The Impact of Design Thinking Based on Humanism on Innovation Management

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Abstract*—In the current global market environment characterized by rapid development and fierce competition, the survival and growth of enterprises increasingly hinge on effective innovation management. This research centers on the design thinking underpinned by humanism and comprehensively and in-depth explores its multifaceted impacts on enterprise innovation management.By systematically dissecting the theoretical origins and key elements of design thinking, this study takes user needs as the starting point and conducts the analysis using rigorous experimental methods. The research findings reveal that design thinking can significantly optimize the innovation process, making it more flexible, iterative, and user-oriented. Through rapid prototyping and user testing, enterprises can promptly obtain feedback and refine the design schemes, thereby enhancing the efficiency and quality of innovation.Simultaneously, design thinking vigorously promotes cross-departmental collaboration, breaks down the barriers of traditional organizations, integrates the knowledge and skills of members with diverse professional backgrounds, and gives rise to more innovative ideas and solutions. Moreover, it actively cultivates an innovative culture, encourages employees to be bold in experimentation and innovation, creates an open, inclusive, and cooperative working atmosphere, and stimulates the innovative potential of employees.The experimental results clearly demonstrate that the teams receiving training in humanistic design thinking significantly outperform the control groups adopting traditional innovation management methods in core indicators such as innovation efficiency, user satisfaction, and team collaboration. The application effects are particularly remarkable in the high-tech industry.This study not only provides abundant and systematic data support for the theoretical development and practical application of design thinking but also further enriches the theoretical framework of innovation management. It offers scientifically-based guidance for enterprises when implementing design thinking and precisely pinpoints the points of convergence between design thinking and the characteristics of different industries, effectively expanding its application scenarios and providing new ideas and directions for enterprises' practices in the field of innovation management.

Keywords—Design Thinking; Humanism; Innovation Management; User Experience; Interdisciplinary Collaboration

I. INTRODUCTION

In the current era of globalization and rapid technological advancements, enterprises are confronted with increasingly fierce market competition. In order to stand out in the competition, enterprises must continuously innovate to meet the ever-changing needs of customers (Drucker et al., 1986); (Christensen et al., 2015). Innovation management, as an important component of enterprise management, aims to promote the innovative activities of enterprises and improve innovation performance through effective organizational and management means (Tidd et al., 2020); (Damanpour et al., 2012). However, traditional innovation management methods often focus on the improvement of technologies and processes, neglecting the importance of user needs and experiences (Strategy et al., 2005); (Porter et al., 2008).

Design Thinking, as an emerging innovative approach with humanism at its core, emphasizes starting from the perspective of users. It provides inspiration and direction for innovation by means of thoroughly understanding users' needs, observing users' behaviors, and exploring users' latent needs (Brown et al., 2008); (Martin et al., 2009). The emergence of design thinking has brought new perspectives and methods to innovation management. It organically combines users' needs, technological feasibility, and commercial feasibility, helping enterprises to better understand and meet customers' needs and enhance the success rate of innovation (Kelley et al., 2001).

In recent years, design thinking has received extensive attention and application in the business community (Carlgren et al., 2016); (Micheli et al., 2019). Many enterprises have integrated design thinking into various fields such as product development, service design, and strategic planning, achieving remarkable innovative results. For example, Apple Inc., with its outstanding design thinking and user experience, has become one of the most innovative enterprises in the world (Isaacson et al., 2011); IBM has successfully achieved business transformation and growth through the implementation of a design thinking-driven innovation strategy (Yoo, Young** et al., 2010). However, although design thinking has achieved certain success in practice, the specific impact mechanism on innovation management and the differences in application effects in different industries still require further research (Seidel et al., 2013).

This research aims to fill this gap by employing the method of experimental research to thoroughly explore the impact of humanism-based design thinking on innovation management. Specifically, this study will verify whether design thinking can significantly enhance the innovative capabilities of enterprises, optimize user experience, promote team collaboration and other aspects of performance, and analyze the differences in application effects across different industries. The results of this study will provide theoretical support and practical guidance for enterprise innovation management, helping enterprises to better apply design thinking, improve innovation performance, and strengthen their market competitiveness.

