# The Prospectus of Human Resources in Science and Technology (HRST) in Supporting Economic Development: Case Study Indonesian Vision 2045

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**Abstracts.** Indonesia has a vision for 2045 to become a member of a high-income country by targeting about $15,287 in 2045. While currently, the Indonesia Global Innovation Index ranks 87th out of 132 countries. One of Indonesia's weaknesses is the lack of knowledgeable workers or intellectual workers. Indonesia occupies the 126th position on this indicator. One national manpower is human resources in science and technology (HRST). Most of them work in the research and development sector to support the nationally competitive and innovation system. This paper focuses on studying the Indonesian HRST profile and developing a scenario planning policy for raising the number of HRSTs to support Indonesia's economic growth through a Scenario Planning model. Some of the findings in this paper indicate a lack of policy planning on how to distribute human resources into appropriate institutions in both the R&D and industry sectors.

***Keywords:*** *HRST, Manpower, Scenario Planning, and Development Policy.*

## INTRODUCTION

This study is intended to explore the prospectus of Indonesian manpower that could be empowered to support national economic development to achieve the Indonesian Vision 2045. This agenda needs a huge effort to shape well-competent manpower and highly skilled workers, where individuals who have completed post-secondary education[1] are required. In OECD's countries policy, the roles of Human Resources in Science and Technology (HRST)[2] are critical to contribute to the national development growth. Practically this issue had analyzed and evaluated the percentage of total employment and the percentage of total employees in the industry periodically by each government. Meanwhile, in Indonesia, Human Resources in Science and Technology terminology is still restricted to R&D institutes and universities.

According to the National Development Planning Agency (Bappenas), Indonesia is expected to experience a demographic bonus in 2030 between 2040, with the population of productive age (aged 15– 64 years) exceeding the population of unproductive age (under 15 years and above 64 years). The productive age population is expected to reach 64% of the total projected population of 297 million people during this period [3]. Meanwhile, according to Korn Ferry's research, it is predicted that numerous economic sectors will head a significant global talent shortage around 2025 and 2030. It is predicted that the shortage of skilled workers will impact 85.2 million people and lead to economic losses of $8.5 trillion[1]. Contrary to our optimism in demography bonus, accelerating technological progress generally requires the availability of competent and high-quality human resources.

Korn Ferry's lookup divides workers into three categories[1], such as Highly skilled workers (Level A), individuals who completed post-secondary education, Mid-skilled workers (Level B), individuals who have attained upper secondary education, such as high school, or a low-level trade college qualification and Low-skilled workers (Level C): These individuals have less than upper secondary education. In 2030, Indonesia's manufacturing zone is expected to face a scarcity of skilled people, 1.6 million. This is due to the divergence policy of the education system in colleges with the need for employment.

Since the minimum developed country GDP is higher than US$ 12,696[4], skillful workers are quite necessary since existing Indonesian employees are at degree C. Therefore, it is important to explore several strategic alternatives to push and develop Human Resources in Science and Technology in the country, in a concert of the most indicators that The Ministry of Manpower and Transmigration may utilize to assess and observe the dynamics of inflow and outflow in domestic industrial sectors. In this paper, we would like to promote some of the prospectus policy scenarios that could push the growth of Human Resources in Science and Technology to support GDP growth through a scenario planning model.

# LITERATURE REVIEW

## 1. Scenario Planning Model

Based on Schoemaker has defined it as "*a disciplined process for developing alternative views about an organization's external future by analyzing key uncertainties that can significantly change the landscape. Scenarios are typically presented in narrative form by telling different stories about the future in ways that are directly relevant to managers. The deeper aim is to challenge people's mindsets by stimulating strategic dialogue and reflection"*[5][6].

In strategic coming up with, situations discuss with script-like narratives of external futures with particular stress on causative connections, internal consistency, and call connexion a couple of situations typically fulfill to outline a broad vary inside that the longer term may unfold. Practical situations gift over associate end-state description, however, highlight the dynamic logic of every story[5][6]. The situations should replicate viewpoints from inside and outside the organization and conjointly delineate a broad range of potentialities. Based on Schoemaker, the government ought to use the situation coming up with a lot of the following conditions apply Uncertainty is high (relative to the organization's ability to predict or adjust), too several expensive surprises and blind spots have occurred within the recent past, and learn new opportunities square measure perceived and generated by the organization, the standard of strategic thinking is low (strategic coming up with has become perfunctory.

