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The Technological Products of The 4th Industrial Revolution From Public R&D Institutions in Indonesia and The Challenges Arising From The Development To The Diffusion Process

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ABSTRACT

This study was aimed to identify and to compile both the primary and the secondary data of the technological products based on the technology of the 4th industrial revolution developed by public R&D institutions in Indonesia, then to analyze the emerging challenges from the development to the diffusion process. The primary data were obtained through the interview with experts. The secondary data were obtained from each institution's website, report archives, and written publications. A qualitative analysis using SWOT approach was applied in this study. As the result, this study has identified as many as 33 technological products, in which the 15 products belong to agriculture as the leading sector, followed by fishery, healthcare, and other sectors. The majority of the products' statuses are prototypes that still require further development. Four main challenges have emerged from the development to the diffusion process: (1) the supporting technologies are mostly imported components and the supplies are not regularly available; (2) the disbursement of the components budget is considered complicated; (3) there is no potential licensing with the private sectors; and (4) the diffusion of the products is considered difficult when it comes to deal with the users that have low level of digital literacy.

I. INTRODUCTION

According to AT Kearney, the 4th industrial revolution is the utilization of the latest technologies, such as networking, artificial intelligence (AI), internet of things (IoT), robotics, virtual reality, 3D printing, and big data, to connect physical and digital aspects in production process (AT Kearney, n.d.). The aim of the 4th industrial revolution is to improve the speed of process, efficiency, productivity, interface experience, and security aspects as well (Carvalho et al., 2018; Ghobakhloo et al., 2021; Rüßmann et al., 2015; Ustundag & Cevikcan, 2017).

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The technology of the 4th industrial revolution (the 4th IR) has become an inseparable aspect of current human life. Nowadays, AI and IoT are the common technologies contained in our smartphones. Furthermore, the 4th IR is also considered a turning point, especially in entering such another current trend as green economy (Hidayatno et al., 2019; Lim & Kim, 2019).

In Indonesia, the majority of research and development (R&D) projects, including technological products development, are still performed by public R&D institutions. As knowledge-intensive body, as well as public entity, their existence not only depends on scientific and technological development, but also the results of their R&D activities are expected to be known and accessible by society (Lim & Kim, 2019).

In 2018, the Indonesian government has launched "Making Indonesia 4.0" as a program to map and support the technological capabilities of the big five industrial sector (food & beverage, textile & fashion, automotive, electronics, and chemical industry) in Indonesia[1].

Since then, the 4th IR has become a trending topic, particularly in public R&D institutions (Febrianda, 2021). A year later, in 2019, the Indonesian government has launched The Regulation No. 11 about National Innovation System, which would become the legal basis for the establishment of National Research and Innovation Agency of Indonesia (BRIN). BRIN was established with aim to integrate all public R&D institutions in Indonesia into one big knowledge-intensive body, in which one of the purposes is to make public R&D projects in Indonesia to be more efficient, focus, and not overlap. This is in line with the study by Lim & Kim (2019), who created a sort of technological product mapping based on public R&D project in South Korea, specifically that relate to the 4th IR. At the end, they recommended to encourage R&D collaboration to avoid overlapping among various public R&D institutions in South Korea.

Indonesia has taken a different and a quite radical approach by merging all public R&D institutions to prevent the overlapping of projects and functions. However, the information about Indonesia's technological products development by public R&D institutions, particularly that based on the 4th IR is still scattered in each public R&D institution. Despite they have been merged into one big institution, we have not yet able to find any publication that provides the integrated information about the technological products. Therefore, first, this study aimed to identify and to compile the primary and secondary data regarding the technological products that relate to the 4th IR theme, including their sectors, supported technologies, and status of implementations (prototype/implemented). It is intended to find out how far the technology development has been carried out by public R&D institutions in Indonesia. Moreover, as the 4th IR is emerging a trend of the latest technological developments, there will be challenges encountered, whether it is come as internal or external factor. Second, this study applied SWOT analysis to discuss the challenges on performing these products development and how did the related literatures respond to the challenges. This second objective is important to learn in order to improve the performance of institutional and technological development.

