The Factors Influencing Users' Adoption of Industry 4.0 in China's Manufacturing Industry: A Conceptual Paper

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ABSTRACT— ***This conceptual paper explores the factors influencing the users' adoption of Industry 4.0 technologies in the manufacturing industry in Jiangsu Province, China, with a particular focus on government intervention as a mediating factor. Using the UTAUT and TTF models, the research examines key internal factors—performance expectancy, effort expectancy, social influence and facilitating conditions—alongside external factor such as technology compatibility. It would highlight gaps between policy initiatives and practical adoption challenges, investigating the role of financial incentives, regulations, and training programs in accelerating technological transformation. By offering insights for policymakers and industry stakeholders, it contributes to the development of targeted strategies that facilitate Industry 4.0 adoption and enhance China's manufacturing competitiveness.***

Keywords— Industry 4.0 (I4.0), Users' Adoption, UTAUT, TTF, Government Intervention.

1. INTRODUCTION

1.1 Economic Challenges and Their Impact on Industry 4.0 (I4.0) Adoption

China's economy experienced moderate recovery in Q4 2024, achieving its annual growth target of 5%. According to the China National Bureau of Statistics (NBS), the country's real GDP reached RMB 134.9 trillion ($18.42 trillion), with a 5.4% year-on-year expansion—the fastest pace in six quarters. This rebound was largely driven by supportive policies, including interest rate cuts and an RMB 12 trillion debt swap initiative. However, nominal GDP growth remained weak at 4.2%, while the Rhodium Group estimated actual growth at only 2.8%, raising concerns about economic stability and investment confidence (Farmer, R., 2025).

These macroeconomic conditions directly affect the adoption of I4.0 technologies in China's manufacturing sector. The current economic landscape—characterized by deflation, trade uncertainties, and a struggling property sector—shapes manufacturers' willingness and ability to invest in automation, digitalization, and smart manufacturing solutions. While exports contributed 30% to overall GDP growth in 2024—the highest share since the 1990s—this increase was largely due to frontloading shipments ahead of potential U.S. tariffs rather than sustained industrial transformation. With new trade restrictions in place, manufacturers face heightened cost pressures, reducing incentives for technology adoption unless strong government interventions provide financial and regulatory support (Farmer, R., 2025).

Additionally, China's prolonged deflationary environment, with industrial producer prices falling by 2.2% in 2024, has placed further pressure on manufacturers to control costs rather than invest in long-term technological advancements. In a deflationary economy, businesses often delay capital expenditures, anticipating further price declines. This significantly hampers the adoption of I4.0 technologies, which require substantial upfront investments in IoT, cyber-physical systems, AI-driven analytics, and smart robotics (Farmer, R., 2025).

1.2 Policy Interventions and the Acceleration of I4.0

Recognizing these economic challenges, the Chinese government has intensified policy measures to stabilize the

manufacturing sector and accelerate digital transformation initiatives. The International Monetary Fund (IMF) recently raised China's 2025 GDP forecast to 4.6%, citing the expected impact of fiscal stimulus measures. Key policy initiatives, including a 10 trillion yuan (US$1.36 trillion) relief package for local governments, have helped mitigate investment constraints caused by trade policy uncertainties and property market difficulties (Jennings, R., 2025).

These policy actions encourage the adoption of I4.0 in China's manufacturing sector. Government-backed financial assistance and incentives facilitate digital transformation, particularly benefiting small and medium-sized enterprises (SMEs) struggling with cash flow issues. Additionally, Beijing's efforts to boost domestic consumption—such as special treasury bonds and subsidies for technological advancements—create new demand for smart manufacturing solutions, encouraging businesses to enhance automation and AI-powered production systems. The global trade tensions remain a critical factor. The reintroduction of US tariffs on Chinese exports could pressure manufacturers to enhance efficiency through automation and digitalization to offset rising costs. Thus, government intervention will play a critical role in determining whether China's manufacturing sector can successfully transition to I4.0.

