

EVALUATION OF SURVEY RESULTS ON THE ROLE AND IMPACT OF SCIENCE, TECHNOLOGY, AND INNOVATION ON LIFE AND SOCIO-ECONOMIC SECTORS

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ABSTRACT

Within the framework of a provincial-level project in Ha Tinh on researching and evaluating the current state and solutions to enhance the Total Factor Productivity (TFP) of Ha Tinh province based on science, technology, and innovation, this study conducted a survey of experts, scientists, and policymakers in Ha Tinh and Nghe An provinces. The results indicate that: (i) Television and the internet are the most common means of accessing information on science, technology, and innovation, with traditional forms of communication gradually being replaced by modern digital media. Notably, there is increasing interest in science, technology, and innovation; (ii) Science and technology are perceived to have significant impacts on life and various sectors, particularly healthcare, the environment, and energy; (iii) Regarding policy, R&D support is considered crucial, with an emphasis on the role of public investment in R&D. Policies should strengthen support for STI research. However, programs serving STI still have many limitations. Strengthening linkages between the government, enterprises, and research institutes is essential; (iv) To promote STI, it is necessary to enhance international cooperation, establish international collaboration programs, and encourage the mobility of researchers.

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1. INTRODUCTION

This study employs a non-probability sampling method, in which units within the population do not have an equal chance of being selected for the sample (Pace, 2021; Vehovar et al., 2016). Within the group of non-probability sampling methods, several approaches can be applied, including convenience sampling, judgmental sampling, quota sampling, and rapid accumulation sampling (Adeoye, 2023; Shamsudin et al., 2024). This research adopts convenience sampling due to its advantages, such as ease of access, feasibility, and the

ability to gather information quickly (Emerson, 2021; Golzar et al., 2022).

The study determines the sample size for a population comprising managers, scientists, and experts in Ha Tinh and Nghe An provinces (Ha Tinh province, 2024; Nghe An province, 2024). If the sample size is insufficient, the conclusions drawn from the research will lack accuracy and reliability, potentially rendering them invalid (Bacchetti, 2010; Cunningham & Baumeister, 2016). Conversely, an excessively large sample size would lead to unnecessary resource consumption, including financial and time-related costs. Therefore, the optimal

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number of survey participants depends on the type of research and is influenced by three key factors: Research design methodology and outcome criteria; Effect size; Acceptable margin of error, specifically Type I and Type II errors (statistical power), with the selected confidence level set at 95%.

Let n be the sample size. With a 95% confidence level, the corresponding z value is 1.96. The allowable error is $e = \pm 5\%$; let p be the estimated percentage rate of the population; $q = 1 - p$; p and q are often estimated as 50%; 50% because it represents the maximum likelihood for the population. The sample size will be calculated using the formula:

$$n = \frac{z^2 \cdot (p \cdot q)}{e^2}$$

Substituting the values into the formula, we get the following result:

$$n = \frac{1,96^2 \cdot (0,5 \cdot 0,5)}{0,05^2} = 385$$

In the survey process, some responses may contain errors and need to be discarded. Therefore, to ensure an adequate sample size, the research team will conduct a survey involving experts in science and technology management and research and development (R&D) in Ha Tinh and Nghe An provinces (Ha Tinh province, 2024; Nghe An province, 2024; General Statistics Office, GSO, 2024a; General Statistics Office, GSO, 2024b; General Statistics Office, GSO, 2024c). The survey will focus on the conditions and ecological environment of the provinces, serving as a foundation for the study and the development of an evaluation framework to assess the impact of STI on total factor productivity (TFP).

The survey focuses on assessing the current role of science and technology in the socio-economic development of the locality, identifying barriers, advantages, and challenges in enhancing the role of science and technology in the economy. The survey is conducted using a Likert scale ranging from 1 to 5, where 1 represents the lowest level of agreement and 5 represents the highest level of agreement.

2. METHODOLOGY

To achieve the research objectives, the authors conducted an in-depth survey targeting managers from relevant provincial departments in Ha Tinh and Nghe An, as well as experts and scientists in these provinces ((Ha Tinh province, 2024; Nghe An province, 2024). Specifically, 30 survey responses were collected in Ha Tinh and 20 in Nghe An. The survey focused on the following key aspects: (i) Understanding and analyzing the system of mechanisms and policies related to the development of science, technology, and innovation (STI); (ii) Assessing the current state of STI in the surveyed areas based on various criteria; (iii) Identifying barriers to the advancement of STI; (iv) Gathering expert recommendations to enhance STI development and increase its contribution to provincial economic growth in the upcoming time.

