

# FRANKA

*by* Sinergi Journal

---

**Submission date:** 20-Apr-2022 03:51PM (UTC+0700)

**Submission ID:** 1815300268

**File name:** PAPER\_FRANKA\_SINERGI\_16.doc (694K)

**Word count:** 4945

**Character count:** 27298



## TECHNOLOGICAL CAPABILITIES ASSESSMENT BY USING TECHNOMETRIC MODELS IN ROUTINE MAINTENANCE OF COMMUTER TRAIN AT DIPO DEPOK TO INCREASE SERVICE PERFORMANCE

Franka Hendra<sup>1,2\*</sup> Estiningsih TH<sup>2</sup> and Supriyono<sup>2</sup>

<sup>1</sup>Razak Faculty of Technology and Informatic Universii Teknologi Malaysia, Malaysia

<sup>2</sup>Industrial Engineering, Pamulang University, Indonesia

### Abstract

Based on data from routine train maintenance records of PT Kereta Commuter Indonesia (KCI) since 2015 - 2017, it is known that the number of operational train trains that are realized on average is below the company's target. In addition, there is a potential risk of backlogs or train queues are not handled by care on the maintenance of overhaul (OH) which is growing every year. Therefore, technology measurement is carried out on the routine maintenance of PT KCI train fleets located in Depok KRL Dipo with a Technometrics model approach. The technometric model will produce a technology contribution coefficient (TCC) value which describes the level of technology applied by routine train maintenance in Depok Dipo. TCC value is obtained by identifying and assessing Technoware technology components (tool facilities), Humanware (HR), Infoware (information), and Orgaware (organizations) involved in the routine train maintenance operation process. The results of this study, obtained the value of TCC routine maintenance of PT KCI trains in Depok KRL Dipo with a value of 0.5 which is in the range of  $0.3 < TCC \leq 0.5$ , can be categorized in a qualitative assessment that the level of PT KCI technology is "sufficient". By applying the AHP (Analytical Hierarchy Process) method, the value of the intensity of the technology component's contribution shows that the order of priority for the development of technology components is the priority of humanware, the second priority of techno was, the third priority of or aware and the fourth priority of info were. With the development of technology components following the priority scale, the maintenance of trains in Depok Dipo can improve consumer service performance.

<sup>1</sup> This is an open access article under the [CC BY-NC license](#)



### Keywords:

Technology components,  
Technology Management,  
Technometrics models,  
Technology contribution  
coefficients

### Article History:

Received: May 2, 2019

Revised: May 29, 2019

Accepted: June 2, 2019

Published: June 2, 2019

### Corresponding Author:

<sup>17</sup> Franka Hendra  
Razak Faculty of Technology  
and Informatic, Universiti  
Teknologi Malaysia  
Pamulang University  
Email:  
dosen01508@unpam.ac.id

### INTRODUCTION

Technology becomes one of the important things in the development of an operation [1, 2]. By utilizing technology, operational activities can improve competitiveness and quality. Technology not only facilitates transformation operations, but also provides infrastructure for integrated enterprise business development [3-5].

Conventional indicators of technology fail to provide a direct measure of technological progress [6, 7]. The greater the contribution of the technology component to an operation will greatly affect the performance of the operation in terms of effectiveness, efficiency and quality [8-10]. The application of technology in maintenance activities is one of the important elements and has a very significant impact on operating activities [11, 12]. Technology is seen

from four dynamically integrated components, namely: 1. Technoware (Hardware); 2. Humanware; 3. Infoware (information device); and 4. Orgaware (organization device) [13, 14]. Sharif, et al [15] said the form of integration of the four components is that the development and control of technoware components is carried out by humanware components, from infoware, all of which have been regulated by orgaware.

As companies in general, there are many factors related to production activities, especially in terms of the application of technology that affects the company to achieve goals. Therefore, it is necessary to see the contribution of technology in the company's production system, so that it is known whether the application of technology is appropriate. Referring to the existence of our interrelated technological components, it is necessary to know the value of the contribution of each technological component [16]. By knowing these values, the right decision can be made about which components need to be prioritized for improvement.

