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Interaction Hierarchy to Sustainable Reverse Logistics Activities in Indonesia

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Abstract

Many developed countries rely on reverse logistics (RL) to address the increasing amount of electronic waste that causes environmental pollution. Unfortunately, many developing countries, including Indonesia, struggle to develop RL activities. In Indonesia, these activities actually cause severe environmental pollution through the inevitable informal business interactions involved. From the other side, governments in many developing countries admit that they still need informal businesses to help manage waste because of the limited number of government officials in office. Therefore, it is necessary to study the form and hierarchy of informal business interactions for sustainable RL activities, so that decision makers can determine the waste management strategy to be implemented. This study uses a descriptive survey approach and applies the snowball sampling technique in collecting data from six provinces that are centers of e-waste processing in Indonesia. Awareness, interest, desire, and actions of stakeholders, including informal business and government, are measured separately because they cater to different interests. Through the analysis, this research is expected to obtain a clear picture of the interaction level of each stakeholder in the implementation or support of sustainable reverse logistics activities. The results of the study show that informal business and government have a moderate level of awareness. They realize that RL activities can improve people's welfare and prevent environmental pollution, knowing that their business processes must strike a balance between economic development and public health. They are also aware of the risks that must be borne, in addition to the benefits they receive. However, interest and desire level of informal business to implement RL activities are low. Conversely, governments have moderate interest and desire to support RL activities. Although informal businesses have low interest in and desire to implement sustainable reverse logistics, they engage in real action such as providing e-waste bankers, creating a traditional machine to prevent direct interaction between employees and e-waste components, buying expensive technology to prevent air pollution, and willing to become freelancers for electronic manufacturers who are unable to treat e-waste in an environmentally friendly manner. In contrast, the government has a lower level of action in supporting RL activities. They do not have complete data about the existing IEBs, as important messages about preventing environmental pollution due to illegal e-waste processing do not reach these groups. They admit that they have not built an SRL governance system, provided facilities and technology, and implemented strict regulations and mechanisms due to the heavy workload from their main jobs.

Keywords
Interaction Hierarchy, AIDA, Sustainable Reverse Logistics, Indonesia

1. Introduction

The growth of illegal electronic waste processing activities in Indonesia continued to increase until the end of 2015 (Maheswari et al., 2017). Although recently the number of waste processing businesses has decreased, the scale of this informal business continues to increase in line with the increase in the amount of electronic waste, which is predicted to increase by 38% in 2030 (Global E-waste Monitor, 2020) from its position in 2019 of 53.6 million tons. The government's encouragement for people to switch to electric cars is predicted to have a significant effect on increasing business in the informal sector.

It is undeniable that the e-waste processing business provides far greater profits than other informal businesses, and income can even exceed that if someone works in the formal sector (Maheswari et al., 2020). The high poverty rate and the low level of education and skills possessed by community members force some people to engage in business

or work in this informal sector. They can assume big risks that threaten health and life in order to survive. The government also realizes that the welfare of villages that carry out informal e-waste business, for example Tegalangus Village, is higher than the nearest village, namely Tanjung Pasir Village, which is a tourism village area in the Tangerang Province (Maheswari et al., 2022). With low education or knowledge, limited skills, and no government support, these e-waste businesses carry out manual waste processing without obeying regulations, such as using personal protective equipment (gloves, mask, and boots), since the use of such equipment reduces their performance (Yin, Gao, & and Xu, 2013).

Until now, the Indonesian government has not had a breakthrough to overcome this problem, because the government of Indonesia and other developing countries face other complex problems, such as flooding, stunting, low-quality education, traffic jams, and other significant problems. Therefore, support for more modern waste management, especially for e-waste treatment, is not provided. The state budget allocation focuses on addressing more pressing issues, and the government does not consider the problem of environmental pollution due to illegal electronic waste processing activities as something to be addressed immediately (Thio, Romadhoni, Nisya, Maheswari, & Rozamuri, 2021). On the other hand, these informal groups must survive with the income obtained from the e-waste business.
Developed countries such as Sweden, the Netherlands, Germany, and Japan do not provide opportunities for informal business groups to process waste, especially electronic waste. They have sufficient funds and qualified technology, as well as well-organized mechanisms that involve the community in the upstream process (Yoon & Jeong, 2016). In contrast, governments in developing countries realize that without the help of the community it is impossible to succeed managing the increasing amount of electronic waste (Forti V., 2020). Therefore, in order to fulfill all interests, especially in minimizing negative impacts, the seriousness of the issues facing informal businesses must be properly studied to ensure that they can truly balance their sustainability goals, which are not only profit and reputation oriented, but also focus on the planet and people. Research on the interaction hierarchy of informal e-waste business on the implementation of sustainable reverse logistics (SRL) is very important to ensure that these businesses' activities do not pollute the environment. Study of informal business interactions will help determine the forms of informal business involvement in managing e-waste.

