considerations, and technical constraints.
- **Testing and Validation**: Testing sustainability aspects of the product involves assessing its environmental impact throughout its lifecycle, including factors like energy consumption, carbon footprint, and recyclability.
- **Launch and Commercialization**: It's essential to ensure transparency and authenticity in marketing and to educate consumers about the product's true environmental impact.
- **Post-launch Evaluation and Improvement**: Monitoring the product's environmental impact throughout its lifecycle and identifying opportunities for further sustainability improvements can be complex.

Overall, there exists the problem that most of these processes are not circular in nature, leading to a lot of waste generation and exploitation of resources (material and human).

In the light of these challenges posing themselves, we see Design Thinking emerging as a solution for the same. Design thinking is a human-centered approach to innovation that emphasizes understanding the needs and perspectives of users to develop creative solutions to complex problems. When applied to product innovation, design thinking can be a powerful framework for achieving sustainability goals. This application would be a "paradigm shift" to achieve both innovation and sustainability. By aligning with user needs and sustainability goals, fostering creativity, integrating sustainability considerations, and adapting to evolving trends, it ensures eco-friendly solutions and continuous product enhancement.

The research article explores how design thinking principles contribute to sustainable product innovation across in-

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dustries by examining theoretical frameworks, case studies, and practical examples.

II. Theoretical Foundations

Design thinking is a transformative problem-solving approach that puts human needs and experiences at its core. There are some implementation challenges that we need to understand better to be able to figure out and use practical methods of using design thinking. A common stumbling block is resistance to change and breaking away from the conventional methods that have been in place for a long period of time. Design thinking, when done right, demands investment in research, prototyping, and user testing, which can strain budgets and schedules. This brings to the question as to what are practice tips for individuals and organizations that can help them reach this goal. An individual can start by exercising empathy, embracing iteration, be open to dialogue and not let their preconceived notions limit a discussion, prototype and test and use a user centric approach. IDEO states that there are five stages to design thinking -

- **Empathize**: Understand your users' needs
- **Define**: Identify the needs and problems.
- **Ideate**: Develop potential solutions.
- **Prototype**: Transform your idea into a tangible solution.
- **Test**: Test your solution.

Sustainable product innovation encompasses the development of products that address environmental, social, and economic concerns while meeting consumer needs. Existing frameworks provide structured approaches to integrate sustainability principles into product design, manufacturing, and life-cycle management. For instance, the Cradle to Cradle (C2C) framework emphasizes designing products with materials that can be continuously recycled or biodegraded, minimizing waste and pollution. Examples of sustainable product innovation include Tesla's electric vehicles, which reduce greenhouse gas emissions and promote renewable energy adoption, and Patagonia's outdoor apparel made from recycled materials, demonstrating a commitment to circular economy principles and resource conservation. These frameworks and examples illustrate how companies can leverage sustainable product innovation to create value for both society and the environment.

Our area of focus is the intersection of these two practices. Sustainable product innovation and design thinking are symbiotic, with design thinking providing a structured framework for integrating sustainability principles into the product development process. By emphasizing empathy, problem reframing, and iterative prototyping, design thinking guides teams to develop eco-friendly solutions that meet user needs while minimizing environmental impacts. Through cross-functional collaboration, design thinking ensures diverse perspectives, including sustainability considerations, are integrated throughout the innovation process, resulting in products that align with sustainability goals and consumer preferences.

III. Methodology

Our study focuses on applying design thinking principles to drive sustainable product innovation, using three case studies. We chose case studies for their ability to provide nuanced insights into real-world situations, showcasing the interplay between design thinking and sustainable innovation. These cases demonstrate design thinking's versatility across sectors, informing a holistic exploration of its impact.

Our data primarily comes from IDEO's repository, known for its human-centered design work. We meticulously analyze these case studies, examining problem framing, ideation, prototyping, stakeholder engagement, and outcomes.

Data collection involves a detailed analysis of case studies, focusing on key elements mentioned above. We synthesize information from various sources to construct a comprehensive narrative on design thinking's role in sustainable product innovation.

