

**MINISTRY OF EDUCATION AND TRAINING
LAC HONG UNIVERSITY**



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**FACTORS AFFECTING THE QUALITY OF HUMAN RESOURCES IN
SEMICONDUCTOR IC DESIGN: A CASE STUDY OF ENTERPRISES
IN THE SOUTHEAST REGION OF VIETNAM**

SUMMARY OF THESIS

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LIST OF AUTHOR'S PUBLISHED WORKS

- Do The Thang^{1*} (2024). HIGH-QUALITY HUMAN RESOURCES FOR THE SEMICONDUCTOR DESIGN INDUSTRY IN VIETNAM: CURRENT SITUATION AND DEVELOPMENT ORIENTATION. *Journal of Science and Technology (Hung Vuong University)*. Volume 37, Issue 4 (2024): 34 - 44.
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CHAPTER 1: RESEARCH OVERVIEW

1.1. Reasons for Choosing the Dissertation Topic

The semiconductor integrated circuit (IC) industry is a core technology sector with strategic importance for economic growth and national competitiveness. In Vietnam, the Government has issued Decision No. 1017/QĐ-TTg and 1018/QĐ-TTg (2024) to develop the semiconductor industry and deeply integrate into the global value chain. The Southeast region, as the country's leading economic, technological, and FDI attraction hub, is home to numerous semiconductor IC design enterprises (Intel, Synopsys, Marvell, Viettel, FPT, etc.). However, in reality, the quality of human resources (HRQ), particularly the workforce of semiconductor IC design engineers, remains a major bottleneck, failing to meet the requirements for professional qualifications, creativity, and adaptability to new technologies.

1.1.1. Practical Context

The global semiconductor IC market reached USD 600 billion in 2024 and is projected to hit USD 1,000 billion by 2030 (Dhiman, 2025), however, high-quality talent shortages persist globally (Rizi et al., 2023; Kim & Kim, 2023; Yin et al., 2024). Key players dominate different segments: the US in chip design and EDA; Taiwan in foundry; South Korea in memory; Japan in materials; Europe in lithography; China in packaging.

In Vietnam, the Government issued Decisions No. 1017/QĐ-TTg and 1018/QĐ-TTg (2024) to develop the semiconductor industry, aiming to train 50,000 personnel and establish 100 IC enterprises by 2030. The Southeast region, the economic hub attracting 51% of FDI (Lương Thị Thuý Lành, 2025), concentrates 66 IC design enterprises (Intel, Synopsys, Marvell, FPT Semiconductor, Viettel High Tech). However, the current situation is alarming: (i) the human resource scale is modest (3,767 engineers, 76.6% in Ho Chi Minh City, reaching only 8% of the 2030 target); (ii) training quality is overly theoretical, lacking EDA skills, requiring enterprises to retrain new engineers for 6-9 months (Nguyễn Đình Đức, 2025); specialized lecturers and laboratories

remain scarce; coordination among universities, enterprises, and the State is loose (Nguyen & Dang, 2025).

The Southeast region is an optimal research context due to policy differences among localities, diverse enterprise types, and its national strategic role. This gap necessitates empirical research on the mechanism of impact of TE, TR, EI, WE, GS on HRQ in the semiconductor IC design sector in the Southeast region.

1.1.2. Theoretical Context

Human resource quality (HRQ) is a central theme in strategic human resource management research (Becker, 1964; Schultz, 1961; Apascaritei & Elvira, 2022). Recent studies indicate that HRQ is influenced by both internal and external factors of enterprises (Chen & Zheng, 2022; Guo, 2022; Yin et al., 2024).

A review of 466 publications (2015–2025) identifies four approaches: (1) input approach – HRQ from investment in education and training; (2) process approach – strategic human resource management practices; (3) outcome approach – through productivity and competitive advantage; (4) integrated approach – interaction among inputs, processes, and institutions. This dissertation adopts the integrated approach.

The dissertation applies three foundational theories: The human capital theory (Becker, 1964) – explaining "where to invest"; Dynamic Capabilities Theory (Teece, 2007) – explaining "how to operate" through three capabilities: sensing, seizing, transforming; Institutional Theory (DiMaggio & Powell, 1983) – explaining "which context supports or hinders" through coercive, mimetic, and normative pressures.

VOSviewer analysis confirms six groups of factors affecting HRQ: (1) HRQ and competitiveness; (2) TE and digital transformation; (3) Training and organizational learning; (4) EI and R&D; (5) WE and organizational culture; (6) GS and public policy. Recent research trends focus on dynamic capabilities, innovation, work environment, and government policy. Based on the analysis of

practical and theoretical contexts, the doctoral candidate selects the topic: "Factors Influencing the Quality of Human Resources in Semiconductor IC Design: A Case Study of Enterprises in the Southeast Region" for the dissertation.

1.2. Research Objectives

1.2.1. General Objective

To develop, measure, and test a model of factors affecting human resource quality (HRQ) and propose managerial implications for state agencies, universities, and semiconductor IC design enterprises in the Southeast region.

1.2.2. Specific Objectives

The dissertation pursues four specific objectives: (1) To measure and evaluate the direct impact of three input factors (technological environment, training, and enterprise innovation level) on HRQ. (2) To test the mediating role of the work environment in the relationship between input factors and HRQ, thereby clarifying the internal transformation mechanism within enterprises. (3) To analyze the moderating role of government support on the relationship between technological environment and HRQ, as well as between training and HRQ. (4) To propose managerial implications for three target groups: semiconductor IC design enterprises, the Government and state management agencies, and training institutions.

1.3. Research Questions

This study focuses on clarifying the factors affecting HRQ in the semiconductor IC design sector. Specifically, the study raises four main questions: First, how do technological environment, training, and enterprise innovation level directly affect HRQ? Second, how does the work environment mediate the relationship between technological environment, training, enterprise innovation level, and HRQ? Third, what moderating role (promoting or constraining) does government support play in the relationship between technological environment and HRQ, as well as between training and HRQ?

