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IMPLEMENTATION OF TECHNOMETRICS AND AHP IN DETERMINING INDICATORS FOR MEASURING THE TECHNOLOGY CONTENT OF HALAL FOOD MSMES IN TANGERANG REGENCY

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ABSTRACT

The competitiveness of a nation no longer lies in the wealth of natural resources and labor, but rests on the ability to innovate and develop technology. One of the supporters of competitiveness is the existence of MSMEs. Currently, the government is implementing halal certification obligations for food MSMEs. To measure the content of technology in halal food MSMEs, measurements are needed using a questionnaire containing technology indicators. Technology is defined as physical things (Technoware), humans (Humanware), knowledge (Infoware), and social components (Orgware). This study uses technometric and AHP methods. The calculations showed that the indicators for Technoware are equipment maintenance, packaging equipment, equipment sophistication, and equipment that is easy to use. Indicators for humanware are experienced human resources, human resources with integrity, skilled human resources, never giving up human resources, and highly motivated human resources. Indicators for Inforware are Ease of Access to Info, Marketing Info, Licensing Info, and Cooperation Info. The indicators of the Orgaware Dimension are Leadership, Organizational Structure, MSME Community, and relationships.

KEYWORDS *AHP, Technometri, Halal, MSME*

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INTRODUCTION

According to Bappenas, the competitiveness advantage of a region will be created if the region has core competencies that can be distinguished from those of other areas. Core competencies can be realized through creating factors, namely, efforts to develop various production factors that can bring much better productivity

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than competitors. Increasing competitiveness is achieved by reducing prices and improving quality (Hernadewita et al., 2019). Many cities hold research about technology, such as Pontianak. Competence itself can be defined as the collective learning process of an organization, especially about coordinating and integrating sectors that develop in an area, such as industry, agriculture, fisheries, transportation, tourism, mining, services, and others. The better the coordination and integration among the leading sectors developed in a region, the higher the level of maturity of the area in creating core competencies, making it difficult for other areas to compete with it. The competitiveness of a nation no longer lies in the wealth of natural resources and labor, but rests on the ability to innovate and develop technology.

According to the United Nations Economic and Social Commission for Asia and the Pacific (UN-ESCAP), technology is categorized in various forms. Some classify technology into high-tech and low-tech. Some clarify it into traditional technology and modern technology. Some classify it as capital-intensive technology and technology at work. Based on their nature, technologies are classified into large and small, aggressive and environmentally friendly, advanced, adaptive, and protective technologies. All of the above classifications imply that the technology combines hardware and software. Especially in halal, MSMEs need the implementation of technology to detect any contamination of non-halal material in the production process. In other words, it can also be questioned whether technology combines physical equipment and all the related knowledge. Based on the combination form above, technology can be sorted into four components, namely:

1. *Technoware* (T) is a technical device or production equipment. *Technoware* includes equipment, machinery, motor vehicles, factories, physical infrastructure, and other capital goods that humans use to operate a production transformation.
2. *Humanware* (H) is the ability of human resources. *Humanware* includes the knowledge, skills/expertise, policies, creativity, achievements, and experiences of a person or a group of people utilizing available natural resources and technology.
3. *Inforware* (I) is an information device. Inforware deals with processes, procedures, techniques, methods, theories, specifications, designs, observations, manuals, and other facts disclosed through publications, documents, and blueprints.
4. *Orgaware* (O) is an organizational/institutional and regulatory apparatus needed to accommodate the technical apparatus of human resource capabilities and the information apparatus, consisting of management practices, interests, and organizational arrangements, to achieve positive results.

The four components of technology above require minimum requirements that must be met so that their application can run effectively. The minimum requirements are:

1. *Technoware*: requires operators with a specific level of ability or expertise specific.
2. *Humanware*: must be able to develop *technoware* operations gradually.

3. *Informware*: requires regular updates to the facts.
4. *Orgaware*: must be developed continuously to anticipate changes inside and outside production transportation activities.