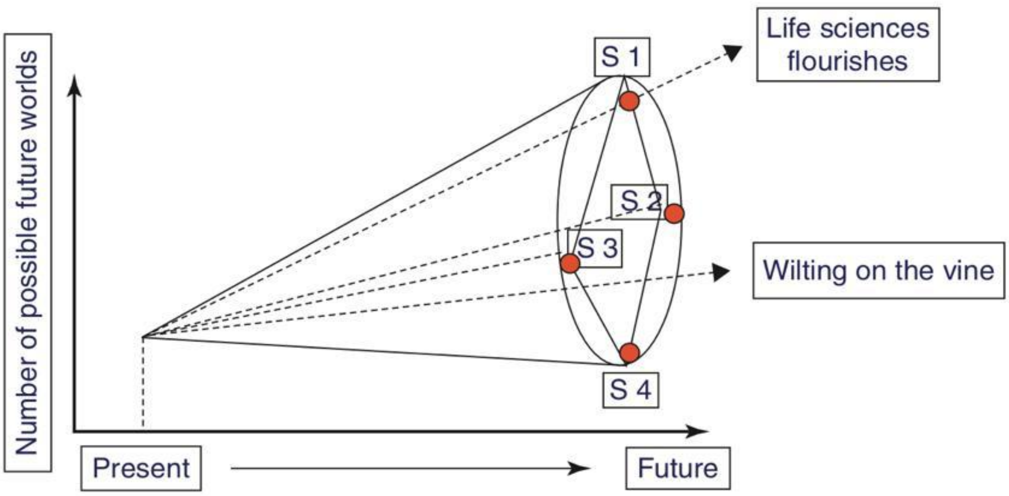


**Figure 1.** Uncertainty cones to bound the future's model, adopted from Schoemaker 2016.

## 2. Basic Definition of HRST

To get an entire understanding of each supply and demand for HRST, the definition relies on two dimensions, qualification and occupation. The qualification axis tells the U.S. concerning the availability of HRST, i.e., the number of individuals UN agency area unit presently or probably on the market to figure at a particular level. The demand for HRST, i.e. the quantity of individuals UN agency are needed in S&T activities at a particular level, is said to be the occupation dimension. as a result demand doesn't continually match provide and since skills are obtained outside the formal education system, the subsequently combined definition is planned[7].

According to *Canberra Manual*[7], HRST is defined as the people who fulfill one or other of the following conditions:

a) *Completed education at the third level in an S&T field of study; b) not formally qualified as above, but employed in an S&T occupation where the above qualifications are typically required.*

b) *Not formally qualified as above, but employed in an S&T occupation where the above qualifications are typically required.*

The definition of HRST needs some clarification. One crucial thinks refer to the Science and Technology context where (a) the people with success completed education at the third level in an S&T field of study; (b) not formally qualified as on top of, however, used during an S&T occupation wherever the on top of qualifications area unit unremarkably needed. (S&T). At its broadest, science means "knowledge" or "knowing"; in a narrower sense, it's understood as being the type of data of that the assorted "sciences" like arithmetic, physics, or economic science area unit examples (and here it's on the point of the Latin "Scientia" and also the German "Wissenschaft").

### 3. Development of Human Resources in Science and Technology

The implementation of science and technology policies concerns the issue of how fiscal or non-fiscal instruments are developed and implemented for the development of science and technology and the functioning of technology to answer problems in other policy areas (such as health services in remote areas, environmentally friendly trade management, and others). The two goals are interrelated, although the priorities set may differ from one country to another from time to time. In advanced industrialized countries, science and technology began to receive central attention in public policy at the end of the 19th century or early 20th century[8][9], which then had implications for the mobilization of national strategic resources to achieve policy goals. Cross-disciplinary and trans-disciplinary modes of knowledge production receive widespread attention to understand the complex phenomena that arise from integrating technology, economics, and other areas of social activity. This encourages the growth and development of a multi-disciplinary study area that is now known as science and technology studies.

### 2.4 Human Resources in Science and Technology Policy in Indonesia

In contrast to foreign human resources in science and technology policies, Indonesia moves with the times, as evidenced by the expansion of science and technology institutions deemed necessary to catch up with Indonesia in global competition. According to the *Indonesian Human Resources in Science and Technology Policy White Paper*, based on the periodization in general terms, HRST policy development can be divided into the following stages of growth: First Stage: The Beginning of Science and Technology Institutional Growth (the 1970s). Second Stage: Consolidation of Activities and Institutions (the 1980s–2000s). Third Stage: Technology Policy as a prime mover of the economy (Advanced Industrial Countries)[8][15]. In the 1970s, Indonesia was in the stage of developing science and technology institutions. Development policy emphasizes economic development. Science and technology policies, including human resources, are derived from economic policy.

## METHOD, DATA, AND ANALYSIS

### 3.1 Method

The research was conducted through a literature review of relevant references and results, followed by a focus group discussion (FGD). To achieve the objectives described above, a qualitative study was conducted using a multi-site case study approach. As suggested by Creswell (1998), a multi-site approach can be used when the case being studied includes several courses that are separate in time, place, and practical context but have related issues. Meanwhile, this study also uses secondary data in the form of interview transcripts from the results of previous studies deemed relevant, legal/policy documents, and statements of observers and experts published in the mass media.