1.3 The China Government Investment Focus Areas

China's economic strategy for 2024 emphasizes investments in "new infrastructure," digital transformation, and high-tech manufacturing to foster a favorable business environment for private sector growth. During the National People's Congress (NPC) session on March 5, 2024, Chinese Premier Li Qiang reaffirmed China's commitment to technological innovation and industrial modernization as key drivers of economic progress. To support these goals, the government announced:

- A 10% increase in the annual science and technology budget, raising total funding to $51.6 billion—the largest increase since 2019 (He, L., 2024).
- An allocation of $1.4 billion for modernizing the manufacturing sector, with a focus on accelerating digitalization and industrial automation (He, L., 2024).

Additionally, President Xi Jinping introduced the concept of "new productive forces" as part of China's long-term industrial strategy. This framework prioritizes advanced manufacturing, renewable energy, new energy vehicles, and artificial intelligence (AI) as critical pillars of economic transformation. These initiatives aim to position China at the forefront of global competition in emerging technologies while shifting from traditional labor-intensive manufacturing to technology-driven production. Xi's vision for a modern industrial system aligns with the necessity for China's manufacturing sector to embrace I4.0 technologies, ensuring long-term economic sustainability and high-value growth (He, L., 2024).

2. PROBLEM STATEMENT

Despite government efforts to promote Industry 4.0 (I4.0) adoption, China's manufacturing sector continues to face significant implementation challenges. While incentives and regulations encourage digital transformation, many firms struggle with unclear strategic priorities and inconsistent policy execution, leading to inefficient resource allocation and misaligned implementation efforts (Zhang et al., 2023).

A key barrier is the complexity of I4.0 technologies, which often results in user resistance. Many manufacturing firms lack the technical expertise to integrate advanced digital solutions, leading to low adoption rates and ineffective implementation strategies (Wang et al., 2024). Additionally, a shortage of skilled professionals and inadequate training programs further hinder successful adoption, preventing firms from realizing the full benefits of I4.0-driven efficiencies (Wang et al., 2024).

Another critical challenge is the misalignment between external government-driven incentives and internal organizational adoption factors. While financial subsidies and regulatory frameworks aim to accelerate digital transformation, they often fail to align with firms' technological readiness, managerial commitment, and operational needs. This disconnect creates inefficiencies in adoption, making it difficult for manufacturers to fully leverage I4.0 technologies (van Zeebroeck et al., 2021). Furthermore, while studies suggest that government interventions influence user adoption behaviors, their relative impact on internal factors—such as technology compatibility, organizational preparedness, and user perceptions—remains unclear. There is a lack of empirical evidence on how these external interventions interact with internal dynamics to shape firms' adoption decisions (Phang et al., 2020; Selim et al., 2020).

To address these gaps, this research integrates the Unified Theory of Acceptance and Use of Technology (UTAUT) and Task-Technology Fit (TTF) models. UTAUT examines the impact of internal factors—performance expectancy, effort expectancy, social influence, and facilitating conditions—on technology adoption. Meanwhile, TTF assesses external factor, particularly technology compatibility, in driving adoption decisions. By combining these frameworks, this research

aims to bridge the gap between policy-driven incentives and real-world adoption challenges, providing insights for policymakers and industry stakeholders to develop more effective strategies for accelerating I4.0 adoption in China's manufacturing sector.

3. PURPOSE OF RESEARCH AND RESEARCH QUESTIONS

The conceptual paper is intended to identify the elements affecting the users' adoption of I4.0 technologies in the manufacturing industry in Jiangsu Province, China, with a particular focus on government intervention as a mediating variable. The research questions that will be addressed in this research are:

