



# The Effect of Innovation Policies on the Innovation Performance of High-tech Enterprises in Hainan

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**Abstract:** Being one of four major industries involved in the development of the free trade port in Hainan vigorously developing high-tech enterprises is an inevitable choice for Hainan to realize its innovation-driven development strategy and to catch up from being a latecomer to realizing the curved-track overtaking. In this process, innovation policy and digital transformation will play a pivotal role in the development of high-tech enterprises and affect their innovation performance. Considering this, this work firstly emphasizes the importance of innovation policy and digital transformation on the innovation performance and development of high-tech enterprises in Hainan; secondly puts forward the three research objectives of this paper; then discusses the research methodology from the research design, the research sample, the sample size, the sampling method and the questionnaire design; finally, the study concludes that the innovation policy and the digital transformation have a positive impact on the innovation performance, and that the digital transformation plays a mediating role in the innovation performance. innovation policy and innovation performance play a mediating role, so as to provide a reference for the government to promote the development of high-tech enterprises.

**Keywords:** *High-tech enterprises, innovation policy, digital transformation, innovation performance*

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## INTRODUCTION

Future economic growth in Hainan will be fueled by the innovation of high-tech enterprises. To this end, the federal and municipal governments have developed and put into effect a number of creative measures to lessen market failures, that arises during high-tech enterprises' R&D processes, to foster an environment that is conducive to their innovation, and to increase the likelihood that the innovation will succeed (Ito, Li, & Wang, 2017). High-tech companies will select distinct innovation strategies based on the unique innovation environment since innovation is a high-risk activity that can provide large returns (L. Zhang, Xiong, Gao, & Yang, 2022). varied innovation results will arise from varied innovation strategies chosen by high-tech companies, and this will ultimately impact the enterprise's innovation performance (Zhou, Li, Liu, & Li, 2017).

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The globe is currently undergoing a profound transformation not witnessed in a century, and China's economic development is confronted with a series of grave hazards as well as a challenging and complicated international environment (Abula, Abula, Wang, & Wang, 2022). The development of advanced technology has faced significant hurdles due to the dynamic changes in both macro and micro contexts. An increasing number of entrepreneurs are implementing digital transformation strategies as a result of the government's introduction of a number of innovation policies and digitalization plans to address the unpredictability of the external environment (Hu, Hao, & Wang, 2022). In high-tech companies, the use of new digital technologies alters the organizational boundaries and resource allocation strategies for innovation in order to achieve a long-term improvement in innovation performance (Cheng & Wang, 2022).

Based on this, the article aims to develop a connection model relating innovation policy, digital transformation, and innovation performance, and to carry out empirical analysis of Hainan's technological companies is undertaken to shed light on how innovation policies in the age of the digital economy impact high-tech firms' innovation success, and thus provide theoretical basis and decision-making reference to promote the innovative development of high-tech corporations in Hainan. The primary objective of the article is to analyze the present state of matters and problems concerning the development of high-tech companies in Hainan. Additionally, it appears at policy on innovation as a starting point and discovers innovation paths that support the growth of high-tech enterprises in Hainan, improves innovation performance, and finds the development of high-quality companies. Consequently, the following are the detailed research goals of this study

- To identify the connections among innovation performance, digital transformation, and policy.
- To determine the mediating role of digital transformation between innovation policy and innovation performance.
- To explore the impact path of innovation policy, digital transformation on innovation performance.

## LITERATURE REVIEW

### *Innovation Policy and Innovation Performance*

The innovation policy's helpful incentive effect on innovation performance has been confirmed by several domestic and international research (Cheng & Wang, 2022). For instance, according to some local and international academics, corporate innovation efficiency can be positively impacted by innovation policies such as tax breaks, financial support, talent policies, and government subsidies (Hanaysha & Abdullah, 2015) ; (Howell, 2016) ; (Mudambi, Mudambi, Mukherjee, & Scalera, 2017); (Peng, Yin, Wen, & Kuang, 2021); (Lin et al., 2020); (L. Zhang et al., 2022) (Zhou et al., 2017). Cin, Kim, and Vonortas (2017) confirmed the effect of government R&D subsidies in encouraging business productivity and R&D investment using Korean small and medium-sized manufacturing industry as the study object. Zhou et al. (2017) noticed through regression analysis that government innovation policies had a positive boosting influence on enterprise innovation performance using data from 2013 high-tech enterprises in Hebei Province. According to (L. Zhang et al., 2022), government patent incentives significantly improve business performance, considering the panel data below of a-share listed firms in my country between 2003 and 2016. After conducting an empirical investigation, (Cheng & Wang, 2022) came to the conclusion that listed businesses' degree of independent innovation has improved as a result of the adoption of science and technology regulations. The growth of high-tech businesses will also be influenced by favorable environmental conditions, market demand, and factor input. Thus, this research proposes the following hypothesis:

**H<sub>1</sub>: Innovation policy positively influences enterprise innovation performance.**

### *Digital Transformation and Innovation Performance*

Although scholars domestically and internationally hold differing opinions in reference to the correlation between corporate innovation performance and digital transformation, the majority of research indicates that businesses can execute digital transformation through the utilization of communication technology and fresh data, which will additionally yield an increasing number of prospects for corporate economic expansion and enhancement of corporate innovation performance. It has been demonstrated by (Akter, Wamba, Gunasekaran, Dubey, & Childe, 2016) that information technology competencies may improve corporate business strategy alignment and lead to improved performance in the big data environment. (Nwankpa & Roumani, 2016) investigated the extent of digital transformation of businesses using a questionnaire survey and conducted an empirical investigation into the beneficial effects of digital transformation on innovation performance.

From a theoretical perspective, (Vial, 2021) examined the phenomena of digital transformation fostering organizational innovation and made the claim that digital transformation can enhance an organization’s capacity for innovation. The finding that regional innovation performance increases with increased digital access was corroborated by (Xu & Li, 2023). According to (L. Zhang et al., 2022), there are three primary ways that digital transformation influences enterprise innovation performance: first, it increases the opportunities for innovation within enterprises; second, it boosts enterprise innovation efficiency; and third, it lowers enterprise innovation costs. We conducted an empirical study to investigate the considerable beneficial impact of digital transformation on the innovative performance of high-tech firms. The sample consisted of data from 2007 to 2019 from a-share listed firms in Shanghai and Shenzhen high-tech firms in my nation. J. Zhang and Long (2022) gathered 303 enterprise samples, used middle and senior managers as study participants, and used empirical analysis to determine that innovation performance is significantly enhanced by digital transformation. After conducting an empirical examination of A-share-listed manufacturing organizations from 2006 to 2021, (Xu & Li, 2023) concluded that corporate innovation performance is positively impacted by digital transformation. The analysis presented above leads this study to offer the following hypotheses:

**H<sub>2</sub>: Innovation performance is positively impacted by digital transformation.**

**Mediating Role of Digital Transformation**

Businesses are currently operating in era of the digital economy. The share of era of the digital economy in my nation’s GDP has grown annually, and by 2023, it should account for almost 45% of GDP. The only path to high-quality development for conventional real firms is now through the "real economy + digitalization" approach. The high-tech sector is essential to the long-term growth of Hainan’s economy and is one of the four main driving industries behind the building of the Hainan Free Trade Port. Consequently, it is essential to successfully encourage high-tech businesses to go digital, since this will enable them to stay innovative and obtain a competitive edge. In terms of policy, the Chinese government is fully in favor of businesses becoming digital as it will help them define their strategic path for development. Support from government policies, such as tax breaks and subsidies, will motivate high-tech firms to invest more money in R&D and strengthen their capacity for innovation, which will boost the performance of these businesses in this area. In light of this, this study holds that innovation policies can help firms improve their innovation performance by encouraging them to make clear its strategy and business orientation, adjusting to the requirements of the digital economy era and actively encourage businesses to upgrade and undergo digital transformation. Consequently, the following hypothesis is put out in this paper:

**H<sub>3</sub>: The link between innovation performance and policy is mediated by digital transformation.**

In conclusion, The study subject in this work is Hainan high-tech businesses; the independent variable is innovation policy; the mediating variable is digital transformation; and the dependent variable is innovation performance. It then establishes a structural equation theory model based on the research results both domestically and internationally. Figure 1 below depicts the model’s theoretical foundation:

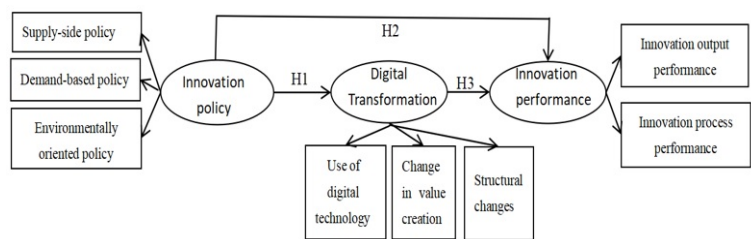


Figure 1 Research Conceptual Framework of Innovation Performance

**METHOD**

In light of the goals and research questions, this study aims to investigate the following links between innovation policy and innovation performance using quantitative research methods. Quantitative research is the application of theory by the researcher to provide explanations or make predictions about the relationship of variables in the research process (Creswell, 2021). In the process of quantitative analysis, it is first necessary to design the statistical survey program in order to determine the purpose of the survey and research, the object of the survey, the time and place of the

survey, the survey method and so on, and then design questionnaire according to research purpose for the collection and collation of data, and to present them in the form of a statistical table or a statistical chart; and finally, it is to analyze the collated data statistically and to verify the hypotheses and predictions put forward in the text, so as to give a analysis report. Overall, quantitative research will make the hypothesis or prediction more convincing.