2. Literature Review

In this section, the theories that form the basis for measuring the level of interaction of informal businesses in implementing sustainable reverse logistics will be explained as well as the SRL indicator itself. To measure the level of interaction, this study uses models A (awareness), I (interest), D (desires), and A (action). Meanwhile, SRL performance is measured through six perspectives, namely financial and efficiency, business processes, innovation and growth, environmental performance, social performance, and reputation improvement (Maheswari et al., 2020).

2.1 Reverse Logistics Definition and Activities

RL activities in Indonesia have actually been carried out by both formal and informal businesses. Although many activities have been carried out, the RL concept is rarely used. They mostly refer to this activity as a recycling activity. Maheswari et al. (2017) define RL activities, especially for Indonesia and developing countries, as waste management and processing activities that start with the process of collecting, sorting, dismantling, smelting for extracting valuable materials, and exporting components that cannot be processed in Indonesia for the sake of profit.
There are clear differences between RL activities in developing countries and those in developed countries, as described in Table 1 below.

Table 1. Reverse Logistics Activities in Developing and Developed Countries

No	RL in Developing Countries (Maheswari, Yudoko, & Adhiutama, 2019)	RL in Developed Countries (Rogers & Tibben-Lembke, 1998)
1	Collecting	Return to supplier
2	Sorting	Resell
3	Dismantling	Sell via outlet
4	Recycling	Salvage
5	Repairing-upgrading	Recondition
6	Refurbishing	Refurbish
7	Reselling as is	Remanufacture
8	Smelting & extracting	Reclaim materials
9	Exporting	Recycle
		Landfill

The focus of RL activities in Indonesia and developing countries, especially for electronic waste, is to smelt it manually and extract material content that still has economic value, which is carried out by informal businesses. The main motive for RL activities carried out by this group is to make a profit. They take plastic materials, silver, copper, palladium, and gold to resell. Unfortunately, this manual extraction process often causes environmental pollution and endangers the health of people in business.

In contrast to developing countries, developed countries carry out these activities to maximize the use of components so they don't quickly turn to waste. RL activities in developed countries focus on recycling and remanufacturing, which provide raw materials for making other products. Its activities are also carried out with high technology that minimizes negative effects on environmental quality. To ensure that the process is well controlled, governments in developed countries do not provide space for the informal sector to participate in this activity. For components that no longer have economic value, a process of incineration and neutralization of toxic substances will be carried out and then disposed of at a certain disposal site. Thus, there is a clear difference in the motives for carrying out RL activities in developed countries within the focus on preventing environmental pollution.

2.2 Interaction Hierarchy

AIDA is a psychological process during which someone decides something (Li & Yu, 2013). In this study, the dimensions of AIDA are measured using different indicators for each group of respondents (as presented in Table 2).