In addition, the four components of technology also complement each other. *Technoware* is at the core of the transformation system. *New technoware* will be functional or productive if it is developed, installed, operated, and repaired by *humanware* based on the information collected over time and the framework established in *the organization*. The complementarity or interest between the four components of the technology depends on the level of sophistication of each element. The higher the operational complexity, for example, the higher the level of sophistication is needed.

Before the industry is assessed its readiness in industry 4.0; The position of technology utilization in general in the industry needs to be known. Technology is defined as physical things (Technoware), humans (Humanware), knowledge (Infoware), and social components (Orgware) (Hariani & Sutrisno, 2023). Technology content measurement is a process of assessing technology in the company and comparing the company's technology with that of competitors (Scott, 2022). The method used to determine the contribution value of technological components in the production process is technometry (Casban et al., 2021). Technometrics is a quantitative method used to examine the technological components in shipbuilding, including several processes in shipbuilding (Adiantoro, 2020). Therefore, measurements are needed to increase rationalization towards labor productivity. The purpose of the research is first to assess the level of shipyard technology capability. Second, knowing the advantages and disadvantages of technological capabilities, so that they can find out which technology development priorities must first receive attention and improvement to welcome the industrial era 4.0 (Utomo & Setiastuti, 2019). The methodology used with the Analytic Hierarchy Process approach to obtain the level of importance of the six smart city indicators by collecting data based on interviews and questionnaires on the three leading actors of smart city development, then an analysis was carried out using techno-economic methods to obtain the level of readiness to carry out activities towards a smart city (Limantara et al., 2020).

Measurement of the level of technology content has been carried out for metal processing MSMEs as suppliers of automotive components (Antesty et al., 2020). The research that combines the technometric method and AHP is the measurement of the contribution of technological components to the ship, where technology management is not only the management of a set of technologies, but also the development strategy of existing resource aspects and the technology that is being used (Safrudin et al., 2020). One of the uses of technology is information technology, which opens up opportunities for the introduction of halal products (Marlyana et al., 2023).

Currently, the government has begun to enforce halal policies for MSMEs. The mentoring process also has several challenges, including those from the facilitator himself and MSE actors who are not yet technologically literate (Sri Apridayani et al., 2023). One of the potentials of MSMEs is technology-based halal industry management (Munawar et al., 2023). The government is trying to develop

the domestic halal food and beverage industry to encourage the growth of halal MSMEs (Anandita et al., 2022). Several things are opportunities and challenges for MSE Development in the halal MSME industry in Indonesia, ranging from Demographic Aspects, Market, Digital Economy, Funding, and also Halal Certificates for MSMEs in Indonesia (Zainorrahman & Reza Zulfikri, 2023).
Various efforts have been made to increase the productivity of MSMEs, such as marketing strategies (Naim et al., 2023). Socialization efforts are also made to expand the reach of halal certification, especially in Tagerang Regency (Rohimah & Saputra, 2024). MSMEs can increase their productivity with digitalization efforts (Rahman Soesilo & Liosten Rianna Roosida Ully Tampubolon, 2023b). Digitizing payments also makes an effort to improve (Syamsudin et al., 2024). In addition, digitalization is also useful in accessing information and finance for MSMEs (Rahman Soesilo & Liosten Rianna Roosida Ully Tampubolon, 2023a).

Further improvement opportunities can be developed towards sustainability in the food supply chain (Soesilo et al., 2024). Simultaneous improvements are made to increase productivity by improving work methods and arranging more ergonomic facilities (Sartono et al., 2022) (Sulistyo et al., 2024). Improving clean production readiness can be integrated with 5S kaizen (Sulistyo et al., 2023).

