

Research on the Development Path of Innovation Management in Technology-Driven Enterprises

Yunxin Du

Information School, The University of Sheffield, Sheffield S10 2TN, South Yorkshire, The United Kingdom

Abstract: This paper explores the development path, key influencing factors and future trends of technology-driven enterprises in innovation management, in order to reveal how they can achieve competitive advantages through effective innovation management in the context of technological change. Research shows that the innovation management of such enterprises presents significant stage characteristics. From early exploration to later product development, the optimal allocation of resources and strict screening mechanisms throughout multiple stages have improved the success rate of innovation. In addition, the management models adopted in different stages are flexible and diverse, including both agile management of fuzzy front-ends and process control in mature stages. The key factors affecting innovation management mainly include technology research and development capabilities, organizational culture, market demand and policy environment. Digitalization and intelligence have further optimized the innovation process, enabling enterprises to respond to market demand more quickly. With the widespread application of open innovation and cross-departmental collaboration, innovation management has gradually developed in an open, collaborative and sustainable direction, contributing key forces to the long-term competitiveness and social value of technology-driven enterprises.

Keywords: Technology-Driven Enterprises; Innovation Management; Development Path; Key Factors; Digitalization

1. Introduction

1.1 Research Background and Importance

Against the backdrop of globalization and rapid technological development, technology-driven enterprises have become the core force driving innovation and economic growth. With the widespread application of emerging technologies such as artificial intelligence, big data, and the Internet of Things, the innovation management model of technology-driven enterprises has shown unique advantages and challenges[1]. By implementing a "technology-driven business strategy", some companies have achieved disruptive innovation, enabling them to gain competitive advantages in a highly competitive market[2]. Innovation management has become a key factor for companies to maintain their market competitiveness and achieve sustainable development, as it helps companies cope with complex challenges and uncertainties in a rapidly changing environment[3].

Research shows that technology-driven companies often adopt open innovation and knowledge sharing models in innovation management to promote internal innovation and cross-organizational collaboration[4]. The key to this model is to enhance the company's innovation capabilities and market response speed by building an innovative culture, thereby ensuring that the company can occupy a favorable position in the fierce market competition[5]. In addition, with the continuous deepening of digitalization and intelligence, the innovation management model of technology-driven companies needs to be constantly adjusted to adapt to the rapid iteration of technology and the diversification of user needs[6]. Therefore, systematically studying the development path of innovation management of technology-driven enterprises not only helps to understand the core driving mechanism of enterprise innovation, but also

provides strategic guidance for policymakers and managers.

1.2 Research Objectives

This paper aims to explore how technology-driven enterprises can build and optimize their innovation management model in a rapidly changing technological environment to promote sustainable development of enterprises. In this process, this study will focus on the development path of innovation management, analyze the innovation characteristics and patterns of technology-driven enterprises in different development stages, and identify the key factors affecting the effectiveness of innovation management. In addition, this study attempts to provide enterprise managers with effective innovation strategies and management tools through a review of the theory and practical cases of innovation management to improve the competitiveness and innovation capabilities of technology-driven enterprises. Finally, by systematically analyzing the development path and trend of innovation management of technology-driven enterprises, this paper will provide theoretical support and practical guidance for subsequent research and enterprise practice.

2. Technology-Driven Enterprises and the Foundation of Innovation Management

2.1 Definition and Characteristics of Technology-Driven Enterprises

Technology-driven enterprises are usually defined as enterprises with technological innovation as their core competitiveness, and their competitive advantage mainly comes from the mastery and application of high-tech. Such enterprises not only achieve business growth through technological development, but also continuously promote industry development and bring new products and services to the market. Research shows that these companies usually have a high proportion of R&D investment to ensure technological leadership and gain market share through patents and unique technological capabilities[7]. Grinstein and Goldman's research analyzed the characteristics of technology-based enterprises and found that these enterprises are highly dependent on

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technology in terms of product strategy and corporate culture, and pay special attention to the direct impact and driving force of technology on the market[8]. In addition, technology-driven enterprises often have a high market acumen and can quickly transform technological achievements into products, thereby gaining a sustained competitive advantage in a dynamic market environment[9]. Therefore, technology-driven enterprises usually show characteristics such as high R&D investment, strong innovation capabilities, and fast market response speed, which provides theoretical support for their definition.