Table 2. AIDA's Indicators for Informal Business and Government

No	Dimension	Indicators for Informal E-waste Business	Indicators for Government
1	Awareness	Knowing it increases welfare & job opportunities (IA1)	Knowing it increases welfare & job opportunities (GA1)
		Understanding to meet environmental requirement (IA2)	Understanding the environmental requirement (GA2)
		Understanding the need to balance between economic development and public health (IA3)	Understanding the need to balance between economic development and public health (GA3)
		Recognizing the advantages and weaknesses (IA4)	Complying national reputation (GA4)
2	Interest	Willingness to extend the knowledge of eco-friendly RL activities (II1)	Willingness to give a chance to IEBs for permanent income (GI1)
		Remembering the regulation (II2)	Interested in changing communities' behavior in handling their own e-waste (GI2)
		Comparing the activities whether it meets the environmental requirement (II3)	Comparing strategies for handling e-waste (GI3)
		Analyzing the pros and cons (benefit and loss) (II4)	Recognizing the role of informal business (GI4)
3	Desire	Looking for in-depth information (ID1)	Looking for in-depth information (GD1)
		Receiving suggestions (ID2)	Institutional commitment to waste management (GD2)
		Sharing the valuable information activities to others (ID3)	Making it a factor in creating a competitive advantage that can alleviate poverty (GD3)
		Discussing with experts (ID4)	Relying on it to lift communities' welfare for low educated and unskilled people (GD4)
4	Action	**Involvement**	**Involvement**
		Using personal protecting equipment (mask, gloves, boots) (IAI1)	Having complete data, the existing of IEBs for handling e-waste in their area (GAI1)
		Providing a specific place for disposal bankers (IAI2)	Promoting reduce, reuse, recycle programs, separate e-waste, and bring it to recycling facilities (GAI2)
		Picking up e-waste and providing incentives (IAI3)	Encouraging to protect the environment via mass media (GAI3)
		Refusing to process e-waste if incapable (IAI4)	Encouraging electronic manufacturers to collaborate with informal e-waste business (GAI4)
		Collaboration	**Collaboration**
		Collaborating with the government for collecting, separating, and sorting e-waste (IAC1)	Arranging green public e-waste disposal (GAC1)
			Providing storage points and giving it to a certified IEB (GAC2)
		Collaborating with government to develop an online collaborative platform (Apps) for collecting e-waste (IAC2)	Collaborating with manufacturers to provide eco-recycling facilities, technology, and e-waste transportation (GAC3)
		Collaborating with manufacturers as dismantler and implementing profit-sharing system (IAC3)	Asking IEBs to be permanent e-waste collector (GAC4)
		Empowerment	**Empowerment**
		Providing technology for eco-recycling (IAE1)	Building the governance of SRL system (GAE1)
		Working as a freelancer for manufacturers (IAE2)	Implementing the regulation & mechanism (GAE2)
		Creating a traditional machine (IAE3)	Providing technology & facilities(GAE3)
			Conducting training (GAE4)

		Buying a specific machine to prevent environmental pollution (IAE4)	Monitoring and supervising of processing, utilizing, transporting, and landfill of e-waste (GAE5)
			Mediating the relationship between e-waste businesses and electronic manufacturers for mutually beneficial businesses (GAE6)

2.3 Sustainable Reverse Logistics

Differences exist in the motives for RL activities between developed and developing countries. The basis for measuring business performance with a balanced scorecard that assesses from four perspectives (Wibisono & Maheswari, 2022) cannot be used to assess the performance of informal businesses that process electronic waste. Therefore, this section specifically describes the dimensions to measure the performance of informal businesses in Indonesia that carry out RL activities. According to Maheswari et al. (2020), the sustainability of RL activities is shown by the fulfillment of the achievement of the following sustainability goals:

1. Financial perspective, namely achieving financial success, providing value to investors and shareholders, increasing revenue and business profitability by reducing costs and expenses to meet tax obligations.
2. Stakeholder perspective, including respecting the interests of each stakeholder, such as investors, customers, employees, suppliers, intermediaries, communities, and government.
3. Processing of internal and external perspectives, such as meeting stakeholder demands and requirements by achieving productivity and efficiency in workflows that help create and deliver value propositions to other stakeholders who pay attention to the work risks and external impacts resulting from these activities.
4. Innovation and growth perspective, namely focusing on innovative efforts to maximize product utilization, reducing resource use, and bringing efficiency into the operational domain of activities through continuous improvement in order to grow and develop.
5. Environmental perspective, which is based on high environmental awareness, public policies, and laws by always complying with regulations but also paying attention to and maintaining efficiency.
6. Social perspective, the ability to fulfill social responsibilities as citizens and people in business to promote ethical behavior consistently so as to meet community and societal expectations and build a good image.

2.4 Hierarchy Interaction to Sustainable Reverse Logistics

The level of interaction between informal businesses and the government regarding achieving sustainable reverse logistics must be properly measured. The hope for the future is that sustainable forms of RL activities can be established that can be carried out by informal businesspeople who greatly dominate waste treatment activities in developing countries, especially Indonesia. Below are the stages of AIDA and the formulation of hypothesis:

1. Awareness of informal business and government to sustainable reverse logistics activities.

RL activities in Indonesia are developing very rapidly in line with the growth of waste, especially e-waste processing, which has proven to provide enormous benefits. Awareness of informal business is still an economic factor as mentioned by (Damanhuri & Padmi, 2012; Budijati, Pujawan, & Asih, 2022). Even though people widely engage in this activity throughout Indonesia, researchers are not sure that both informal business and government understand the sustainable reverse logistics concept well. To prove this, this study proposes the following descriptive hypotheses:
Hypothesis 1: Informal e-waste businesses do not have sufficient awareness of sustainable reverse logistics concepts and goals.
Hypothesis 2: Government officers do not have strong and consistence awareness of sustainable reverse logistics concepts and goals.