II. ANALYTICAL FRAMEWORK

A. The 4th Industrial Revolution (The 4th IR)

The 4th IR has developed in the digital revolution, in which technology and human have been practically interconnected since then. The technologies remove the boundaries among physical, digital, and biological entities (Radziwill, 2018). The 4th IR not only provides modern techniques in industry, but also contributes to support sustainability, in which renewable energy and energy efficiency are two inseparable aspects (Hidayatno et al., 2019). In detail, the 4th IR aims to design sustainable manufacturing systems that generate a higher level of complexity in order to integrate production processes and products operated using the internet, cyber-physical systems, artificial intelligence, and machines (Carvalho et al., 2018). There are seven main principles in the 4th IR manufacturing system, in which each principle

[1] Opening remarks from Head of Research and Development Agency, Ministry of Industry at the launching event of Making Indonesia 4.0 as a part of Indonesia Industrial Summit Series in Jakarta, April 4, 2018.

is supported by one or more technologies, as presented in Figure 1. The use and development of one or more of these technologies (e.g. adaptive robotics, cloud technologies) serve as the underpinning for products identification.

B. SWOT Analysis

SWOT analysis is a strategic planning tool used to evaluate the strengths, weaknesses, opportunities, and threats of a business or a specific situation. As a simple framework, SWOT analysis can leverage the organization's strengths, improving weaknesses, reducing threats, and taking the possible advantages of opportunities (Puyt et al., 2023). It can be implemented in various fields of engineering as well (Lee et al., 2021). SWOT consists of four principal elements as follows:

i) Strengths: These are the internal factors that give an organization an advantage over the others.

ii) Weaknesses: These are the internal factors that put an organization in a disadvantage over the others.

iii) Opportunities: These are the external factors that potentially generate positive impact in an organization's growth.

iv) Threats: These are the external factors that could cause risks or challenges in an organization's success.

SWOT analysis can be applied at various levels, including project evaluation and market assessment. It helps organization to understand their current position by identifying certain areas for improvement, as well as to determine strategies in order to mitigate risks (Humphrey, 2005; Weihrich, 1982).

III. METHODOLOGY

This study aimed to compile the data of the technological products development by public R&D institutions in Indonesia that relate to the 4th IR, and to analyze the emerging challenges from the development to the diffusion process. The units of analysis included the technological products, and the representative of each public R&D institution as the developer, such as Head of Unit, Head of Dissemination, and the Key Researcher/Engineer. This study was conducted using online method. The steps taken are described as follows:

- The target. This study used the database of public R&D institutions from Indonesia's Ministry of Research and Technology in 2020. The data consists of 52 public R&D

Technologies	Principles						
	(1) Real time data management (collection/processing/analysis/inference)	(2) Interoperability	(3) Virtualization	(4) Decentralization	(5) Agility	(6) Service orientation	(7) Integrated business processes
Adaptive robotics					●		
Data analytics & Artificial intelligence	●			●	●	●	
Simulation			●		●		
Embedded systems				●			
Communication & Networking		●		●	●		●
Cyber security		●					●
Cloud technologies					●	●	●
Additive manufacturing					●		
Virtualization technologies (VR & AR)			●		●		
Sensors & Actuators	●			●			●
RFID & RTLS technologies	●			●	●		●
Mobile technologies					●		

Figure 1. Categorization of technologies and principles in the 4th industrial revolution (Ustundag & Cevikcan, 2017)

work units in Indonesia from ministry and non-ministerial bodies.

- Data of the products. This secondary data were obtained from each unit's website, consisting of R&D report archives and publications, such as journals, bulletins, magazines, brochures/leaflets, posters, and booklets that contain information about technological products that relate to the 4th IR. The data of the products were then analyzed descriptively.
- The challenges. This primary data were obtained through online interview with five representatives from Indonesian public R&D institutions as the informants. These informants were selected purposively because (1) they are the representatives of the institution, namely the leader in terms of the number of the products, and (2) they are the representatives of the products that have been implemented. The challenges were identified based on the general aspects of R&D management, such as fund, infrastructures, people, administration, and diffusion (Jain et al., 2010).
- The challenges were analyzed qualitatively using SWOT and several related literatures.
- Triangulation. The results of the products were triangulated with relevant informants from each unit of R&D institution. These triangulations were also conducted through online meetings.
- Conclusion. The resulting data were the profiles of the 4th IR products from public R&D institutions in Indonesia, and the encountered challenges along with several major coping strategies.