Preliminary Survey Results: (i) All surveyed experts have at least a bachelor's degree. Among the total respondents, 57% hold a bachelor's degree, 37% have a postgraduate degree, and the group with a college degree accounts for a small proportion, only 5.5%; (ii) In terms of gender, male experts constitute a significantly larger proportion than female experts, with males accounting for 70.5% and females making up only 29.5%; (iii) Regarding the work sector, the private sector has the highest representation, accounting for 78% of respondents. This sector is considered to play a dominant role in innovation and digital transformation. Conversely, the public sector accounts for only 3%, the foreign-invested sector accounts for 4%, and the collective sector represents just 2.5%.

3. ANALYSIS AND EVALUATION OF SURVEY RESULTS

3.1. Access to Information on STI

(1) Access to Media Information. Survey results indicate that television and the internet are the most commonly used media channels, with usage rates of 92.5% and 96%, respectively. Meanwhile, traditional media such as printed newspapers, magazines, and radio are gradually being replaced by modern digital communication platforms.

The primary purposes of internet usage include searching for social information, entertainment, science and technology, business, email communication, and education. Meanwhile, areas such as religion and politics have relatively lower internet usage rates. Specifically, 88% of experts use the internet for information searching, 81% use it for science and technology related purposes, 80% of respondents use the internet for entertainment. The survey results also show that up to 79% of surveyed participants use the internet for business activities and 70.5% of experts utilize the internet for email communication. Meanwhile, 64.5% of respondents use the internet for educational purposes. For other related activities such as information related to politics, only 41.5% of participants search for political information online and a significant 93% do not use the internet for religious information.

(2) Survey results on sources of information for STI reveal a modernization trend in information access among experts. Electronic media such as television, the internet, and specialized journals dominate, while traditional media like printed newspapers and radio are gradually becoming less utilized. Specifically, Television (TV) is the most widely used information source, with 67.5% of respondents reporting its use. The internet ranks as the second most common source, with 64.5% using it to access STI-related information. Specialized journals come third, with 65.5% of respondents considering them an important information source. Next, books are also widely used, with 53.5% of respondents selecting them as a source. Online newspapers are a popular medium for accessing STI information, with 54% of respondents

using them. Meanwhile, non-specialized printed magazines are used by 41.5% of respondents for information gathering. Printed newspapers, while still relevant, are less popular than modern media, with 40.5% of respondents using them. Non-STI specialized printed magazines are utilized by only 29.5% of respondents. Finally, radio is the least popular source of information, with only 10% of respondents using it to access STI-related content.

(3) Survey results on participation rates in science and technology exhibitions indicate that most respondents have attended such events once or twice with 46.5% of respondents have participated twice and 27.5% have attended once. Meanwhile, 10.5% have never attended an science and technology exhibition. Only 7.5% of respondents have participated three times and participation rates for four and five times are both 3% each. Attendance of six or more times is extremely rare, with only 1% of respondents have attended six times and 0.5% have attended seven and eight times. Overall, the majority of respondents have attended at least once, but the number of participants attending more than three times remains very low.

(4) Regarding the level of Interest in Scientific Issues, Survey results indicate that the application of inventions and new technologies garners the highest level of interest, with 90% of respondents expressing concern. This was followed by issues related to environmental pollution and innovation, accounting for 89% and 87% of participants, respectively. The level of interest in new scientific discoveries is also very high, with 88.5% of respondents selecting this option. New medical discoveries and renewable energy receive moderate levels of interest, with 67.5% and 78.5% of respondents expressing concern, respectively. Meanwhile, only 72.5% of respondents express interest in STI. Lastly, renewable energy and STI related issues in Vietnam record the highest levels of disinterest, at 21.5% and 27.5%, respectively.

(5) Regarding the understanding of STI, survey results indicate that technological innovation is the most recognized and highly regarded aspect of innovation, with 52% of respondents highlighting it as the primary focus of their understanding of STI. Other key areas of innovation identified by respondents include: Managerial innovation (24%), referring to changes in business operations and management to enhance efficiency and effectiveness. Process innovation (19.5%), emphasizing the importance of improving and optimizing production processes to boost productivity and product quality. Meanwhile, Product innovation (4.5%), reflecting a certain level of interest in developing and improving products to meet market demands. Both product and process innovation were mentioned by only 2.5% of respondents.