2.2 Basic Concepts and Theoretical Framework of Innovation Management

Innovation management aims to stimulate innovation activities within the enterprise through effective resource allocation and strategic planning, and ensure that the results of innovation can bring actual benefits to the enterprise. Research shows that the core of innovation management is to build an environment that encourages creativity and maintains efficient operation of the organization[10]. The "strategic technology management" model proposed by Ansoff advocates that through meticulous technology planning and market segmentation strategies, technological innovation can be aligned with market demand to achieve the best market effect [11]. In addition, the innovation management framework also covers the whole process management method from innovation resource acquisition, innovation process management to innovation results application, ensuring that enterprises can maintain their technological and market advantages in a highly competitive market. The innovation management framework emphasizes flexible response to market changes while maintaining the continuity of the innovation process, thereby creating long-term value for enterprises in a complex and changing environment.

2.3 The Impact of Technology-Driven Innovation Management

Technology-driven enterprises show different characteristics from traditional enterprises in innovation management. This drive stems from a high degree of reliance on

technological innovation. The innovation management of technology-driven enterprises involves more technology-oriented market innovation and product development strategies, and achieves product and service differentiation by integrating technology resources with market demand [12]. Steinhardt's research shows that the management strategy of technology-driven enterprises usually promotes innovation through technology, and also involves in-depth exploration of market and user needs to create products that meet market trends. Cho et al.'s research further pointed out that technology-driven innovation management usually combines the dual strategies of market-driven and technology-driven to ensure that competitive advantages can be obtained in both technology research and development and market response [13]. In general, technology-driven not only accelerates the innovation process, but also brings differentiated competitive advantages to enterprises, enabling them to maintain their leading position in a rapidly changing market.

3. Development Path of Innovation Management in Technology-Driven Enterprises

3.1 Phased Development of Innovation Management

Innovation management in technology-driven enterprises usually follows a phased development path to ensure that innovation activities can be systematically and effectively promoted. The Stage-Gate system is a widely used innovation management method that divides the innovation process into several stages, with "gates" as evaluation points after each stage to gradually screen out the most promising innovation projects [14]. This method is applicable to all aspects of the product development process, especially in high-tech enterprises, where it can effectively reduce the risk of innovation failure and increase project success rate [15]. In addition, management can optimize resource allocation and improve innovation efficiency through clear phased goals and evaluation criteria. This model provides a highly operational management framework for complex technological innovation projects, enabling enterprises to maintain flexibility and control

in a highly uncertain environment. This phased innovation management approach enables companies to identify and support high-potential innovation projects at an early stage through layered screening, thereby achieving sustained competitiveness in a dynamic market.

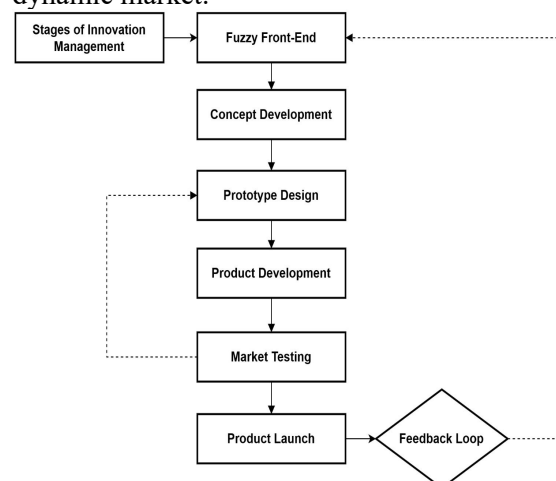


Figure1. Stages of Innovation Management
Figure1 illustrates the stages of innovation management in technology-driven enterprises, emphasizing the iterative nature of the process. Starting with the fuzzy front-end phase, where initial ideas and inspirations emerge, the process advances through concept development and prototype design, where foundational concepts are translated into initial designs. These prototypes are refined through product development and rigorously evaluated during market testing to ensure alignment with market needs. After product launch, a structured feedback loop enables insights from the market and technology to inform adjustments in earlier stages, facilitating continuous improvement and adaptability. This feedback mechanism, especially between market testing and prototype design, underscores the process's responsiveness, allowing for ongoing refinement and ensuring the final product's relevance and competitive advantage.