IV. RESULTS AND DISCUSSION

A. Profiles

In 2021, Indonesia also struggled to deal with the COVID-19 pandemic. At that time, many non-essential government programs, including public R&D programs, have been adjourned temporarily in order to handle the pandemic situation. After the Regulation No. 11 was launched in 2019, three years later, in 2022, all public R&D institutions in Indonesia were executed to be merged into one big knowledge-intensive institution, namely National Research and Innovation Agency (BRIN). Following the execution, all public R&D programs are currently being reorganized. Therefore, the data generated by this study can be viewed as representation of the latest results of public R&D projects in Indonesia.

It is shown that there are 8 public R&D institutions from 17 work units that developed technological products relating to the 4th IR theme. They have developed 33 technological products, in which 12 products intended for agriculture sector, such as smart irrigation, *sapa mektan*, and autonomous tractor, were developed by Indonesian Agency for Agricultural Research and Development under Ministry of Agriculture (from Appendix 1). Therefore, agriculture is the leading sector in terms of number of products (from Appendix 2). The second place was BPPT (Agency for the Development and Assessment of Technology) as non-ministerial R&D institution that has developed 10 products. Currently, all of these products are managed by BRIN.

Communication and networking, referred to as the internet of things (IoT), is the common supporting technology because it is the basic stance for other supporting technologies in the 4th IR. Despite IoT is the basic supporting technology, it is still considered impractical as many people will experience difficulties in adopting the products, mainly because the prospective users, such as farmers, still have low technology literacy.

Among the 33 products, as many as 15 products belong to agricultural sectors, while the rests belong to other various sectors, such as fishery, healthcare, and garment (from Appendix 2). For the majority of the products (67%), their statuses are still prototypes. That means they are considered not yet ready to be implemented and still require further development. Only 33% of them have been diffused to be applied by intended users, such as the mobile app of Laut Nusantara to support the digital transformation of Indonesian fishermen. This app provides various informations on fishing grounds, selling prices, sea navigation, weather information, and live chatting. The majority of the products were generally intended for society. The advanced supporting technologies, such as adaptive robotics and cyber security were recently developed for healthcare sector and defense & security sector, for example autonomous mobile robot for disinfection and sterilization in hospital, and unmanned aircraft for military purpose. Meanwhile, for agriculture sector, they adopted simpler supporting technologies like IoT and mobile technologies to run the smart greenhouse and smart irrigation.

The other advanced supporting technologies, such as additive manufacturing technology (3D printing) and virtual reality or augmented reality, which are the complex supporting technologies in the 4th IR, have not yet been developed (from Appendix 3). This mainly occurred because public R&D institutions are generally expected to allocate their resources to address the more pressing societal issues, such as agriculture and healthcare issues. As a result, the development of additive manufacturing and virtual reality technologies might not be prioritized or receive the necessary attention and funding. Moreover, public R&D institutions are often constrained by limited funding, making it difficult to invest in the necessary equipment and materials to develop these complex technologies.

B. The Challenges

There are four major challenges experienced by public R&D institutions in Indonesia, especially those who conducting R&D projects that relate to the 4th IR. We have tried to summarize these challenges and used SWOT to analyze the findings. **First**, almost all components of the supporting technologies were imported components and the supplies were not regularly available. It could be the weakness of the local condition as it is considered an obstacle in the development process. However, we also consider this is inevitable because several countries or regions may specialize in the production of certain components, while the others may specialize in different components. It may be cheaper to import certain components than to produce them domestically due to several factors, such as lower labor costs, economies of scale, or government subsidies in the exporting country (Ahn & Lee, 2023; Carrasco & Hernandez-del-Valle, 2023; Massini et al., 2023). Moreover, several components may be protected by patents or other forms of intellectual property as well (Brander & Spencer, 2023; Ikeda et al., 2021), thus making it difficult or illegal to produce them domestically. If projects development requires these components, then they may need to be imported from various locations. Public R&D institutions can expedite the process of importing components by attempting the following opportunities: (a) Establishing agreement with reliable suppliers, (b) Streamlining customs clearance of the components, (c) Utilizing technology for real-time visibility regarding the status of shipments, and (d) Considering the alternative sourcing options from local manufacturers or local suppliers if available. (e) It is part of the import policy that government may reduce import tariff if any tariff is applied. These strategies can improve the efficiency of the importing process and accelerate the development timelines.