### 3.2 Data & Analysis

#### 3.2.1 The Trend of Indonesian GDP

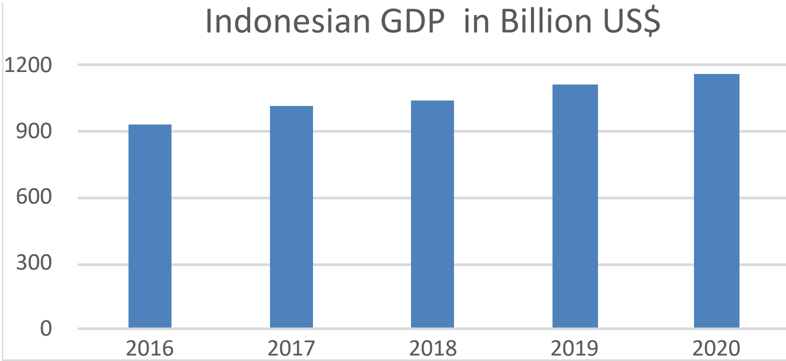


**Figure 2.** Indonesian GDP from 2016–2020 (Source: World Bank 2022).

According to the Central Statistics Agency (BPS), Indonesia's economic growth in the second quarter of 2021 grew to 7.07 percent yearly. Furthermore, the Indonesian economy increased by 3.31 percent (quarterly growth) in the second quarter of 2021 compared to the first quarter. Indonesia's economy has grown in the second quarter of 2021, mainly owing to improved performance in exports, private consumption, investment, and government consumption.

More than half of Indonesian workers lack the skills of employers. Indonesia's workforce is mainly comprised of people with a primary school education or less. Compared with peers, the proportion of the labor force with upper secondary education is relatively high. In contrast, the proportion of the labor force with a university degree is low, although it has increased in recent years. About 30.2% of workers were farmers in 2018, higher than the average for peers.

Furthermore, the informality rate in agriculture in Indonesia is more than 90%, according to OECD estimates (2018). Meanwhile, informal employment in the non-agricultural sector is more than 70%. This figure is significantly higher than in other countries.

High costs discourage employers from adding permanent or full-time workers, which also involves less training. More information on this will be explained in the regulatory and institutional sections. Intermediate skills, i.e., the workforce with secondary education, rank second in the demographics of the Indonesian workforce. The average number of years an Indonesian 25 years of age or older attends school has doubled from four in 1990 to eight in 2017. Although this improvement is impressive, the average number of years of enrollment in Indonesia remains low than in comparable countries' per capita income[18].

The World Bank (2018) shows that Indonesia's education quality improvement is prolonged. At the current rate, Indonesia will not achieve the average PISA scores of the OECD countries until 2065, which assumes no improvement in these countries. Indonesia's TIMSS scores indicate a decline in math ability. The Global Innovation Index (2018) shows that higher education in Indonesia is cut off compared to the rest of the world, as evidenced by low student mobility within the country.

#### 3.2.2 The Trend of Research and Development Expenditure

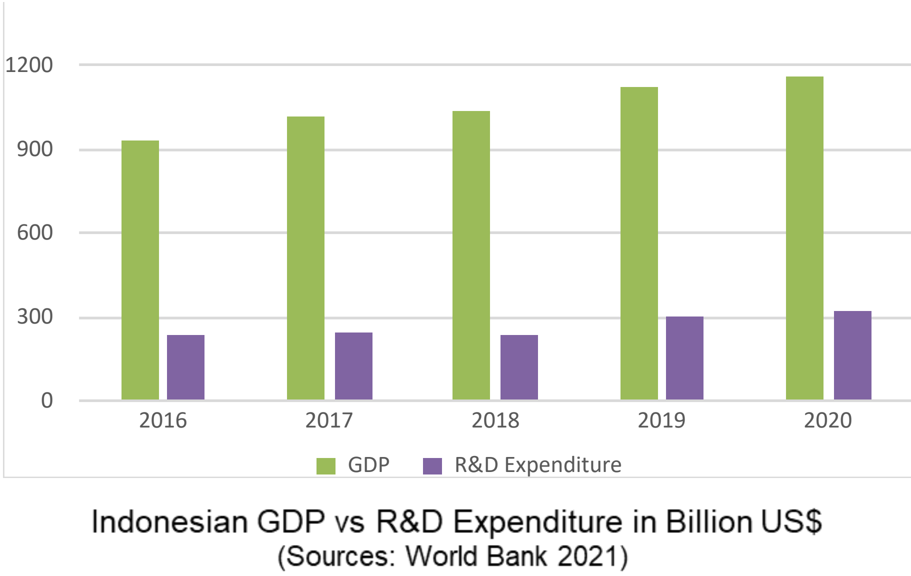


**Figure 3.** Indonesian GDP vs. R&D Expenditure from 2016–2020 (Source: World Bank 2022).

Looking at the development of Indonesia's GDP versus GERD figures from 2016 to 2020, it can be seen that there is a difference from time to time. In 2017, the percentage increase in GDP was higher than the GERD value, and even in 2018, there was a decrease in growth of -0.02288%. However, in 2019 there was a growth spurt in the GERD value, which experienced a growth rate of 0.26%, while the GDP growth rate was only 0.076%. Furthermore, in 2020 the growth rate of Indonesia's GERD value is 0.074%, which is still higher than the GDP growth rate, around 0.035%.