II. RELATED WORK

The concept of design thinking can be traced back to the 1960s when it was proposed by American scholar Herbert A. Simon (Simon et al., 1969). He regarded design as a problem-solving process that is closely related to science and art. Since then, design thinking has gradually developed into

a systematic innovative method and has been widely applied in various fields (Cross et al., 2001); (Rowe et al., 1987).

During the development of design thinking, many scholars have conducted in-depth research and discussions on it. For example, Brown defined design thinking as "a human-centered innovative method that provides inspiration and direction for innovation by thoroughly understanding users' needs, observing users' behaviors, and exploring users' latent needs". Martin, on the other hand, emphasized the application value of design thinking in the business field, believing that design thinking can help enterprises create more competitive products and services, and improve their innovative capabilities and market shares (Martin et al., 2009).

In the field of innovation management, traditional innovation management methods mainly focused on technological innovation and product innovation, neglecting the importance of users' needs and experiences (Joseph et al., 1990). With the intensification of market competition and the diversification of customer needs, more and more scholars have begun to pay attention to user-oriented innovation management methods (von Hippel et al., 2005); (Chesbroughl et al., 2003). As a user-centered innovative method, design thinking is highly consistent with the concept of user-oriented innovation management, and thus has received extensive attention and research (Sanders et al., 2008); (Prahalad et al., 2004).

Some studies have explored the relationship between design thinking and innovation performance. For example, Cagan et al. found through empirical research that design thinking can significantly improve the innovation performance of enterprises, including product innovation capabilities, innovation efficiency, and market competitiveness (Cagan et al., 2013). Liedtka, from the perspective of cognitive biases, explored the impact of design thinking on innovation, believing that design thinking can help teams reduce cognitive biases and improve the quality of innovation decisions (Liedtka et al., 2017).

However, there are still some deficiencies in the current research on the impact of design thinking on innovation management. Firstly, most studies have adopted methods such as case analysis or questionnaire surveys, lacking experimental verification, and the reliability and universality of the research results need to be further improved (Elsbach et al., 2018); (Sonalkar et al., 2013). Secondly, the research on the differences in the application effects of design thinking in different industries is not in-depth enough, lacking targeted guidance suggestions (Swan et al., 2011); (Dym et al., 2005).

This research aims to overcome the above deficiencies by adopting the experimental research method to systematically explore the impact of humanism-based design thinking on innovation management and analyze the differences in its application effects in different industries. This research will provide more in-depth theoretical support and practical guidance for the application of design thinking in the field of innovation management.

III. The Origin and Development of Design Thinking

The origin of design thinking can be traced back to the Bauhaus movement in the early 20th century. This movement emphasized the combination of art and technology and focused on the unity of function and form. Since then, design thinking has been continuously developed and evolved in different fields. In the engineering field, design thinking is used to solve complex technical problems; in the business field, design thinking is applied to product innovation and service design; in the social field, design thinking is utilized to address various social problems.

In the 1960s, American scholar Herbert A. Simon put forward the concept of "design science", regarding design thinking as a scientific method and emphasizing the solution of problems through systematic analysis and synthesis. In the 1980s, design thinking began to draw the attention of the business community, and some enterprises started to apply it to product development and innovation management. Since the 21st century, with the development of the Internet and information technology, design thinking has been more widely spread and applied, becoming a global innovative method.

IV. The Central Position of Humanism in Design Thinking

Humanism represents the core value of design thinking, which emphasizes putting people first and focusing on people's needs, experiences, and emotions. During the process of design thinking, designers always prioritize users. By thoroughly understanding users' needs and behaviors and exploring their latent needs, they can design products and services that better meet users' requirements.

The manifestations of humanism in design thinking mainly include the following aspects

a) User Research: Through various methods such as observation, interviews, and questionnaire surveys, a deep understanding of users' needs, behaviors, and psychology is achieved to provide a basis for design.

b) Empathy: Designers are required to think from the perspective of users, experiencing their needs and emotions, so as to better understand users.

c) Participatory Design: Users are encouraged to participate in the design process, making them an integral part of the design, and jointly creating products and services that better meet their needs.

d) Human-Centered Design: Emphasis is placed on the ease of use, comfort, and safety of products and services to enhance users' experience and satisfaction.

