READINESS ASSESSMENT FOR IMPLEMENTATION OF INDUCTION STOVE's INDONESIAN NATIONAL STANDARDIZATION (SNI)

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Abstract

The Indonesian government has set a target to achieve net zero emissions (NZE) by 2060, part of which involves converting gas stoves to induction stoves for 8.2 million households by 2025. This initiative not only aims to reduce carbon emissions but also to decrease reliance on imported Liquefied Petroleum Gas (LPG), easing the strain on the state budget due to LPG subsidies. Standardizing induction stoves is crucial to ensure product quality and user safety. While Indonesia has existing standards for electric cooking equipment, specific standards for induction stoves are lacking, necessitating the development of Indonesian National Standards (SNI). To prepare for the implementation of these standards, a study focusing on the readiness of institutions involved in SNI implementation was conducted. Using the technoware, humanware, infoware, orgaware, cysnetware, manageware, and partnerware (THIOCMP) model, the study assessed the readiness of stakeholders. Thirty expert respondents participated in questionnaires and Focus Group Discussions (FGD). The findings indicate a high level of readiness among stakeholders, although improvements are needed in the orgaware component to ensure sustainable implementation of SNI for induction stoves. This research underscores the importance of thorough preparation for the successful adoption of new standards in Indonesia's transition to sustainable energy practices.

Keywords: Energy Transition, Induction stove, Technometrics, Standardization.

Abstrak

Pemerintah Indonesia bertekad untuk mencapai emisi neto nol (NZE) pada tahun 2060, salah satu strategi adalah melakukan konversi kompor gas menjadi kompor induksi untuk 8,2 juta rumah tangga pada tahun 2025. Selain untuk mengurangi emisi karbon, Indonesia mengejar target meminimalkan ketergantungan pada impor Liquid Petroleum Gas (LPG) untuk menurunkan anggaran belanja negara akibat peningkatan subsidi LPG, standarisasi kompor induksi adalah aspek penting yang perlu disiapkan untuk menerapkan strategi ini. Hal ini terutama untuk memastikan kualitas produk kompor induksi yang diproduksi oleh produsen perangkat rumah tangga demi melindungi pengguna. Saat ini telah ada Standar Nasional Indonesia (SNI) untuk peralatan memasak listrik di Indonesia, yaitu SNI IEC 60335-2-6, SNI IEC 60335-2-9, dan SNI IEC 60335-2-36. Namun, belum ada standar khusus kompor induksi seperti produk kompor gas, sehingga SNI kompor induksi dinilai perlu diinisiasi, apabila program konversi akan diaplikasikan secara nasional. Untuk mempersiapkan SNI kompor induksi, diperlukan pengukuran tingkat kesiapan lembaga yang terlibat dalam implementasi SNI. Tingkat kesiapan diukur berdasarkan model komponen teknologi, yaitu technoware, humanware, infoware, orgaware, cysnetware, manageware, dan partnerware (THIOCMP). Tiga puluh (30) responden ahli yang mewakili pemangku kepentingan terkait SNI untuk kompor induksi terlibat mengisi kuesioner dan Focus Group Discussion (FGD). Hasil studi melaporkan bahwa pemangku kepentingan di Indonesia sangat siap dalam penerapan SNI kompor induksi. Namun, komponen orgaware masih perlu diperbaiki dan ditingkatkan agar SNI kompor induksi dapat direalisasikan dan diimplementasikan secara berkelanjutan.

***Kata kunci**: Transisi Energi, Kompor Induksi, Teknometri, Standarisasi.*

1. INTRODUCTION

In line with the energy sector roadmap as a manifestation of the Indonesian government's commitment to achieving NZE, one crucial action is to reduce dependence on imported LPG by promoting the widespread use of electric induction stoves (IEA, 2022). To realize this commitment, a pilot project for converting to induction stoves was implemented in Indonesia in 2022 (Dian Pratiwi et al., 2023).

The transition from LPG to electric induction stoves is a consideration for the Indonesian government due to its many advantages and benefits, including cost reduction, environmental friendliness, and a decrease in cooking accidents (Hakam et al., 2022). These benefits also motivate countries around the world to adopt induction stoves, including the United States (Mai et al., 2018); South Korea (Kim et al., 2017)(Im & Kim, 2020); Canada (Atta, 2019); India (Banerjee et al., 2016); Equador (Rodríguez et al., 2019); Nepal (Paudel et al., 2023), and others.

Induction stoves are considered a relatively innovation in modern cooking appliances, especially for developing countries (Damayanti et al., 2024). This stove technology has undergone refinement and development since its inception as a prototype in 1933, which was showcased at the General Motors technology exhibition in the United States in 1950 and only became famous as a replacement for LPG gas stoves in the last decade (Damayanti et al., 2023).