| Year | GDP (in Billion US$) | GERD (in Billion US$) | GDP Growth | GERD Growth |
|---|---|---|---|---|
| 2016 | 931.88 | 2,33 | 0% | 0% |
| 2017 | 1020 | 2,44 | 0.094562% | 0.050779% |
| 2018 | 1040 | 2,39 | 0.019608% | -0.02288% |
| 2019 | 1120 | 3,02 | 0.076923% | 0.264214% |
| 2020 | 1160 | 3,24 | 0.035714% | 0.074074% |

**Table 1.** The Growth of Indonesian's GDP vs GERD.

### 3.2.3 The Existing of HRST in Indonesia

According to Act No. 11/2019, the concept of human resources includes researchers, engineers, and lecturers. In Indonesia, the number of researchers and engineers indicated about 9,691 researchers and engineers. The Ministry for Education, Culture, Research and Technology, Innovation Agency, and local governments is home to researchers and engineers. There are 166,979 male and 129,061 female lecturers. While the number of lecturers with doctoral qualifications is 42,825, for lecturers with master's degrees, there are 207,586 lecturers, undergraduate lecturers amount to 30,612 lecturers, and specialization-based lecturers amount to 3,093, reaching 4,593. The number of study programs amounted to 29,413 based on Pangkalan Data Dikti in 2020.

When the number of researchers and engineers was compared to the number of lecturers scattered throughout approximately 4,600 universities, it was discovered that just 3.23 percent were accessible as researchers. This demonstrates that the number of researchers and engineers in research, development, study, and application institutes is greater than the number of researchers in universities. The expansion of our universities has yet to be explained in terms of GRDP and national GDP growth. With a population of 278 million (as of December 2021), the number of new researchers is 7,000, implying that there are 24 researchers available for every million people. In comparison, there are 5,000 researchers in

Japan, with a population of one million people, 5,500 in South Korea, and 6,500 in Israel. This demonstrates Indonesia's scarcity of researchers.

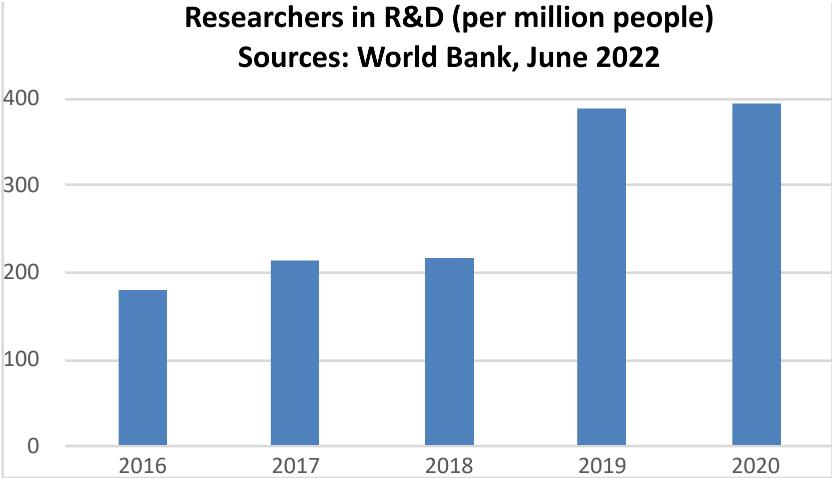


**Figure 4.** The Researchers in R&D (per million people) (Sources: World Bank, June 2022).

| Year | The Growth of Researchers in R&D (per million people) |
|---|---|
| 2016 | 0% |
| 2017 | 0.201117% |
| 2018 | 0.004651% |
| 2019 | 0.796296% |
| 2020 | 0.020619% |

**Table 2.** The Growth of Researchers in R&D (per million people) in Indonesia.

From 2016 to 2020, there has been an increase in the percentage of researchers in R&D per one million population. Referring to the World Bank data, it can be seen in the graph and table the percentage growth above, where in 2017, there was a significant increase in growth of 0.2%. However, in 2018 the growth decreased by only about 0.0046%, but in 2019 there was a significant increase around 0.79%, but in 2020 the percentage growth rate decreased again by only 0.02%. This increase was strongly influenced by the formation of recruitment of researchers in government agencies and universities.