RESEARCH METHODS

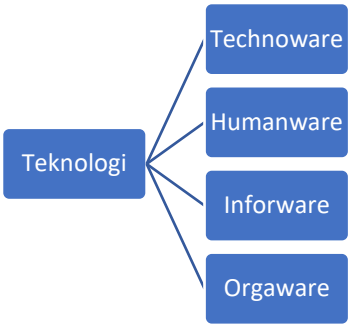
The method used in this study is a combination of AHP and technometrics. This research is the initial stage in determining the criteria for measuring the content of technology. The stages of research from the beginning to the determination of the technology content indicators are as follows:

1. Establish a hierarchy to define complex problems until they become clear and detailed. The hierarchy for measuring technology content is grouped into four according to the type of UN-ESCAP dimension: technoware, humanware, information ware, and/or awareness.
2. Interviews were conducted to discuss the indicators to be used to measure the content of technology. These interviews were conducted with parties with a vision and mission related to the progress of halal food MSMEs in Tangerang Regency.
3. AHP (Analytical Hierarchy Process) Stage

a. In preparing the questionnaire, I aimed to weight the assessment of each technology development criterion. This quiz will compare the relative importance of the criteria and dimensions in pairs. The validity and reliability test was conducted using Minitab software.
b. Questionnaire I was distributed to three groups of respondents who are experts and strategic decision-makers in Halal Food MSMEs.
c. Calculate the consistency ratio (CR) value and determine each respondent's criterion weights. This stage is carried out after the results of the questionnaire are collected. The final result of the weight calculation is a decimal number under one (e.g., 0.01 to 0.99), with the total weight for elements in one dimension equal to one.

RESULTS AND DISCUSSION

1. Results of determining criteria and sub-criteria



2. The results of the interviews with stakeholders are indicators that will be used to measure the content of halal food technology. These indicators will be used as questions in a questionnaire that will be distributed to halal food MSMEs as a tool to measure the content of technology.

3. AHP Stage

From the questionnaire that has been distributed to stakeholders or questionnaire experts, the calculation of the priority matrix, the determination of eigenvalue, and the consistency of the ratio of each indicator obtained from the interviews with stakeholders is carried out. An example of calculating the priority matrix and determining the eigenvalue of each respondent is shown in Tables 1. a to 1. d, and the results of the calculation of the consistency of the ratio are shown in Table 1e. below.

Table 1. An example of the calculation of the priority matrix and the determination of the eigenvalue of each respondent

Technoware Indicator	Equipment Maintenance	Packaging Equipment	Equipment Sophistication	Easy-to-use equipment	Sum	Priority	Eigenvalue
Equipment Maintenance	0,5	0,409	0,375	0,670	1,954	0,489	0,977
Packaging Equipment	0,167	0,136	0,375	0,074	0,752	0,188	1,380
Equipment Sophistication	0,167	0,045	0,125	0,032	0,369	0,092	0,738
Easy-to-use equipment	0,167	0,409	0,125	0,223	0,924	0,231	1,034

Table 1 shows that equipment maintenance is the highest priority in the Technnoware criteria, which means that equipment maintenance has the highest impact on MSME's facility improvement.

Table 2. Example of the calculation of the priority matrix and the determination of the eigenvalue of each respondent

Human ware Indicator	Experienced HR	Human Resources with Integrity	Skilled human resources	Human resources never give up	Highly motivated HR	Sum	Priority	Eigenvalue
Experienced HR	0,081	0,059	0,176	0,060	0,111	0,488	0,098	1,203
Human Resources with Integrity	0,405	0,294	0,294	0,181	0,333	1,508	0,302	1,025
Skilled human resources	0,027	0,059	0,059	0,036	0,111	0,292	0,058	0,993
Human resources never give up	0,243	0,294	0,294	0,181	0,111	1,123	0,225	1,243
Highly motivated HR	0,243	0,294	0,176	0,542	0,333	1,589	0,318	0,954

Table 2 shows that the highest priority in the Humanware criteria is highly motivated human resources, which means that highly motivated human resources have the highest impact on MSME's human resources improvement.

Table 3. Example of the calculation of the priority matrix and the determination of the eigenvalue of each respondent

Inforware	Info Acces	Mkt info	Reg. info	Relation info	Jumlah	Prioritas	Eigen value
Info Acces	0,3	0,192	0,3	0,404	1,196	0,299	0,997
Mkt info	0,3	0,192	0,5	0,135	1,127	0,282	1,465
Reg. info	0,1	0,038	0,1	0,058	0,296	0,074	0,740
Relation info	0,3	0,577	0,1	0,404	1,381	0,345	0,855

From Table 3, it is known that relation information is the highest priority in the Inforware criteria, which means that relation information has the highest impact on MSME information improvement.