Second, the disbursement of the budget, especially for purchasing imported components needed for development, was considered inflexible and quite complicated. As an internal factor, this is viewed as a weakness. The main reason of this occurrence is because the public R&D budget is allocated in a rigid manner with specific amounts allocated vary among different departments or different projects. Then, the process for approving the budget for purchasing imported components may be lengthy due to requiring multiple levels of approval. These can slow down the process, thus making it difficult to allocate additional funds for purchasing imported components or other unexpected expenses in order to respond quickly to changing needs. The flexibility and agility required to respond quickly to the changing needs involves a combination of process improvements, updated policies, and financial strategies. Therefore, several experts and scholars suggest taking external opportunity, namely the policymakers can collaborate with the government to facilitate the funding for public R&D project by encouraging it through partnerships with private sectors or other business entities (Hall & Lerner, 2010), as these parties are considered more flexible on funding disbursement. The majority of public R&D institutions are equipped with skilled and higher educated human resources. It should be considered the key advantage of public R&D institutions when it comes to collaborate with external funding entities or sponsors.

Third, there was no potential licensing of the products with local industry. This challenge is considered an external factor that can be perceived as a threat because local industry should act as a stakeholder that is expected to be interested in the results of the public R&D projects. Otherwise, the performance of public R&D institution will be considered worthless by generating zero revenue. The following strategies can be applied to maximize the potential for licensing agreements with local industry: (a) Public R&D institutions need to build strong relationships with industry partners in order to establish trust and credibility, as well as to provide valuable insights regarding market needs and trends. This can be implemented by colaborating with industry associations, attending trade shows, and participating in industry events to build these relations. (b) Public R&D institutions can identify potential licensing opportunities by conducting market research, analyzing competitor products and strategies, and engaging with industry partners. By understanding the market landscape, they can identify certain areas where their products can add value, then create licensing opportunities on them. (c) Public R&D institutions can invest in marketing and communication. Effective marketing and communication can help increasing the public awareness of the products and generating interest from potential industry partners. They can utilize a wide range of channels, such as social media, press releases, and webinars, to promote their products and engage with potential partners. In brief, increasing the potential for license with industry requires a combination of relationship building, market research, and effective communication (Mowery & Ziedonis, 2015; Slavova, 2023; Wang & Li-Ying, 2014). By optimizing these opportunities, public R&D institutions should be able to maximize the potential for licensing and generating revenue.

Fourth, the diffusion of the product was more difficult when it comes to deal with the users that have low levels of digital literacy, such as farmers and fishermen. Regarding the results of products development, social return to the public sector should be higher than to the private sector (Griliches, 1992; Hall & Lerner, 2010). Therefore, public R&D institutions should care not only about the quality of outputs and licensing with local industry, but also about how to diffuse those results to society (Laliene & Liepe, 2015). This last challenge is considered a threat because it brings a risk to the diffusion success. However, we also consider it as an opportunity because queries and suggestions could arise from users' preferences as a feedback for public R&D institutions to develop more feasible and efficient products. The following are several strategies that can be applied by public R&D institutions in dealing with people that have low levels of digital literacy: (a) Building a good cooperation with extension services to organize technical training to the users (Rice, 2017). This is important, because public R&D institutions are often considered weak in carrying out technical guidance to the public on a regular basis. This cooperation can enable the institutions to provide training and facilitate the users with low levels of digital literacy in order to help them understand how to use the digital products. This can be implemented by creating online tutorials, user guides, and customer support services to help users overcome their issues and handle their queries. (b) Collaborating with community organizations to reach users with low levels of digital literacy. This can be implemented by partnering with non-profit organizations, community centers, and local government agencies to promote digital literacy and provide support to users. The role model from community center is proven to be helpful for the people with low level of digital literacy, as it enable them to understand how to use the digital products (Febrianda, 2021). (c) The product features and interfaces also play an important role. The digital products should be designed with a user-friendly interface that is easy to be navigated and operated. The products should have clear instructions and should be intuitive in the use, even for users with low levels of digital literacy. This can be implemented by removing the unessential features, simplifying the interface, and providing step-by-step instructions for common tasks. The lower the complexity of using the products, the better the user perception (Magsamen-Conrad & Dillon, 2020; Rogers, 2003). (d) Public R&D institutions must incorporate feedback from users with low levels of digital literacy to improve their products' usability. This can be implemented by conducting user surveys, usability tests, and focus group discussions to obtain feedback regarding the users' experience. All of these strategies may ensure that the digital products are accessible to all users, regardless of their level of digital literacy (Li et al., 2023; Shang et al., 2021; Yu et al., 2017).