Commuter trains are mass public transportation that can transport large numbers of people and can cover long distances in a short time, which are in great demand by people in the Greater Jakarta area of Indonesia. With the need for the availability of the fleet, Commuter Train Indonesia has increased the target number of passengers by 10% per year since 2019. Based on this, KCI must prepare a train fleet in sufficient numbers and good condition so that it can constantly carry passengers every day. in a lot. Therefore, the increase in the target number of passengers crossing Jabodetabek must also be balanced with good management of train fleet maintenance.

The management of the maintenance of the train fleet in the process applies technology to produce a train fleet in prime condition, good quality, and insufficient quantity for traffic needs. Good application and mastery of technology will greatly affect the quality and quantity of available train fleets that are ready to operate [17]. Thus, the measurement of the application of technology in the maintenance of train fleet facilities can describe management regarding deficiencies in the fleet facility maintenance system. So that these deficiencies can be minimized or even eliminated and support the company's performance and targets [18, 19].

Several empirical studies have been conducted to assess the role of technology in various industries. The calculation of technology's contribution to the agricultural industry reveals that the components of technology that contribute the most to the

transformation process are orgaware and infoware, while the components of technoware and humanware contribute the least [20-22].

Measurement of the application of technology in the maintenance of train fleet facilities can use several approaches [23, 24], such as the technology audit model (GRACIA-ARREOLA), the technology audit model (SALADA-VELOSO), and the technometric model [25, 26]. In this study, the level of technology application of the Indonesian Commuter Train (KCI), train fleet facility maintenance system will be studied using a technometric model

## METHOD

The value of level technological sophistication and artistic value on four components of Technoware, Humanware, Infoware and Organware (THIO) technology was determined using qualitative data. The use of quantitative data is carried out in order to obtain component contribution value technology through the use of an equation technometric model.

The first step is to classify the data from direct observations (observations) and interviews based on the type of technology component. The stages of data processing 3) calculate the contribution coefficient value of the technology component and the contribution intensity value of the technology component based on the technometric model.

Before 10) determining the level of sophistication, state of the art, determining the contribution of technology components, and determining the intensity value of the contribution of technology components, identification needs to be carried out. technology components (T, H, I, O) that exist in the process of transforming the research object. Technoware includes physical facilities, equipment, machinery, transportation equipment, and available infrastructure; [2] Humanware which includes technoware users in carrying out the container transport operation process; [3] Infoware which includes the availability of information that can be utilized by employees in carrying out the operation process; [4] Orgaware, includes the framework available in the operating process such as management practice (management practice), organizational structure, organizational arrangements (organizational arrangement).

The estimation method used is scoring to determine the level of sophistication/sophistication of the technology components. Testing and identifying all major items of techno were and humanware while the components of infoware and organware are evaluated at the enterprise level.

The state-of-the-art assessment procedure is to use general criteria for each technology component that has been suggested as specific criteria that can be quantified and then these criteria are developed. Specific criteria are used to develop a rating system for the state-of-the-art. State-of-the-art ratings for Technoware, Humanware, Infoware, and Orgaware.

Based on knowledge of the sophistication level limit and state of the art rating, in this third step, the component contribution data is then calculated using the formula: Calculation of the contribution value of each technology component is carried out using the upper and lower limits of the degree of sophistication and the results of the calculation of the state of the art (SOTA). The intensity of the contribution of technology components is estimated using the AHP "pairwise comparison" method. The estimation procedure is that all companies under study are taken from pairwise comparison weight data and all companies must have a consistency ratio of 10%. If this condition has been met, then the calculation of the geometric mean of all the companies studied can be found.