### 3.2.4 Indonesian Workforce by Education Level

| Education Level | | Gender | | |
|---|---|---|---|---|
| | | Male | Female | Total |
| Highest Education Level Completed | <=Elementary | 28,190,902 | 20,839,157 | 49,030,059 |
| | Junior High School | 15,130,533 | 9,167,808 | 24,298,341 |
| | Senior High School | 15,604,336 | 9,040,255 | 24,644,591 |
| | Vocational High School | 11,149,167 | 5,009,196 | 16,158,363 |
| | College | 1,657,026 | 1,936,207 | 3,593,233 |
| | University (S1/S2/S3) | 6,834,206 | 6,505,512 | 13,339,718 |
| | **Total** | **78,566,170** | **52,498,135** | **131,064,305** |

**Table 3.** Indonesian Workforce by Education Level (Ministry of Manpower: 2022).

Based on data from the Ministry of Manpower, Republic of Indonesia, we could find that the proportion of university level in the national workforce is only 10.177%. It includes both Bachelor, Magister, and PD graduates, and the proportion is less if we compare only the number of Ph.D. graduates. Meanwhile, according to Central Statistics Agency (BPS), the percentage of workers who have graduated from Indonesian institutions has increased. In August 2017, university graduates made up 9.35 percent of the Indonesian labor force. The proportion increased to 9.4 percent in August 2018 and 9.7 percent in August 2019. However, by August 2020, this proportion could fall to 9.63 percent. In early 2021, the proportion of college graduates will rise to 10.18 percent. The number of experts who graduated from elementary school and below was 49.39 million, or 37.69 percent [20].

### 3.2.5 Profile of Indonesian HRST on National Workforce

| Employed | Population |
|---|---|
| Researcher | 9,691 |
| Lectures | 207,586 |
| University graduated | 13,339,718 |
| Total Workforce | 131,064,305 |
| Proportion HRST to compare to Indonesian Manpower (University Graduates) | 1.63% |
| Proportion HRST to compare to Total Indonesian Manpower | 0.166% |

**Table 4.** The proportion of Indonesian HRST in the National Workforce.

According to the most recent data collected by the Republic of Indonesia's Ministry of Workforce, PDDIKTI, the Ministry of Education, Culture, Research, and Technology, and BRIN, we will see that the proportion of HRST compared to both university graduates and the entire Indonesian manpower that includes national labor is just 1.63 percent and 0.166 percent, respectively. It is still far behind OECD countries, which have established HRST as the foundation of a knowledge-based economic platform to boost economic growth.

| Year | GDP (in Billion US$) | GERD (in a million US$) | Researchers in R&D (per million people) | The Proportion of University Graduates in the Workforce | University Employment | University Graduates Unemployment | GDP Growth Rate/Real GDP Growth Rate Per Person Worked Per Year |
|---|---|---|---|---|---|---|---|
| 2016 | 931.88 | 2,33 | 179 | 9.36 | 0 | 695304 | 1.85 |
| 2017 | 1020 | 2,44 | 215 | 9.35 | 0 | 567235 | 2.8 |
| 2018 | 1040 | 2,39 | 216 | 9.4 | 13.28 | 606939 | 0.79 |
| 2019 | 1120 | 3,02 | 388 | 9.7 | 13.5 | 618758 | 3 |
| 2020 | 1160 | 3,24 | 396 | 9.63 | 17.5 | 803624 | -1.84 |

**Table 5.** The comparative table of growth rates among GDP, GERD, R&D researcher, University Graduates, Workforce, and Unemployment.

By observing the table above, here we can find that the Indonesian GDP is still rising from time to time annually within the growth of GERD and also the rate's growth of researchers in R&D (per million people) by looking at the growth in the proportion of employment for university graduates and the level of employment for university graduates, there is at least an influence from the educated workforce on Indonesia's GDP growth, in particular from 2016 to 2020, despite the decrease in the GDP Growth Rate/ Real GDP Growth Rate Per Person Worked in 2020 due to Covid-19.

## RESULT AND DISCUSSION

After learning the potential for science and technology resources in Indonesia, in this case, the next phase is to look at the potential resources in each agency and institution related to budget schemes and programs to make future scenario plans. The following are national strategic programs, including the LPDP Scholarship Program, Research and Matching Dikti Program, Science and Technology HR Talent Management Program, and other programs for the development of Science Techno Park. These programs are directed at improving the quality of human resources and enhancing the research culture in Indonesia.

In the future, related strategic ministries such as the Ministry of Education, Culture, Research and Technology, the Ministry of Manpower and the Ministry of Industry, and the National Research and Innovation Agency need to start preparing a new platform and redefining what is meant by the term science and technology HR personnel (HRST). In the sense that if it is formatted as a standard career function, then again, the problem of formation at each of these R&D institutions will be the main obstacle.

Here the scenario or strategy proposed is that the ministries and related institutions above need to evaluate and restructure HR development programs that have been established but have not had a significant impact.

Second, the Ministries and related institutions above need to develop a reasonably specific *database* related to information on Science and Technology Resources (HRST) that is integrated nationally, as in the Canberra Manual concept.