2. Interest of informal business and government in sustainable reverse logistics activities.

The achievement of sustainable reverse logistics goals is largely dependent on the interests of stakeholders in carrying out activities. According to Congdon (2021), interest depends significantly on the amount of money that can be obtained from the activities carried out. Based on process theory and assessment structure, interest consists of an assessment of novelty (factors related to ignorance and complexity) and an assessment of the coping potential (the ability to understand new, complex things) (Silvia, 2005). Lutz states that interest is influenced by three factors, namely stimulation from the environment, stimulation from someone else, and feelings and emotions that evoke feelings of pleasure (Lutz, 2017). In the context of the waste management business, researchers predict the interest of informal businesses in carrying out RL activities in line with the concept of interest put forward by Congdon (2021) and the third factor from the concept of interest in Lutz (2017). On the other hand, the government also has strong interest (Maheswari, et al., 2017) in running waste management activities so that environmental pollution can be

controlled, social lives are healthier, and the welfare of people with a low educational background is improved (Maheswari et al., 2019; Damanhuri & Padmi, 2012; Budijati et al., 2022). To test these things, the following descriptive hypotheses are formulated:

Hypothesis 3: Informal businesses are interested in implementing sustainable reverse logistics activities.
Hypothesis 4: The government is interested in supporting sustainable reverse logistics activity implementation.

3. Desire of informal business and government for sustainable reverse logistics activities.

The third level of behavior after awareness and interest is desire to conduct SRL activities. Desires can be realized if several elements are met, such as adequate facilities (Demajorovic, Auguto, & Souza, 2016), information resources, availability of technology (Correa & Xavier, 2013), user-friendly technology, and knowledge-sharing programs (Budijati, Pujawan, & Asih, 2022). Researchers still doubt the willingness of informal businesses and governments to seek in-depth information about the SRL concept. The desire to discuss subjects with experts from both business and government circles needs to be studied further. Researchers predict that businesspeople who are familiar with running SRL activities are also reluctant to share information for reasons of business competition. To prove these points, descriptive hypotheses are formulated as follows:
Hypothesis 5: Informal businesses have a desire to implement sustainable reverse logistics activities.
Hypothesis 6: Governments have a desire to support sustainable reverse logistics activities.

4. Real action of informal business and government for sustainable reverse logistics activities.

Many RL activities that have been carried out in Indonesia, especially by informal businesses, have been discussed in Table 1 above. However, research has yet to focus on whether the activities carried out have met the sustainability goals, and this is the main concern of this research. In general, informal businesses in many developing countries cannot fulfill sustainability assessments (Sauza, Climaco, & Sant'Anna, 2016). The willingness of informal businesses to be involved in realizing SRL activities and participate as well as collaborate in them is very weak (Khan, Lodhi, & Akhtar, 2014; Demajorovic, Auguto, & Souza, 2016). Thus, this study presents the descriptive hypotheses to answer these questions:
Hypothesis 7: Informal businesses have conducted sustainable reverse logistics activities.
Hypothesis 8: The government supports sustainable reverse logistics activities.

3. Methods

This research is a descriptive survey. By using snowball sampling technique in collecting the data researchers believe the data obtained represents the perceptions of informal businesses from areas that carry out waste management on a large scale. The main areas of e-waste processing business in Indonesia are Jakarta, Tangerang-Banten, Depok, Citayam-Bogor, Cikarang, Panguragan-Cirebon, Paniisan, and the Dawagung villages of Tasikmalaya, Jombang-East Java, Sekupang-Batam, and Tomia-Wakatobi.
For analyzing the interaction hierarchy, this research calculated mean values. The average score of each indicator < 2 indicates low interaction, the score $2 \leq x \leq 3{,}5$ shows moderate interaction, and the score $> 3{,}5$ clarifies strong interaction (Jayashree, et al., 2021; Maheswari H. , Yudoko, Adhiutama, & Agustina, 2020). All indicators are tested for validity. An indicator is declared valid if the indicator correlation value and the total value are more than 0.30 (Wibisono & Maheswari, 2022).

4. Data Collection

The researcher distributed the closed-ended questionnaire to 264 respondents from the informal business group. Complete responses were collected from only 216 respondents from Jakarta (8), Tangerang (74), Depok (18), Citayam (36), Cikarang (6), Cirebon (3), Tasikmalaya (61), Jombang (4), Sekupang-Batam (2), and Tomia (6). The closed-ended questionnaire was also distributed to a government group; i.e., Local Government and Environmental Agencies in 6 provinces, namely Jakarta, Tangerang-Banten, West Java, East Java, Batam, and Wakatobi-Sulawesi Tenggara.