Countries transitioning to induction stove technology also prepare product standards to minimize risks. For example, Nepal, through the Nepal Bureau of Standards and Metrology, has initiated such standardization (MECS, 2021). Furthermore, in Ecuador, the testing of induction stove product standards was initiated with IEC 6100 (2012), EMC, and EN 50160 (2011) (Rodríguez et al., 2019).

The Indonesian government has recognized the importance of pioneering induction stove standards. It has designated them as (SNI) to protect users in preparation for implementing these stoves (KumparanBISNIS, 2018). Currently, in Indonesia, there are standards related to household electrical appliances, namely SNI-IEC 60335-1, with several standards that can be adopted to regulate the safety testing of induction stove products, including SNI-IEC 60335-2-6 on household and similar electrical appliances - safety - specific requirements for cookers, hotplates, hobs, and similar appliances (Badan Standardisasi Nasional, 2010c), NI-IEC-60335-2-36 on household and similar electrical appliances - safety - specific requirements for cookers, ovens, hotplates, and commercial electric hobs (BSN, 2010a), SNI-IEC 60335-2-9 on household and similar electrical appliances - safety - specific requirements for grills, toasters, and similar portable cooking appliances BSN, 2010b).

Several potential SNI standards need to be identified, and an assessment of the readiness of relevant institutions in Indonesia for the implementation of SNI for induction stoves needs to be made. Stakeholders related to the implementation of SNI for induction stoves include the (BSN), the primary institution developing standards nationally recognized internationally. The Conformity Assessment Body (LPK) tests product compliance with established standards. Other institutions involved include PT.PLN, which executes supporting programs for the energy transition strategy. The involvement of independent research institutions such as universities is also critical, as they house experts relevant to the transition needs and induction stove product standards.

The readiness for implementing new technology can be measured by applying the THIOC (Technoware, Humanware, Infoware, Orgaware, and Cysnetware) components (Sharif, 2012). In its development, Kilubi (2012) included the aspects of Manageware (M) and Partnerware (P) to measure the readiness of technology components. Furthermore, Marlyana et al. (2018), integrated these two models, namely technoware, humanware, infoware, orgaware, cysnetware, managerware, and partnerware (THIOCMP), to comprehensively measure readiness.

The implementation of SNI requires the cooperation and involvement of entities across institutions and organizations. Therefore, this research aims to measure the readiness for implementing SNI by considering the involvement of stakeholders from various organizations. The THIOCMP readiness model will be used in this research.

This study has the potential to provide knowledge benefits, namely the application of the THIOCMP model, which represents the latest development in readiness measurement for technology implementation (Marlyana, 2018). From a practical perspective, THIOCMP is applied to measure the readiness of organizations involved in implementing SNI for induction stoves. Based on the measurement results, efforts will be formulated to improve the readiness levels of various organizations for the implementation of SNI for induction stoves. This readiness measurement for SNI implementation is part of the preparation for the national gas-to-induction stove conversion program.

2. RESEARCH METHOD

This research consists of four stages, including exploring the literature for developing the research model and framework, designing the questionnaire as the instrument for data collection, and then data processing and analysis. Figure 1 displays the flowchart of this research.

2.1 Research Model Development

The research model development is carried out by exploring references on organizational readiness measurement models for technology implementation. The THIOCMP model is applied in this research. Based on the references, seven technology components are integrated into developing the assessment of readiness for standard implementation.