Technology Contribution Coefficient from a company showing the contribution of technology to the overall transformation operation, in this case, the train routine maintenance operation process. TCC is calculated using the values of T, H, IO, and that have been obtained. The flow of the steps for measuring technometrics can be seen in Figure 1.

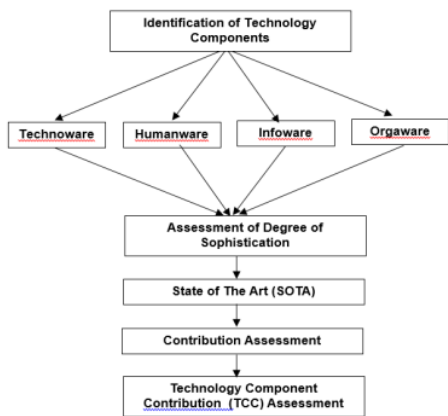


Figure 1. Step of Technometric

## 6 RESULTS AND DISCUSSION

The data that has been obtained is then processed and analyzed using the 6 steps contained in the technometric model. The results of the processing can be seen below.

### 1. Identification of Technology Components

The result of the identification process is the process of operating the train routine maintenance. The process of routine maintenance of the train which has been summarized is shown in the table below:

Table 1 Process of operating routine maintenance

Num	Operation Process
1	Administration
2	Investigation
3	Preparation and security
4	Lifting
5	maintenance Pneumatic and compressor
6	Interior and exterior
7	Bogie and wheel
8	maintenance Motor traction
9	maintenance Air Conditioning (AC)
10	Tests static and dynamic
11	Recording and reporting

Based on the above-operating processes, an assessment is made of the techno wave, humanware, info wars, and or aware components involved in the above operations.

### 2. Assessment of Degree of Sophistication

The value of Degree of Sophistication (DOS) or the degree of sophistication of technological components is shown in table 2.

Table 2 DOS Value

Technology Components	Sophistication Level	
	LL	UL
Technoware	3	5
Humanware	4	6
Infoware	3	5
Orgaware	4	6

Components Technoware has a lower limit of 3 in the "Manual tools [1 2 3]" range. This is because there is still manual equipment used in the operation process. While the determination of number 3 is in the range of "Manual equipment [1 2 3]" because the available manual equipment

is complete, organized, and organized to facilitate the operation process. component technoware has an upper limit of 5 which is in the "Automatic equipment [5 6 7]" range. The existing automatic equipment in the operation process is a crane. The value of the crane itself has reached number 6, meaning that the crane used is quite sophisticated. However, this number had to be shifted to 5 due to a lack of automatic equipment in other maintenance operations processes. As in the static test simulator tool, as well as wheel lathe in terms of capacity and time for working on the wheelset.

The humanware component has an upper limit of 4 in the "Able to Take Care [3 4 5]" range. The maintenance ability possessed by humanware on facility technicians who are indeed required to take care of train maintenance equipment has a value of 5. But the overall maintenance ability is worth 4 because it is influenced by the ability to care for other humanware. While the bottom line for the humanware component is 6 which is in the range of "Ability to innovate with the help of external parties [6 7 8]". The holders of authority in the train maintenance department are generally filled by employees with a minimum experience of more than 7 years. This experience coupled with efforts to increase knowledge and insight made by PT KCI make humanware have the ability to innovate. The number 6 is obtained because of the different innovation abilities between the implementing technician and the authority holder. The difference in innovation ability is influenced by experience, educational background, training, and the breadth of authority possessed.

The infoware component has an upper limit of 3 in the range of "Able to provide and process general information (1 2 3)". Administrative documents are examples of general information that exists in the operation process. The value of 3 was chosen because this process has been carried out optimally with the help of the provided technoware. The infoware component has a lower limit of 6 in the range of "Ability to provide and process information for effectiveness and efficiency (4 5 6)". Infoware such as SOPs, Checksheets, maintenance history documents, technician data, spare parts data, and equipment data have been provided to make the operation process more effective and efficient. This document has gone through the stages of revision, adjustment, and certification.