Fourth, what managerial implications can be drawn from the research findings?

1.4. Research Subjects and Scope

1.4.1. Research Subjects

Research subject: Factors (technological environment, training, innovation level, work environment, government support) and their relationships with the quality of human resources (HRQ) in semiconductor IC design enterprises in the Southeast region.

Research objects: Enterprises operating in semiconductor IC design in the Southeast region, comprising 66 enterprises. These enterprises are classified into 4 groups: (1) fabless enterprises; (2) IDM enterprises; (3) design houses and R&D centers; (4) startups.

Survey respondents: Managers at semiconductor IC design enterprises across three levels: top management (Directors, Deputy Directors), middle management (Heads/Deputy Heads of departments), and lower management (Team leaders, Group leaders).

1.4.2. Research Scope

Space: The Southeast region (6 provinces/cities: Ho Chi Minh City, Binh Duong, Dong Nai, Ba Ria - Vung Tau, Tay Ninh, Binh Phuoc).

Field: Enterprises engaged in semiconductor IC design activities.

Time: Secondary data from 2020–2024; primary data from October 2024 to March 2025.

1.5. Research Methods

1.5.1. Qualitative Research

Qualitative research was conducted in the initial stage to refine the measurement scale, complete the research model, and add in-depth perspectives. The author employed semi-structured interviews with 10 experts and managers in the semiconductor IC design sector in the Southeast region. Implementation steps: (1) synthesis of theoretical foundations; (2) development of preliminary

questionnaire; (3) in-depth expert interviews; (4) development of final questionnaire.

1.5.2. Quantitative Research

The preliminary quantitative study was conducted through a survey of 112 managers. The measurement scale was evaluated using Cronbach's Alpha and EFA. The formal quantitative study tested the model and hypotheses.

Sample size and sampling technique: Stratified sampling combined with purposive sampling. The target sample of 250 respondents comprised managers at semiconductor IC design enterprises across 6 provinces/cities in the Southeast region.

Measurement scale: All scales (TE, TR, EI, WE, GS, HRQ) were adopted from international studies and adjusted to fit the Vietnamese context. A 5-point Likert scale was used.

Data analysis methods: SPSS for descriptive statistics; scale evaluation through Cronbach's Alpha, CR, AVE, Fornell-Larcker, HTMT; structural model analysis using PLS-SEM (SmartPLS) with 5,000 Bootstrap samples; mediation and moderation testing.

1.6. Contributions of the Research

1.6.1. Theoretical Contributions

The dissertation achieves three new contributions: First, it develops and tests a comprehensive integrated model combining both internal enterprise factors (work environment, technology, training, innovation) and external institutional factors (government support), overcoming the limitation of fragmented approaches in previous studies. Second, it clarifies the mediating mechanism of the work environment – not as a passive space but as an active catalyst that amplifies the value of inputs (technology, training) and transforms them into actual HRQ. Third, it provides empirical evidence on the moderating role of government support, reinforcing Institutional Theory in the context of emerging economies.

1.6.2. Practical Contributions

The dissertation provides specific and highly feasible managerial and policy implications for stakeholders. For enterprises: it offers a reference framework to identify key factors requiring priority investment to enhance HRQ. For the Government: the research findings serve as a basis for adjusting support policies toward focused and effective directions within the context of the Semiconductor Industry Development Strategy to 2030. For educational institutions: the dissertation serves as a bridge providing evidence on the industry's actual needs, forming the basis for adjusting training programs and strengthening university-industry collaboration.

1.7. Structure of the Dissertation

In addition to the introduction, conclusion, and references, the dissertation consists of 5 chapters:

Chapter 1: Research Overview

Chapter 2: Theoretical Foundation and Research Model

Chapter 3: Research Methodology

Chapter 4: Research Results and Discussion

Chapter 5: Conclusions and Managerial Implications

CHAPTER 2: THEORETICAL FOUNDATION AND RESEARCH MODEL

2.1. Research Concepts

2.1.1. Concept of Human Resources

Human resources is a foundational concept in organizational management and socio-economic development. According to Schultz (1961), human resources should be viewed as a form of human capital, i.e., assets that can yield returns if properly invested through education, training, and healthcare. Becker (1964) systematized this into human capital theory, distinguishing between two types of skills: general skills and firm-specific skills.

At the organizational level, Apascaritei and Elvira (2022) approach human resources as a core element in building dynamic capabilities of enterprises. Chen and Zheng (2022) emphasize that human resources must be a system capable of continuous learning and restructuring in a rapidly changing technological environment. In the context of the semiconductor IC design industry, Rizi et al. (2023) point out the requirement for interdisciplinary competence; Gunarathne and Chaitanya (2024) identify three core requirements: scientific foundation, EDA proficiency, and compliance with international standards. In Vietnam, Nguyen Dinh Duc (2024) shows that human resources remain thin, unevenly distributed, and weak in practical skills.

Based on the analysis of various perspectives, this dissertation defines: Human resources are the aggregate of individuals constituting the workforce of an organization, an industry, or a nation, encompassing traditional constituent elements (knowledge, skills, experience) and extended elements (creative capacity, psychological qualities, social relationships, and adaptability to technology). This definition emphasizes "technological adaptability" – a survival characteristic of the semiconductor industry, where design tools and production processes are constantly changing.

2.1.2. Concept of Human Resource Quality

Human resource quality answers the question of the extent to which workers meet job requirements. According to Becker (1964) and Apascaritei and Elvira (2022), human resource quality is the foundation of human capital for building organizational dynamic capabilities. Juliana Jaya et al. (2020) propose four components constituting human resource quality: educational attainment (0.766), professional skills (0.924), training level (0.915), and execution capability (0.757). Darmawan et al. (2020) indicate that human resource quality affects performance through three channels: competence, effort, and behavior.