V. CONCLUSION

There are 33 technological products identified in this study that based on the 4th industrial revolution. Communication and networking system, referred to as internet of things (IoT), is the common supporting technology as it is the basic stance for other supporting technologies. Among the 33 products, 15 of them belong to the agriculture sector. The majority of them, 67% of the products, are prototype products that are still require further development before ready to implementation. The other advanced supporting technologies, such as adaptive robotics and cyber security, were developed for the healthcare sector and defense & security sector. Meanwhile, for agriculture sector and fishery sector intended for farmers and fisherman, the products adopted simpler supporting technologies, such as IoT and mobile technology. In this study, we have found as well that the other advanced supporting technologies, such as additive manufacturing and virtual reality technology, have not yet been developed by public R&D institutions in Indonesia.

There are four major challenges that emerged from the development to the diffusion process. First, the components of supporting technologies are dominated by imported components and the supply is not constantly available. Establishing agreement with reliable suppliers could accelerate the importing timelines. Second, the disbursement of the budget for purchasing the components is considered inflexible and complicated. Encouraging public R&D projects through collaboration with private sectors or other business entities could be an alternative strategy because they are more flexible on funding disbursement. Third, licensing agreements with the private sector need to be supported. Public R&D institutions should invest in marketing and communication. Effective marketing and communication will increase awareness of the products and generate interest from industry partners. They can utilize a wide range of channels, such as social media, press releases, and webinars to promote their products and engage with potential partners. Fourth, the diffusion of the products is difficult when it comes to deal with the users that have low levels of digital literacy, such as farmers and fishermen. Public R&D institutions should collaborate with non-profit organizations, community centers, and local government agencies to provide digital literacy to users. Creating the role model from community center is proven to be able to facilitate the people with low level of digital literacy in order to enable them to understand how to use the products. Furthermore, public R&D institutions must gather and execute feedback from users with low levels of digital literacy to improve their products' usability.