The analysis utilizes thematic coding and pattern recognition to identify emergent themes and trends. Drawing from qualitative analysis frameworks like grounded theory and thematic synthesis, we distill actionable insights and theoretical generalizations from the empirical data.

IV. Case Study: Design Thinking in action

a. Case Study 1: Bayer Crop Science - Design Thinking in China

Bayer Crop Science, in partnership with IDEO, aimed to improve agricultural services in China by engaging rural farming communities with scalable and sustainable solutions. Facing challenges in understanding local needs due to a fragmented market structure, Bayer focused on empowering retailers and farmers.

Extensive field research in Anhui province revealed retailers struggling to meet farmers' demands for product knowledge and support. Farmers lacked access to expertise and resources due to factors like illiteracy and limited space in stores.

A design sprint generated numerous concepts to address these challenges. Rapid prototyping transformed a retail store in Dangtu, enabling feedback from 50+ stakeholders. Iterative refinement led to concepts seamlessly integrated into store operations, enhancing customer experiences. Successful prototypes were showcased at Bayer's National Annual Sales Conference, with over half integrated into dealer support kits for rollout across 1,000+ flagship stores. The initiative also boosted engagement through platforms like Bayer Joy Grower, benefiting over 10,000 retailers.

This collaboration illustrates design thinking's transformative potential in driving sustainable innovation in agricultural ecosystems, prioritizing local stakeholder needs and embracing iterative prototyping for enhanced engagement and empowerment.

b. Case Study 2: Innovating Airway Intubation with Design Thinking

Verathon Medical, recognizing the urgent need to enhance airway intubation procedures, collaborated with IDEO to revolutionize laryngoscopy and bronchoscopy equipment. This partnership resulted in the creation of the GlideScope Core, a groundbreaking system aimed at streamlining intubation processes in emergency situations, particularly during the COVID-19 pandemic.

The GlideScope Core features a large high-definition monitor and an integrated workstation, offering improved visibility and workflow efficiency for medical professionals. Verathon and IDEO conducted extensive research to identify pain points in existing equipment, focusing on issues like limited visibility and cumbersome workflows.

Using design thinking methodologies, the team engaged in collaborative sessions with physicians and clinic staff to ideate, prototype, and refine the GlideScope Core. Through iterative cycles of experimentation and feedback, they developed user-centric features such as touchscreen controls and team viewing capabilities.

During the COVID-19 pandemic, the mobility and high-definition display of the GlideScope Core proved invaluable in maintaining safe distances between healthcare providers and patients while ensuring swift and effective intubation.

This collaboration between Verathon and IDEO demonstrates the transformative power of design thinking in healthcare innovation. By prioritizing user needs and leveraging innovative technologies, they have significantly improved both patient outcomes and the operational efficiency of medical professionals.

c. Case Study 3: Logitech's Climate Leadership Through Design Thinking

Logitech, a leader in consumer electronics, partnered with IDEO to drive climate leadership and innovation. This collaboration aimed to develop strategies benefitting society, business sustainability, and the environment.

A key milestone for Logitech is its commitment to achieve climate positivity by 2030, going beyond carbon neutrality. This demonstrates Logitech's dedication to environmental stewardship and innovation. The partnership used creative storytelling and interactive mediums to explore sustainability, moving beyond traditional brainstorming. This approach fostered collaboration and deeper exploration of emerging trends.

Through research and collaboration, Logitech and IDEO identified innovative solutions to systemic challenges. This integration of creative thinking and analysis propelled Logitech towards sustainable leadership.

Logitech's partnership with IDEO showcases design thinking's role in driving sustainable innovation, emphasizing collaboration and imaginative approaches. This commitment to climate positivity highlights the potential for companies to create value while addressing environmental challenges.