3.2. Impact of STI on Life and Various Sectors

3.2.1. Impact of STI on Life

Survey results indicate that 93% of respondents believe that STI have a positive impact on their lives. Only 0.5%

perceive STI as having a negative effect, while 6.5% of respondents stated that they do not know or are uncertain about its impact. These findings underscore the significant role of STI in enhancing quality of life, providing substantial benefits ranging from improving work efficiency and fostering social connections to optimizing business operations and healthcare services. Ultimately, STI contributes to sustainable development and the modernization of daily life.

Many experts believe that STI have made life more convenient through the use of smart devices such as smartphones, tablets, washing machines, robot vacuums, dishwashers, and other advanced technologies. These devices help save time and improve quality of life while assisting in managing daily tasks more efficiently (e.g., robot mops, online medical appointment scheduling). Additionally, the internet and technological devices enable users to easily access information, from staying updated with the latest news to finding essential resources for work, study, and entertainment. They also enhance social connectivity, making communication and networking more seamless. This optimizes work processes, making jobs more efficient and convenient. Many people have shifted from reading printed newspapers to digital news platforms, and online work applications have become widely adopted. The role of STI in business development is also highly valued, particularly in e-commerce platforms, business management technology, and automated production. These technologies help reduce costs, improve efficiency, and expand business opportunities by connecting with a broader customer base. Moreover, STI has improved access to healthcare services, such as online medical appointment scheduling and health monitoring through medical applications. The development of technology has also created new opportunities in the service industry, including electric vehicles and online delivery services.

Regarding personal information security, only 30.5% of respondents feel safe, while 41% express concerns about negative impacts, and 28.5% remain uncertain. Social isolation is another area of concern, with 55% of respondents believing that science and technology have a negative impact on social relationships. In contrast, only 11.5% see a positive effect, while 33.5% have no clear opinion on the matter. Finally, in terms of passivity in lifestyle, 58% of respondents believe that science and technology may contribute to increased passivity, whereas only 7.5% perceive a positive impact in this regard.

3.2.2. Impact of STI on Various Sectors

Survey results indicate that 81.5% of respondents believe that STI has had a positive impact on the healthcare sector and 88% state that education has improved due to advancements in STI. The field of communication also has a clear change, with 71.5% of respondents affirm that communication has undergone significant changes due to STI. In addition, social digitalization is also a field with a large impact, with 64.5% recognize STI as a key driver

of social digitalization. The environment and transportation have also received positive impacts from science and technology, with 71% and 60.5% of respondents believe that STI has significantly improved environmental conditions and transportation, respectively. However, in rural development, only 58.5% of respondents feel that STI has contributed to improvements, while 41.5% do not perceive a significant impact.

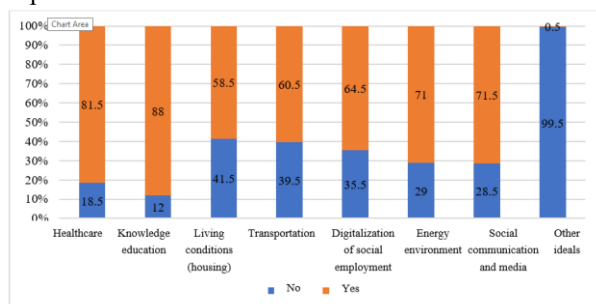


Figure 1. Impact of STI on Various Sectors

Source: Author

The survey results indicate that STI have a strong impact on various aspects of social life (Figure 1). Specifically: 94.5% of respondents believe that STI has significantly increased convenience in daily life, while only 1.5% perceive it as having a negative impact. Regarding fast communication, 93% of respondents evaluate it positively. 91% of participants believe that easy access to information is an important benefit brought by STI. However, in terms of social skills development, only 56% assess a positive impact, while 19.5% think that STI reduces social skills, and 24.5% have no specific opinion. Specifically:

(1) For the digital society, the impact of STI on digitalization shows that efficiency in production and commerce and easy access to information and services are highly rated. Specifically: 95% of respondents believe that STI positively impacts efficiency in production and commerce and 95.5% state that STI facilitates easy access to information and services. Regarding skill obsolescence, 53% think that STI may lead to skill degradation, while only 11.5% believe STI has a positive impact on personal skills. These findings suggest that while STI brings significant benefits in terms of efficiency and convenience, there are concerns about potential risks related to unemployment and skill obsolescence in the digital era.

