Sustainable Product Strategy System Frame from the Perspective of Transition Design

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Abstract: As an important means for enterprises to achieve sustainable development, sustainable product strategy has received increasing attention. In the study of sustainable product strategy, transition design is a relatively new and forward-looking research method that proposes a design philosophy and approach by focusing on the trends of future social, cultural, and technological changes, aiming to promote sustainable development and social innovation. This paper analyzes the sustainability issues of corporate product strategy through the STEEP and multi-level perspective (MLP) approaches and develops a product strategy framework under the perspective of transition design. Based on the evaluation of five energy consumptions throughout the product life cycle, a product design strategy process is proposed. By establishing a product strategy system that promotes positive economic, social, and ecological cycles of energy consumption at corresponding stages, this system can coordinate stakeholder interests, meet the goal of sustainable development for the enterprise, and shape sustainable lifestyles for users. This study adopts a research approach that combines a transitional design perspective, sustainable design theory, and systems thinking methods, which fills the gaps in traditional design research methods in sustainable product strategy, provides enterprises with more sustainable product design solutions and promote the realization of sustainable development.

Keywords: transitional design, product design strategy, multi-level perspective, system dynamics

1. Introduction

To achieve sustainable transitions, it is essential to implement profound and fundamental transformations in the social, cultural, and organizational aspects, in addition to technological advancements and infrastructural modifications. These changes need to go beyond mere technological innovation and encompass a holistic approach that addresses the broader dimensions of society, culture, and organizations [1]. Design as a Catalyst for Sustainability Transitions, it is widely agreed that in order to contribute to transitions towards sustainability, both practitioners and design itself must also transition [2]. The issue of sustainable development is a hot topic of global concern, and the introduction of the "carbon neutral" goal has pushed the concept of sustainable development to a new level, and innovation also requires transformation to reduce environmental pollution and promote healthy economic and social development. The construction of an ecological civilization in China has reached a crucial phase that emphasizes carbon reduction as the central strategic direction.

This entails fostering the integration of pollution and carbon reduction efforts, driving the overall green transformation of economic and social development, and achieving a shift from quantitative to qualitative improvements in ecological and environmental quality. This critical period highlights the importance of prioritizing carbon reduction to advance the goals of building a sustainable and environmentally conscious society in China. In this macro context, this paper attempts to use the transition design approach, based on the socio-technical transition theory, to study the enterprise-centered sustainable product strategy, and use it to link multiple social actors to collaborate in innovation development, so as to provide enterprises with the opportunity to move from innovation to improve economic productivity to "green innovation", this may provide an implementable framework for firms to move from innovation that aims at economic growth to innovation that aims at sustainable development. Designing for sustainability not only requires the redesign of ourhabits, lifestyles, and practices, but also the way people think about design [3].

This study aims to explore the design principles and practical methods of sustainable product strategy based on the transitional design perspective. The study adopts a multi-level perspective analysis method, combining the theory of life systems, social-technical transition theory, and the entire life cycle to investigate the role of sustainable product strategy in achieving social, environmental, and economic sustainable development.

2. Method

Wicked problems are complex issues that are deeply rooted within large socio-technical systems, thus demanding innovative problem-solving methods. The Transition Design Framework encompasses a growing collection of methodologies that can be employed to: visualize and analyze intricate problems and their interconnectedness, contextualize them within expansive spatio-temporal frameworks, identify and reconcile conflicts among stakeholders while capitalizing on areas of agreement, facilitate collaboration among stakeholders to co-create visions of desirable futures, and pinpoint strategic intervention points within the complex problem system for design implementation. Instead of offering a rigid, standardized process, the Transition Design Framework offers a logical structure that brings together an evolving range of practices that are relevant to designing for systemic-level change [4].

The symbiotic relationship between the broader macro and micro levels of society, as well as the interplay between top-down and bottom-up approaches in transition efforts, is crucial. It is essential to contextualize transition-related knowledge and effectively integrate multiple sectors that require transitioning. Furthermore, understanding everyday life as the fundamental context for transition and recognizing the process of need satisfaction as a motivation for social practices are important considerations to foster sustainability. By integrating these three areas, we aim to enhance their effectiveness as tools for transition solutions, as they are more valuable when considered collectively rather than in isolation [5].