V. Cross-Case Analysis

Upon examining the three case studies highlighting the application of design thinking in driving sustainable product innovation across different industries, several similarities, differences, and noteworthy implications emerge.

a. Similarities

- **Collaboration with IDEO**: All three case studies involve collaboration between the respective companies (Bayer Crop Science, Verathon Medical, and Logitech) and IDEO, a renowned design firm known for its expertise in human-centered design and innovation. This collaboration underscores the importance of leveraging external expertise and perspectives to catalyze innovation processes effectively.
- **Human-Centered Approach**: Each case study demonstrates a commitment to understanding and addressing the needs and challenges of end-users or stakeholders through a human-centered design approach. Whether it's empowering rural farmers in China, enhancing medical procedures in emergency rooms, or driving sustainability initiatives in a corporate setting, the focus remains on empathy, understanding, and responsiveness to user needs.
- **Iterative Prototyping**: A common thread across the case studies is the emphasis on iterative prototyping and testing to refine solutions. From transforming retail environments in China to revolutionizing medical devices and envisioning sustainable business strategies, iterative cycles of feedback and refinement are integral to the design thinking process. This iterative approach allows for rapid experimentation and adaptation, leading to more effective and user-centric outcomes.

b. Differences

- **Industry Context**: While all three case studies involve leveraging design thinking for innovation, they operate within distinct industry contexts—agriculture, healthcare, and consumer electronics. Each industry presents unique challenges, opportunities, and stakeholder dynamics, necessitating tailored approaches to innovation.
- **Nature of Innovation**: The nature of innovation varies across the case studies, ranging from enhancing customer engagement and scalability in agricultural services (Bayer Crop Science) to developing groundbreaking medical devices for airway management (Verathon Medical) and formulating strategic sustainability initiatives (Logitech). These differences highlight the versatility of design thinking in driving innovation across diverse domains.
- **Scope and Scale**: The scope and scale of the innovation initiatives differ among the case studies. For instance, Bayer Crop Science's initiative focuses on enhancing engagement at the grassroots level in rural China, while Verathon Medical aims to revolutionize medical procedures globally. On the other hand, Logitech's partnership with IDEO encompasses strategic initiatives with

far-reaching implications for the company's sustainability goals and industry leadership.

c. Implications and Insights

- **Importance of Collaboration and External Expertise**: The collaborative partnerships between the companies and IDEO underscore the value of interdisciplinary collaboration and leveraging external expertise in driving innovation. By engaging with design experts and diverse stakeholders, companies can access fresh perspectives, foster creativity, and navigate complex challenges more effectively.

- **User-Centricity as a Key Driver**: The emphasis on human-centered design principles highlights the importance of prioritizing user needs, preferences, and experiences in the innovation process. Understanding and empathizing with end-users not only leads to more impactful solutions but also fosters deeper connections and trust with stakeholders.

- **Iterative and Adaptive Approach**: The iterative and adaptive nature of design thinking facilitates rapid experimentation, learning, and refinement. Embracing a mindset of continuous improvement enables companies to respond swiftly to changing market dynamics, emerging trends, and evolving user requirements, thereby increasing the likelihood of success and sustainability.

- **Industry-Specific Challenges and Opportunities**: Recognizing the industry-specific challenges and opportunities is crucial for tailoring innovation strategies effectively. While design thinking principles are applicable across diverse sectors, customizing approaches to address industry-specific needs and contexts is essential for achieving meaningful impact.

VI. Conclusion

With a search for improved solutions, dearth of resources and integration of domains, there exists the need to enhance product innovation such that it is more adaptive in nature, can keep up with the evolving lifestyles, is more user-centric and is conscious of its social and environmental impact. By helping a value chain be somewhat circular and reduce wastage, promoting stakeholder engagement, and being a catalyst and support for finding sustainable solutions, design thinking has the scope to play a pivotal role in reshaping product innovation. The same is supported by our analysis of three case studies chosen from different sectors with the intent to highlight the versatility. The cross-case analysis highlights the overarching principles and methodologies of design thinking while acknowledging the nuances and contextual differences inherent in each case study. By synthesizing insights from diverse contexts, companies can glean valuable lessons and best practices to inform their own innovation journeys and contribute to sustainable product development and societal impact.

As we look ahead, the application of design thinking methodologies for sustainable product innovation holds immense potential to not only address current environmental challenges but also to inspire a future where creativity, empathy, and innovation converge to shape a more sustainable world.

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