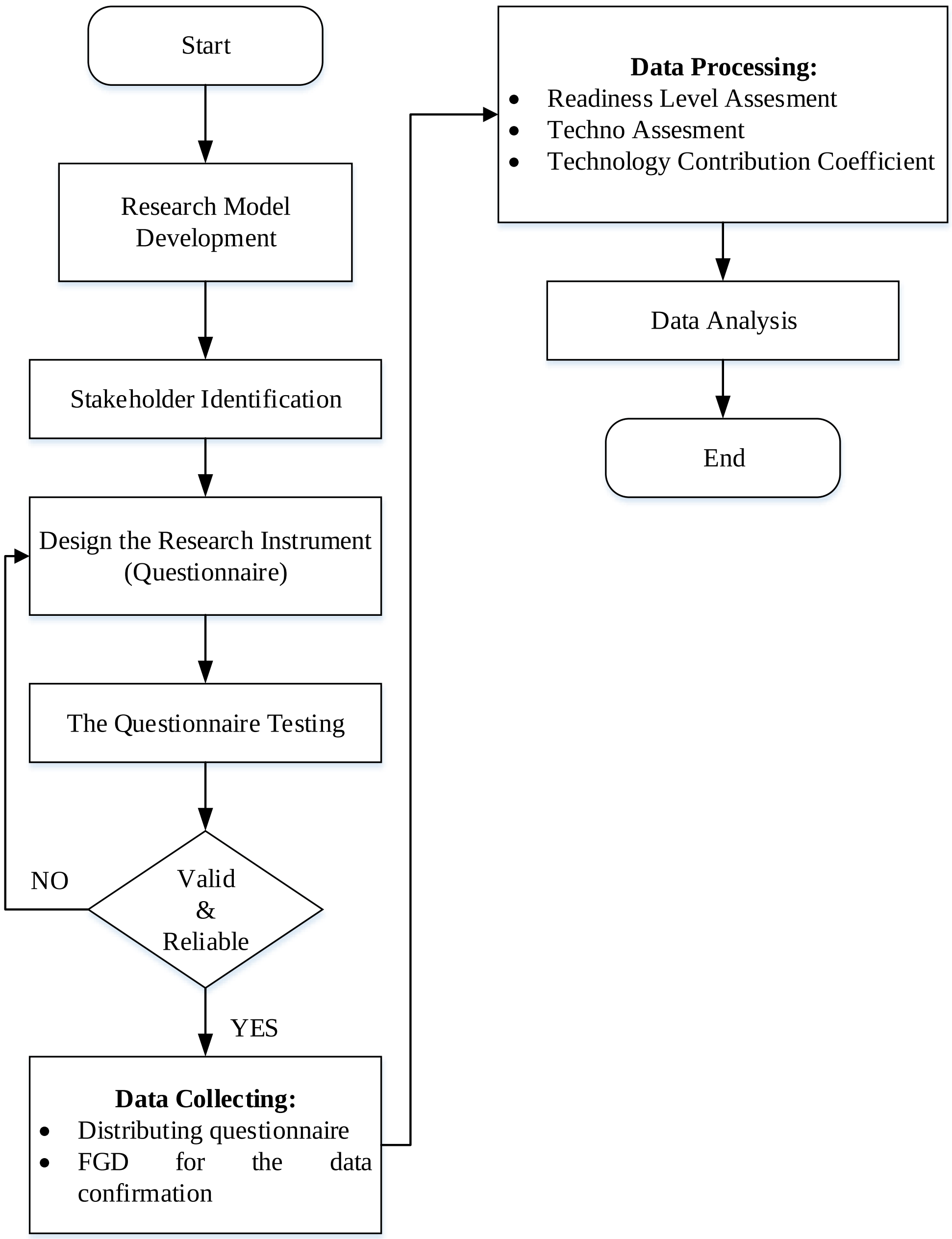

Figure 1 Research Methodology.

Criteria and indicators are adopted based on specific case studies, which include the formulation of components to evaluate the readiness for standard implementation for induction stove products in Indonesia. The research model is illustrated in Figure 2.