Transition design processes can be categorized into three distinct phases: First, design research is conducted to gain an understanding of the past, present, and envision potential future scenarios. Second, interventions are designed with the aim of creating appropriate solutions that align with the needs of the specific context, timing, and location. Last, design practice for transition involves accumulating these design interventions to actively drive societal transitions [6].

2.1. Mapping the Problem with STEEP

STEEP is basically an acronym which stands for Social, Technological, Economical, Environmental, and Political. It is also known around the world as PEST, PESTEL, PESTLE, STEPJE, STEP, STEEPLED, and LEPEST. Anyone who wants to control developments in the contextual factors can

conduct a STEEP analysis [7]. Using the STEEP approach, as shown in Fig. 1, this paper illustrates what problems exist in the product strategies of companies today at the social, technological, economic, environmental and policy levels, and show the links that exist between these problems. For example, most companies' product strategies are still oriented to economic benefits, while the transformation needs at the policy and environmental levels conflict with the pursuit of profits; at the technological level, companies' technological development cannot precisely correspond to the needs of consumers' cultural diversity and social identity at the social level; at the environmental level, companies' technological innovation barriers cannot meet the requirements set by ecological development, and users' consumption behaviors are influenced by their established lifestyles and sustainable lifestyles are still to be established. At the environmental level, the technological innovation barriers of enterprises cannot meet the requirements of ecological development, and the consumption behaviors of users are influenced by the existing lifestyle, and a sustainable lifestyle is still to be established.
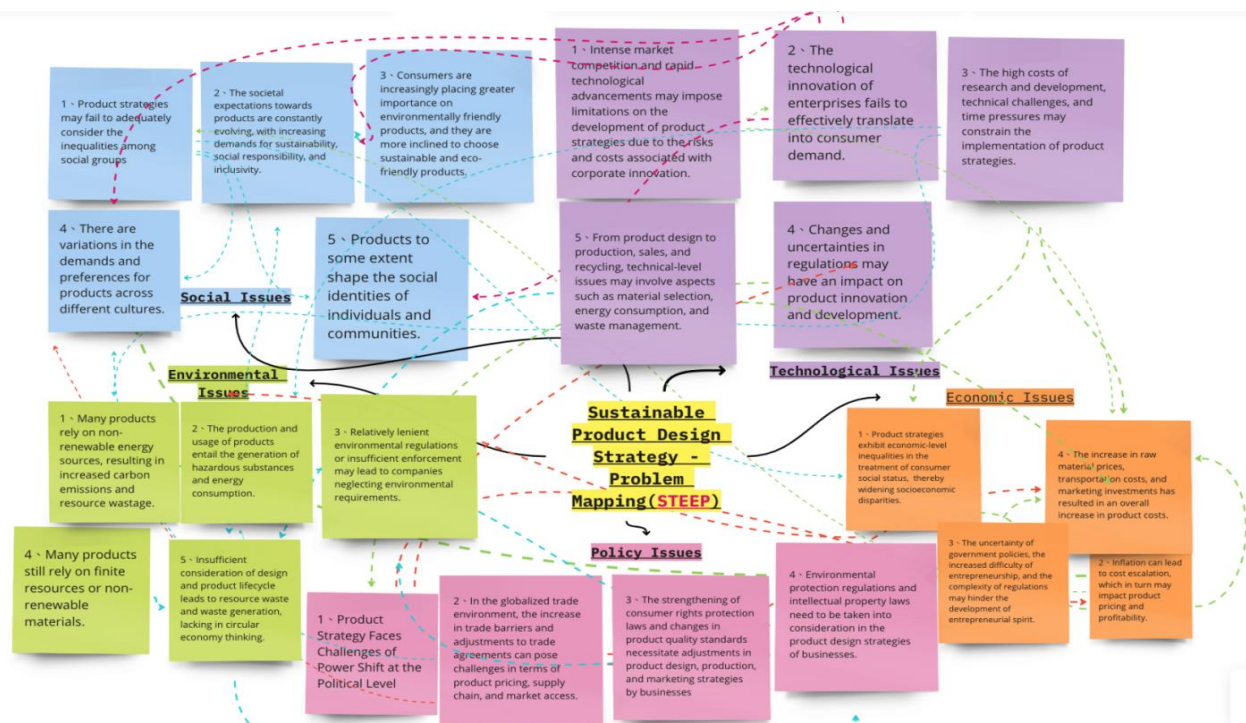