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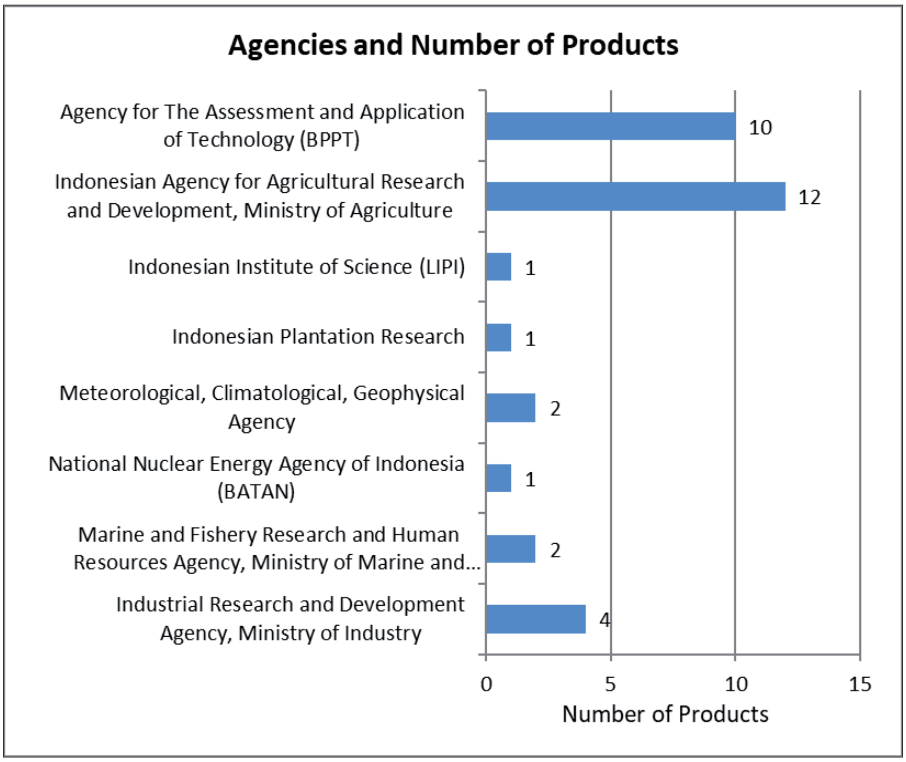
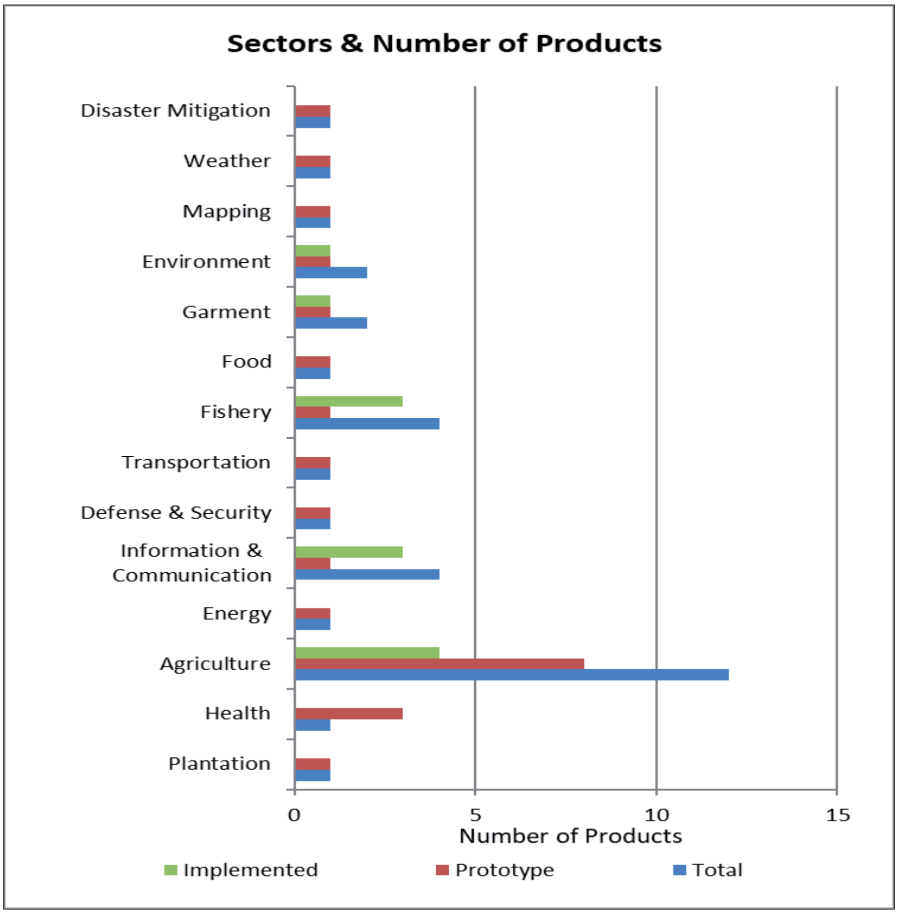
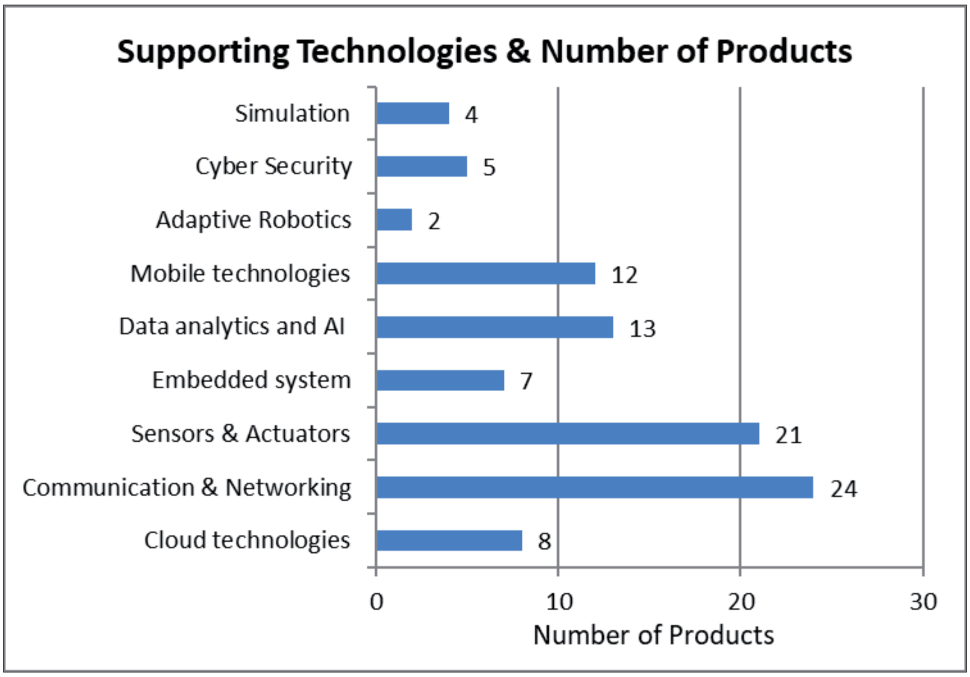
Appendix 1