5. Results and Discussion

This research should separate the hierarchy analysis between informal e-waste business and the government, since the type of interactions among them differ. This research measures the interaction hierarchy of informal business to sustainable reverse logistics activities as presented in Table 4. The analysis of government interaction to support SRL activities is presented in Table 5.

5.1 Interaction Hierarchy Test

Table 3, Table 4, and Figure 1 show the interaction of informal e-waste business and government for sustainable reverse logistics activities. On average, IEBs have moderate awareness to implement SRL activities (2,957). Therefore, hypothesis 1 is not accepted. Informal e-waste businesses are aware that RL activities will increase significantly their welfare and open job opportunities (4,400), although they slightly ignore the environmental requirement (2,971) and the balance between economic development and public health (2,429). This finding is contradictory with the research conducted by Damanhuri and Padmi (2012) and Budijati et al. (2022).

The interest of IEBs to conduct SRL activities is low, with an average score of 1,847. They do not remember the regulation and tend to refuse it. So, hypothesis 3 is not accepted. The IEBs also do not have strong desire to conduct SRL activities, with an average score of 1,822. This score is also lower than the desire of the government to support the implementation of SRL activities. So, hypothesis 5 is also not accepted. All indicators that measure the level of desire of informal business have a low score under 2. They are not concerned with looking for in-depth information on how to carry out environmentally friendly e-waste processing. The business owner with extensive capability is reluctant to share valuable information activities with others for reasons of competition. Discussion with experts is also rare, since the difficulties to obtain the raw materials and they must manage the process by themselves.
In contrast to IEBs, the government has the awareness, interest, and desire to support SRL activities. So, hypothesis 2, stating that government officers do not have strong and consistence awareness to sustainable reverse logistics concepts and goals, is not accepted. The interest (3,326) and desire (2,802) of the government are at moderate levels, so hypotheses 4 and 6 are accepted. However, without the facilities and technologies provided by the government, desire will not be realized (Correa & Xavier, 2013; Demajorovic, Auguto, & Souza, 2016).

Table 3. Interaction Hierarchy of Informal E-waste Businesses

No	Dimension	Indicators for Informal E-waste Business	Validity	Mean	STDEV
1	Awareness	Knowing it increases welfare & job opportunities (IA1)	0,333	4,400	0,736
		Understanding to meet environmental requirement (IA2)	0,521	2,971	1,248
		Understanding to balance between economic development and public health (IA3)	0,498	2,429	1,119
		Recognizing the advantages and benefits (IA4)	0,625	2,029	1,361
		Average of awareness		**2,957**	
2	Interest	Willingness to extend the knowledge of eco-friendly activities (II1)	0,685	2,243	1,094
		Remembering regulations (II2)	0,666	1,400	1,612
		Comparing the activities to meet the environmental requirement (II3)	0,632	1,343	1,413
		Analyzing the pros and cons (benefit and loss) (II4)	0,692	2,400	1,168
		Average of interest		**1,847**	
3	Desire	Looking for in-depth information (ID1)	0,688	1,200	1,346
		Receiving suggestions (ID2)	0,575	2,857	1,498
		Sharing valuable information activities with others (ID3)	0,532	1,743	1,197
		Discussing with experts (ID4)	0,552	1,486	1,245
		Average of desire		**1,822**	
4	Action	**Involvement**			
		Using personal protecting equipment (mask, gloves, boots) (IAI1)	0,581	1,914	1,245
		Providing a specific place for disposal banker (IAI2)	0,586	3,314	1,549
		Picking up e-waste and giving incentives (IAI3)	0,630	4,343	1,187
		Refusing to process e-waste if incapable (IAI4)	0,390	1,914	1,560
		Average of involvement		**2,871**	
		Collaboration			
		Collaborating with government for collecting, separating, and sorting of e-waste (IAC1)	0,368	2,486	1,314
		Collaborating with government to develop an online collaborative platform (Apps) for collecting e-waste (IAC2)	0,654	1,229	0,942
		Collaborating with manufacturer as dismantler and implementing profit-sharing system (IAC3)	0,545	1,800	1,183
		Average of collaboration		**1,838**	
		Empowerment			
		Providing a technology for eco-recycling (IAE1)	0,721	1,286	0,859
		Working as a freelancer for manufacturer (IAE2)	0,533	2,829	1,498
		Creating a traditional machine (IAE3)	0,616	2,743	1,498
		Buying a specific machine to prevent environmental pollution (IAE4)	0,670	2,486	1,443
		Average of empowerment		**2,336**	
		Average of action		**2,348**	