The organizational component has an upper limit of 4 and an upper limit of 6, both of which are in the range "The organization begins to have a network of cooperation that continues to grow, begins to have a standard management

system, is recognized by third parties, can identify potential markets (4 5 6)". KCI has a growing partnership with Japan in the procurement of trains. KCI's management system is standardized and has been recognized by the parent company, namely PT. KAI. The company sees the public's enthusiasm for commuter rail transportation as a potential market, so KCI has raised its passenger growth target to 10% per year, since 2017. standard management, recognized by third parties, able to identify potential markets". Following the guidelines of the technology development framework of the technometric model, if a component is in a range of values, then the lower limit value is taken from the lowest value of that range. While the upper limit is taken from the highest value of the range.

3. State of The Art (SOTA)

The next assessment on the technological components involved in the operation process is the SOTA assessment. Based on the technology development framework, State of The Art – (SOTA) assesses the complexity of technology components. The SOTA rating range is from 0 to 10. If DOS assesses the degree of sophistication of the technological components involved in the operation process, then SOTA assesses the level of sophistication of the sophistication.

The reference value of SOTA Technoware is based on the latest technology in similar industries. One of the latest train depots that started operating in 2017 is the Singapore Tuas Depot. Since its inception, the Tuas Dipo in Singapore claims that they have the latest technology applied that they have not had at the other six Dipo in Singapore. Technoware's SOTA value can be calculated by the following equation:

$$ST_i = \frac{1}{10} \left[ \frac{\sum_k t_{ik}}{k_t} \right]_{k=1,2, \dots, k_t} \dots \dots \dots (1)$$

$k_t$  = the number of criteria for technoware  
 where  $t_{ik}$  is the value of the k-th criterion of technoware category i

The reference value of SOTA Humanware is the company's target for each maintenance unit in particular as well as on maintenance management in general. The SOTA value of Humanware can be calculated by the following equation:

$$SH_j = \frac{1}{10} \left[ \frac{\sum_i h_{ij}}{j_h} \right]_{j=1,2, \dots, j_h} \dots \dots \dots (2)$$

$h_j$  components humanware

where  $h_{ij}$  is the value of the  $i$ -th criterion of humanware category  $j$

For the SOTA Infoware assessment, the reference is the certification of SOP and Checksheet guidelines, ease of document access, document updates, and document management which can be calculated by the following equation :

$$SI = \frac{1}{10} \left[ \frac{\sum_{m=1}^{m_f} f_m}{m_f} \right] \quad m = 1, 2, \dots, m_f \quad \dots\dots\dots(3)$$

where  $f_m$  is the value of the  $m$ th criterion of infoware at the enterprise level

Meanwhile Organware SOTA, according to the technology development framework for technometric models, is the most difficult SOTA to measure due to the many factors that can affect the organization. Organware SOTA value can be obtained from the following equation:

$$SO = \frac{1}{10} \left[ \frac{\sum_{n=1}^{n_o} o_n}{n_o} \right] \quad n = 1, 2, \dots, n_o \quad \dots\dots\dots(4)$$

$n_o$  component criteria or aware where  $o_n$  is the value of the  $n$ th criterion of aware at the company level.

In this study, the SOTA O reference is the total number of trains that can be maintained per year in terms of overhaul maintenance. The overhaul treatment was chosen because the overhaul treatment is comprehensive maintenance and represents other treatments from the side of the maintenance operation process. In addition to the number of commuter trains that carry out overhaul maintenance, it is also seen from the adequacy of technoware, humanware, and infoware provided by or aware. The SOTA value for the technology component involved in the routine maintenance operation process of the KCI fleet using equations 1,2,3 and 4 is shown in table 3.