Appendix 2



Appendix 3



Appendix 4

No.	Name of the products	Features	Developer	Status
1.	Mocaf 4.0	Automatic machine to produce mocaf (modified cassava flour). This machine uses sensors & actuators, communication & networking, and cloud technology	Industrial Research & Development Agency, Ministry of Industry	Prototype
2.	Automatic batik stamp based on programmable logic controller	Hydraulic machine for automatic batik stamping in large quantities. This machine uses sensors & actuators, and embedded system	Industrial Research & Development Agency, Ministry of Industry	Prototype
3.	Batik analyzer	Applications to distinguish between original and imitation batik products using Tensorflow. This product uses data analytics & AI, and mobile technology	Industrial Research & Development Agency, Ministry of Industry	Implemented
4.	Online monitoring system of emissions and waste water based on Internet of Things	An integrated web-based system for monitoring waste water and air emissions from the chimney of production units in industry. The system uses data analytics & AI, sensors & actuators, and communication & networking	Industrial Research & Development Agency, Ministry of Industry	Implemented
5.	Laut Nusantara	Android-based app for the needs of fishermen, which can provide information on fishing areas, etc. The system uses cloud technology, mobile technology, simulation, and communication & networking	Marine and Fishery Research and Human Resources Agency, Ministry of Marine and Fishery	Implemented

No.	Name of the products	Features	Developer	Status
6.	e-Fishery	Digital app for fish cultivation. The system uses sensors & actuators, communication & networking, and mobile technology	Marine and Fishery Research and Human Resources Agency, Ministry of Marine and Fishery	Implemented
7.	Environmental radiation monitoring drone	The development of drones to monitor environmental radiation for safety and security purposes. The system uses mobile technologies, and communication & networking	National Nuclear Energy Agency (BATAN)	Prototype
8.	GUI-GMT	Graphical User Interface (GUI) program for mapping based on Generic Mapping Tools (GMT) that can produce simple maps, topographic maps, seismicity, etc. The system uses data analytics & AI	Meteorological, Climatological & Geophysical Agency (BMKG)	Prototype
9.	Smart TMC	This tool can perform weather forecasting to analyze the impact of certain hotspot areas on forest, land fires, drought, and crop failure. The system uses cloud technology, and data analytics & AI.	Collaboration of Meteorological, Climatological, & Geophysical Agency (BMKG) and Agency for the Assessment and Application of Technology (BPPT)	Prototype
10.	Rubber-tapping robot	Automatic rubber tapping tool. The system uses sensors & actuators and communication & networking	Indonesian Plantation Research (RPN)	Prototype
11.	Autonomous UVC mobile robot	Indonesia's first disinfectant robot to fight COVID-19. The system uses sensors & actuators, communication & networking, and adaptive robotics	Collaboration of Indonesian Institute of Sciences and Telkom University	Prototype
12.	UPJA Smart mobile app	An android app for machinery rental services and rice cultivation. The system uses mobile technology	Indonesian Agency for Agricultural Research and Development, Ministry of Agriculture	Implemented
13.	Nutrient detection drone	Drones that use remote sensing technology to obtain information on soil nutrient. The system uses sensors & actuators, mobile technology, and communication & networking	Indonesian Agency for Agricultural Research and Development, Ministry of Agriculture	Implemented
14.	Smart irrigation	Control remote for electronic valve using Android system in smartphone. The system uses mobile technology and communication & networking	Indonesian Agency for Agricultural Research and Development, Ministry of Agriculture	Prototype
15.	Smart greenhouse	Smart horticulture practices using hydroponic method in a controlled greenhouse. The advantage is that the method can be controlled automatically using sensors and Android system. The system uses sensors & actuators, mobile technologies, and communication & networking	Indonesian Agency for Agricultural Research and Development, Ministry of Agriculture	Prototype