Figure 1: Mapping the problem with STEEP.

2.2. Mapping Stakeholder Relationships

Showing the stakeholder relationships in the research problem, positive relationships are linked by green lines, adversarial relationships are linked by red lines, and complex relationships are linked by blue lines, where a complex relationship is one in which there is sometimes an adversarial conflict between two groups of stakeholders, but that conflict may be indirect and has a good chance of developing synergistically through cooperation. From the stakeholder relationship diagram shown in Fig. 2, it is clear that the focus needs to be on addressing the need to improve the adversarial relationship by transforming the complex relationship into a positive one through product strategy.
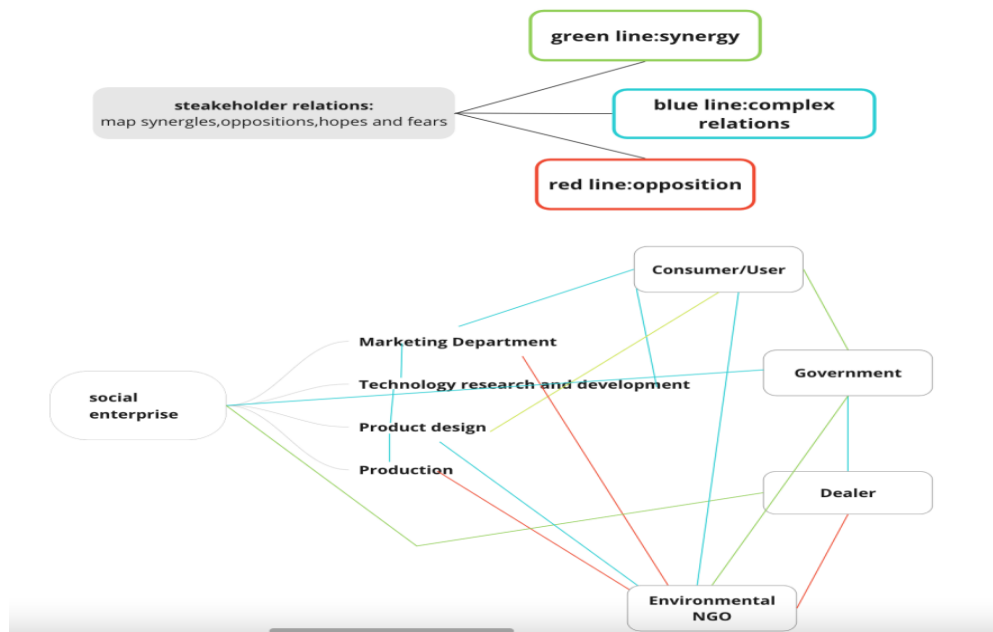
Figure 2: Steakeholder relations.

2.3. Mapping the Evolution of a Wicked Problem with MLP

The initial iteration of the Multi-Level Perspective (MLP) was introduced by Rip and Kemp, and in the 2000s, it underwent further refinement and development through empirical research conducted by Geels. MLP is particularly effective in comprehending the intricate interplay of various forces operating at the macro, meso, and micro levels, contributing to disruptive changes and understanding the dynamics among transition actors. It elucidates the evolution of niches, institutions, and social and economic subsystems as a co-evolutionary process of innovation [8]. The perspective differentiates three conceptual levels: niche, socio-technical regime, and socio-technical landscape. The underlying ontology of this perspective is rooted in the sociology of technology, where three interrelated dimensions play a crucial role. Firstly, socio-technical systems encompass the tangible elements necessary to fulfill societal functions. Secondly, social groups are responsible for maintaining and perpetuating the elements and connections within socio-technical systems. Lastly, rules (referred to as regimes) provide guidance and direction for the activities of actors and social groups involved in these systems [9].