Table 3 SOTA value

Technology Component	Determination	value
SOTA	Humanware	3,857 0,3857
7,750	0	, 7750
Infoware	7,111	0,7111
Orgaware	6,333	0,6333

Based on table 3, it is known that  $H > I > O > T$ , indicates that humanware is a technological component that is considered the

most recent that plays a role in train maintenance. These results are also directly proportional to the ability of humanware to meet the targets set by the company. Humanware has made maximum efforts so that the target, namely the availability of a train fleet ready to operate for traffic needs, is still achieved.

After humanware, the most advanced technology component is the infoware. This is due to the completeness of the documents required at the time of treatment. In addition, maintenance supporting documents such as SOPs and checksheets have obtained ISO 9001:2015 certification. The drawback lies in that these documents are not accessible on digital platforms when the operation is carried out so when information is needed regarding these documents, they must go through several stages of the bureaucratic process first.

**4. Contribution Assessment**

The contribution value of the technology component is obtained through a formula. The formula is a calculation between the DOS value and the SOTA value. Changing the DOS value and SOTA value will have an impact on the contribution value of the technology component. The contribution value of the technology component describes the contribution of each technology component to the routine maintenance of the train fleet. The greater the value of the contribution, the greater the contribution of these components to the routine maintenance of the train fleet. The calculation of the contribution value of each technology component is carried out using the upper and lower limits of the degree of sophistication and the results of the calculation of the state of the art (SOTA) value which are formulated in the following equation:

$$T = 1/9 [LT + ST (UT - LT)] \dots\dots\dots(5)$$

$$H = 1/9 [LH + SH (UH - LH)] \dots\dots\dots(6)$$

$$I = 1/9 [LI + SI (UI - LI)] \dots\dots\dots(7)$$

$$O = 1/9 [LO + SO (UO - LO)] \dots\dots\dots(8)$$

- Where :
- LT = Lower limit technoware
  - UT = Upper limit of technoware
  - LH = Lower limit of humanware
  - UH = Upper limit of humanware
  - LI = Lower limit of infoware
  - UI = Upper limit of infoware
  - LO = Lower limit of or aware
  - UO = Upper limit of or aware

ST = SOTA technoware  
 SH = SOTA humanware  
 SI = SOTA infoware  
 SO = Sota or aware

The results of the calculation of the value of the contribution of technology components in routine maintenance of the train fleet can be seen in table 4.

Table 4 Value

components	contribution
value 0.4190	0.6059
Humanware	Infoware
0.4667	0.5852
Orgaware	Technoware

Table 4 shows that  $H > O > I > T$ . Humanware has the highest contribution to carriage maintenance. This can be proven by the maintenance process that involves many technicians with certain capabilities. Orgaware is a technology component that has the highest contribution after humanware. This is because even though humanware is a component that is in direct contact with train maintenance, all decisions made by humanware regarding train maintenance must be approved by the or aware.

Such as the classification of the type of treatment or the use of vendor services. Technoware and infoware are the 2 lowest components that contribute to training fleet maintenance. The incompatibility of the number of humanware with references to infoware is one of the causes. Meanwhile, most of the available technoware have not been updated or added to support humanware work.

**5. Contribution Intensity Assessment**

Calculation of the contribution intensity value of technology components using the Analytical Hierarchy Process (AHP) method. The value of the intensity of the contribution of the technology component is obtained from giving weights/values through a questionnaire whose assessment is carried out by experts who are competent in the management of technology components at PT KCI. The AHP hierarchy is composed of goals, criteria, and alternatives. The goal or goal of the AHP hierarchy is the priority of developing technological components in routine maintenance of PT KCI trains. Determination of criteria based on the objectives and needs of train fleet maintenance as well as discussions with several authorized train fleet maintenance officials, namely operational readiness, reliability,

and ease of maintenance. While the alternatives are based on the technology components to be developed, namely technoware, humanware, infoware, and or awareness. The AHP hierarchy that has been compiled along with the scores obtained with the expert choice 11 tools is shown in the image below.

Based on the results of questionnaire data processing with expert choice tools 11, the value of the intensity of the contribution intensity on the technology component can be seen in table 5.