V. The Impact of Design Thinking on Innovation

A. Transformation of Innovation Concepts

Traditional innovation management concepts have often focused on technological innovation and product innovation while neglecting user needs and experiences. The introduction of design thinking prompts enterprises to shift from a technology-centered innovation concept to a user-centered one. Enterprises begin to pay attention to user needs and experiences, taking user needs as the starting point and ending point of innovation, thereby increasing the success rate of innovation.

B. Optimization of Innovation Processes

Design thinking provides a brand-new set of processes and methods for innovation management, including stages

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such as problem discovery, problem definition, solution conceptualization, prototype making, testing, and iteration. Compared with traditional innovation processes, the design thinking process is more flexible, iterative, and user-oriented. Through rapid prototype making and user testing, enterprises can promptly obtain user feedback and adjust and optimize the design scheme, thereby improving the efficiency and quality of innovation.

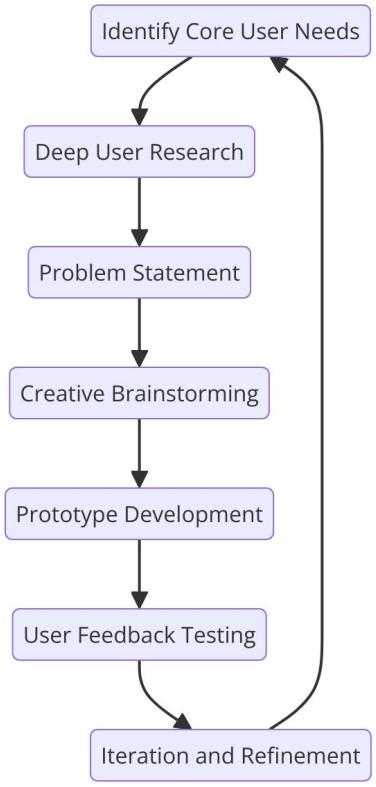

Fig. 1. Innovation Process

C. Collaboration of Innovation Teams

Design thinking emphasizes interdisciplinary and cross-departmental team collaboration, breaking down the barriers between departments in traditional organizations. In a design thinking team, members come from different professional backgrounds, such as design, engineering, marketing, and psychology. Through close cooperation and communication among team members, the knowledge and skills of different professions are integrated, thereby generating more innovative ideas and solutions.

D. Cultivation of Innovation Cultures

Design thinking is helpful in cultivating an innovation culture that encourages employees to be brave enough to try and dare to innovate. In the process of design thinking, it is emphasized that failure is the mother of success, encouraging employees to learn and grow from failures. Meanwhile, design thinking also focuses on creating an open, inclusive, and cooperative working atmosphere, enabling employees to freely express their ideas and viewpoints, thereby stimulating their innovation potential.

VI. Application Cases of Design Thinking in Different Fields

A. Product Design Field

Apple Inc. is a successful exemplar of the application of design thinking in the product design field. With user experience at its core, Apple emphasizes the simplicity, ease of use, and aesthetic design of its products. By thoroughly understanding user needs, Apple has continuously launched innovative products, such as the iPhone and iPad, leading the trend of global consumer electronics.

B. Service Design Field

Starbucks is one of the representative enterprises applying design thinking in the service design field. Starbucks creates a unique experience for customers by creating a unique in-store environment, providing personalized services and high-quality coffee products. Meanwhile, Starbucks also focuses on interacting and communicating with customers, continuously improving service quality to enhance customer satisfaction.

C. Education Field

The d.school at Stanford University represents an innovative practice of design thinking in the education field. The d.school adopts a project-based learning approach, allowing students to solve practical problems in interdisciplinary teams. Through the training of design thinking, students not only master innovative methods and skills but also cultivate teamwork spirit and problem-solving abilities.

D. Medical Field

The Cleveland Clinic in the United States is one of the application cases of design thinking in the medical field. By introducing design thinking, the Cleveland Clinic has redesigned the medical processes, improving medical efficiency and quality. Meanwhile, the Cleveland Clinic also focuses on patient experience, enhancing patient satisfaction by improving the hospital environment, providing personalized medical services, and other means.