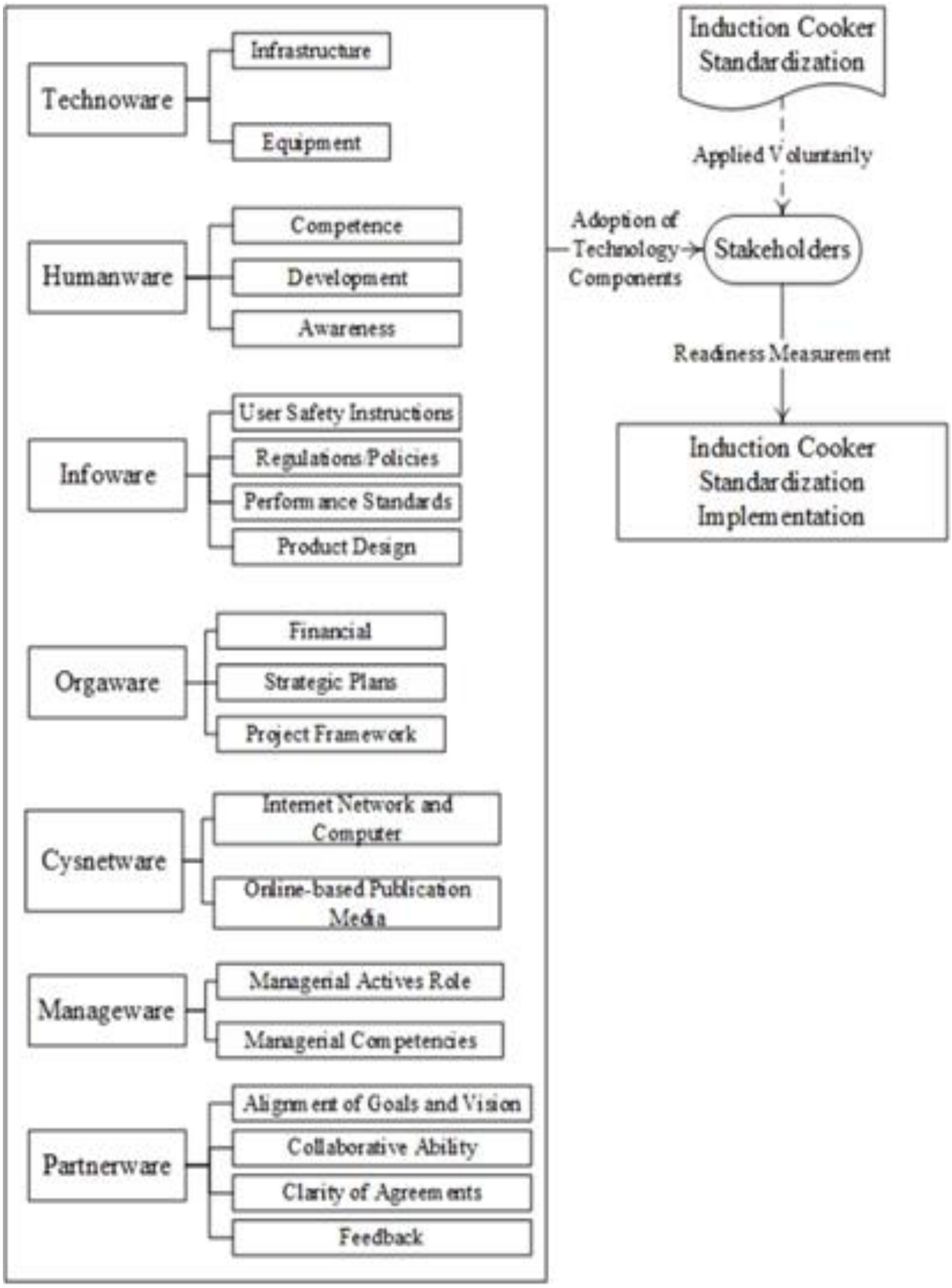

Figure 2 Model Implementation Framework.

2.2 Stakeholder Identification

Stakeholders in assessing organizational readiness for the implementation of SNI for induction stoves include BSN, Testing and Certification Laboratory, Academic Team (e.g., from university research institutions), electronic household appliance industry (manufacturers and those planning to produce induction stoves), and PT.PLN Persero. These stakeholders are engaged and considering their roles in implementing SNI for induction stoves. Table 1 shows the stakeholders involved in this study and their respective roles.

Table 1 Stakeholders involved in the study.

No	Stakeholders	Department	Description
1	State Electricity Company (PT PLN)	Field Technicians and Induction Stove Conversion Project Team	Consumers
2	Induction Stove Industry	PT Adyawinsa Electrical Power	Manufacturers
3	Research and Development Team	Pilot Project Research Team for Induction Stove (Universitas Sebelas Maret team)	Supervisory and Research Team
4	Training Institute	Testing and Certification Laboratory	Testing and Certification Institutions
5	National Standardization Agency (BSN	Standard Implementation and Compliance Assessment Team	Standardization Authorities

2.3 Design and Questionnaire Testing

The readiness measurement questionnaire for SNI induction stoves is designed with a 5-point Likert scale (1 = very low to 5 = very high). The THIOCMP instrument is detailed into 28 indicators. Before distributing the questionnaire to respondents, a pilot study is conducted to ensure the instrument is suitable for data collection. Table 2 displays the operational definitions of variables and indicators and a summary of the questionnaire testing. All questionnaire indicators are valid and reliable.

Table 2 Operationalization of Readiness Measurement Variables.

Technology Component	Criteria	Reference	Description	Indicator	Code	Validity	Reliability	Description
Technoware	Infrastructure	(UNIDO, 2016)	Basic facilities required for operational activities	Policy/regulation program	A1	0,562	0,959	Valid & Reliable
				Standardized documents	A2	0,604	0,958	Valid & Reliable
			Equipment readiness for operational activities	Institutions/agencies implementing standards	A3	0,739	0,957	Valid & Reliable
	Equipment	(Savicheva & Enikeeva, 2020)	Ability, skills, and expertise of human resources Improving the quality and quantity of human resources Human resources' response to environmental stimuli Safety guidelines	Readiness of electrical current testing equipment for household appliances	A4	0,574	0,958	Valid & Reliable
				Readiness of temperature testing equipment for household electrical devices	A5	0,679	0,987	Valid & Reliable
				Readiness of resistance testing equipment for induction stove bodies	A6	0,778	0,957	Valid & Reliable
				Readiness of electromagnetic radiation testing equipment for electrical devices	A7	0,657	0,957	Valid & Reliable
				Readiness of MCB installation equipment for induction stoves according to standards	A8	0,654	0,958	Valid & Reliable
Humanware	Competence	(Rivai, 2021)	Formal regulations to guide actions	Personnel knowledge about induction stove standards	B1	0,859	0,956	Valid & Reliable
	Development (Rastgoo, 2016)	(Rastgoo, 2016)	Information forms regulating workflow processes	Induction stove standard training activities	B2	0,817	0,956	Valid & Reliable
	Awareness	(Apascaritei & Elvira, 2022)	Planning in creating an object	Awareness of the importance of standard implementation	B3	0,657	0,958	Valid & Reliable
Infoware	User Safety Instructions	(Hollmann, 2020)	Government financial support	Availability of induction stove usage instructions	C1	0,572	0,958	Valid & Reliable