Table 5 Value of Intensity

of Technology Components	Value of Contribution Intensity
Technoware	0.301
Humanware	0.438
Infoware	0.132
Orgaware	0.129
Consistency Ratio	0.09

The Consistency Ratio (CR) value in the AHP calculation must have a value of  $< 0.1$ . This value is a description of the consistency of the expert in answering the questionnaire given. The contribution intensity value shows how often the technology component contributes to training maintenance. The value of the contribution intensity in the table above shows that  $H > T > I > O$ . Humanware is the component that most often contributes to car maintenance. This form of contribution is supported by technoware which causes technoware to have the 2nd highest value in the value of contribution intensity after humanware. Humanware works with the help of technoware based on Infoware compiled by Orgaware.

**6. Technology Component Contribution (TCC) Assessment**

The value of the technology component contribution coefficient or Technology Contribution Coefficient – TCC is obtained through a formula. The formula is in the form of a calculation between the contribution value and the contribution intensity value. The contribution value of each technology component is raised to the power of the contribution intensity value of each technology component. The results of the rank are then multiplied with each other so that the TCC value is obtained. The TCC value can be calculated by the following equation:

$$TCC = T^1 \times H \times I \times O^0 \dots\dots\dots(9)$$

Where:

TCC = technology contribution coefficient

T = contribution value of technoware component contribution intensity technoware

H = the value of the contribution of the humanware value of the intensity of the contribution of the humanware

I = the value of the contribution of the infoware

i = the value of the intensity of the contribution of the infoware

O = contribution value of or aware

o = the value of the contribution intensity of the or aware component

The calculation result of the Technology Contribution Coefficient (TCC) or the value of the technological component's contribution coefficient on the routine maintenance of the KCI train is 0.5 which is in the "enough" technology classification.

## CONCLUSION

Based on the results of the TCC calculation using the technometric model, the TCC value for routine maintenance of the train fleet at Dipo Depok is 0.5 which is in the "adequate" technology classification range. This value can be increased by developing technology components in order of priority. According to the technometric model, four technology components can be developed by PT KCI as an effort to optimize the routine maintenance of the train fleet and will also have an impact on optimizing the TCC value. Based on the calculation of the contribution intensity value in the technometric model, the value of the Humanware component (availability of human resources) is 0.438, the value of the Technoware component (facilities and tools) is 0.301, the value of the Infoware component (availability of information and supporting documents) is 0.132, and the value of the Orgaware component (management organization) of 0.129. The greater the value of a technology component, the more important it is for the component to be prioritized for development. In the case of routine maintenance of the train fleet, the order of components based on the development priority scale is Humanware, Technoware, Infoware, and Orgaware or can be written as  $H > T > I > O$ .

From the component technometric model developed based on the priority scale, there are (1) Humanware, (2) Technoware, (3) Infoware, and (4) Orgaware. Humanware development is HR development, which includes: Humanware in

question is implementing HR, including Daily Check (DC) maintenance technicians, Monthly Check (MC) technicians, and Overhaul technicians. The current number of DC, MC, and OH technicians is experiencing a shortage of time to carry out train maintenance because the number of fleets that must be maintained is not proportional to the number of technicians. Therefore, it is necessary to increase the number of DC, MC, and OH technicians.

## ACKNOWLEDGMENT

This research was supported/partially supported by Pamulang University and Universiti Teknologi Malaysia. We thank our colleagues from [Name of the supporting institution] who provided insight and expertise that greatly assisted the research, although they may not agree with all of the interpretations/conclusions of this paper.