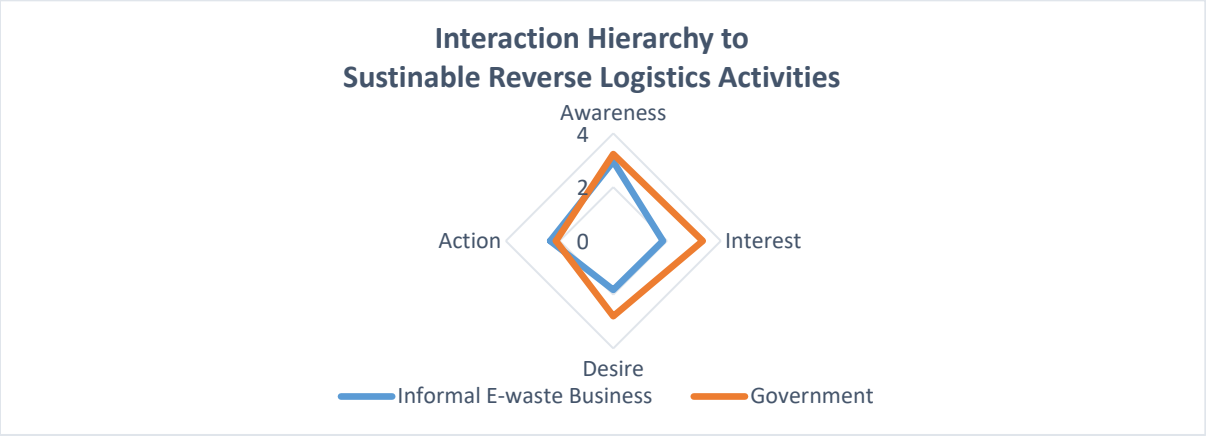

Figure 1. Interaction Hierarchy of IEBs and Government to SRL Activities

Table 4. Interaction Hierarchy of Government

No	Dimension	Indicators for Government	Validity	Mean	STDEV
1	Awareness	Knowing it increases welfare & job opportunities (GA1)	0,382	3,835	0,532
		Understanding the environmental requirement (GA2)	0,277	2,700	0,410
		Understanding to balance between economic development and public health (GA3)	0,210	2,738	0,404
		Complying national reputation (GA4)	0,953	3,643	0,940
		Average of awareness		**3,229**	
2	Interest	Willingness to give a chance to IEBs for permanent income (GI1)	0,710	2,643	0,550
		Interested in changing communities' behavior in handling their own e-waste (GI2)	0,246	4,580	0,771
		Comparing some strategies in handling e-waste (GI3)	0,735	3,160	0,699
		Recognizing the role of informal business (GI4)	0,369	2,920	1,031
		Average of interest		**3,326**	
3	Desire	Looking for in-depth information (GD1)	0,883	2,763	1,312
		Institutional commitment to waste management (GD2)	0,332	2,928	1,243
		Making it a factor in creating a competitive advantage that is able to alleviate poverty (GD3)	1,626	3,170	0,789
		Relying on it to lift communities' welfare for low-educated and unskilled people (GD4)	0,990	2,345	0,655
		Average of desire		**2,802**	
4	Action	**Involvement**			
		Having complete data, the existing of IEBs for handling e-waste in their area (GAI1)	0,717	1,137	1,095
		Promoting "reduce, reuse, recycle" programs, separate e-waste, and bring it to recycling facilities (GAI2)	0,907	4,085	0,059
		Encouraging protecting the environment via mass media (GAI3)	0,641	3,923	1,430
		Encouraging electronic manufacturers to collaborate with informal e-waste business (GAI4)	0,853	1,350	0,061
		Average of involvement		**2,624**	
		Collaboration			
		Arranging green public e-waste disposal (GAC1)	0,959	2,208	0,618
		Providing storage point & give it to a certified IEB (GAC2)	0,584	2,393	0,981
		Collaborating with manufacturer to provide eco-recycling facilities, technology, and e-waste transportation (GAC3)	0,729	1,053	1,604
		Asking IEBs as permanent e-waste collector (GAC4)	0,841	1,610	0,662
		Average of collaboration		**1,816**	
		Empowerment			
		Building the governance of SRL system (GAE1)	0,358	1,005	0,167
		Implementing the regulation & mechanism (GAE2)	0,603	1,220	0,210
		Providing technology & facilities (GAE3)	0,316	1,013	0,889
		Conducting training (GAE4)	0,448	2,109	1,241