No.	Name of the products	Features	Developer	Status
16.	Grafting robot	Automatic cocoa-grafting tool using sensors & actuators and embedded system	Indonesian Agency for Agricultural Research and Development, Ministry of Agriculture	Prototype
17.	Sapa Mektan	Android-based and web-based for agricultural machine test. The system uses cloud technology and mobile technology	Indonesian Agency for Agricultural Research and Development, Ministry of Agriculture	Implemented
18.	Seed & fertilizer drones	Drones to spread rice seeds and fertilizers. The system uses sensors & actuators, mobile technology, and communication & networking	Indonesian Agency for Agricultural Research and Development, Ministry of Agriculture	Prototype
19.	Sprayer drone	Drone for controlling plant pests. The system uses sensors & actuators, mobile technology, and communication & networking	Indonesian Agency for Agricultural Research and Development, Ministry of Agriculture	Prototype
20.	Rice-planting robot	Transplanter machine by adding GPS-based automation so that it can be used in the field automatically along with programmed cropping patterns. The system uses embedded system, sensor & actuators, and communication & networking	Indonesian Agency for Agricultural Research and Development, Ministry of Agriculture	Prototype
21.	Autonomous tractor	Autonomous four-wheel tractor equipped with GPS navigation system. The system uses embedded system, sensor & actuators, and communication & networking	Indonesian Agency for Agricultural Research and Development, Ministry of Agriculture	Prototype
22.	AWS and AWLR telemetry	ICT application to automatically record and transmit climate and river water level data in real time. The system uses sensors & actuators, embedded system, data analytics & AI, and communication & networking	Indonesian Agency for Agricultural Research and Development, Ministry of Agriculture	Implemented
23.	Katam terpadu	Indonesia's integrated planting calendar information system. The system uses mobile technology and data analytics & AI	Indonesian Agency for Agricultural Research and Development, Ministry of Agriculture	Implemented
24.	Automatic seed system	An automatic seed machine that uses sensors & actuators and embedded system	Indonesian Agency for Agricultural Research and Development, Ministry of Agriculture	Prototype
25.	Smart grid	Remote electric power control and operation system that uses data analytics & AI, communication & networking, and cyber security	Agency for the Assessment and Application of Technology (BPPT)	Prototype
26.	Perisalah	A voice machine for converting text that uses communication & networking, and data security	Agency for the Assessment and Application of Technology (BPPT)	Prototype
27.	PUNA	Unmanned aircraft. The system uses sensors & actuators, communication & networking, and cyber security	Agency for the Assessment and Application of Technology (BPPT)	Prototype

No.	Name of the products	Features	Developer	Status
28.	Smart parking	Smart parking control system design for rotary parking model. The system uses sensors & actuators, embedded system communication & networking, and RFID & RTLS technologies	Agency for the Assessment and Application of Technology (BPPT)	Prototype
29	Data center	Data center services. The system uses cloud technologies cyber security	Agency for the Assessment and Application of Technology (BPPT)	Implemented
30	BELFOS	Boxed Electronic Logbook for Fisheries Observation System. The system uses data analytics & AI, simulation, and communication & networking	Agency for the Assessment and Application of Technology (BPPT)	Implemented
31.	Sidian	Information system on the dispersion of smoke and pollutants in forest and peatland areas. The system uses sensor and actuators, data analytics & AI, simulation, and communication & networking	Agency for the Assessment and Application of Technology (BPPT)	Prototype
32.	Sikbes-ikan	Intelligent fish detection software that uses data analytics & AI and communication & networking	Agency for the Assessment and Application of Technology (BPPT)	Prototype
33.	Sibanyumaning	Machine learning-based flood prediction system that uses data analytics & AI, simulation, and communication & networking	Agency for the Assessment and Application of Technology (BPPT)	Prototype