## **METHOD**

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### ***Sample***

The focus of this study is 2096 high-tech companies spread across 20 cities, counties, or districts in Hainan Province. Managers of high-tech enterprises as unit of survey, including grassroots managers, middle managers and senior managers, etc.

In structural equation modeling studies, there is no unanimous consensus on the determination of sample size, which is mostly done using rules of thumb. If the model is simple, a smaller sample size can be taken, although it should be at least 100-150 units. (Howell, 2016); (Hanaysha & Abdullah, 2015); (Mudambi et al., 2017). Some scholars also believe that the sample size needs to be at least 200 units to reflect the quantitative characteristics of the aggregate. A simple CFA analysis requires a minimum of 150 samples to support the data when it conforms to a normal distribution. Of course, in the case of multiple cohort comparisons, at least 100 samples are required for each cohort (Peng et al., 2021). Based on the combination of previous empirical analysis and the characteristics of high-tech enterprises, this paper believes that the sample size of high-tech enterprises should reach at least 200 to be reasonable.

To account for those they were unable to reach, many studies usually increase the sample size by 10% to 30% (Singh & Masuku, 2014). Therefore, to guarantee the impartiality of the study's findings, this paper increases the sample size by 30%, i.e.,  $200 \times (1 + 30\%) = 260$ .

This article aims to study the correlation between high-tech firms' innovation policies and innovation performance. As a result, the research object will be high-tech businesses located in 20 Hainan Province cities, counties, and districts. The Hainan provincial bureau of statistics issued statistics showing that, as of the end of 2023, the proportion of high-tech firms in the province was roughly 64.12% (1,344/2,096), with the majority located in (Hanaysha & Abdullah, 2015). Therefore, this survey will first conduct a focused investigation and then use a simple random sampling method to select enterprises as samples. The term "simple random sampling" describes a sampling technique that uses the randomization principle to choose units from the population to produce a sample. Simple random sampling allows for the total elimination of the impact of subjective personal variables on sample selection, as well as uniform sample selection probability. In practice, the study's primary units were Haikou and Sanya. After that, 260 questionnaires were distributed to high-tech businesses in these two locations as part of a sample survey. The selection of Haikou and Sanya was based on the fact that these two areas are the most technologically and economically developed in the province of Hainan, and the survey results have some reference value for high-tech businesses in other Hainan locations.

### ***Instrument***

Initially, a survey of the literature was used to develop the questionnaire's content. The survey content includes all the variables involved in this study, including innovation policies (supply-side policies, demand-side policies, and environmental policies), digital transformation (use of digital technology, changes in value creation, and structural changes), and innovation performance (innovation output performance and innovation process performance). It also contains basic data about high-tech businesses and respondents, like the size of the business, the respondents' age, gender, and educational attainment.

Secondly, establish the questionnaire's format. Every characteristic on the survey has many indications that explain it, and each response is rated on a 5-point Likert scale. When filling out the questionnaire, the respondents circled the corresponding number on each indicator item, with "1" means strongly disagree, and "5" means strongly agree.

Finally, the designed scale was modified and improved with reference to the more mature international standardized scale, and the questionnaire was finally determined. To better align the scale with the real state of Hainan's free trade port building and enhance the significance of the research, the features of the city's high-tech firms were integrated into the scale modification process.

## EMPIRICAL ANALYSIS

Since the research object of this paper is the high-tech firms in Hainan Province, the questionnaire survey adopted is integrating fieldwork and internet research, all of which are conducted in a random sampling manner, and there were 260 surveys issued in total. Due to some human or objective reasons during the questionnaire filling process, 11 of the questionnaires were of low quality, so they were eliminated, and a total of 249 valid questionnaires were collected, accounting for 95.77% of the entire quantity of questionnaires, meeting the quantity of questionnaires required for subsequent analysis. Among them, there are 15 questions on innovation policy, 9 questions on digital transformation, and 10 questions on innovation performance.