RQ1: How does performance expectancy (PE) affecting the users' adoption of I4.0 technologies (UA)?
RQ2: How does effort expectancy (EE) affecting the users' adoption of I4.0 technologies (UA)?
RQ3: How does social influence (SI) affecting the users' adoption of I4.0 technologies (UA)?
RQ4: How does facilitating conditions (FC) affecting the users' adoption of I4.0 technologies (UA)?
RQ5: How does technology compatibility (TC) affecting the users' adoption of I4.0 technologies (UA)?
RQ6: How does government intervention (GI) affecting the users' adoption of I4.0 technologies (UA)?
RQ7: How does performance expectancy (PE) affecting government intervention (GI)?
RQ8: How does effort expectancy (EE) affecting government intervention (GI)?
RQ9: How does social influence (SI) affecting government intervention (GI)?
RQ10: How does facilitating conditions (FC) affecting government intervention (GI)?
RQ11: How does technology compatibility (TC) affecting government intervention (GI)?
RQ12: How does government intervention (GI) mediating the performance expectancy (PE) affecting the users' adoption of I4.0 technologies (UA)?
RQ13: How does government intervention (GI) mediating the effort expectancy (EE) affecting the users' adoption of I4.0 technologies (UA)?
RQ14: How does government intervention (GI) mediating the social influence (SI) affecting the users' adoption of I4.0 technologies (UA)?
RQ15: How does government intervention (GI) mediating the facilitation conditions (FC) affecting the users' adoption of I4.0 technologies (UA)?
RQ16: How does government intervention (GI) mediating the technology compatibility (TC) affecting the users' adoption of I4.0 technologies (UA)?

4. SIGNIFICANT OF THE RESEARCH

This research provides critical insights into the factors influencing Industry 4.0 (I4.0) adoption in China's manufacturing sector, with significant implications for economic and technological modernization. Successful implementation of I4.0 technologies can enhance global competitiveness, productivity, and efficiency, reinforcing China's position as a leading industrial powerhouse. By identifying key facilitators and barriers to adoption, this research supports innovation, accelerates research and development (R&D) investments, and fosters a more technologically advanced and sustainable manufacturing ecosystem.

4.1 Policy Implications

The findings offer valuable guidance for government agencies, policymakers, and industry stakeholders in assessing the effectiveness of existing incentives and regulatory frameworks. By evaluating the role of government intervention in shaping user adoption behaviors, this research can help refine policy strategies, enhance financial support mechanisms, and strengthen regulatory structures to drive a more structured and effective approach to I4.0 adoption.

4.2 Industry Impact

For manufacturers, business leaders, and technology providers, this research provides a deeper understanding of organizational, technological, and behavioral factors affecting adoption. These insights will enable firms to develop tailored digital transformation strategies, optimize resource allocation, and overcome adoption challenges, ultimately improving long-term sustainability and market resilience.

4.3 Workforce Development

Understanding the psychological and sociological aspects of technology adoption can inform the design of effective training programs, skill-building initiatives, and workforce adaptation strategies. By addressing skill gaps and reducing resistance to change, this research contributes to the development of a highly skilled, technologically proficient workforce essential for the successful implementation of I4.0.

4.4 Academic Contribution

This research advances theoretical and empirical knowledge on digital transformation and industrial evolution, contributing to the academic discourse on I4.0 adoption. By providing insights into one of the world's largest manufacturing hubs, it serves as a valuable resource for scholars, practitioners, and policymakers while encouraging further research and innovation in smart manufacturing and digitalization.

5. DELIMITATIONS, LIMITATIONS AND FUTURE RESEARCH DIRECTIONS

Although this research offers insightful information on the elements impacting users' adoption of I4.0 technologies, it is important to recognize a number of restrictions and limitations.

5.1 Delimitations

Geographical Scope: This research focuses exclusively on the manufacturing sector in Jiangsu Province, China, which may limit the generalizability of findings to other regions or industries with different economic, technological, or regulatory conditions. As of 2023, Jiangsu Province reported a nominal GDP of RMB 12.8 trillion, reflecting a 5.8% year-on-year growth, and remains a key hub for foreign capital utilization (China National Bureau of Statistics, 2023). However, the findings may not fully apply to regions with different industrial and policy landscapes.

Research Scope: This research considers government intervention as the sole mediator influencing the adoption of I4.0 technologies, excluding other potential mediators such as leadership influence, competitive market dynamics, or corporate culture. Future research could examine these additional factors for a more holistic understanding.