(2) In the healthcare sector, the majority of respondents highly appreciate the role of STI in improving medical care, particularly in the development of medicines and vaccines. Specifically: 92.5% of respondents believe that STI has contributed to the development of new medicines and vaccines. The field of treatment and modern medical equipment also received a very high consensus, with 95% of participants positively assess STI's role in modern medical treatment and equipment and 88.5% acknowledge that STI has enhanced disease prevention and diagnosis through preventive medicine and diagnostic tools. However, regarding genetic cloning, the positive assessment rate is 66%, while 15.5% express

concerns about negative effects, and 18.5% have no specific opinion. For public health issues related to technology, 69.5% recognize a positive impact, whereas 12.5% perceive it negatively. Notably, ethical concerns in medicine reveal a clear divide, with 58% of respondents viewing STI positively, 13% rating it negatively, and 29% being uncertain or having no clear opinion.

(3) Regarding the environment and energy, STI play a crucial role in promoting renewable energy and improving eco-friendly urban development. However, there are also significant concerns about pollution, resource depletion, and the use of pesticides and food preservatives. Specifically: 81.5% of respondents believe that STI has a positive impact on renewable energy (such as wind and solar energy). Eco-friendly urban development is also highly rated, with 74.5% of respondents giving a positive assessment, while 7.5% rate it negatively. However, regarding pollution, only 20.5% of respondents believe STI has a positive impact, while 51% think it has a negative effect, and 28.5% are uncertain. In terms of natural resource depletion, 47.5% express concerns about the negative impact of STI, while only 19.5% see a positive effect, and 33% have no specific opinion. Regarding the use of pesticides and food preservatives, 47.5% of respondents believe STI has a negative impact, while 23.5% rate it positively. Conversely, recycling capabilities receive highly positive feedback, with 73.5% of respondents believing STI has improved recycling efforts, while only 9% think it has had a negative effect.

(4) In the construction sector, STI have significantly contributed to improving the quality of building materials. The use of new construction materials is rated positively by 90% of respondents. However, when considering costs, only 38% of respondents view STI positively in this regard, while 34.5% believe that STI increases costs, while 27.5% have no clear opinion on the matter.

(5) In the transportation sector, STI have significantly contributed to improving infrastructure, vehicles, and traffic safety. However, challenges related to emissions and environmental pollution remain a concern. 91% of respondents believe that STI has improved transportation infrastructure and 94% give a positive assessment of transportation vehicles. Regarding convenience and safety features in transportation, such as GPS, ABS, and airbags, 88.5% of respondents recognize significant benefits from STI. However, emissions and pollution issues receive high negative feedback, with 51% of respondents believing that STI contributes to environmental harm, while only 23% view it positively, and 26% have no clear opinion.

(6) In the education sector, survey results indicate significant positive impacts from STI with 95.5% of respondents believe that STI has created new learning opportunities and 93.5% positively assess the methods and tools used in education. However, in terms of communication and interaction in learning, only 73% of respondents consider STI to have a positive impact, while

11.5% believe that STI reduces interaction in the learning process. Regarding learning workload, only 52.5% of respondents view it positively, while 23.5% rate it negatively.

(7) *Regarding the application of scientific and technological research results in business, the majority of survey respondents rate the level of application as relatively high.* Specifically, 43% of respondents consider the application level to be high, while 10% rate it as very high. 37.5% assess the application level as moderate while 8.5% believe the application level is low. Only 1% of respondents rate the application level as very low.

3.3. Evaluation of STI Policies

(1) *Policies on STI Development:* Survey results indicate that the majority of respondents support and highly evaluate the current STI policies being implemented. Specifically, 73% of respondents agree that STI development policies focus on applied research, while 7% disagree, and 20% are uncertain or unaware. Regarding whether STI policies are guided by key economic and social needs, 86% of respondents agree, while only 3.5% disagree, and 10.5% remain uncertain or have no opinion. These findings suggest strong consensus that STI policies are on the right track, prioritizing the resolution of critical national issues, including economic growth, food security, and employment opportunities.