		Monitoring and supervising of processing, utilizing, transporting, and landfill of e-waste (GAE5)	0,743	4,045	1,488
		Mediating the relationship between e-waste businesses and electronic manufacturers for mutually beneficial businesses (GAE6)	0,643	2,368	0,883
		Average of empowerment		**1,960**	
		Average of action		**2,133**	

There are four accepted hypotheses dan four unaccepted hypotheses in this research. IEBs and government have sufficient awareness to SRL's concepts and goals. But IEBs are not interested in and desire to implement SRL activities. Unlike IEBs, government officers have strong awareness and desire to support SRL activities. Both have conducted some SRL activities, although they have different goals.

Table 5. Recapitulation of Hypothesis Testing

No	Hypothesis Statement	Result
1	Informal e-waste businesses do not have sufficient awareness of sustainable reverse logistics concepts and goals.	Not accepted
2	Government officers do not have strong and consistence awareness of sustainable reverse logistics concepts and goals	Not accepted
3	Informal businesses are interested in implementing sustainable reverse logistics activities	Not accepted
4	The government is interested in supporting sustainable reverse logistics activity implementation	Accepted
5	Informal businesses have a desire to implement sustainable reverse logistics activities	Not accepted
6	Governments have a desire to support sustainable reverse logistics activities	Accepted
7	Informal businesses have conducted sustainable reverse logistics activities	Accepted
8	The government supports sustainable reverse logistics activities	Accepted

Note:

5.2 Real Action in Sustainable Reverse Logistics Activities

Although the awareness, interest, and desire of informal businesses are low, their real action in implementing SRL activities is higher than at the government level, as clearly presented in Figure 2. Informal businesses have conducted reverse logistics activities, although they pay little attention to environmental issues. They are willing to collaborate with government and electronic manufacturers in collecting, sorting, and dismantling e-waste components. They are willing to become freelancers for electronic manufacturers. They also can be empowered to create a traditional machine to avoid direct interaction of employee to e-waste components or buy a specific machine to prevent environmental pollution if it is required to operate their business.

Apparently, informal business has a high involvement level in providing a specific place for disposal banker (3,314) and picking up e-waste and giving incentives to community members (4,343). These are done for several reasons; i.e., first, they know the danger of e-waste component for human body. They do not want the e-waste components to be a toy for their children. So, they devote a certain area in their house to be a disposal banker. Some structures that are not operating in processing electronic waste are rented as shelters. Second, giving incentive to communities as the compensation for delivering their e-waste have been provided ever since. So do not be surprised if the score for the indicator of providing incentives to people who provide their waste is very high. Since the average score of action level of IEBs is 2,348, hypothesis 7 is accepted.