VII. Experimental Verification of Design Thinking in Innovation Management

A. Experimental Objectives

This experiment aims to verify whether humanistic design thinking can significantly enhance the performance of enterprises in innovation management, particularly in terms of product innovation capabilities and user experience optimization. Through a rigorous experimental design, the actual effects of design thinking in the enterprise environment will be examined, and data support will be provided for its application.

B. Experimental Hypotheses

The experimental group that receives humanistic design thinking training will have significantly higher product innovation capabilities than the control group that adopts traditional innovation management methods.
The experimental group will be significantly superior to the control group in terms of user experience optimization (measured by user satisfaction).

There are differences in the effects of design thinking training on innovation management in different industries.

C. Experimental Design

Experimental Subjects: 120 innovation management teams from the manufacturing, service, and high-tech industries were selected, with each team consisting of 8 - 10 members.
Experimental Grouping: A random grouping method was used to divide the teams into an experimental group and a control group, with 60 teams in each group.
Intervention Measures:
Experimental Group: Received a six-week humanistic design thinking training course, including theoretical learning, case analysis, and practical project sections. The training content covered user research methods, empathy training, creative idea generation techniques, prototype making and testing, etc.
Control Group: Did not receive any design thinking training and continued to work according to traditional innovation management methods.

D. Experimental Procedure

Pretest: Before the start of the experiment, a baseline assessment of the innovation capabilities and user experience of all teams was conducted. Methods such as questionnaire surveys, team project evaluations, and expert reviews were used to collect data on the teams' innovation concepts, innovation processes, team collaboration, and user orientation.

Intervention Implementation: The experimental group underwent design thinking training according to the training plan, while the control group continued with their regular work. During the training period, the training process of the experimental group was tracked and recorded to ensure the quality and effectiveness of the training.

Posttest: After the end of the experiment, the innovation capabilities and user experience of all teams were re-evaluated using the same methods as in the pretest. At the same time, data on the teams' project achievements, user feedback, etc. during the experiment were collected.

Data Analysis: The collected data were organized and analyzed, and statistical methods were used to compare the differences between the experimental group and the control group in terms of innovation capabilities and user experience. Specific analysis methods included descriptive statistical analysis, independent sample t-test, analysis of variance, correlation analysis, and regression analysis.

E. Data Collection

Innovation Capability Indicators:
Innovation Evaluation of New Products or Services: Industry experts were invited to rate the innovation of the projects completed by the teams on a scale of 1 - 10.
Innovation Efficiency Indicators: The time taken by the teams to complete the projects, the number of iterations, and the resource inputs were recorded.
Market Impact of Innovation Achievements: A combination of market research and expert evaluation was used to assess the popularity and competitiveness of the innovation achievements in the market.

User Experience Indicators:

User Satisfaction Survey: The satisfaction scores of the project users were collected through online questionnaires (on a scale of 1 - 10), and their feedback comments were also collected.

User Behavior Data: The interaction data between the users and the products or services were analyzed, such as the frequency of use, the duration of use, and the retention rate.

Team Collaboration Indicators:

Team Member Self-Assessment Questionnaires: The degree of communication, collaboration, and trust among team members was evaluated on a scale of 1 - 10.
Team Collaboration Observation Records: The collaborative behaviors of the teams during the implementation of the projects were observed, and key events and interaction situations were recorded.

F. Data Analysis

Descriptive Statistical Analysis: The mean, standard deviation, median, etc. of each indicator were calculated to describe the basic situations of the experimental group and the control group before and after the experiment.

Independent Sample t-Test: The differences between the experimental group and the control group in terms of innovation capabilities and user experience indicators were compared to test Hypotheses 1 and 2.

Analysis of Variance: The differences in the degrees of improvement in innovation capabilities and user experience among different industries were tested to verify Hypothesis 3.

Correlation Analysis: The correlation coefficients between each indicator were calculated to analyze the relationships among innovation capabilities, user experience, and team collaboration.

Regression Analysis: A regression model was constructed to explore the influence mechanism of design thinking training on the results of innovation management and to identify the key influencing factors.