This approach is used to analyze the problematic evolution of corporate product design strategies at THE NICHE, THE REGIME, and THE LANDSCAPE levels, where Huawei and Xiaomi are used as examples. The multi-level perspective considers that socio-technical system transformation is not a simple linear causality, but a complex process of multi-subjects, multi-dimensions, and multi-levels, interacting with each other over time. Among them, the role of the socio-technical mechanism layer is the most important, because socio-technical system transformation is usually defined as a fundamental transformation of the socio-technical mechanism. As shown in Fig. 3, taking Xiaomi and Huawei as examples, the dynamic interactions between macro, meso, and micro levels of socio-technical system transformation include: (1) top-down scenario-level pressures promote the formation of new mechanisms; e.g., the direction of national macro policy development ecology requires corresponding feedback from enterprises as important players in economic development; (2) the dynamic instability of the mechanism layer brings a window of opportunity for niche innovation, such as Xiaomi's emphasis on Internet; (3) niche innovation provides an intrinsic impetus for socio-technical system transformation through the learning process of each dimension and the social

network built, and imposes a bottom-up impetus for mechanism layer transformation, with outstanding enterprises such as Xiaomi and Huawei building new user lifestyles and habits to drive the formation of new mechanism layers.
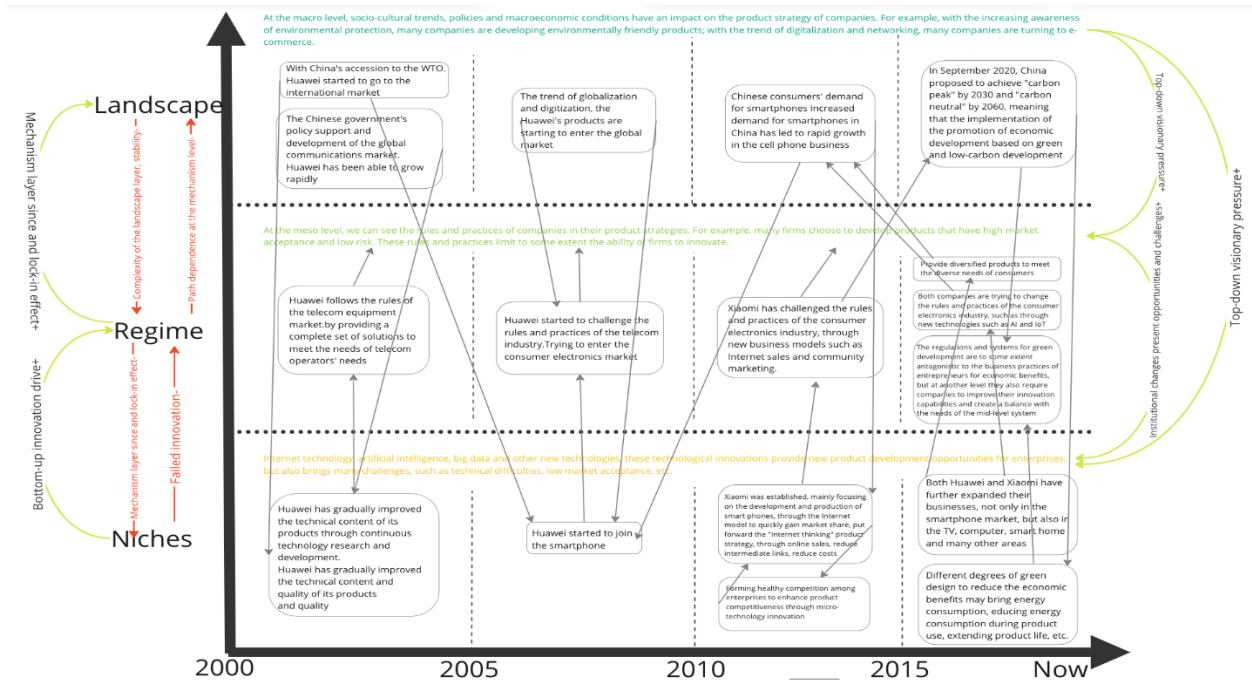

Figure 3: Mapping the evolution of a wicked problem with MLP.