In the semiconductor IC design industry context, Guo (2022) developed an AI model for evaluating human resource quality with 30 indicators, emphasizing innovation capability. Sahusilawane (2025) demonstrated that human resource

quality positively correlates with information system effectiveness. In Vietnam, Pham Thi Hanh (2020) affirmed that in Industry 4.0, people and knowledge are endogenous factors; Nguyen Thi Thanh Lam and Pham Thuy Hien (2025) identified three gaps: theory-heavy curricula, lack of EDA; weak soft skills; and lack of strategic cooperation.

This dissertation defines: Human resource quality is the aggregate of factors pertaining to specialized educational attainment, practical skills with modern technologies and tools, the capacity to update and adapt to changes in technology and markets, as well as personal qualities, all manifested through the ability to complete professional tasks, solve practical problems, and meet quality, performance, and schedule targets in a professional work environment. This definition specifies human resource quality in relation to modern technology practice, emphasizes updating and adaptive capacity, and links to output results of the work process.

2.2. Overview of Related Theories

This dissertation proposes an integrated theoretical framework based on three pillars: Human Capital Theory (Becker, 1964) as the central theory; Dynamic Capabilities Theory (Teece, 2007) explaining the operating mechanism; and Institutional Theory (DiMaggio & Powell, 1983) explaining the impact of the external context.

2.2.1. Human Capital Theory

Human capital is the entire stock of knowledge, skills, abilities, health, and experience embodied in each individual, capable of generating future income and economic benefits (Becker, 1964). The core point is viewing people as a form of capital assets, inseparable from their owners and non-transferable. Becker distinguishes between general skills (valuable across multiple enterprises) and firm-specific skills (valuable only within a particular enterprise).

2.2.2. Dynamic Capabilities Theory

Teece et al. (1997) define dynamic capabilities as "the firm's ability to

integrate, build, and reconfigure internal and external resources to adapt to rapidly changing environments." Teece (2007) identifies three core microfoundations: (1) sensing capabilities for opportunities and threats; (2) seizing capabilities through R&D investment and innovation; (3) transforming capabilities to continuously adjust internal resources and processes.

2.2.3. Institutional Theory

According to North (1991), institutions are the set of rules, norms, and practices socially accepted, shaping the behavior of actors. DiMaggio and Powell (1983) identify three mechanisms creating institutional pressures: (1) coercive pressure from legal policies; (2) mimetic pressure from leading enterprises; (3) normative pressure from professional associations and training systems.

2.3. Review of Related Studies

2.3.1. Studies on Human Resource Quality

Juliana Jaya et al. (2020) specify human resource quality into four components: educational attainment (0.766), professional skills (0.924), training level (0.915), and execution capability (0.757), with human resource quality affecting product performance ($\beta = 0.527$) and competitive capability ($\beta = 0.522$). Sahusilawane (2025) demonstrated that human resource quality positively correlates with information system effectiveness ($p = 0.047$), emphasizing self-capability. Guo (2022) proposed an AI model for evaluating human resource quality with 30 indicators, achieving 84% accuracy. This dissertation adopts the human resource quality scale from Juliana Jaya et al. (2020) and supplements the indicator "EDA tool proficiency."

2.3.2. Studies on Technological Environment

Davis (1989) developed the Technology Acceptance Model (TAM) with two factors: perceived usefulness and perceived ease of use. Chen and Zheng (2022) showed that enterprises with good technology integration achieve 25% higher performance. Ou et al. (2024) indicated that AHP and Markov application helps evaluate employee performance with 95% accuracy. This dissertation

adopts the technological environment scale from Chen and Zheng (2022) consisting of 4 items.

2.3.3. Studies on Training

Kirkpatrick and Kirkpatrick (2006) proposed a four-level training evaluation model (reaction, learning, behavior, results). Alsalamah and Callinan (2021) applied it and recorded that 95.2% of participants improved their competence, with educational attainment having a positive effect ($\beta = 0.264$). Hasan and Tsou (2021) proposed a Kaizen model improving learning effectiveness by 18.5%. This dissertation adopts the training scale from Alsalamah and Callinan (2021), focusing on the learning level.

2.3.4. Studies on Enterprise Innovation Level

Hassan et al. (2024) indicated that digital diffusion positively affects innovation performance ($\beta = 0.12\text{--}0.18$), depending on absorptive capacity. Čater et al. (2025) extended to green innovation. This dissertation adopts the enterprise innovation level scale from Hassan et al. (2024) consisting of 4 items.

2.3.5. Studies on Work Environment

Bruyneel et al. (2024) indicated that "staffing and resource adequacy" has a negative correlation with missed care ($\beta = -3.90$). Smerek and Peterson (2007) tested the work environment scale with Cronbach's alpha = 0.82. Hussain et al. (2025) proposed a 5-factor scale with reliability $\alpha = 0.871$. This dissertation adopts the work environment scale from Bruyneel et al. (2024) consisting of 5 items.

2.3.6. Studies on Government Support

Yin et al. (2024) indicated that government support directly affects innovation efficiency in China's semiconductor industry ($\beta = 0.28\text{--}0.35$). Zhang and Zhu (2024) emphasized flexibility and institutional commitment from local governments. This dissertation adopts the government support scale from Yin et al. (2024) consisting of 4 items.

2.3.7. Synthesis of Empirical Studies

From synthesizing empirical studies, four observations are drawn: (1) Studies highly agree on the central role of human resource quality but very few examine it as a dependent variable requiring explanation. (2) Internal factors (technological environment, training, enterprise innovation level, work environment) have been proven to have positive effects, but with varying intensities depending on context. (3) The role of work environment is confirmed, but no study has tested its mediating role in the relationship between inputs and human resource quality. (4) No study has tested the moderating role of government support in the Vietnamese context.