Theoretical Framework: The research applies the Unified Theory of Acceptance and Use of Technology (UTAUT) model and Task-Technology Fit (TTF) model to analyze adoption behavior. While these models provide a solid foundation, alternative frameworks—such as the Diffusion of Innovation (DOI) model or the Technology-Organization-Environment (TOE) model—could offer additional perspectives on technology adoption dynamics.

5.2 Limitations

Survey-Based Data Collection: The research relies on quantitative survey data, which may be subject to social desirability bias and self-reporting inaccuracies, potentially affecting the validity of the results.

Time Constraints: The research captures data at a specific point in time, while I4.0 technologies, regulatory policies, and market conditions evolve rapidly. As a result, the findings may not remain as relevant in the future.

Lack of Qualitative Insights: Although the research provides quantifiable insights, it does not fully capture behavioral, cultural, or strategic factors affecting technology adoption. A mixed-methods approach, incorporating case studies or interviews, could provide a more comprehensive perspective.

5.3 Future Research Directions

To address these limitations, future research could:

- Expand the geographical scope beyond Jiangsu Province to improve generalizability.
- Incorporate qualitative methods (e.g., interviews, case studies) for deeper insights into adoption behaviors.
- Examine additional mediating and moderating factors, such as organizational readiness, leadership commitment, and market competitiveness.
- Explore alternative theoretical frameworks to gain a broader understanding of I4.0 adoption dynamics.

By addressing these gaps, future research can provide a stronger foundation for academic inquiry and practical guidance for industry stakeholders, contributing to the advancement of I4.0 adoption in the manufacturing sector.

6 THEORETICAL FRAMEWORK OVERVIEW

This research integrates two well-established models—the Unified Theory of Acceptance and Use of Technology (UTAUT) and the Task-Technology Fit (TTF) model—to examine the factors influencing users' adoption of Industry 4.0 (I4.0) technologies in Jiangsu Province's manufacturing sector. Additionally, government intervention is introduced as a mediating variable, bridging the gap between policy-driven incentives and practical adoption challenges.

6.1 Unified Theory of Acceptance and Use of Technology (UTAUT)

The UTAUT model, developed by Venkatesh et al. (2003), is widely used to analyze user acceptance and adoption of new technologies (Chatterjee et al., 2021; Handoko & Liusman, 2021; Lin et al., 2022; Rahim et al., 2022; Zhai et al., 2021). It identifies four key constructs of user adoption:

- Performance Expectancy (PE): The degree to which users believe that using the technology will enhance their job performance.
- Effort Expectancy (EE): The perceived ease of use of the technology.
- Social Influence (SI): The extent to which users feel external pressure from significant individuals (e.g., colleagues, supervisors) to adopt the technology.
- Facilitating Conditions (FC): The perceived availability of organizational and technological infrastructure that supports technology adoption.

These factors collectively shape user adoption behaviors, making UTAUT an effective framework for studying I4.0 implementation in manufacturing.

6.2 Task-Technology Fit (TTF) Model

The TTF model, introduced by Goodhue and Thompson (1995), explains how the alignment between technology and the tasks it supports influences adoption. The model posits that the better the fit between technology and organizational needs, the higher the likelihood of adoption.

This research employs the TTF model to examine technology compatibility as an external determinant of adoption. According to Goodhue (2006), technology compatibility refers to the extent to which a technology aligns with users' needs, prior experiences, and values. If I4.0 technologies are perceived as compatible with existing workflows and expertise, adoption rates are expected to increase.

6.3 The Role of Government Intervention as a Mediator

Beyond internal and external factors, this research considers government intervention as a mediating variable influencing I4.0 adoption. Government policies—including funding programs, regulations, tax incentives, and training initiatives—can accelerate technology adoption by addressing financial and technical barriers.