2.4. Designing for Transitions

2.4.1 Developing Long-term Future Visions

This section focuses on constructing future scenarios from a transition design perspective, after all problems have been solved, describing a complete and sustainable ideal state in the realm of everyday life, so that it is clear how future systems above and below will intervene at key nodes.

As shown in Fig. 4, the enterprise as a micro-system and the external environment of the boundary and relationship, in an ideal state of transition, the enterprise and the external environment of the user, society, ecological environment to form a positive cycle of joint influence. The internal product design strategy of the enterprise shapes the sustainable lifestyle of the users and realizes the social responsibility of the enterprise; the enterprise and the users jointly promote the social and environmental benefits, while the social power and environmental resources support the development of the enterprise and human survival.
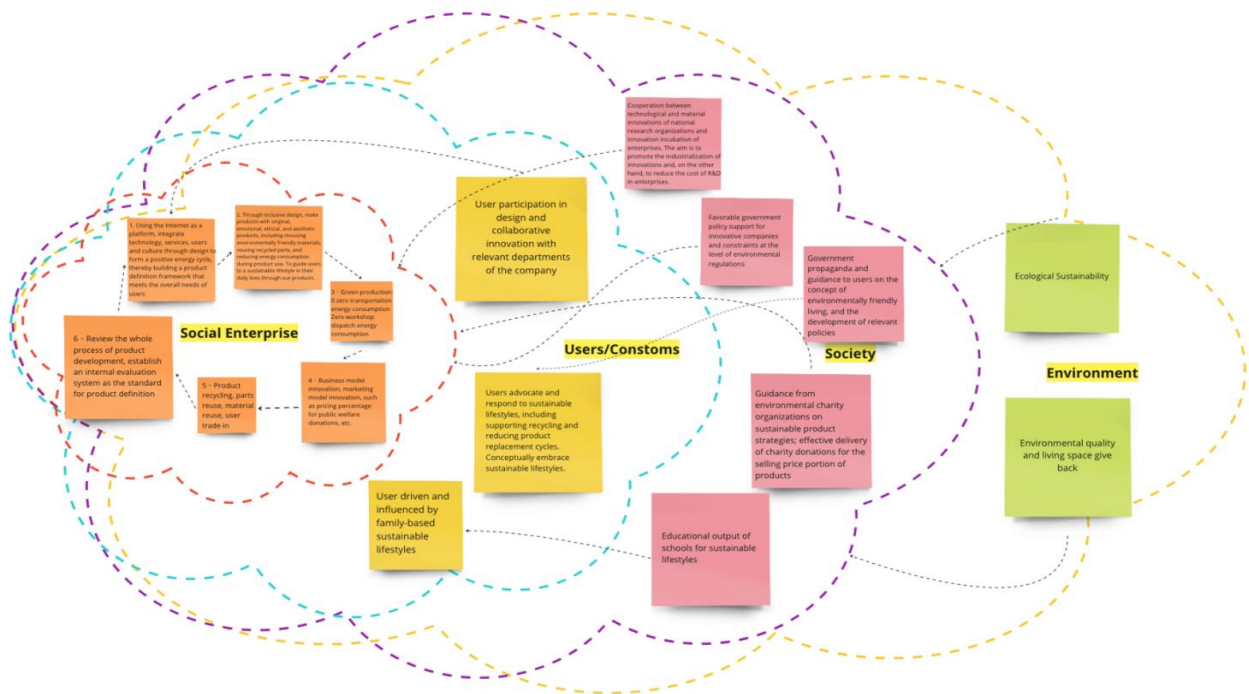
Figure 4: Designing for transition: developing long-term future visions.