2.3.8. Conclusions Drawn and Identification of Research Gaps

2.3.8.1. Conclusions Drawn from the Literature Review

(1) Studies have reached high consensus on the strategic importance of human resource quality for competitive capability. (2) Studies have identified a set of influencing factors but have not reached consensus on the mechanism of impact, lacking mediation and moderation analysis. (3) The research context and industry specificity are high but have not been fully exploited.

2.3.8.2. Research Gaps

(1) Gap regarding the mechanism of impact – lack of a model explaining "why" and "how." (2) Gap regarding research context – lack of empirical evidence in nascent high-tech markets with strong policy intervention. (3) Gap regarding the role of institutions – lack of a model testing "when" internal factors exert their effects.

2.4. Research Hypotheses and Research Model

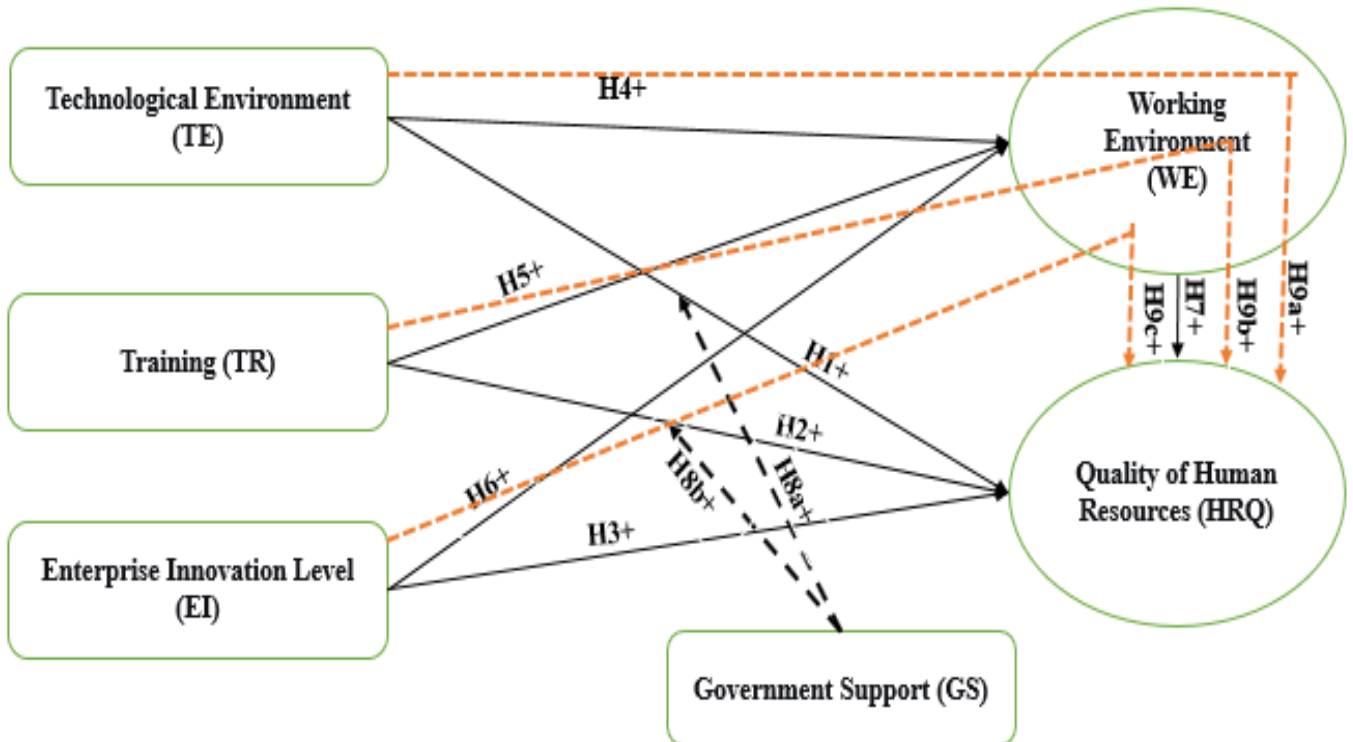
2.4.1. Research Hypotheses

Symbol	Research Hypothesis	Expected Sign
H1	TE has a positive impact on HRQ	+
H2	TR has a positive impact on HRQ	+
H3	EI has a positive impact on HRQ	+
H4	TE has a positive impact on WE	+

H5	TR has a positive impact on WE	+
H6	EI has a positive impact on WE	+
H7	WE has a positive impact on HRQ	+
H8a	GS moderates the relationship between TE and HRQ	+
H8b	GS moderates the relationship between TR and HRQ	+
H9a	TE has a positive impact on HRQ through the mediation of WE	+
H9b	TR has a positive impact on HRQ through the mediation of WE	+
H9c	EI has a positive impact on HRQ through the mediation of WE	+