Previous studies suggest that government-driven incentives and regulatory frameworks play a crucial role in shaping technology adoption behaviors (Alfaro-Serrano, 2021). However, the extent to which government interventions enhance the effectiveness of UTAUT and TTF factors remains an area requiring empirical investigation. This research aims to fill this gap by exploring how policy-driven initiatives influence both organizational readiness and user perceptions, ultimately impacting I4.0 adoption outcomes.

6.4 Integrated Theoretical Framework

By integrating UTAUT, TTF, and government intervention, this research develops a comprehensive framework to understand the key factors affecting I4.0 adoption in Jiangsu's manufacturing sector. The findings will provide practical insights for policymakers and industry stakeholders, enabling them to:

- Design more effective regulatory and incentive programs.
- Develop targeted strategies for overcoming adoption barriers.
- Enhance manufacturing competitiveness through improved I4.0 implementation.

This theoretical foundation sets the stage for empirical validation, offering valuable contributions to both academic literature and industrial practice.

7 DISCUSSION OF THE LITERATURE REVIEW

7.1 Industry 4.0 (I4.0)

Industry 4.0 (I4.0) is transforming the manufacturing sector by integrating digital, physical, and social technologies, enabling seamless data collection and exchange across the supply chain. Defined as "new technologies that integrate the physical, digital, and social," I4.0 has a profound impact on global industries, economies, and enterprises. Its core technologies—including the Internet of Things (IoT), Cloud Manufacturing (CM), Big Data (BD), Automation and Industrial Robotics (AIR), Additive Manufacturing (AM), and Augmented Reality (AR)—significantly enhance efficiency and connectivity, linking billions of devices and users worldwide (Xie et al., 2021; Yu et al., 2021).

The IoT facilitates real-time communication between devices, improving fault detection, reducing product recalls, and optimizing operational efficiency across sectors such as transportation, healthcare, and manufacturing. Cloud Manufacturing enables the centralized management of distributed resources, enhancing flexibility and scalability in production. Big Data analytics empowers manufacturers with real-time insights for quality improvement and product customization, providing a competitive edge. Automation and industrial robotics streamline precision-driven tasks such as assembly and quality control, minimizing human error and enhancing productivity. Additive Manufacturing (3D printing) accelerates prototyping and reduces production time and costs. Finally, Augmented Reality (AR) enhances workforce efficiency through interactive training, maintenance support, and quality assurance (Xie et al., 2021; Yu et al., 2021).

Despite these advancements, gaps remain in the understanding of I4.0 technology adoption. Most existing studies focus on individual technologies rather than the integrated effects of multiple technologies. Research on standards (Janak & Hadas, 2015), integration technologies (Bangemann et al., 2016), virtual engineering (Shafiq et al., 2015), and industrial wireless networks (Li et al., 2017) primarily examine discrete advancements, overlooking the complexities of adopting bundled technologies. This fragmented approach makes it difficult to assess the organizational and operational challenges of implementing I4.0 holistically.

From a socio-technical perspective, successful I4.0 adoption depends on complementary factors such as human skills, work structure, and implementation maturity. However, the literature provides insufficient analysis of how these factors influence technological transitions. Upskilling the workforce is critical to equipping employees with the competencies required for I4.0, while work structure must evolve to accommodate new operational paradigms. Studies suggest that aligning these socio-technical elements with I4.0 technologies can drive industrial performance improvements (Frank et al., 2019; Brettel et al., 2014; Ras et al., 2017).

This research seeks to address these gaps by exploring users' adoption of I4.0 technologies as integrated bundles, emphasizing the role of human factors and work organization. By investigating these socio-technical elements, the research advances knowledge on how I4.0 technologies can revolutionize manufacturing when supported by appropriate organizational strategies.

7.2 The Unified Theory of Acceptance and Use of Technology (UTAUT)

The Unified Theory of Acceptance and Use of Technology (UTAUT) is widely recognized for its ability to predict technology adoption based on four key constructs: performance expectancy, effort expectancy, social influence, and facilitating conditions (Venkatesh et al., 2016). Venkatesh et al. (2016) suggested expanding UTAUT to consider socio-organizational and environmental influences, including location-specific characteristics and organizational support. Their work highlighted the need for further studies on how UTAUT applies to advanced and emerging technologies, such as business intelligence and analytics systems.