2.4.2 Developing Milestones on a Transition Pathway

The solution to all problems may require a long process, which will be subdivided and milestones will be set for each stage. As shown in Fig. 5, the product design strategy is expected to achieve in the future development. Design about the decades-long transition between the problematic present and that long-term desired future.
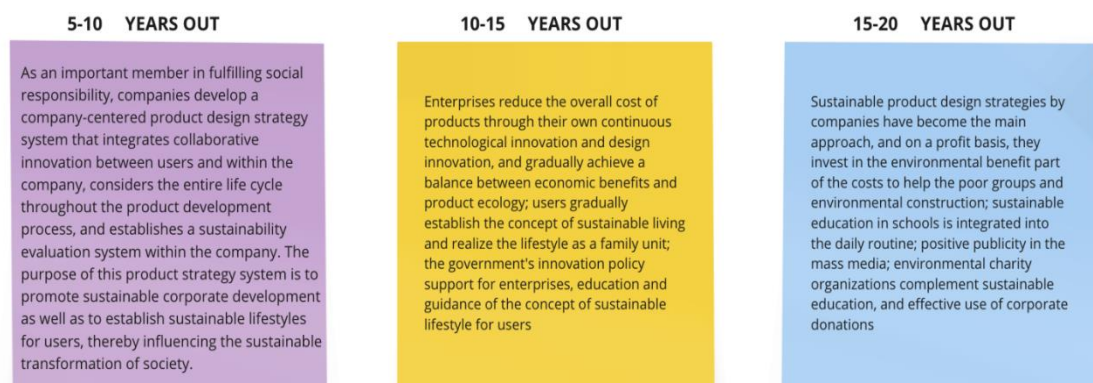

Figure 5: Designing for transition: developing milestones on a transition pathway.

2.5. Designing Systems Interventions

This section focuses on a matrix showing the initiatives that can be taken in the 5 categories corresponding to the problem and labeling the level of daily life domain they correspond to. In the actual intervention, these initiatives are linked in series and support each other, as shown in Fig. 6. Since the carrier of the research object is the enterprise, the product strategy system to be adopted by the enterprise is shown specifically in the following, i.e., this product design strategy is internal to the