2.4.2. Proposed Research Model

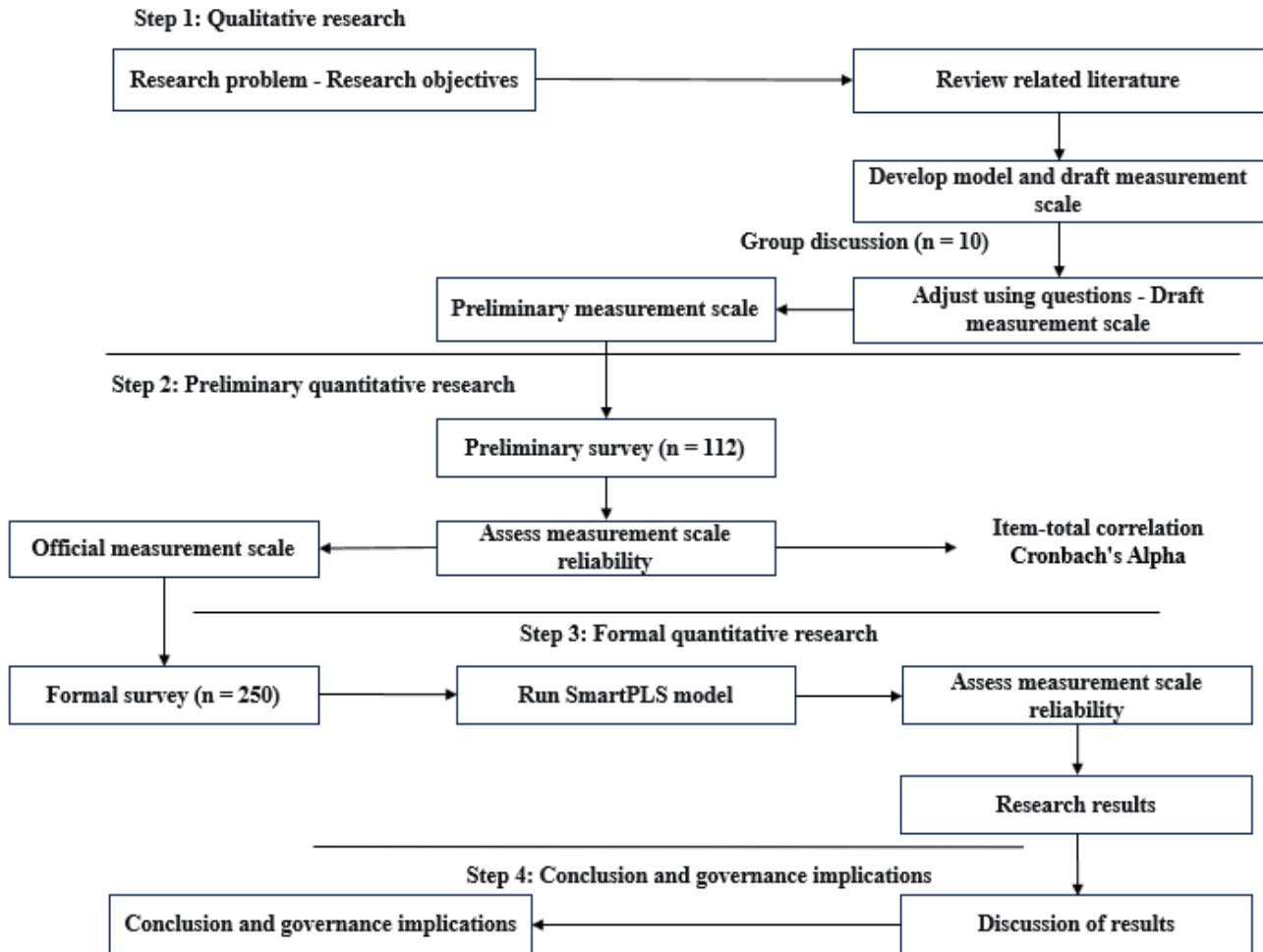
The model consists of 3 independent variables (TE, TR, EI), 1 mediating variable (WE), 1 moderating variable (GS), and 1 dependent variable (HRQ).



CHAPTER 3: RESEARCH METHODOLOGY

3.1. Research Process

The research was conducted following a mixed-methods process consisting of four sequential steps, combining qualitative and quantitative research methods to ensure scientific rigor, coherence, and the verifiability of results.



3.2. Qualitative Research

The qualitative research employed semi-structured interviews with 10 experts (from FDI and private enterprises) in Ho Chi Minh City and Binh Duong, selected through purposive sampling based on three criteria: ≥ 5 years of experience in IC design/high-tech human resource management; position from Department Head to Director; and in-depth understanding of human resource quality. Interviews were conducted until data saturation was achieved (Guest et al., 2006; Saunders et al., 2018). The experts' roles included: evaluating the

reasonableness of the model and hypotheses; and refining the semantics of observed variables. The three-step procedure included: (1) synthesizing original scales, translation – back-translation; (2) sending the preliminary scale, evaluating each item based on three criteria (clarity, relevance, measurability), with audio recording and note-taking; (3) synthesizing feedback, removing items with $\geq 7/10$ experts deeming them inappropriate or redundant, and refining the language of the remaining items. The result was a preliminary scale with 26 observed variables (Appendix 6).

3.3. Quantitative Research

3.3.1. Preliminary Quantitative Research

The preliminary quantitative research was conducted from October 2024 to November 2024 across 24 enterprises with 112 valid observations (the list of enterprises is presented in Appendix 8.1). The purpose of this phase was to preliminarily assess the reliability and validity of the measurement scales before conducting the official survey.

3.3.2. Sampling Method and Sample Size for Preliminary Quantitative Research

The preliminary quantitative research utilized an online survey through Google Forms. Stratified sampling combined with purposive sampling was applied, including managers at three levels (top, middle, lower) from the departments of Human Resources, Technical, Quality Management, and R&D. The questionnaire consisted of 3 parts: (1) Screening; (2) Content measuring the variables (TE, TR, EI, WE, GS, HRQ); (3) Demographic information.

3.3.3. Quantitative Data Analysis Method

The study employed PLS-SEM with SmartPLS 4.0, which is suitable for exploratory research and medium-sized samples (Hair et al., 2017). The procedure consisted of 4 stages: Stage 1, measurement model assessment; Stage 2, structural model assessment; Stage 3, Bootstrap testing; Stage 4, model fit assessment.

3.3.4. Sampling Method

The study employed stratified sampling by geographical area (6 provinces/cities) combined with purposive sampling. Enterprises were randomly selected within each stratum according to size proportion, followed by selecting managers at three levels (top, middle, lower) from the departments of Human Resources, Technical, R&D, and Quality Management. Selecting managers was appropriate because the research objective is to assess the impact of governance factors on human resource quality, which falls within the decision-making and supervisory scope of managers. This approach is consistent with international practices (Chen & Zheng, 2022; Juliana Jaya et al., 2020).