## REFERENCES

- [1] J. Wan, H. Cai, and K. Zhou, "Industry 4.0: enabling technologies," in *Proceedings of 2015 international conference on intelligent computing and internet of things*, 2015, pp. 135-140.
- [2] H. Ning and H. Liu, "Cyber-physical-social-thinking space based science and technology framework for the Internet of Things," *Science China Information Sciences*, vol. 58, pp. 1-19, 2015.
- [3] E. Oztemel and S. Gursev, "Literature review of Industry 4.0 and related technologies," *Journal of Intelligent Manufacturing*, vol. 31, pp. 127-182, 2020.
- [4] L. Sukarma, F. Hendra, R. Effendi, and E. Mohamad, "The manufacturing technology optimisation model: the crucial contribution of industrial mass-training in improving company performance," in *IOP Conference Series: Materials Science and Engineering*, 2020, p. 012049.
- [5] B. K. Mohanta, S. S. Panda, and D. Jena, "An overview of smart contract and use cases in blockchain technology," in *2018 9th international conference on computing, communication and networking technologies (ICCCNT)*, 2018, pp. 1-4.
- [6] A. A. Rumanti, I. I. Wiradmadja, P. Ajidarma, and M. Hidayat, "Application of Technometric to Improve Productivity in Indonesian Small Medium Industries (SMI)," in *Proceedings of the*

- International Manufacturing Engineering Conference & The Asia Pacific Conference on Manufacturing Systems*, 2019, pp. 217-223.
- [7] A. A. Rumanti and V. Hadisurya, "Analysis of Innovation based on Technometric Model to Predict Technology Life Cycle in Indonesian SME," *International Journal of Innovation in Enterprise System*, vol. 1, pp. 29-36, 2017.
- [8] S. A. Brah and H. Y. Lim, "The effects of technology and TQM on the performance of logistics companies," *International Journal of Physical Distribution & Logistics Management*, 2006.
- [9] D. C. Fettermann, C. G. S. Cavalcante, T. D. d. Almeida, and G. L. Tortorella, "How does Industry 4.0 contribute to operations management?," *Journal of Industrial and Production Engineering*, vol. 35, pp. 255-268, 2018.
- [10] S. G. Azevedo and H. Carvalho, "Contribution of RFID technology to better management of fashion supply chains," *International Journal of Retail & Distribution Management*, 2012.
- [11] L. Cherbakov, G. Galambos, R. Harishankar, S. Kalyana, and G. Rackham, "Impact of service orientation at the business level," *IBM Systems Journal*, vol. 44, pp. 653-668, 2005.
- [12] J. Cantwell, J. H. Dunning, and S. M. Lundan, "An evolutionary approach to understanding international business activity: The co-evolution of MNEs and the institutional environment," *Journal of International Business Studies*, vol. 41, pp. 567-586, 2010.
- [13] D. D. Nugraheni, M. Hisjam, and W. Sutopo, "A Measurement Model and The Techno-Economy Analysis for Traceability Technology Adoption: A Case Study of Melon Distribution in Indonesia," *Jurnal Mekanikal*, 2018.
- [14] S. Miranda and E. Kusriani, "Technology Content Assessment for Technology Development in Small Medium Enterprise (SME) of Wood Furniture: A Case Study," in *2021 IEEE 8th International Conference on Industrial Engineering and Applications (ICIEA)*, 2021, pp. 242-246.
- [15] M. N. Sharif, "Technological innovation governance for winning the future," *Technological forecasting and social change*, vol. 79, pp. 595-604, 2012.
- [16] M. Kajko-Mattsson, R. Karim, and A. Mirjamdotter, "Essential components of e-maintenance," *International Journal of Performability Engineering*, vol. 7, p. 555, 2011.
- [17] M. Bielli, A. Bielli, and R. Rossi, "Trends in models and algorithms for fleet management," *Procedia-Social and Behavioral Sciences*, vol. 20, pp. 4-18, 2011.
- [18] W. Uddin, W. R. Hudson, and R. Haas, *Public infrastructure asset management*. McGraw-Hill Education, 2013.
- [19] C. Janiesch, J. Wanner, and L.-V. Herm, "Design Principles for Shared Maintenance Analytics in Fleet Management," in *International Conference on Design Science Research in Information Systems and Technology*, 2021, pp. 236-247.
- [20] L. Robertson, A. M. Aneiros, and K. Michael, "A theory of exposure: Measuring technology system end user vulnerabilities," in *2017 IEEE International Symposium on Technology and Society (ISTAS)*, 2017, pp. 1-10.
- [21] A. S. Fernandes, "Assessing the technology contribution to value added," *Technological Forecasting and Social Change*, vol. 79, pp. 281-297, 2012.
- [22] W. Susihono, "Technology assessment to determine total contribution of coefficient, technoware, humanware, inforware, and organware in metal industry of creative community," in *ICETIA 2014*, 2014, pp. 249-253.
- [23] P. Umiliacchi, D. Lane, F. Romano, and A. SpA, "Predictive maintenance of railway subsystems using an Ontology based modelling approach," in *Proceedings of 9th world conference on railway research*, May, 2011, pp. 22-26.
- [24] E. Bernal, M. Spiriyagin, and C. Cole, "Onboard condition monitoring sensors, systems and techniques for freight railway vehicles: a review," *IEEE Sensors Journal*, vol. 19, pp. 4-24, 2018.
- [25] M. C. Diaz and T. Loraas, "Learning new uses of technology while on an audit engagement: Contextualizing general models to advance pragmatic understanding," *International Journal of Accounting Information Systems*, vol. 11, pp. 61-77, 2010.
- [26] M. Coccia, "Technometrics: Origins, historical evolution and new directions," *Technological Forecasting and Social Change*, vol. 72, pp. 944-979, 2005.