G. Chart Statistics and Analysis

Bar Charts: The mean differences between the experimental group and the control group in terms of innovation capabilities and user experience indicators were shown to intuitively compare the effects between the two groups.

Line Charts: The change trends of each indicator before and after the experiment for the experimental group and the control group were presented to analyze the long-term effects of design thinking training.

Box Plots: The distribution of data and outliers were shown to help identify the degree of data dispersion and potential problems.

Scatter Plots: The correlations between each indicator were analyzed to reveal the relationships between variables.

VIII. Experimental Results and Analysis

A. Results of Innovation Capability

Innovation Rating: The mean innovation rating of the experimental group was significantly higher than that of the control group ($p < 0.05$), indicating that humanistic design thinking training can effectively enhance the product innovation capabilities of the team.

Innovation Efficiency: The experimental group was significantly superior to the control group in terms of the time taken to complete projects and the number of iterations

($p < 0.05$), demonstrating that design thinking can improve innovation efficiency.

Market Impact: The popularity and competitiveness of the innovation achievements of the experimental group in the market were also significantly higher than those of the control group ($p < 0.05$), further confirming the positive impact of design thinking on innovation capability.

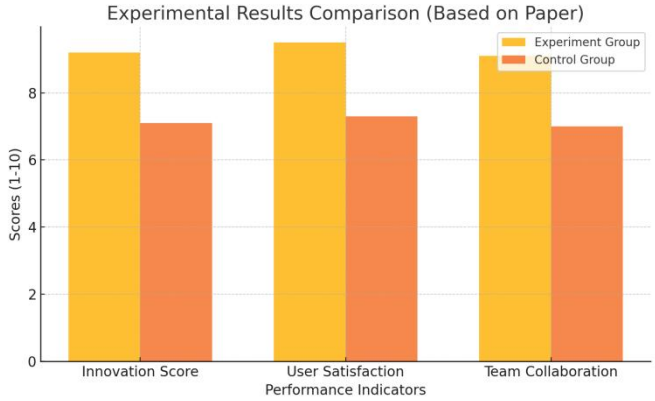

Fig. 2. Experimental Results Comparison (Based on Paper)

B. Results of User Experience

User Satisfaction: The mean user satisfaction rating of the experimental group was significantly higher than that of the control group ($p < 0.01$), suggesting that humanistic design thinking can significantly optimize user experience.

User Behavior Data: The indicators such as the frequency of use, duration of use, and retention rate of users in the experimental group were all better than those of the control group, indicating that design thinking can increase users' participation and loyalty to products or services.

C. Results of Team Collaboration

Team Member Self-Assessment: The scores of the team member self-assessment questionnaires in the experimental group in terms of communication, collaboration, and trust were all significantly higher than those of the control group ($p < 0.05$), illustrating that design thinking training is helpful in improving the team collaboration atmosphere.

Observation Records: The team collaboration observation records showed that the experimental group exhibited more active collaborative behaviors during the project implementation process, such as more information sharing, more frequent brainstorming, and more effective problem-solving.

D. Analysis of Industry Differences

The results of analysis of variance showed that there were certain differences in the degrees of improvement in innovation capability and user experience among different industries ($p < 0.05$). Further analysis revealed that the teams in the high-tech industry had the most significant improvement effects on innovation capability and user experience after receiving design thinking training, followed by the service industry and the manufacturing industry.

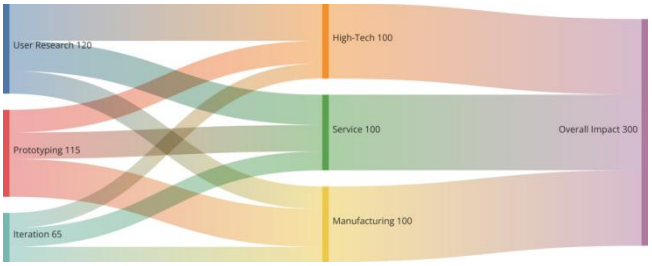

Fig. 3. Analysis of Industry Differences

E. Correlation Analysis

The results of correlation analysis indicated that there were significant positive correlations among innovation capability, user experience, and team collaboration ($p < 0.01$). This implies that design thinking promotes team collaboration, thereby enhancing innovation capability and user experience.