(2) *Policies on Funding for STI in the Future:* Survey results highlight the importance of enhancing support for research and innovation. Specifically, 35.5% of respondents consider increasing support for high-risk research to be important, while 19.5% rate it as very important. Regarding increasing the contribution of private companies to research and innovation, 34.5% of respondents see this as very important, while 30.5% rate it as important. A smaller proportion, 6%, considers it less important. When asked about overall support for STI research, 35.5% of respondents view it as important, while 28.5% consider it very important. Lastly, in terms of supporting businesses in research and development (R&D), 34.5% of respondents see this as very important, while 29% rate it as important. A minority, 6.5%, believe this factor is not important.

(3) *Successful Areas of STI Programs.* Several areas have achieved notable success in serving STI: 67% of respondents agree that the program has enhanced STI infrastructure and 71.5% recognize that the program has fostered innovation ideas. However, only 35.5% believe that the program has significantly improved research capacity, while 64.5% feel that this aspect has not met expectations. 69.5% acknowledge the program's positive impact on strengthening international collaboration, whereas 30.5% disagree. Regarding expanding the research workforce, only 34.5% of respondents believe the program has been successful, while 65.5% feel that research capacity has not expanded significantly. In terms of increasing the number of patents and published research papers, only 23% and 37%, respectively, assess

these aspects positively, while the majority (77% and 63%) do not perceive significant improvements.

(4) *Weaknesses of STI Programs.* Survey results indicate several limitations in the implementation of STI programs: 54.5% of respondents believe that the program has not effectively strengthened connections, while 45.5% feel that connectivity has improved. Regarding program efficiency, 51.5% of respondents think that the program has not been truly effective, while 48.5% acknowledge some improvement. Job creation is considered a major weakness, with 62.5% of respondents feeling that the program has not generated sufficient employment opportunities, whereas only 37.5% have a positive assessment. 59.5% of respondents believe that the program has not developed strongly, while 40.5% recognize significant progress. Lastly, in terms of enhancing research capacity, 65% of respondents state that the program has not met expectations, while only 35% perceive improvements in this area.

(5) *Public investment in research and development (R&D) is generating high-quality scientific outcomes and fostering innovation in the province.* Overall, the majority of respondents highly appreciate the role of public funding in driving STI, highlighting its significant importance. Specifically: 46% of respondents rate the role of public investment as high while 12.5% consider it very high. At a lower level, 34.5% assess its role as moderate. 6% believe public investment has a low impact and Only 1% perceive it as very low.

(6) *Key Directions for Public R&D Investment to Promote STI.* Survey results reveal clear trends in priority areas for investment, highlighting specific fields that require funding. Strengthening collaboration between organizations and researchers is rated as the most important direction, with 80% of respondents agreeing on its significance, while 20% do not consider it a key factor. Funding for R&D projects is recognized as an important investment area by 54.5% of respondents, whereas 45.5% do not share this view. Similarly, 51.5% of respondents believe that establishing R&D infrastructure is necessary, while 48.5% disagree (Figure 2).

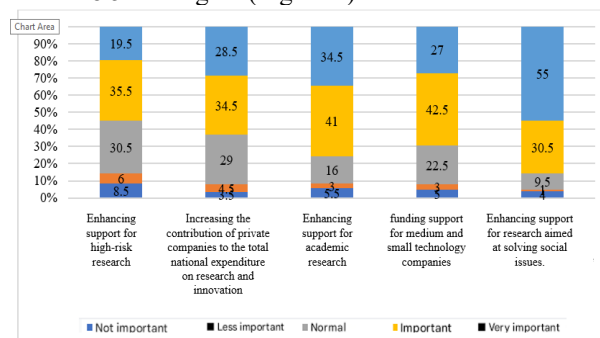


Figure 2. Funding for science and technology in the upcoming time

Source: Author

Lastly, 50% of respondents consider research projects crucial for advancing scientific outcomes, whereas 5% have differing opinions on these investment directions.

3.4. Evaluation of the Role of International Cooperation in STI Development

(1) Survey results indicate that international cooperation plays a crucial role in various aspects of STI development. Specifically, 72.5% of respondents believe that international cooperation significantly enhances the recognition of STI and 64% agree that it helps improve research capacity. Regarding the introduction of new science and technology, 58.5% recognize its positive role in introducing new STI advancements while 55.5% consider international cooperation beneficial for training and human resource development. However, only 32.5% of respondents think that it contributes to supplementing financial resources for R&D.