Technology Component	Criteria	Reference	Description	Indicator	Code	Validity	Reliability	Description
	Regulations/ Policies	(Cercell, 2017)	Objectives, strategic targets, and policy directions of a program	Regulations/policies for standard implementation	C2	0,567	0,958	Valid & Reliable
	Performance Standards	(Anggraini, 2022)	Flow determining the chain of responsibility	Indonesian National Standard (SNI) documents	C3	0,817	0,956	Valid & Reliable
	Product Design	(Ravasi, 2012)	Utilization of computers and internet networks	Standardized design of induction stove products	C4	0,817	0,956	Valid & Reliable
Orgaware	Financial	(Peter & Adegbuyi, 2018)		Financial support from the Indonesian government for the program	D1	0,650	0,96	Valid & Reliable
	Strategic Plans	(PT. Pertamina (Persero), 2011)	Promotion and socialization activities	Roadmap for induction stove conversion program	D2	0,884	0,955	Valid & Reliable
	Project Framework	(Thoday et al., 2018)	Communication, honesty, and conflict resolution from top management	Division of responsibilities for induction stove quality infrastructure by relevant institutions	D3	0,911	0,956	Valid & Reliable
Technology Component	**Criteria**	**Reference**	**Description**	**Indicator**	**Code**	**Validity**	**Reability**	**Description**
Cysnetware	Internet Network and Computer	(Sari et al., 2023)	Managerial ability to make accurate, fast, and planned decisions	Computing facilities	E1	0,631	0,958	Valid & Reliable
				Readiness of internet access facilities	E2	0,643	0,958	Valid & Reliable
	Online-based Publication Media	(PLN, 2022)	Shared understanding of the program	Websites and social media	E3	0,810	0,956	Valid & Reliable
Manager	Managerial Active Role	(Arbaa & Varon, 2018)	Ability to collaborate in program implementation Structured program complexity	Team leader taking an active role in implementation	F1	0,684	0,958	Valid & Reliable
				Readiness of team management skills for the development and implementation of stove standards	F2	0,595	0,958	Valid & Reliable
	Managerial Competencies	(Jiménez et al., 2015)	Initiative to form relationships	Leader's ability in team management	F3	0,642	0,958	Valid & Reliable
Partnerware	Alignment of Goals and Vision	(Holopainen et al., 2020)	Description	Aligned vision and goals among stakeholders	G1	0,681	0,958	Valid & Reliable
	Collaborative Ability	(World Wildlife Fund, 2000)	Basic facilities required for operational activities	Collaboration of quality infrastructure among stakeholders	G2	0,750	0,957	Valid & Reliable
	Clarity of Agreements	(Youmatter, 2019)		Collaborative agreements among stakeholders	G3	0,840	0,956	Valid & Reliable
	Feedback	(Networks, 2020)	Equipment readiness for operational activities	Interaction and feedback loop in standard implementation	G4	0,595	0,958	Valid & Reliable

2.4 Data Collecting

Data collection was conducted by distributing the questionnaire to stakeholders and holding discussions with stakeholder experts involved in the standardization implementation activities in Indonesia. 30 stakeholders involved as the respondents in this study. The questionnaire was sent online to respondents, followed by coordination and discussions to address the questionnaire responses. These discussions took place via Zoom for approximately 1.5 hours. The discussion outcomes were recorded and elaborated upon with the questionnaire results.

2.5 Data Processing

Data processing begins with cleaning outliers and missing values, followed by assessing the readiness indicators for SNI implementation using descriptive statistics. The next stage involves calculating the readiness level for each component based on the average value of each component, followed by calculating the readiness level and component contribution value or TCC using the *technometric* method (Marlyana & Khoiriyah, 2021),with Equation 1.

$$TCC=\alpha\times T^{\beta T}\times H^{\beta H}\times I^{\beta I}\times O^{\beta O}\times C^{\beta C}\times M^{\beta M}\times P^{\beta P} \quad (1)$$

Where:

α	:	Trends factor of technology
T	:	Contribution value of technology component
βT	:	Intensity value of contribution of technology component
H	:	Contribution value of humanware component
βH	:	Intensity value of contribution of humanware component
I	:	Contribution value of infoware component
βI	:	Intensity value of contribution of infoware component
O	:	Contribution value of orgaware component
βO	:	Intensity value of contribution of orgaware component
C	:	Contribution value of cynetware component
βC	:	Intensity value of contribution of cynetware component
M	:	Contribution value of manageware component
βM	:	Intensity value of contribution of manageware component
P	:	Contribution value of partnerware component
βP	:	Intensity value of contribution of partnerware component

2.6 Data Analysis

Each indicator's mode score from the questionnaire and the results of expert judgment from stakeholders during the discussion are analysed. Scores are determined based on the readiness of each indicator using a 5-point scale, where 1 = very low readiness and 5 = very high readiness.
The readiness results of each indicator are analysed using the *technometric* contribution coefficient with Equation (1). Each component's contribution value indicates the readiness level of each component in creating value in an activity (Marlyana & Khoiriyah, 2021), specifically in the implementation of SNI for induction stoves.