3.2 Innovation Management Models and Case Analysis at Different Stages

Different stages of innovation management often adopt their own adaptive management models to cope with different needs at each stage. For example, in the early "fuzzy front end" stage, enterprises need greater flexibility and creative freedom to stimulate potential

breakthrough innovations. Gonzalez proposed that the use of agile project management methods to manage the early stages of innovation can improve the dynamics and adaptability of management, and is suitable for innovation projects in the high-tech field that need to respond quickly to market changes [16]. In terms of case analysis, Bayer Group used a four-stage Stage-Gate process in the field of life sciences, covering the entire process from early innovation exploration to later product development. The process combines market potential, innovation degree and other indicators, enabling Bayer to accurately evaluate project value at different innovation stages and optimize decision-making processes [17]. These examples show that the innovation management models and case analysis at different stages provide a reference for enterprises to choose appropriate management methods in the innovation process.

3.3 Development Path of Typical Technology-Driven Enterprises

Technology-driven enterprises usually adopt a variety of strategies in innovation management to cope with the rapidly changing market demand and technology update speed. For example, NASA's innovation management path adopts a complex Stage-Gate model, emphasizing strict resource evaluation and technology screening at each stage to improve the technical maturity and market adaptability of the project [18]. This innovation management path emphasizes scientific resource allocation and strategic decision-making in the early stages to reduce technical risks and increase project success rates. In addition, Xia's research points out that the innovation management development path of high-tech enterprises usually presents a complete process from resource acquisition, strategy formulation to execution and maintenance [19]. These development paths enable technology-driven enterprises to continue to advance in the wave of technological change, ensure their leading position in the industry, and achieve long-term sustainable growth through innovation management.

Figure 2 shows the innovation development path of a typical technology-driven enterprise. Starting from the technology research and

development stage, the enterprise focuses on the development and breakthrough of core technologies, and then enters product concept generation to transform technology into a feasible product concept. Subsequently, the preliminary design is verified in prototype design and testing, and then the product is optimized to improve functions and performance. In the market testing stage, market feedback is collected through small-scale launches, and then the product is mass-produced to achieve large-scale production. After the market promotion stage, the enterprise reviews the entire process through feedback collection in order to optimize the cycle according to market demand and technology improvement, ensuring that the product continues to meet the market and technology development trends.

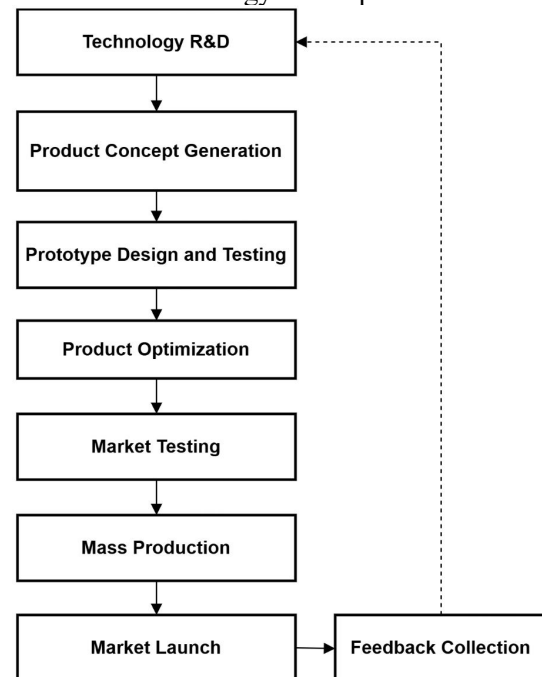


Figure 2. Development Path of a Typical Technology-Driven Enterprise

4. Key Factors and Trends in Innovation Management of Technology-Driven Enterprises

4.1 Key Influencing Factors of Innovation Management

The innovation management of technology-driven enterprises is affected by many factors, which together determine the innovation performance of enterprises in a complex market environment. First, one of the key factors is the ability of enterprises in