enterprise, but this users, other players in the social environment are in the external environment of the system and constantly interacting with the product strategy system. This product design strategy is therefore a company-centered system in which other stakeholders participate to varying degrees. As shown in Fig. 7, the product strategy framework formed by the above analysis takes the product development and design process as the basic path, and adds the evaluation links that are missing in the general corporate design process, and the interventions in the overall process can correspond to the technical, social, commercial, policy, and environmental levels. In this framework, the corresponding links are intended to reduce the five types of energy consumption generated during the whole life cycle of the product: embedded energy (material selection), gray energy (material transportation link), induced energy (manufacturing link), operational energy (product operational energy consumption), and disposal energy (dismantling, end-of-life link) [10].
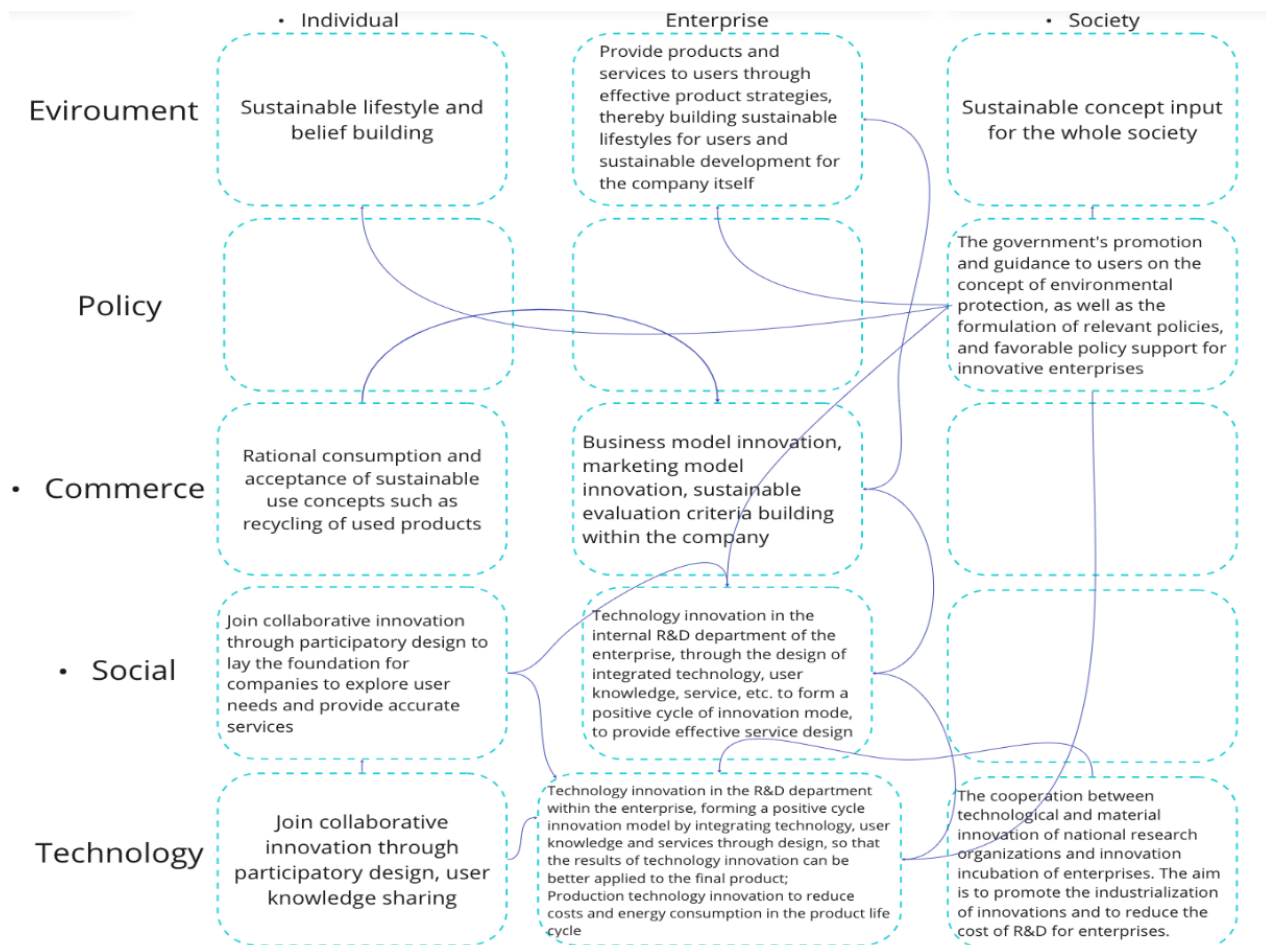