Subsequent research has extended UTAUT by incorporating additional factors tailored to specific contexts. For example, Xie et al. (2021) examined fintech adoption by including perceived value and perceived risk. Hashim and Al-Sulami (2020) studied IoT adoption in education, emphasizing security concerns as a key determinant. Similarly, Almaiah et al. (2019) explored mobile learning adoption, integrating variables such as perceived compatibility, self-efficacy, and trust. These studies demonstrate UTAUT's adaptability but also highlight the need for further customization to address the

complexities of I4.0 adoption.

Cultural factors also influence UTAUT's applicability across regions. Srite (2006) and Gao (2014) emphasized the importance of incorporating cultural values and user perceptions into the model, particularly in cross-cultural contexts like the US and China. Differences in perceived usefulness, social influence, and trust can significantly impact adoption outcomes (Bandyopadhyay, 2007; Faaeq et al., 2013).

Building on these insights, this research expands UTAUT by incorporating technology compatibility (TC) to assess its role in I4.0 adoption. TC examines how well a technology aligns with users' requirements and existing processes, particularly within Chinese manufacturing firms. By integrating contextual, cultural, and technological factors, this research enhances the theoretical and practical understanding of technology adoption, offering valuable insights for organizations navigating the challenges of I4.0.

7.3 The Task-Technology Fit Model (TTF)

The Task-Technology Fit Model (TTF), proposed by Goodhue and Thompson (1995), evaluates how well a technology aligns with user tasks, asserting that better alignment leads to higher adoption rates. Regardless of user attitudes, adoption is less likely if a technology fails to meet task requirements (Goodhue & Thompson, 1995; Goodhue, 2006).

Several studies have extended TTF to different technological contexts. Gebauer and Ginsburg (2009) applied it to mobile systems, demonstrating how task-technology alignment enhances user satisfaction. Robles-Flores and Roussinov (2012) analyzed its role in automated Q&A systems, while D'Ambra, Wilson, and Akter (2013) explored TTF in e-book adoption. However, critics argue that TTF overlooks psychological and environmental factors, such as managerial support and organizational culture (Agarwal, Sambamurthy, & Stair, 2000). In order to improve the model, Staples, Hulland, and Higgins (1999) highlighted the impact of individual variations on the results of technology usage and recommended that future research includes environmental and psychological elements.

This research addresses these limitations by incorporating technology compatibility (TC) in the research framework, investigating how TC influences users' adoption of I4.0 technologies in Jiangsu Province's manufacturing sector. By considering broader psychological and environmental factors, the research deepens the understanding of how TC impacts I4.0 adoption.

7.4 Government Interventions

Government interventions play a critical role in facilitating technology adoption, particularly in economies where market forces alone cannot ensure widespread participation (Keynes, 1936). Research indicates that subsidies, tax incentives, regulatory frameworks, and knowledge-sharing initiatives can significantly drive the transition to advanced manufacturing, especially for small and medium enterprises (SMEs) (Bianchini & Kwon, 2021). These interventions aim to reduce financial risk, enhance technological capabilities, and promote industry-wide digital transformation.

Empirical studies highlight various sectoral interventions that have successfully supported technology adoption. Seeman (2007) explored government support in wireless location systems, while Xiao (2014) examined logistics information technology adoption. Scupola (2009) found that public policies significantly influence e-commerce adoption among SMEs, primarily through financial incentives and expertise sharing. However, despite these initiatives, government interventions yield mixed results in fostering I4.0 adoption. According to Lin and Song (2023), government interventions had minimal impact on large private firms, which were more aggressive in using I4.0 technology through their own initiatives as I4.0 technology significantly improved firm efficiency, financial performance and innovation activity.