3. RESULTS AND DISCUSSION

3.1 Technology-Readiness Measurement

The results of the questionnaire for the components of technoware, humanware, infoware, orgaware, cynetware, manageware, and partnerware are obtained. The collected data is processed using modus statistics to determine the achievement for each readiness scale. This analysis is used to identify which indicators meet the criteria and to determine their level of achievement as a basis for improving readiness. Table 3 shows the readiness point (modus score) for each component indicator.

Table 3 Indicators Readiness Level.

Indicator (Code)		Point	Readiness Level
T	Program policy/regulation. (A1)	3	Medium
	Standardized documents. (A2)	4	High
	Institutions/agencies implementing standards. (A3)	4	High
	Readiness of electrical current testing equipment for household appliances. (A4)	4	High
	Readiness of temperature change testing equipment for household appliances. (A5)	4	High
	Readiness of induction stove body durability testing equipment. (A6)	4	High
	Readiness of electromagnetic radiation testing equipment for electrical devices.(A7)	4	High
	Readiness of MCB installation equipment for induction stoves according to standards. (A8)	4	High
H	Personnel knowledge about induction stove standards. (B1)	4	High
	Induction stove standard training activities. (B2)	3	Medium
	Awareness of the importance of standard implementation. (B3)	4	High
I	Availability of induction stove usage instructions. (C1)	4	High
	Regulations/policies for standard implementation. (C2)	3	Medium

	Indicator (Code)	Point	Readiness Level
	Indonesian National Standard (SNI) documents. (C3)	4	High
	Standardized designs of induction stove products. (C4)	3	Medium
O	Financial support from the Indonesian government for the program. (D1)	3	Medium
	Roadmap for induction stove conversion program. (D2)	3	Medium
	Division of responsibilities for induction stove quality infrastructure by relevant institutions. (D3)	3	Medium
C	Computing facilities. (E1)	4	High
	Readiness of internet access facilities. (E2)	4	High
	Website and social media presence. (E3)	4	High
M	Team leadership takes an active role in implementation. (F1)	4	High
	Team management readiness for the development and implementation of stove standards. (F2)	4	High
	Leader's ability in team management. (F3)	4	High
P	Aligned vision and goals among stakeholders. (G1)	4	High
	Collaboration on quality infrastructure among stakeholders. (G2)	4	High
	Collaborative agreements among stakeholders. (G3)	3	Medium
	Interaction and feedback loop in the standard implementation. (G4)	4	High

Note: T= Technoware; H=Humanware; I=Infoware; O=Orgaware; C=Cysnetware; M= Manageware; P=Partnerware

Out of a total of 28 indicators, 29% of the indicators are at a moderate level of readiness,

while 71% achieve a high level of readiness. Meanwhile, there are no indicators at a low level, and none reach the ideal level of readiness. The distribution of these readiness levels is visualized in Figure 4.

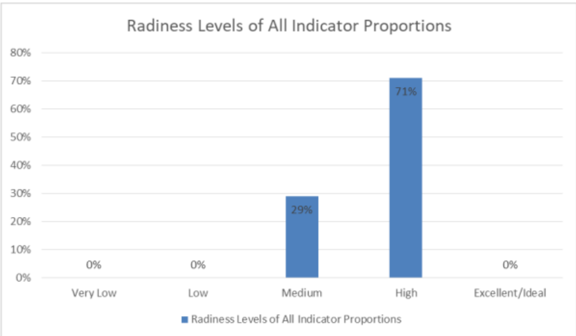

Figure 4 Readiness Levels of All Indicator Proportions.

Next, the readiness scores for each component are calculated by averaging the scores of the indicators. Here's an example calculation for the technoware component:

Level of Readiness for Technoware

$$=\frac{1}{8}(Score\ A1\ +\ Score\ A2\ + ScoreA3 + \ldots + Score\ A8$$

$$= \frac{1}{8}(3+4+4+4+4+4+4+4)$$

$$= 3.875\ \approx 4$$

The detailed calculation results for the readiness value of each component are presented in Table 4.

Table 4 The readiness value of each component.