Figure 6: Designing interventions (Situate each project in a specific problem areas and optimal level of scale).
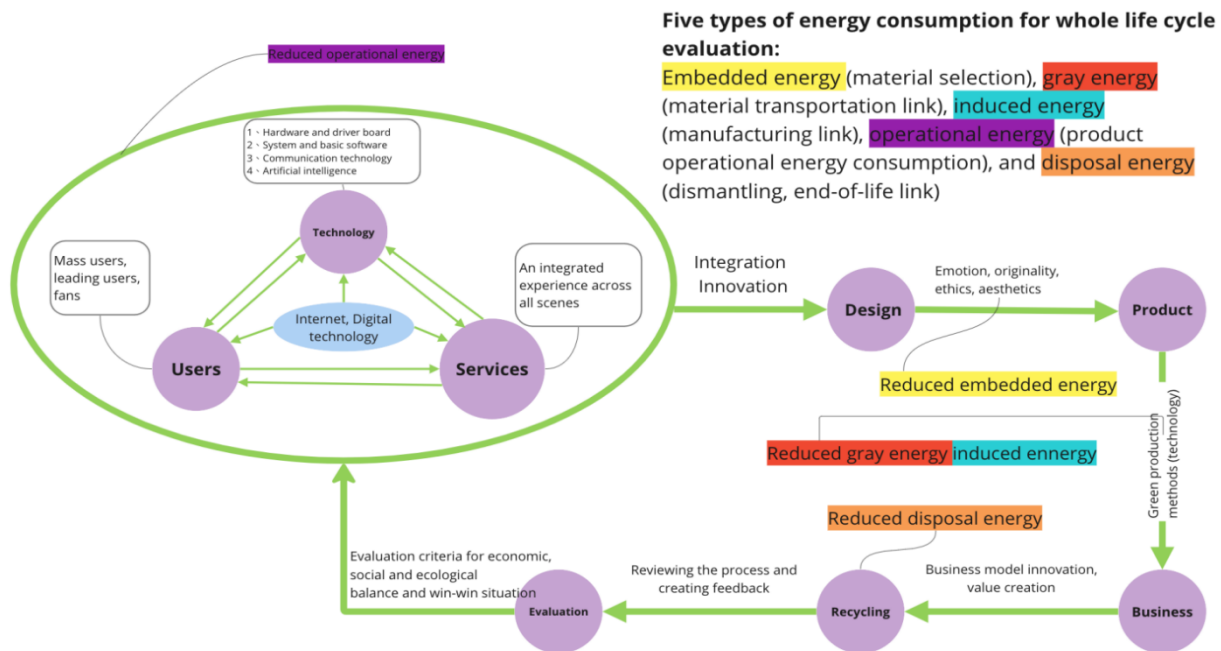
Figure 7: A framework for product strategy system from a transitional design perspective.

3. Conclusion

The sustainable product design strategy under the transitional design perspective requires the participation of various social actors and stakeholders. In this study, we focus on how companies, as the core participants, can convey the concept of sustainability to the outside world through internal sustainable product strategies, influence the establishment of sustainable lifestyles of direct stakeholders, and realize corporate social responsibility. In the product strategy framework derived from this study, the product development process is optimized and the energy consumption generated during the entire product life cycle is reduced at the corresponding stage: at the demand discovery stage, artificial intelligence technology and effective user engagement are used to accurately transform user demand in a timely manner, forming a positive cycle of technology, user, and service complementing each other, which facilitates precise positioning of demand at the beginning of product development and takes sustainability into consideration. Through cross-disciplinary integration, product design is completed with emotion, ethics, originality and aesthetics as the standard; green production methods such as scientific workshop scheduling reduce gray energy and induced energy in the production process; sales of products through business model innovation to realize value creation; perfect product recycling and reuse policy Finally, the evaluation criteria will be incorporated into the first step of product development, i.e. demand mining and transformation, and the sustainability of products will be considered at the beginning of design to form a systematic closed loop.

Sustainable product strategy is an important approach to achieving social, environmental, and economic sustainability. By adopting a transitional design perspective and a multi-level analysis approach, this study proposes a series of design principles and practical methods for sustainable product strategy. These include: considering sustainability comprehensively from the perspectives of the product's entire lifecycle and the three dimensions of environment, society, and economy; approaching the design process from the standpoint of stakeholders, utilizing open innovation models and collaborative design methods; and emphasizing user experience and human-centered design. This research combines the perspectives of transitional design, sustainable design theory, and systems

thinking methodology to address the shortcomings of traditional design research methods in the context of sustainable product strategy. Such as the lack of user participation in demand mining, product development for the purpose of purely economic revenue, the lack of recycling and evaluation links in the product process, such as the above deficiencies are due to the lack of participation in the design strategy of system thinking. The purpose of this study is to promote the sustainable development and transformation of society by establishing sustainable product strategies for enterprises and shaping sustainable lifestyles for users and forming a positive feedback loop with society and the ecological environment.

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