One of the key challenges is that government programs often focus on financial incentives without adequately addressing internal organizational readiness, workforce skills, and cultural adaptation, which are essential for sustainable I4.0 implementation. Organizational inertia, resistance to change, and limited expertise in advanced digital technologies further complicate adoption efforts, reducing the effectiveness of top-down interventions. This research addresses this gap by examining how government interventions influence the internal conditions necessary for successful I4.0 adoption. By analyzing both direct and indirect effects, this research provides a comprehensive framework for understanding the impact of government policies on overcoming technological, human, and organizational barriers in China's manufacturing sector.

For government interventions to be truly effective, they must go beyond financial assistance and active support:

- Organizational Readiness: Encouraging firms to assess their digital maturity and align government incentives with industry-specific needs.
- Workforce Skills Development: Establishing training programs and reskilling initiatives to bridge the digital skills gap.

- Cultural Transformation: Promoting a pro-innovation mindset through leadership development and changing management strategies.
- Tailored Support for Different Enterprises: Differentiating policies for large corporations and SMEs to ensure equitable access to resources.

By integrating these elements, government interventions can serve as a crucial mediating factor in accelerating I4.0 adoption, fostering an innovative, competitive, and resilient industrial ecosystem in China.

8 CONCEPTUAL MODEL DEVELOPMENT

This conceptual paper attempts to investigate the factors influencing the users' adoption of I4.0 technologies in the manufacturing industry in Jiangsu Province, China. The research focuses on using the UTAUT and TTF models as the theoretical framework to develop a conceptual model for this research as shown in Figure 1.

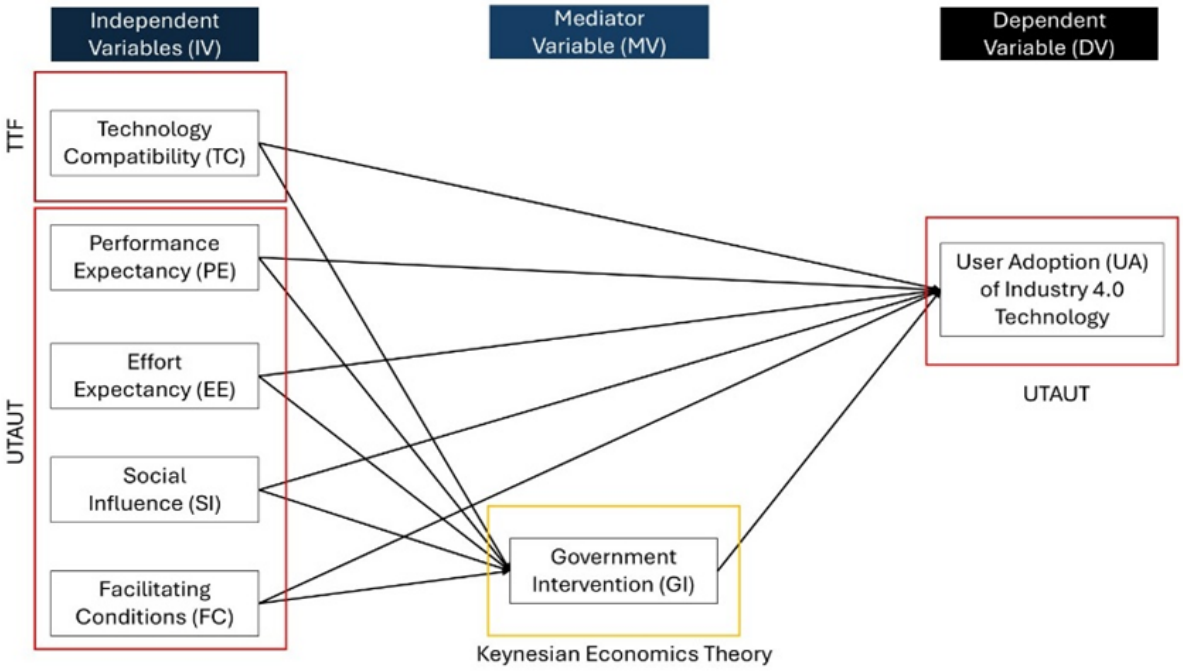

Figure 1: Proposed Conceptual Model For This Research

9 METHODOLOGY

This research employs a quantitative research approach to examine the factors influencing the users' adoption of Industry 4.0 (I4.0) technologies in Jiangsu Province's manufacturing sector. The Unified Theory of Acceptance and Use of Technology (UTAUT) and Task-Technology Fit (TTF) models serve as the theoretical framework.