### *Reliability and Validity Analysis*

Reliability analysis is used to test the degree of consistency of the questionnaire results, if it can pass the reliability test, it means that the questionnaire data have credibility. Generally, Cronbach's Alpha (CA) and Composite Reliability (CR) were used to evaluate the dependability of internal consistency. The higher the CA value, it means that all the index scores within a dimension have the same significance and range. Cronbach (1951) suggests that the CA threshold is greater than 0.7. Werts, Linn, and Jöreskog (1974) suggested that a CR value between 0.7 and 0.95 is a more satisfactory level, while a value higher than 0.95 is problematic and unacceptable. Convergent validity is a reflection of the degree of convergence of a latent variable indicator compared to other latent variables and is generally measured by Average Variance Extracted (AVE). According to citeformell1981evaluating suggested that if the AVE is greater than 0.5 it indicates that convergence is more desirable and 0.36-0.5 indicates that it is acceptable. Typically the VIF value is used to test for covariance. If the VIF is falls below 5, it description model does not have covariance problem (Kock, 2015).

Table 1 *RELIABILITY AND VALIDITY*

| Constructs             | Items | Loadings | Cronbach's alpha | CR (rho_a) | AVE   | VIF   |
|------------------------|-------|----------|------------------|------------|-------|-------|
| Innovation Policy      | SOP   | 0.765    | 0.927            | 0.93       | 0.552 | 1.987 |
|                        | DOP   | 0.791    |                  |            |       |       |
|                        | EOP   | 0.742    |                  |            |       |       |
| Digital Transformation | UDT   | 0.735    | 0.897            | 0.898      | 0.55  | 1.631 |
|                        | CVC   | 0.752    |                  |            |       |       |
|                        | STC   | 0.742    |                  |            |       |       |
|                        | MAU   | 0.746    |                  |            |       |       |
| Innovation Performance | IOP   | 0.788    | 0.935            | 0.935      | 0.631 | 2.186 |
|                        | IPP   | 0.801    |                  |            |       |       |

From the above table, we can see that the values of Cronbach's alpha, CR (rho\_a), AVE, and VIF are all within the standard range, indicating that the variables have good reliability and validity.

### *Hypothesis testing*

The bootstrap approach is used by SmartPLS 4.0 to test hypotheses, with a sample size of 5000. Results can be seen in Table 2:

Table 2 SIGNIFICANCE RESULTS FOR PATH COEFFICIENTS

| Hypothesis   | Original sam-<br>ple (O) | Sample mean (M) | Standard<br>deviation<br>(STDEV) | t statistics<br>(IO/STDEVI) | p values | Status    |
|--|--------------------------|-----------------|----------------------------------|-----------------------------|----------|-----------|
| H <sub>1</sub> : Innova-<br>tion policy<br>-> Innovation<br>Performance                                      | 0.272                    | 0.274           | 0.066                            | 4.1                         | 0        | Supported |
| H <sub>2</sub> : Digital<br>transfor-<br>mation -><br>Innovation<br>Performance                              | 0.194                    | 0.195           | 0.07                             | 2.751                       | 0.006    | Supported |
| H <sub>3</sub> : Innova-<br>tion Policy<br>-> Digital<br>Transfor-<br>mation -><br>Innovation<br>Performance | 0.145                    | 0.148           | 0.034                            | 4.218                       | 0        | Supported |

From the above table, we can see the findings demonstrate that innovation performance is significantly influenced by supporting innovation policies, as evidenced by the path coefficient of 0.272 and the corresponding *t*-value of 4.100, both of which are significant at the 0.000 level. Similarly, digital transformation has a constructive influence on innovation performances.

The findings confirm the hypothesis that digital transformation acts as a mediating element in the manner that innovation policy enhances innovation performance by promoting digital transformation inside enterprises. Specifically, the indirect impact of 0.01 (*t* = 4.218, *p*=0.000) is statistically significant. These findings provide credence to the idea that innovation policies enhance innovation performance, if only by providing incentives for companies to become digital.

The formula of VAF is  $VAF = \text{Indirect Effect} / \text{Total Effect}$ . by calculation: the VAF value in H<sub>3</sub> is  $0.145 / (0.145 + 0.272) = 34.77\%$ , which indicates that digital transformation plays a role of partial mediation between innovation policies and innovation performances.

## CONCLUSION

Based on the aforementioned data, three assumptions concerning the innovation performance of Hainan’s high-tech companies may be derived: H<sub>1</sub>: Enterprise innovation performance is positively influenced by innovation policy; H<sub>2</sub>: Enterprise innovation performance is positively impacted by digital transformation. H<sub>3</sub>: The connection between innovation performance and policy is mediated by digital transformation. Data were obtained through questionnaire surveys, and SMART-PLS analysis was used to verify the previously proposed hypothesis, namely that both innovation policy and digital transformation have a positive effect on innovation performance, and digital transformation plays a partial mediating role between innovation policy and innovation performance.

In the future, the scope of the sample will be expanded and the influence of Chinese culture will be taken into consideration, thus providing a modest contribution to the development of China’s high-tech enterprises.

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