(2) Survey results indicate that various forms of international cooperation are being actively implemented to enhance STI collaboration. 69.5% of respondents consider establishing international cooperation programs as a common and effective approach. This reflects a strong interest in promoting international collaboration through joint organizations and projects. 62.5% of respondents highlight undergraduate and postgraduate training cooperation as an ongoing initiative with a positive impact. In addition, 65.5% acknowledge that participation in international projects is a key form of cooperation that enhances scientific and technological development. Notably, 96.5% of respondents expressed additional views on international cooperation, indicating the diversity of approaches and implementation strategies across different organizations and countries.

(3) The impact of researcher mobility on STI Knowledge Acquisition shows significant impacts on many aspects. 68% of respondents believe that mobility contributes to knowledge development and facilitates connections with cutting-edge fundamental research and 71% agree that researcher mobility strengthens connections and integration with the international STI community. However, only 48% consider researcher mobility as a crucial factor in fostering transnational collaboration, while 52% disagree. Regarding access to modern STI information, 57.5% of respondents recognize a positive impact, while 42.5% disagree. In improving language skills, 58% of respondents believe that researcher mobility positively influences language skill development, whereas 42% do not perceive a significant effect. When evaluating the absorption of modern knowledge on innovation organization and management practices, 62.5% of respondents acknowledge improvements, while 37.5% see no significant changes. Notably, 65% of respondents agree that researcher mobility helps identify foreign markets, and 62% believe it enhances Vietnam's vision and awareness of STI.

(4) Key Forms of Research and Technology Infrastructure to Support International Researchers. Survey results indicate strong consensus on facilitating opportunities for international researchers to work in Vietnam. Up to 60% of respondents believe that scholarships and grants for international students and scholars working in Vietnam are essential. 58% support

offering positions for international researchers at universities or government-affiliated research centers, considering this an important area for further development. Additionally, respondents emphasize the importance of expanding business opportunities for startups founded by international researchers. 55% of respondents agree on the need to strengthen programs encouraging Vietnamese-origin scientists to return to Vietnam.

4. DISCUSSION OF SURVEY RESULTS AND CONCLUSION

Based on the survey results from experts, scientists, and managers in Ha Tinh and Nghe An provinces, the study draws the following conclusions:

(1) STI play a crucial role across multiple fields, particularly in healthcare, the environment, and energy in the surveyed provinces. In healthcare, 92.5% of respondents highly appreciate the role of STI in the development of medicines and vaccines. However, ethical concerns remain, with 13% of respondents perceiving negative impacts in the field of medical ethics. In renewable energy and environmental protection, 81.5% of respondents recognize STI's contribution to advancing renewable energy. However, concerns persist regarding resource depletion and environmental pollution.

(2) STI development policies receive strong support from experts, scientists, and managers. 73% of respondents agree that current policies focus on applied research to address key socio-economic issues. 86% believe that STI policies are aligned with the country's urgent needs. However, limitations remain, particularly in job creation, with 62.5% of respondents feeling that the program has not generated sufficient employment opportunities.

(3) Regarding to Successes and Challenges in STI Development. The current state of STI development in the surveyed provinces presents both achievements and challenges: 67% of respondents agree that the program has strengthened STI infrastructure and 71.5% believe that the program has encouraged innovation ideas. However, only 35.5% feel that the program has significantly improved research capacity. Limitations in patent registration and published research are evident, with 77% and 63% of respondents not observing significant improvements in these areas.

(4) Survey results indicate that state management through policies and regulations on STI must adapt to evolving contexts and development needs. Key recommendations include: Modernizing information dissemination by transitioning from traditional methods to digital communication platforms. Diversifying and enhancing STI programs and activities to better align with the practical needs of citizens and businesses. Prioritizing key areas of concern in Ha Tinh and Nghe An, particularly healthcare, environmental protection, and energy, while also accelerating digital transformation in public administration. Strengthening collaboration

networks between government agencies, businesses, and research institutes to effectively address policy challenges. Improving the efficiency of STI development funds by expanding financial support and simplifying administrative procedures. Promoting international cooperation and encouraging researcher mobility to

enhance global knowledge exchange (Jacob & Meek, 2013). Developing innovation models across different sectors, such as: Integrating innovation into investment promotion and attraction and Applying innovation in education and healthcare.

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