3.3.5. Data Collection Method

Preliminary survey (10-11/2024): 142 questionnaires were sent to 24 enterprises, with 128 returned (90.1%), and after screening, 112 valid responses remained (78.9%).

Official survey (12/2024-02/2025): 300 questionnaires were sent to 66 enterprises, yielding 250 valid responses, meeting the sample size requirements for PLS-SEM (Hair et al., 2017).

To control for Common Method Bias (CMB), the study applied procedural measures (5-point Likert design, intermixed variable arrangement) and statistical measures (Harman's single-factor test: $31.4\% < 50\%$), confirming that CMB was not a serious concern (Podsakoff et al., 2003).

3.4. Results of Qualitative and Preliminary Quantitative Research

3.4.1. Qualitative Research Results

3.4.1.1. Introduction to Measurement Scales

Scale	Code	Source
Technological Environment	TE	Chen and Zheng (2022)
Training	TR	Alsalamah and Callinan (2021)
Enterprise Innovation Level	EI	Hassan et al. (2024)
Work Environment	WE	Bruyneel et al. (2024)
Government Support	GS	Yin et al. (2024)
Human Resource Quality	HRQ	Juliana Jaya et al. (2020)

3.4.1.2. Results of Qualitative Research with Experts

The 10 experts showed high consensus on the model structure and proposed eliminating 5 unsuitable items: For Technological Environment (TE), the item "Implementation of ISO 9001:2000 human resource standards" was removed (10/10 experts agreed that it does not reflect the essence of technological environment in IC design). For Training (TR), two items were removed: "helped me succeed in my work" and "changed my attitude" due to duplication and difficulty in measurement. For Enterprise Innovation Level (EI), the item "Highly skilled workforce" was removed as it tends to measure human resource quality rather than innovation level. For Government Support (GS), the item "The government provides necessary support solutions" was removed due to being overly general and redundant. The remaining items were linguistically refined to enhance clarity and appropriateness for the context of semiconductor IC design in Vietnam.

3.4.1.3. Preliminary Measurement Scale after Expert Discussion

After the refinement process, the preliminary measurement scale consists of 26 observed variables, divided into 6 factor groups: Technological Environment (TE) with 4 items (TE1-TE4), Training (TR) with 5 items (TR1-TR5), Enterprise Innovation Level (EI) with 4 items (EI1-EI4), Work Environment (WE) with 5 items (WE1-WE5), Government Support (GS) with 4 items (GS1-GS4), and Human Resource Quality (HRQ) with 4 items (HRQ1-HRQ4).

3.4.2. Results of Preliminary Quantitative Research

3.4.2.1. Data Collection Results

The preliminary survey yielded 112 valid responses from 24 enterprises, achieving a response rate of 78.9% of the total distributed questionnaires. The sample characteristics are as follows: males accounted for 75.9%; the under-30 age group accounted for 55.4%; university graduates accounted for 65.2%; and those with less than 3 years of experience accounted for 65.2%.

3.4.2.2. Coding of Preliminary Measurement Scale

A coding system was established for the 6 measurement scale groups: TE, TR, EI, WE, GS, and HRQ, with each observed variable coded correspondingly from TE1 to HRQ4.

3.4.2.3. Results of Reliability Assessment in Preliminary Quantitative Research

The Cronbach's Alpha results for all measurement scales met the requirements (>0.8): Training (0.843), Enterprise Innovation Level (0.818), Technological Environment (0.858), Work Environment (0.874), Government Support (0.854), and Human Resource Quality (0.878). The KMO test value = 0.850 (>0.5) and Bartlett's test was statistically significant (Sig. = 0.000), indicating that the data is suitable for EFA analysis. Five factors were extracted, explaining 68.128% of the total variance. The rotated factor matrix showed a clear factor structure with 5 factors: work environment, training, government support, enterprise innovation level, and technological environment, with no cross-loading phenomena.

3.4.3. Official Questionnaire and Measurement Scale

Based on the preliminary test results and the scale refinement process through expert interviews, the official survey questionnaire was finalized with 26 observed variables, measuring six key constructs (TE, TR, EI, WE, GS, HRQ) on a 5-point Likert scale.

3.4.4. Conclusion on Preliminary Quantitative Research

The preliminary quantitative research confirmed that the measurement scales are reliable (Cronbach's Alpha ranging from 0.818 to 0.878), with good convergent and discriminant validity (EFA extracted 5 factors, explaining 68.128% of the variance), fully meeting the standards of the PLS-SEM method. Therefore, the official questionnaire is fully qualified for large-scale data collection.

CHAPTER 4: RESEARCH RESULTS AND DISCUSSION

4.1. Context and Current Status of Semiconductor IC Design Human Resources in the Southeast Region

4.1.1. Overview of the Southeast Region and Current Status of Semiconductor IC Design Human Resources

The Southeast Region, comprising 6 provinces and cities (Ho Chi Minh City, Binh Duong, Dong Nai, Ba Ria - Vung Tau, Tay Ninh, and Binh Phuoc), is considered the economic engine of Vietnam, contributing 30.2% of the nation's GDP. The region's population reaches 19,177,464 people, of which Ho Chi Minh City accounts for 49.67%. According to the researcher's survey data, as of January 2025, the entire Southeast Region has 66 semiconductor IC design enterprises and 3,767 IC design engineers. Among these, Ho Chi Minh City leads with 2,886 engineers (76.6%), Binh Duong has 549 engineers (14.6%), Dong Nai has 210 engineers (5.57%), and the remaining provinces account for a very small proportion. Although this is where the largest concentration of semiconductor IC design human resources in the country is located, the reality still poses many challenges: the scale of fewer than 4,000 people remains very modest compared to the target of 50,000 human resources by 2030; the unbalanced distribution reveals an over-reliance on Ho Chi Minh City; and most newly graduated engineers still lack practical skills with modern EDA tools.