Third, the Ministry and related institutions above need to build collaborative projects that are national and regional, in which case it is necessary to map out the R&D needs for both national and local industries. In the case of this study, developing activities that can support *priority setting* in the three sub-sectors above.

The four ministries and related institutions need to formulate policies for establishing *research schools* and *Science Techno Parks* affiliated with the government, private R&D institutions, and universities on one platform, both in *urban* and *rural areas*. Fifth, build a monitoring and evaluation instrument model to supervise the program intensively.

Furthermore, the working mechanism of this model is initiated by creating national projects to assist domestic industries/institutions that need support for R&D findings (focus on *setting priority* ). In this phase, the Ministries and related institutions above must first create a database of science and technology resources and local resources and map the problems in the industry/domestic institution entirely. The second phase is for the Ministry to develop policies for the establishment of *research schools* and *Science Techno Parks* (STP) at the location that will host the project, in which case the relevant Ministry needs to facilitate universities in the area to develop *research schools* and *STPs* with other institutions, local or central R&D.

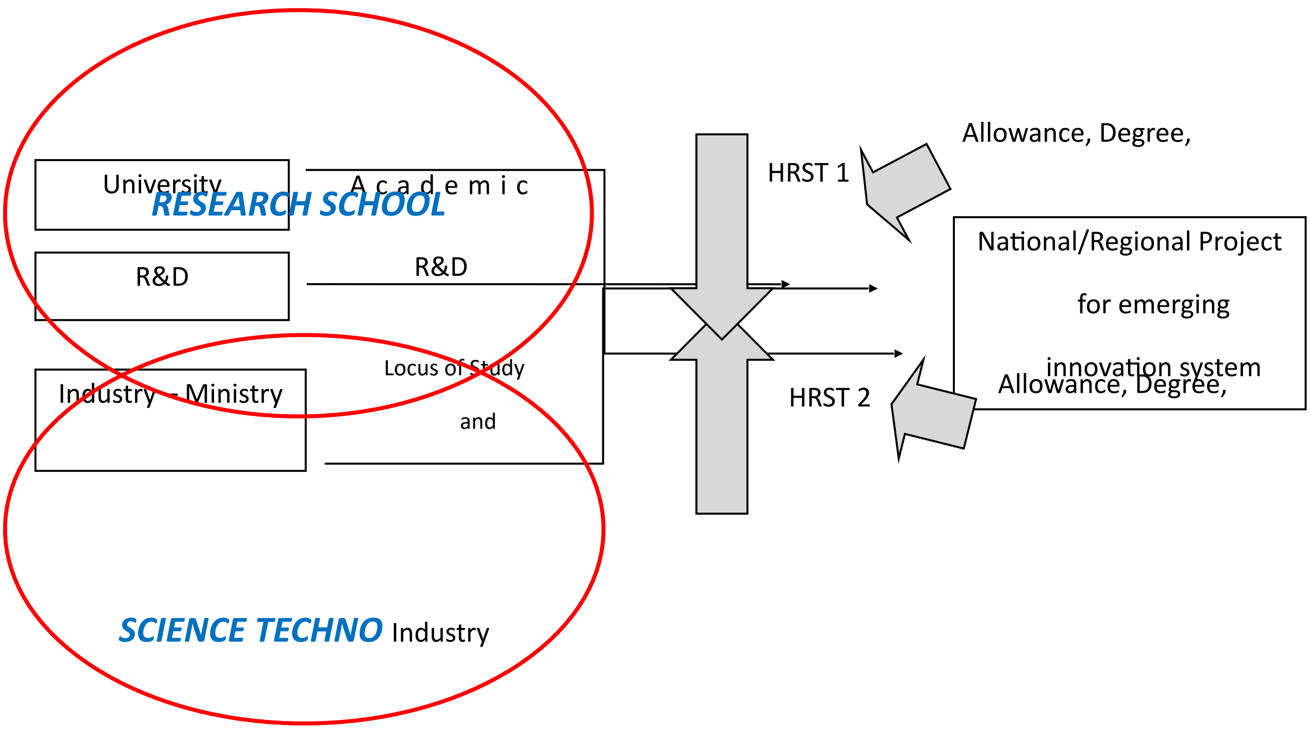

**Figure 5.** National Science and Technology HR Enhancement Policy Model.

Here the main target of participants is bachelor's, master and doctoral graduates in the science and engineering field, who are then positioned as researchers and engineers. However, in parallel, in this project, they are also positioned as postgraduate students/ *Post-Doctoral staff*, but they will get facilities and rights as workers in general. So practically, they will be given the status of a *Master/PPh.D.vacancy* as is expected in the Netherlands, where research-based postgraduate students are generally given the status of workers in laboratory projects at the University. So that in this activity, the parties that will be involved are universities, R&D institutions, and industry. In this case, the government will act as a policy maker, regulator, and supervisor. Meanwhile, other parties involved in the project on this model are researchers, engineers, and lecturers.