technology research and development. Continuous investment in R&D and well-developed technological capabilities can enable the enterprise to keep its competitive advantage in fierce market competition and quickly respond to market needs. In addition, the organizational culture and management systems should be appropriate to support innovation. The open and inclusive cultural environment makes employees bolder in the exploration of innovative opportunities with less fear of failure. An atmosphere like this is important for innovative behavior. Finally, market demand and policy environment are influencing factors too. A technology-driven enterprise often needs to pay close attention to market changes and adjust strategies with a faster pace to cope with the changing needs of users. What is more, relevant policies and regulations published by governments and industries also guide the way of innovation importantly. In one word, main factors in innovation management are multi-dimensional; an enterprise should coordinate multi-dimensional progressive circumstances in technology, culture, market, and policy with a view to providing an unmovable yet dynamic environment for innovation.

4.2 The Impact of Digitalization and Intelligence on Innovation Management

The wave of digitalization and intelligence has driven the innovation management model of technology-driven enterprises to profound transformation. By the means of digitalization, an enterprise can further understand market trends and user needs through data analysis and thus make more accurate adjustments to innovation strategies. Taking big data analysis as an example, it can help enterprises predict changes in market demand and make the goods and services provided more personalized. Meanwhile, intelligent technologies represented by artificial intelligence and the Internet of Things bring higher automation and intelligent management to the innovation process. This not only improves efficiency in innovation but also promotes refinement and personalization during the innovation process. Application of the intelligent technologies simplifies the product development process: rapid prototyping is possible, thus iteration is possibly done, which shortens the product

cycle from concept to market. This trend not only improves innovation efficiency, but also provides enterprises with more flexible innovation management tools, enabling them to adapt to changes in market demand more quickly.

4.3 Future Development Trends of Innovation Management

Looking to the future, the innovation management of technology-driven enterprises will tend to be more open, collaborative and sustainable. First, open innovation will become the mainstream trend. Enterprises will no longer be limited to internal innovation, but will obtain a wider range of innovation resources through cooperation with external enterprises, scientific research institutions and users. This kind of collaborative innovation helps enterprises break through the limitations of their own resources and accelerate the generation of innovative results. Secondly, cross-departmental collaboration and platform management will provide a new development path for innovation management. By integrating the resources and capabilities of different departments within the enterprise, innovation projects can obtain stronger support and achieve collaborative management of the entire process. In addition, sustainable development will also become an important goal of innovation management in the future. In the process of innovation, enterprises will place more emphasis on efficient use of resources and ecological responsibility to achieve long-term sustainable growth. In general, future innovation management will tend to be flexible, open and responsible in order to cope with the increasingly complex market and technological environment.

5. Conclusion

This paper systematically analyzes the paths, key factors and trends of innovation management in technology-driven enterprises, and explains how these enterprises can maintain their competitiveness through effective innovation management in a rapidly changing technological environment. The development path of innovation management in technology-driven enterprises has a phased characteristic, from the early exploration of the "fuzzy front end" to the gradually mature product development. This process is usually

accompanied by multi-stage screening and resource optimization allocation to ensure that innovation projects can find the best balance between market demand and technological possibilities. At the same time, the innovation management models adopted in different stages also have their own characteristics, including highly flexible early agile management and later processes that emphasize evaluation and control. Technology-driven enterprises can significantly improve the success rate of innovation and inject momentum into the sustainable development of enterprises through the flexible application of innovation models at various stages.

Among the multiple factors affecting the innovation management of technology-driven enterprises, technical capabilities, organizational culture, market demand and policy environment play a core role. In addition, the in-depth application of digitalization and intelligence has further improved the efficiency of innovation management, enabling enterprises to grasp market trends and user needs more accurately and respond quickly. Looking to the future, innovation management will be more open, collaborative and sustainable. Open innovation and cross-departmental collaboration will further promote resource integration, and the integration of sustainable development concepts will ensure that enterprises fulfill their ecological responsibilities while pursuing innovation. In short, the innovation management of technology-driven enterprises needs to find a dynamic balance between flexibility and control, openness and collaboration, in order to achieve a dual improvement in long-term competitive advantages and social value.

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