4.1.2. Characteristics of Surveyed Enterprises

The study surveyed all 66 semiconductor IC design enterprises in the Southeast Region. The results show that FDI enterprises account for the highest proportion (51.52%), followed by domestic private enterprises (45.45%),

reflecting the dominant role of foreign direct investment. In terms of scale, enterprises with 50-200 employees account for the largest proportion (40.91%). Regarding operational duration, the group with 5-10 years of operation accounts for 48.48%.

4.1.3. Current Status of Factors Affecting Human Resource Quality

Survey results from 250 managers show that all measurement scales have mean values above 3.5/5. Work Environment was rated highest (3.672/5), followed by Technological Environment (3.645/5), Government Support (3.640/5), Human Resource Quality (3.623/5), Training (3.591/5), and Enterprise Innovation Level (3.520/5). Notably, Government Support has the highest standard deviation (0.983).

4.1.4. Detailed Current Status of Human Resource Quality

Detailed assessment of human resource quality reveals consistency across dimensions. The ability to use EDA tools (HRQ4) has the highest mean value (3.636/5), followed by the level of updating new knowledge (HRQ3, 3.632), professional skills (HRQ2, 3.620), and educational attainment (HRQ1, 3.604).

4.1.5. Overall Assessment and Emerging Challenges

The current status picture shows that resources are at a good level, with human resource quality being rated positively. However, challenges regarding scale, uneven distribution, and differences among enterprise groups remain.

4.2. Descriptive Statistics

4.2.1. Sample Size Determination

According to Hair et al. (2017), a sample size of 100 to 200 is sufficient for PLS-SEM. This study collected 250 valid survey responses, meeting the requirement.

4.2.2. Descriptive Statistics of the Official Quantitative Research Sample

The research sample consists of 250 managers from 66 enterprises. Regarding gender: male 51.2%, female 48.8%. Regarding age: under 30

(36.4%), 30-40 (52.8%), over 40 (10.8%). Regarding education: undergraduate (60.4%), postgraduate (15.2%), others (24.4%). Regarding experience: under 3 years (48.8%), 3-10 years (39.2%), over 10 years (12%). Regarding management level: middle management accounts for 47.2%, lower management 34.4%, top management 18.4%. Regarding department: Technical (32.0%), Human Resources (28.0%), R&D (20.0%), Quality Management (12.0%), Business (8.0%).

4.2.3. Data Collection Results

A total of 300 questionnaires were distributed, with 295 returned. After screening, 250 valid responses were used for the final analysis.

4.3. Measurement Model Assessment

4.3.1. Assessment of Outer Loadings

The analysis results show that all observed variables in the model have factor loadings ranging from 0.722 to 0.881, exceeding the minimum required threshold of 0.7. Therefore, all observed variables ensure the necessary reliability and are retained.

4.3.2. Assessment of Reliability and Convergent Validity

Cronbach's Alpha values range from 0.849 (HRQ) to 0.890 (WE). Composite Reliability (CR) ranges from 0.893 (GS) to 0.919 (WE). Average Variance Extracted (AVE) values range from 0.662 (TR) to 0.718 (EI). All values exceed the required thresholds, confirming the reliability and convergent validity of the measurement scales.

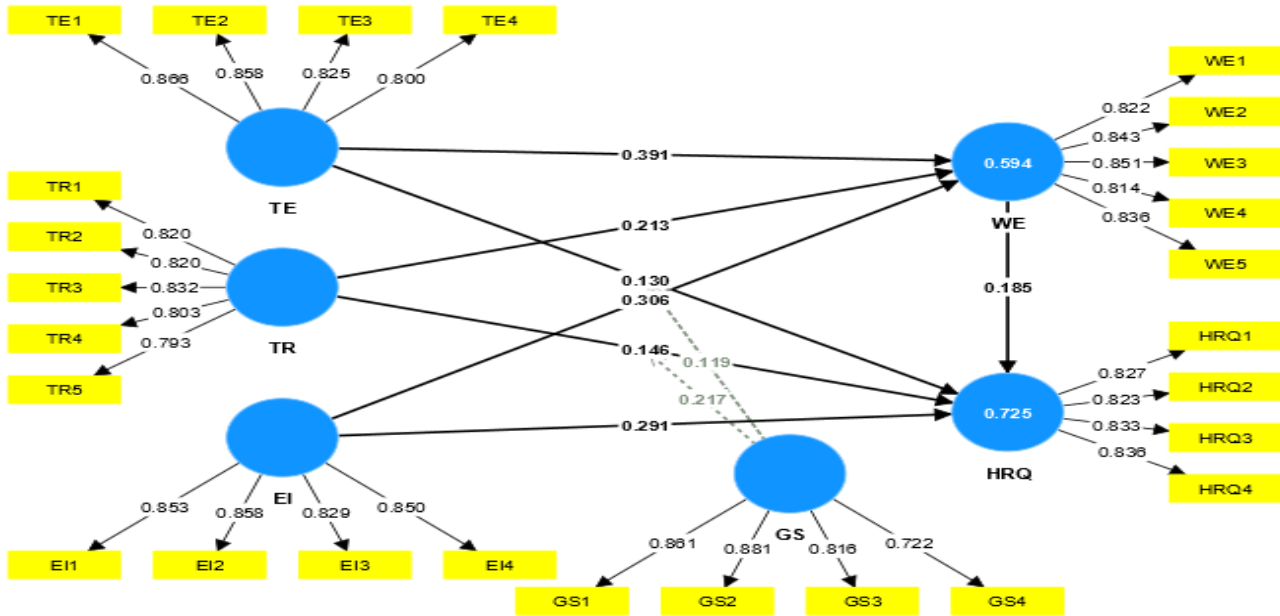
4.3.3. Assessment of Discriminant Validity

4.3.3.1. Fornell-Larcker Criterion Assessment

The square root of the AVE for each construct is greater than the correlation coefficients between that construct and other constructs, confirming discriminant validity.