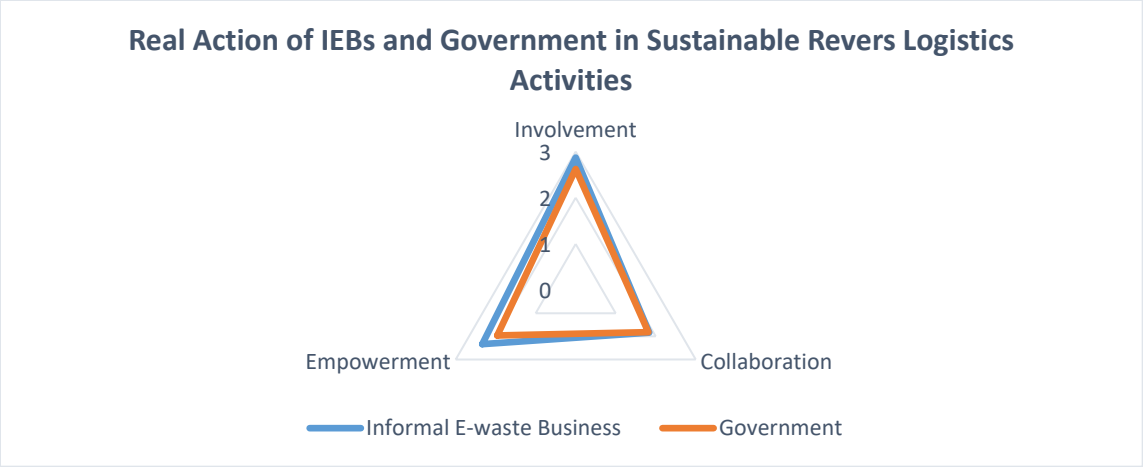

Figure 2. Real Action in Sustainable Reverse Logistics Activities

In contrast to IEBs, the government promotes "reduce, reuse, recycle" programs, separates e-waste, brings it to recycling facilities, and encourages communities to protect the environment via mass media massively, but they do not have complete data about the existing of RL businesses in their own areas. This causes the promotions carried out by the government are not conveyed properly to IEBs. Informal groups may not be allocated to process electronic waste that requires high technology (Demajorovic, Auguto, & Souza, 2016; Pratitis & Maheswari, 2021). They admit that they do not play a significant role in bridging the business relationship between IEBs and electronic manufacturers, because the government workload is very time-consuming. They only monitor and supervise the processing, utilizing, transporting, and landfill of e-waste, which is part of their job responsibilities. The government cannot build the governance for the SRL system, implement the regulation and mechanism, and provide technology and facility e-waste processing. Nevertheless, the score of government action level is a little more than 2, so, hypothesis 8 can also be accepted.

Informal E-waste Business	Mean		Government	Mean
Involvement			**Involvement**	
Using personal protecting equipment (mask, gloves, boots) (IAI1)	1,914		Having complete data, the existing of IEBs for handling e-waste in their area (GAI1)	1,137
Providing a specific place for disposal banker (IAI2)	3,314		Promoting "reduce, reuse, recycle" programs, separate e-waste, and bring it to recycling facilities (GAI2)	4,085
Picking up e-waste and giving incentives (IAI3)	4,343		Encouraging protecting the environment via mass media (GAI3)	3,923
Refusing to process e-waste if incapable (IAI4)	1,914		Encouraging electronic manufacturers to collaborate with informal e-waste business (GAI4)	1,35
Average of involvement	**2,871**		Average of involvement	**2,624**
Collaboration			**Collaboration**	
Collaborating with government for collecting, separating, and sorting of e-waste (IAC1)	2,486		Arranging green public e-waste disposal (GAC1)	2,208
			Providing storage point & give it to a certified IEB (GAC2)	2,393
Collaborating with government to develop an online collaborative platform (Apps) for collecting e-waste (IAC2)	1,229		Collaborating with manufacturer to provide eco-recycling facilities, technology, and e-waste transportation (GAC3)	1,053
Collaborating with manufacturer as dismantler and implementing profit-sharing system (IAC3)	1,8		Asking IEBs as permanent e-waste collector (GAC4)	1,61
Average of collaboration	**1,838**		Average of collaboration	**1,816**
Empowerment			**Empowerment**	
Providing a technology for eco-recycling (IAE1)	1,286		Building the governance of SRL system (GAE1)	1,005
Working as a freelancer for manufacturer (IAE2)	2,829		Implementing the regulation & mechanism (GAE2)	1,22
Creating a traditional machine (IAE3)	2,743		Providing technology & facilities (GAE3)	1,013
Buying a specific machine to prevent environmental pollution (IAE4)	2,486		Conducting training (GAE4)	2,109
			Monitoring and supervising of processing, utilizing, transporting, and landfill of e-waste (GAE5)	4,045
			Mediating the relationship between e-waste businesses and electronic manufacturers for mutually beneficial businesses (GAE6)	2,368

Figure 3. Collaboration Models between Informal Business and Government

There are four collaboration models that can be built between informal e-waste business and government as shown in Figure 3, namely:

1. Providing specific places as disposal bankers or storage points for e-waste;
2. Arranging a green public e-waste disposal, while the IEBs are tasked with collecting, segregating and sorting electronic waste based on its type;
3. Developing a mutually beneficial relationship between IEBs and electronic manufacturers
4. Provision of manpower for the collecting, separating, sorting, and dismantling processes.

6. Conclusion

Local government and environmental agencies in Indonesia have moderate awareness, interest, and desire to support sustainable reverse logistics. Conversely, even though informal businesses have moderate awareness, their interest in and desire to organize RL activities that are environmentally friendly and pay attention to the harmony of life are very low. Surprisingly the findings of this research show that low interest in and desire for IEBs to comply with environmental regulations does not prevent community members from trying to achieve environmental goals. To prevent a negative impact, they are willing to provide e-waste bankers, create traditional machines, buy expensive technology, and serve as freelancers for electronic manufacturers. Their main reason is to survive by conducting business that is dangerous but provides far greater profits than other informal businesses.

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