Technology Component	Average Value	Definition
Technoware	4	High
Humanware	4	High
Infoware	4	High
Orgaware	3	Medium
Cysnetware	4	High
Manageware	4	High
Partnerware	4	High

To assess the readiness of implementing the induction stove standard, *technometric* calculations using the TCC formula equation (1) are conducted under the following conditions:

- The β value is the weight value of the composition of each component (THIOCMP) where ∑ β = 1. According to Aqidawati (2022), the weight of each element is represented based on the distribution portion of each component relative to each other. To achieve the benefits of standardization as an ideal condition, this study assumes that all components have the same weight. This is in line with the requirements of BSN (2014:66) in implementing product standards (especially product) requiring at least three stages, namely company commitment in analyzing the benefits of implementing standards by a managerial team assisted by staff and experts, controlling the production process by producers, and checking (monitoring) by LPK and the research team. When the three stages have been fulfilled by synergy between stakeholders implementing the standards, publications will be made to the public regarding product quality so that the benefits of standardization can be achieved and ideal conditions can be achieved.

- The weight of each component in the THIOCMP composition is ∑β=1. All components have the same weight because they are interrelated and influence each other. The components of readiness to implement SNI for induction stoves are analyzed from 7 aspects, so that each component has a value of 0.14 ($\beta_T = \beta_H = \beta_I = \beta_O = \beta_C = \beta_M = \beta_P = 0{,}14$).
- The technology trend factor (α) represents the importance of readiness measurement. The α value was initially assumed to have no effect or be 1 (Aqidawati, 2020) but with a maximum measurement scale of 5, it produces a value of α = 0.2 so the TCC formula is as follows,

$$TCC = 1\,x\,\frac{T^{0,14}}{5} \text{ x } \frac{H^{0,14}}{5} \text{ x } \frac{I^{0,14}}{5} \text{ x } \frac{O^{0,14}}{5} \text{ x } \frac{C^{0,14}}{5} \text{ x } \frac{M^{0,14}}{5} \text{ x } \frac{P^{0,14}}{5}$$

$$= \frac{1}{5}\,x\,T^{0,14} \text{ x } H^{0,14} \text{ x } I^{0,14} \text{ x } O^{0,14} \text{ x } C^{0,14} \text{ x } M^{0,14} \text{ x } P^{0,14}$$

$$= 0{,}2\,x\,T^{0,14} \text{ x } H^{0,14} \text{ x } I^{0,14} \text{ x } O^{0,14} \text{ x } C^{0,14} \text{ x } M^{0,14} \text{ x } P^{0,14}$$

Table 4 shows the readiness values for the technoware, humanware, infoware, cynetware, and manageware components are the same. The contribution values for each element are also the same ($4^{0,14}$) = 1,21. For the orgaware component, the contribution value is ($3^{0,14}$) = 1,17. Thus, the readiness of each element can be depicted on a spider web graph (Figure 5).

The contribution figures are applied to calculate the TCC, resulting in a TCC for the implementation readiness of the SNI at 0.75. The value of 0.75 falls within the range of 0.7 < TCC ≤ 0.9, indicating excellent readiness to implement the induction stove standard. It also falls within the 0.7 < TCC ≤ 1 range, which suggests readiness for modern technology.

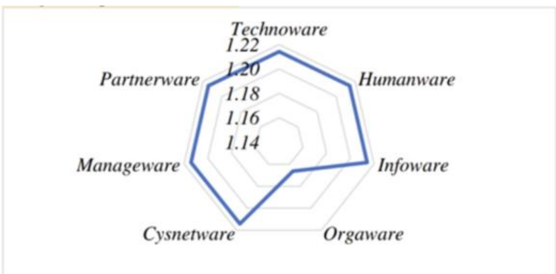

Figure 5. Diagram of Contribution Values for Each Component

Therefore, the technoware, human resources (humanware), organizational structure (orgaware), internet facilities (cysnetware), management capabilities (manageware), and partnership networks (partnerware) of institutions in Indonesia are ready for the implementation of the SNI for induction stoves. The readiness discussion for each of these components is discussed below:

Technoware:

The readiness of technoware for implementing the SNI induction stove in Indonesia is assessed based on the required infrastructure and equipment. The results from the questionnaire and stakeholder discussions show that almost all indicators have a "high" readiness level. The aspect that still needs preparation is at a medium level, which relates to policy readiness and program regulations. This indicates that readiness in these aspects needs to be improved to enhance the readiness for implementing the induction stove standard, similar to Indonesia's transition from kerosene to LPG stoves (Tyler & Kelly, 2018).

Humanware:

The readiness of humanware for implementing the SNI induction stove in Indonesia is assessed based on competency, human resource development, and awareness levels. The measurement results show that all indicators have a "high" readiness level. The aspect that still needs preparation, at a medium level, is induction stove standard training activities. Training is one of the strategy to develop the team's knowledge and skills (Rastgoo, 2016).

Infoware:

The readiness of infoware for implementing the SNI induction stove in Indonesia is assessed based on safety instructions, regulations/policies, performance standards, and product design, where indicators show a "high" and "medium" readiness level. This indicates that safety guidance and performance standards in Indonesia are sufficiently prepared to support the implementation of the induction stove standard. However, readiness in terms of information related to the application of more specific regulations/policies for induction stoves from the government to support the successful implementation of the induction stove standard need to be improved (KumparanBISNIS, 2018).