# FRANKA

## ORIGINALITY REPORT

14%

SIMILARITY INDEX

10%

INTERNET SOURCES

8%

PUBLICATIONS

6%

STUDENT PAPERS

## PRIMARY SOURCES

1	<a href="http://publikasi.mercubuana.ac.id">publikasi.mercubuana.ac.id</a> Internet Source	3%
2	W Sulistiyowati, R B Jakaria. "Assessment of technology content level with integrated technometrics and Analytical Hierarchy Process (AHP) methods in small and medium enterprises", IOP Conference Series: Materials Science and Engineering, 2018 Publication	3%
3	<a href="http://insightsociety.org">insightsociety.org</a> Internet Source	2%
4	Submitted to Universitas Mercu Buana Student Paper	1%
5	<a href="http://ejournal.kemenperin.go.id">ejournal.kemenperin.go.id</a> Internet Source	1%
6	<a href="http://jurnal.umj.ac.id">jurnal.umj.ac.id</a> Internet Source	<1%
7	A. A. Rumanti, F. Muhammad, A. F. Rizana, I. I. Wiratmadja, C. Adelia. "Competitive Advantage Analysis of Small Medium	<1%

Industries in Indonesia: An Approach of Management Technology and Strategic Management", 2019 IEEE International Conference on Industrial Engineering and Engineering Management (IEEM), 2019

Publication

8

Submitted to Universitas Diponegoro

Student Paper

<1 %

9

seari.mit.edu

Internet Source

<1 %

10

123dok.com

Internet Source

<1 %

11

pinpdf.com

Internet Source

<1 %

12

www.emeraldinsight.com

Internet Source

<1 %

13

António S.C. Fernandes. "Assessing the technology contribution to value added", Technological Forecasting and Social Change, 2012

Publication

<1 %

14

"Recent Advances on Soft Computing and Data Mining", Springer Science and Business Media LLC, 2017

Publication

<1 %

15	"iMEC-APCOMS 2019", Springer Science and Business Media LLC, 2020 Publication	<1 %
16	dokumen.pub Internet Source	<1 %
17	iopscience.iop.org Internet Source	<1 %
18	mafiadoc.com Internet Source	<1 %
19	pdffox.com Internet Source	<1 %
20	www.ieomsociety.org Internet Source	<1 %

Exclude quotes    On

Exclude matches    Off

Exclude bibliography    On