F. Regression Analysis

The results of regression analysis showed that design thinking training had a significant positive impact on the results of innovation management ($p < 0.01$). Among them, the training contents such as user research methods, empathy training, and creative idea generation techniques had the most significant effects on the improvement of innovation capability and user experience.

IX. Discussion

A. Significance of the Experimental Results

The results of this experiment have verified the positive impact of humanistic design thinking on innovation management, providing strong evidence for enterprises to apply design thinking. By enhancing product innovation capabilities and optimizing user experience, design thinking can help enterprises stand out in the fierce market competition. Meanwhile, the experimental results also indicate that design thinking training can improve the team collaboration atmosphere, enhancing the innovation efficiency and effectiveness of the team.

B. Analysis of the Reasons for Industry Differences

The differences in the degrees of improvement in innovation capabilities and user experience among different industries may be due to the distinct characteristics and requirements of each industry. The high-tech industry usually faces a rapidly changing technological and market environment, with a more urgent need for innovation. Therefore, the application effect of design thinking in this industry is more significant. The service industry focuses on customer experience, and design thinking can better meet the personalized needs of customers, thereby enhancing user experience. The manufacturing industry places more emphasis on the function and quality of products, and design thinking can help enterprises make breakthroughs in product innovation.

C. Limitations of the Research

Although this study adopted a double-blind randomized controlled trial to ensure the scientific and objective nature of the experiment, there are still some limitations. Firstly, the experimental subjects were only from the manufacturing, service, and high-tech industries, which may not be representative of all industries. Secondly, the experiment

time was relatively short, and it may not be possible to comprehensively evaluate the long-term effects of design thinking. In addition, only methods such as questionnaire surveys, team project evaluations, and expert reviews were used to collect data in the experiment, which may involve a certain degree of subjectivity.

X. Conclusions and Prospects

A. Research Conclusions

This study has experimentally verified the significant impact of humanistic design thinking on innovation management. Design thinking can effectively enhance enterprises' product innovation capabilities and user experience, promote team collaboration, and improve innovation efficiency and effectiveness. Meanwhile, the research results also indicate that the application effects of design thinking vary in different industries. Enterprises should apply design thinking in a targeted manner according to their own industry characteristics and requirements.

B. Practical Recommendations

Based on the conclusions of this study, the following suggestions are put forward for enterprises to apply design thinking in innovation management:

Strengthen Design Thinking Training: Enterprises should attach importance to the training of design thinking and provide employees with systematic design thinking courses to cultivate their innovation capabilities and user-oriented awareness.

Establish Interdisciplinary Teams: Design thinking emphasizes interdisciplinary and cross-departmental team collaboration. Enterprises should break down departmental barriers and establish diversified innovation teams to promote the integration of different professional knowledge and skills.

Focus on User Needs: Enterprises should take user needs as the starting point and ending point of innovation. By thoroughly understanding users' needs and behaviors and exploring their latent needs, they can design products and services that better meet users' requirements.

Create an Innovation Culture: Enterprises should create a cultural atmosphere that encourages innovation and tolerates failure to stimulate employees' innovation potential and enable them to dare to try and innovate.

C. Future Research Directions

This study has provided certain theoretical support and practical guidance for the application of design thinking in innovation management. However, there are still many issues worthy of further research. Future research can be carried out from the following aspects:

Expand the Range of Experimental Subjects: Further study the application effects of design thinking in other industries to verify its universality.

Extend the Experiment Time: Conduct a follow-up study on the long-term effects of design thinking to provide enterprises with more comprehensive decision-making bases.

Explore More Data Collection Methods: Combine qualitative and quantitative research methods to evaluate the effects of design thinking more comprehensively and objectively.

Study the Integration of Design Thinking with Other Innovation Methods: Explore how to combine design thinking with other innovation methods to improve the effectiveness of innovation management.

In conclusion, humanistic design thinking has an important impact on innovation management. Enterprises should actively apply design thinking to continuously enhance their innovation capabilities and competitiveness to adapt to the increasingly fierce market competition environment.

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