4.3.3.2. HTMT Ratio Assessment

All HTMT values are below 0.85, confirming the discriminant validity of the measurement scales. 4.4. Structural Model Testing



4.4.1. Model Fit Assessment

The SRMR value = 0.054 (< 0.08) and NFI = 0.843 indicate that the model has good fit with the data.

4.4.2. Hypothesis Testing Results

The results of testing all 12 research hypotheses are as follows:

Hypothesis	Relationship	Coefficient (β)	p-value	Conclusion
Direct Effects				
H1	TE $\rightarrow$ HRQ	0.130	0.035	Supported
H2	TR $\rightarrow$ HRQ	0.146	0.018	Supported
H3	EI $\rightarrow$ HRQ	0.291	< 0.001	Supported
H4	TE $\rightarrow$ WE	0.391	< 0.001	Supported
H5	TR $\rightarrow$ WE	0.213	< 0.001	Supported
H6	EI $\rightarrow$ WE	0.306	< 0.001	Supported
H7	WE $\rightarrow$ HRQ	0.185	0.007	Supported

Moderating Effects				
H8a	$GS \times TE \rightarrow HRQ$	0.119	0.022	Supported
H8b	$GS \times TR \rightarrow HRQ$	0.217	< 0.001	Supported
Indirect Effects (via WE)				
H9a	$TE \rightarrow WE \rightarrow HRQ$	0.072	0.022	Supported
H9b	$TR \rightarrow WE \rightarrow HRQ$	0.039	0.035	Supported
H9c	$EI \rightarrow WE \rightarrow HRQ$	0.057	0.024	Supported

4.4.3. Explanatory Power (R^2) and Predictive Relevance (Q^2)

The model explains 71.7% of the variance in human resource quality (adjusted $R^2 = 0.717$) and 58.9% of the variance in work environment. Both Q^2 values are greater than 0.35 (work environment: 0.402; human resource quality: 0.490), demonstrating that the model has strong predictive relevance.

4.5. Multi-group Analysis

The model is stable across management groups. Notable differences include: female managers perceive a stronger impact of technological environment on human resource quality; the under-30 age group values the indirect effect of training through work environment, while the over-30 group emphasizes its direct effect; managers with over 5 years of experience and postgraduate qualifications have a deeper understanding of the roles of innovation and training.

4.6. Discussion of Research Results

Enterprise innovation level has the strongest impact on human resource quality ($\beta = 0.291$), consistent with the semiconductor industry's characteristic technology lifecycle of 18-24 months. Work environment plays the role of a "transformational bridge" between tangible investment and actual competence. Government support serves as an "institutional catalyst" with its strongest amplification effect on training ($\beta = 0.217$), confirming that supportive policies

create a favorable environment for enterprises' internal efforts to achieve maximum effectiveness.

CHAPTER 5: CONCLUSION AND MANAGERIAL IMPLICATIONS

5.1. Conclusion

This dissertation develops and tests an integrated model of the mechanism for forming human resource quality in the semiconductor industry (surveying 250 managers across 66 enterprises using PLS-SEM). The results show that all four factors have positive effects, with enterprise innovation level having the strongest impact ($\beta = 0.291$), followed by work environment ($\beta = 0.185$), training ($\beta = 0.146$), and technological environment ($\beta = 0.130$). Work environment serves as a transformational bridge converting investment into human resource quality; government support has a positive moderating effect, particularly amplifying training effectiveness ($\beta = 0.217$). The model explains 71.7% of the variance in human resource quality ($R^2 = 0.717$). The dissertation integrates three foundational theories, elucidating the "bridging" role of work environment and the "catalytic" role of government support.

5.2. Managerial Implications

5.2.1. Implications for Semiconductor IC Design Enterprises

Prioritize strategic focus on enterprise innovation level. Build the work environment as a "transformational bridge." Design flexible training programs differentiated by age group and educational level.

5.2.2. Implications for the Government and State Management Agencies

Concentrate support resources on practical training and shared infrastructure. Coordinate support policies evenly across localities in the Southeast region.

5.2.3. Implications for Training Institutions (Universities and Research Institutes)

Transform the training model from purely theoretical to "learning by doing," closely linked with enterprise practice. Develop a faculty with practical industry experience and strong industry connections.

5.3. Contributions and Future Research Directions

Theoretical Contributions: (i) an integrated model explaining 71.7% of the variance in human resource quality; (ii) the mediating role of work environment – a "transformational bridge" between investment and outcomes; (iii) the moderating role of government support – an "institutional catalyst," reinforcing Institutional Theory.

Practical Contributions: (i) a self-assessment toolkit and strategic priority hierarchy for enterprises; (ii) scientific evidence for the government to design targeted support policies and coordinate evenly across localities; (iii) a four-step training reform roadmap for training institutions, narrowing the gap between academia and industry.

5.3.3. Limitations and Future Research Directions

5.3.3.1. Research Limitations:

(i) single-source data (managers) with potential bias; (ii) The cross-sectional design cannot fully confirm causal relationships; (iii) geographical scope limited to the Southeast region; (iv) government support measured through subjective perception; (v) model leaves approximately 28% of variance unexplained; (vi) nested data not addressed through multilevel modeling.

5.3.3.2. Future Research Directions:

Future research should expand the scope nationwide, employ longitudinal designs and multi-source data to confirm causal relationships; incorporate new variables (organizational culture, quality of educational inputs); improve government support measurement using objective indicators; and test the model for other high-tech industries.