Table 4. Example of calculation of the priority matrix and determination of the eigenvalue of each respondent

Orgaware Indicator	Leadership	Organizational Structure	MSME Community	Relationship	Sum	Priority	Eigenvalue
Leadership	0,3	0,500	0,200	0,286	1,286	0,321	1,071
Organizational Structure	0,1	0,167	0,200	0,286	0,752	0,188	1,129
MSME Community	0,3	0,167	0,200	0,143	0,810	0,202	1,012
Relationship	0,3	0,167	0,400	0,286	1,152	0,288	1,008

source: Data Processing, 2024

From Table 4, the highest priority in the or aware criteria is leadership, which means that leadership has the highest impact on MSME's organisational improvement.

Table 5. The results of the calculation of the consistency of the ratio from each respondent

	R1	R2	R3	Friendly
TECHNOWARE	0,0930	0,0997	0,047	0,0799
HUMANWARE	0,0783	0,0780	0,093	0,0831
INFORWARE	0,0617	0,0770	0,020	0,0529
ORGAWARE	0,0617	0,0770	0,080	0,0729

source: Data Processing, 2024

The calculation results show that all dimension indicators have a CR value of < 0.1, meaning that the indicator has been consistent. Weight calculations are carried out from interviews and questionnaires after the CR calculation is carried out. This result means that this indicator can measure the technology content in MSMEs. The results of the weight calculation are shown in the following table.

Table 6. Weight of Technoware Dimension criteria

Indicators	R1	R2	R3	Weight
Equipment Maintenance	0,488576	0,438112	0,501082	**0,48**
Packaging Equipment	0,188125	0,239176	0,262987	**0,23**
Equipment Sophistication	0,092259	0,068341	0,159091	**0,11**
Easy-to-use equipment	0,23104	0,254371	0,07684	**0,19**

source: Data Processing, 2024

Table 7. Humanware Dimension Indicator Weight

Indicators	R1	R2	R3	Weight
Experienced HR	0,097545	0,107787	0,107787	**0,10**
Human Resources with Integrity	0,301539	0,276303	0,276303	**0,28**

Skilled human resources	0,058386	0,058988	0,058988	**0,06**
Human resources never give up	0,224663	0,231859	0,231859	**0,23**
Highly motivated HR	0,317867	0,325063	0,325063	**0,32**

source: Data Processing, 2024

Table 8. Inforware Dimension Indicator Weight

Indicators	R1	R2	R3	Weight
Ease of access to info	0,299038	0,438112	0,30625	**0,35**
Marketing Info	0,281731	0,239176	0,30625	**0,28**
Licensing Info	0,074038	0,068341	0,14375	**0,10**
Cooperation Info	0,345192	0,254371	0,24375	**0,28**

source: Data Processing, 2024

Table 9. Weight Indicator Dimensions Orgaware

Indicators	R1	R2	R3	Weight
Leadership	0,321429	0,40625	0,325	**0,35**
Organizational Structure	0,188095	0,177083	0,191667	**0,19**
MSME Community	0,202381	0,239583	0,241667	**0,23**
Relationship	0,288095	0,177083	0,241667	**0,24**

source: Data Processing, 2024

CONCLUSION

From the calculation results, it is known that the indicator value in each technology content <0.1 means that the indicators in each technology dimension can be used to measure the content of technology in halal food MSMEs. The indicators for Technoware are Equipment Maintenance, Packaging Equipment, Equipment Sophistication, and Easy-to-use Equipment. Indicators for humanware are experienced human resources, human resources with integrity, skilled human resources, never giving up human resources, and highly motivated human resources. Indicators for Inforware are Ease of Access to Info, Marketing Info, Licensing Info, and Cooperation Info. The indicators of the Orgaware Dimension are Leadership, Organizational Structure, MSME Community, and relationships. These indicators will be used as questions in a questionnaire that will be distributed to halal food MSMEs as a tool to measure the content of technology. The recommendation is to improve the information aspect, especially in relation to information, develop a marketing system, develop access to the government, and establish halal institutions.

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