In this context, there may be a question, aren't they embedded *in* their respective institutions? Why should it be explained again? To discuss these questions, the following in Figure 6. is a double-triple helix model that describes the involvement of higher education institutions, R&D institutions, and industry. In this case, we are often familiar with the term triple helix.

Related to the previous question regarding the separation of their status from institutions here, it is necessary to understand that the actors mapped in the image model below are new actors who will be recruited as researchers-engineers or, if possible, lecturers.

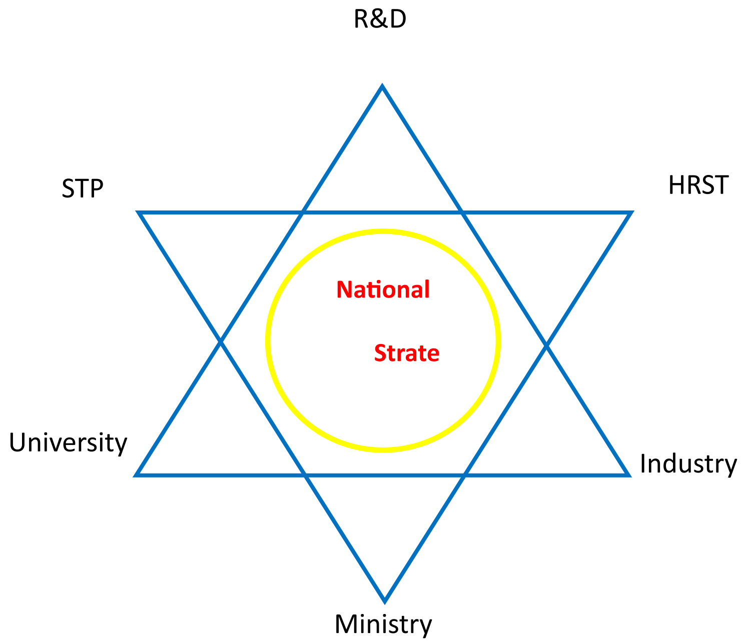


**Figure 6.** The double-Triple Helix collaboration model involves the research community, engineers, lecturers, higher education institutions, R&D institutions, and industry.

This model requires that the R&D activities they carry out must be multi/interdisciplinary so that orientation in responding to problems that occur in the public/community can be achieved. This model offers a strategy that may be achieved to answer the problems above, namely, first, related to increasing the number of researchers and engineers. In the sense that when a formal formation model will be very difficult to provide for civil servant mode, this model offers a contract model for a certain period to the participants who are involved in the R&D activities, whether they are involved in the *Master and Ph.D. by research program*. They are positioned as workers so that their activities can be recorded or included as *stock* or assets for the availability of national research/engineering human resources. This is the policy model proposed as a strategy to increase researchers and engineers in Indonesia.

In this model, the relevant Ministries and BRIN, as regulators and implementers of R&D, can compare policies and programs that have been released previously, especially those related to scholarships and incentives. So far, the program tends to be seen as a *cost center,* considering that there has been no significant and fundamental impact on building changes in this country. This model also offers a new paradigm in the governance system of higher education and R&D in Indonesia by establishing massive *research schools* and *science technoparks* in this country at universities that are considered to have been established in terms of human resources and R&D capacity, where this is also directed at strengthening the basis of R&D and education activities in Indonesia to be able to compete with other countries in the international world.

In the practical project this run, the Ministry of Manpower and the Ministry of Industry could start to adopt and develop the *Canberra* model step by step, starting from mapping needs field, condition *workforce* based on field expertise, analysis placement until planning more technical in details.

# CONCLUSION

According to data on the development of Indonesia's GDP in recent years, there has been a progressive increase in national GDP growth each year. According to World Bank data, this is accompanied by a gain in Indonesia's GERD value and the number of researchers per million people. However, the proportion of HRST in the Indonesian workforce remains very low, at around 0.166 percent. Based on the present potential where Indonesia is now enjoying a demographic bonus, this number should be boosted further so that the potential for Indonesia's national economic growth can significantly increase if adequately employed. As a result, one possible opportunity is to systematically improve the quality of Indonesian human resources, particularly the quality and quantity of national human resources in science and technology (HRST), so that the HRST activity space does not only focus on the R&D's government and university sectors, but also the Ministry of Manpower and the Ministry of Industry, which can strategically increase the quantity and quality, and empower them in the real sector.

By looking at the current conditions, it will be complicated for Indonesia to achieve the GDP per capita target of $12,000 by 2045, primarily by relying on existing human resources as it is today. The development of human resources in science and technology is necessary to accelerate the growth rate of knowledge, technology, innovation, and national productivity as a step toward achieving Indonesia's Vision in 2045.