Orgaware:

The readiness of orgaware for implementing the SNI induction stove in Indonesia is assessed based on financial, strategic planning, and standard implementation framework aspects. All indicators in this component have a "medium" readiness level. This indicates that the organizational system in Indonesia is sufficiently prepared for the implementation of the induction stove standard, including the availability of Indonesia's roadmap to achieve NZE (Medrilzam, 2022). However, this aspect needs to improve its readiness, especially regarding the realization of the roadmap and the accuracy in developing the framework for each organization (Thoday et al., 2018).

Cysnetware:

The readiness of cysnetware for implementing the SNI induction stove in Indonesia is assessed based on computers, internet networks, and publication media. All indicators have a "high" readiness level. Computational devices in Indonesia, especially at various institutions like BSN, are ready to implement electricity-related SNI (Haryanto, 2019), including induction stoves.

Manageware:

The component of manageware for implementing the SNI induction stove in Indonesia is assessed based on the active role of company management and managerial competence. All indicators have a "high" readiness level. This indicates that the managerial team or team leaders at each stakeholder implementing the induction stove standard in Indonesia have good organizational management knowledge. Managing the team becomes a good decision-maker in implementing technology (Hipkin & Bennett, 2014), including the induction stove standard.

Partnerware:

The readiness of partnerware components for implementing the SNI induction stove in Indonesia is assessed based on goal and vision alignment, cooperation, agreement clarity, and mutual interaction. Almost all indicators have a "high" readiness level. This indicates that collaboration capabilities among stakeholders in implementing the induction stove standard can be achieved well because they are aligned with the goals and missions of standard implementation. The aspect that is still at a medium level and potentially needs improvement is collaborative agreement among stakeholders. Collaboration and cooperation among stakeholders are crucial to ensuring the quality of a product and providing feedback to each other in implementing national standards (Suprapto & Budi Kharisma, 2020).

4.2 Recommendations for Improving the Readiness of Implementing Induction Stove SNI

Although stakeholders for the implementation of SNI for induction stoves in Indonesia have shown excellent readiness levels, several aspects need strengthening to enhance readiness further and maintain consistency.

4.2.1 Recommendations for Government / Regulatory Standards

The results of this research strongly suggest to the government, as the regulator through BSN do initiatives for implementing induction stove standards, accelerate regulation implementation, enhance consumer and producer safety, and protect the domestic market from inferior foreign products (Ciptawan, 2022).

This study also emphasizes Indonesia's roadmap towards net-zero emissions by comprehensively converting gas stove programs to induction stoves, including the implementation of SNI for induction stoves. The government can map testing tools, production capacity, and testing institutions to facilitate standard implementation (Faridah et al., 2018). The next step for the government is establishing safety standards for induction stove use and conducting training by *Lembaga Pelatihan Kerja* after implementing the regulations.

4.2.2 Recommendations for Testing and Product Certification Service Providers

Indonesia's stakeholders have shown readiness to implement induction stove standards, but LPKs need to enhance their capacity to anticipate future spikes in testing and certification demands (Komite Akreditasi Nasional, 2019). Capacity improvement will affect infrastructure provision and equipment, requiring further investment analysis from the research findings.

4.2.3 Recommendations for Induction Stove Manufacturers

Standard implementation, mainly through SNI-labeled product certification, positively impacts induction stove manufacturers by enhancing product superiority and consumer trust (Haryanto, 2019). This can improve energy efficiency and facilitate product marketing with more confidence (GEMA, 2019). This research also provides product innovation references for household appliance manufacturers, particularly induction cooking appliances powered by electricity.

4.2.4 Recommendations for Research Teams

The analysis indicates that this research opens opportunities for implementing induction stove standards. This is based on the limitations of this study, which have not analyzed readiness from economic aspects or readiness from the consumer perspectives. Especially when SNI for induction stoves has been mandated and implemented, many aspects need further examination, ranging from field standardization implementation to standardized induction stove performance. Additionally, this study can serve as a reference for research teams and assist stakeholders in conducting standard implementation supervision mapping, conducting research related to induction stove design compliant with standards, and meeting market needs.

5. CONCLUSION

The analysis results of the TCC indicate that all stakeholders in Indonesia are ready and capable of implementing the national standard for induction stoves. The readiness level for the technoware, humanware, infoware, cynetware, manageware, and partnerware components has reached a "high" level, but the orgaware component remains at a "moderate" level. Efforts that can be made to improve the orgaware component include the Indonesian government facilitating the issuance of regulations related to induction stove standards, developing a more comprehensive roadmap that allows stakeholders to establish a framework for the implementation of induction stove standards, and mapping training and human resource development for the readiness of implementing induction stove standards.

This study has successfully examined the THIOCP components to determine the readiness of implementing SNI for induction stoves. The measurement of technology readiness for the economic component has yet to be conducted in this research and will be explored in future studies.

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