9.1 Research Design

A structured survey-based approach is used to collect data from manufacturing enterprises in Jiangsu Province. The survey measures key constructs related to I4.0 adoption, including performance expectancy, effort expectancy, social influence, facilitating conditions, and technology compatibility. Additionally, it assesses the role of government interventions, such as financial assistance, regulatory policies, promotional efforts, and training programs.

9.2 Data Collection

The survey is distributed both online and in-person to ensure a high response rate and diverse participation. The target

respondents include employees directly involved in I4.0 implementation.

9.3 Pilot Testing

A pilot test is conducted to validate the survey instrument. Reliability analysis indicates that all constructs achieve Cronbach's Alpha values above 0.8, confirming high internal consistency and reliability.

9.4 Statistical Analysis

The collected data is analyzed using statistical software. Key analyses include:

- Descriptive statistics to summarize respondents' demographic characteristics.
- Inferential statistics, including multiple regression analysis and structural equation modeling (SEM), to test relationships among independent variables, the mediating role of government interventions, and I4.0 adoption.

9.5 Ethical Considerations

This research adheres to ethical research standards, ensuring respondent anonymity and data confidentiality. Informed consent is obtained from all participants, and the study complies with data protection regulations.

10 CONCLUSIONS

The rapid advancement of Industry 4.0 (I4.0) technologies presents a transformative opportunity for China's manufacturing sector. However, adoption remains constrained by technological, organizational, and policy-related barriers, requiring a strategic approach to overcome these challenges. This research examines the key factors influencing users' adoption of I4.0 technologies, emphasizing the mediating role of government interventions in driving this transformation. By integrating the UTAUT and TTF models, this research provides a comprehensive framework for understanding how adoption drivers—performance expectancy, effort expectancy, social influence, facilitating conditions, and technology compatibility—interact with government-led initiatives to promote industrial modernization.

Government interventions, including financial incentives, regulatory policies, training programs, and promotional campaigns, serve as critical enablers of I4.0 adoption. However, their effectiveness depends on how well they address internal organizational readiness, workforce skills development, and cultural transformation. Many organizations struggle with inertia, resistance to change, and a lack of expertise in integrating advanced technologies. Without targeted efforts to align policies with industry needs, government interventions may not fully translate into sustainable adoption. Addressing these issues requires a multi-faceted approach, including:

- Enhancing Organizational Readiness – Policymakers should develop structured support programs that help firms assess readiness levels, bridge technological gaps, and foster a culture of innovation.
- Investing in Workforce Skills Development – Industry-academia collaborations should be strengthened to provide upskilling and reskilling programs, ensuring employees are equipped with I4.0 competencies.
- Overcoming Organizational Inertia – Leadership training and change management initiatives should be promoted to address resistance to digital transformation.
- Tailoring Government Support – Incentive programs should be customized based on firm size, industry type, and adoption maturity, ensuring equitable access to financial aid and technical support.

By addressing these challenges through strategic interventions, China's manufacturing sector can fully harness I4.0 technologies, fostering a more innovative, resilient, and globally competitive industrial ecosystem. Future research should focus on empirical validation and explore additional factors, such as leadership commitment, competitive market dynamics, and industry-specific adoption barriers, to provide a holistic understanding of I4.0 adoption.

This research provides valuable insights for policymakers, industry leaders, and stakeholders, offering a roadmap for facilitating effective technology integration. A coordinated effort between government, industry, and academia will be crucial in ensuring the successful implementation of I4.0, ultimately strengthening China's position in the global manufacturing landscape.

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