# IMPLICATION/LIMITATION AND SUGGESTIONS

This analysis is very limited to data from the BPS, Ministry of Manpower, Ministry of Education, Culture, Research, and Technology, and BRIN, as well as World Bank data for the 2016-2020 period. This is done because researching national science and technology HR (HRST) is problematic since data collection on quantity, quality, distribution, productivity, and performance is still quite restricted. The World Bank only publishes discontinuous data on Indonesian human resources in science and technology. However, OECD member countries have conducted extensive surveys and data collection to assess the stock and flow of this HRST. It is strongly recommended for anyone interested in conducting quantitative analysis on the impact of the performance of human resources in science and technology on economic growth, particularly Indonesia's GDP.

# REFERENCES

[1] Korn Ferry Institute, "Future of Work: The Global Talent Crunch," *Korn Ferry*, p. 52, 2017.

[2] I. K. Economy, "5. Investing in The Knowledge Economy 5. 3. Human resources in science and technology 5. Investing in The Knowledge Economy," *Technology*, No. 95, pp. 136–137, 2009.

[3] T. Afandi, "Bonus Demografi 2030-2040: Strategi Indonesia Terkait Ketenagakerjaan dan Pendidikan," *Kementeri. Perenc. Pembang. Nas.*, pp. 1–2, 2017.

[4] World Bank, "World Bank High-Income Economy," 2020. [Online]. Available: https://en.wikipedia.org/wiki/World_Bank_high-income_economy#:~:text=A high-income economy is, definitions of these terms differ.

[5] P. Schoemaker, "The Palgrave Encyclopedia of Strategic Management," *Palgrave Encycl. Strategy. Manag.*, No. December 2016.

[6] P. Schoemaker, “Scenario planning: a tool for strategic thinking,” *Long Range Plann.*, Vol. 28, No. 3, p. 117, 1995.

[7] Organization for Economic Co-Operation and Development, *The Measurement of Scientific and Technological Activities Manual on The Measurement of Human Resources Devoted to S&T* “*Canberra Manual,”* First Edition, No. 95. Paris, 1995.

[8] Moehtadi F. *Arsitektur Peningkatan SDM Iptek Indonesia untuk Penguatan Daya Saing Bangsa*. Jakarta: BPPT Press, 2021.

[9] Moehtadi F., Yuliar S. *Menuju Perguruan Tinggi Riset, Pusat Pengkajian Kebijakan Inovasi Teknologi*. Jakarta: BPPT Press, 2015.

[10] Moehtadi F. *Sistem Inovasi Nasional: Belajar dari Pengalaman China* published in *Pengembangan Jaringan Inovasi*. Jakarta: BPPT Press, 2013.

[11] Moehtadi F. “Kebutuhan Sumber Daya Manusia Iptek Masa Depan di Indonesia,” Jakarta, 2009.

[12] J. S. Jauhiainen, “Regional and Innovation Policies in Finland – Towards Convergence and/or Mismatch?,” *Reg. Stud.*, Vol. 42, No. 7, pp. 1031–1045, 2008.

[13] M. Deschryvere and M. Deschryvere, “OECD Science, Technology and Industry Working Papers Targeting R&D intensity in Finnish innovation policy,” No. June 2021.

[14] D. Beckers, “Eco-Innovation in Finland,” 2017.

[15] Gugus Tugas SDM pada Rakor LPND Ristek, *White Paper Kebijakan SDM Iptek Indonesia, Konsep Kebijakan Baru Pemberdayaan SDM Iptek – Hasil Pemikiran Gugus Tugas SDM, Laporan Perkembangan Gugus Tugas SDM pada Rakor LPND Ristek*. 2004.

[16] A. Mohsin, “The Overseas Fellowship Program: A Technoscientific Scholarship Program in New Order Indonesia,” *Korean J. Hist. Sci.*, vol. 40, no. 2, pp. 275–303, 2018.

[17] BKPM, “Pertumbuhan Ekonomi di Indonesia,” 2021. [Online]. Available: https://www.bkpm.go.id/id/publikasi/detail/berita/pertumbuhan-ekonomi-di-indonesia.

[18] M. F. Hidayat, A. N. Saputro, and B. F. Maulia, “Indonesia Growth Diagnostics: Strategic Priority to Boost Economic Growth Ministry of National Development Planning/ National Development Planning Agency Directorate for Macroeconomic Planning and Statistical Analysis,” pp. 1–50, 2019.

[19] World Bank, “Indonesian Researcher per million people,” 2022. [Online]. Available: https://data.worldbank.org/indicator/SP.POP.SCIE.RD.P6?end=2020&locations=ID&start=2014.

[20] Dwi Hadya Jayani, “Persentase Pekerja Lulusan Universitas di Indonesia Semakin Meningkat,” 2021. [Online]. Available: https://databoks.katadata.co.id/datapublish/2021/11/10/persentase-pekerja-lulusan-universitas-di-indonesia-semakin-meningkat.