Study of Economic Waste Exchange in Batam City

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***Abstract*— The problem of industrial waste in Batam City has not been fully solved. For this reason, this study was conducted to examine the concept of the application of the waste exchange and the applications. The waste exchange aims to help industries, especially for manufacturing industry, to solve their waste by opening business opportunities for waste users. It also help related agencies to monitoring and manifesting waste. It can be used as the initiator of joint office to oversee the possibility of transactions and waste traffic, so the waste does not cause impact on the environment. This research was carried out using in-depth interview techniques and consultations. Determining respondents is done by using purposive sampling, which is the respondents are determining by certain considerations. The AHP method used to carry out factors that influence of the waste exchange formation and strategic recommendations to the relevant agency of establishing waste exchange in Batam City. The results of the AHP analysis of the main factors that were prioritized by agency respondents were economic factors (32.4%) and the factors that had the lowest priority were organizational governance (17.1%). Respondents to waste utilization or waste users, technology availability factors have a high priority (43.1%) and the characteristics of waste characteristics have the lowest priority (20%)**

***Keywords*— Waste Exchange, AHP Method, Batam City.**

I. INTRODUCTION

BATAM City is a leading region in increasing national and regional economic growth. Based on BPS data from Batam City, the industries that dominate in Batam City include the electronic and optical goods component industries; metal goods industry (except machinery and equipment); motorized vehicle industry (trailer and semi); and the rubber industry, rubber and plastic goods. In addition, industries that are spread in Batam City are chemicals and goods from chemicals, machinery and equipment industries, paper industry, and other industries [1]. Some industries that are spread in Batam City mainly dominate, besides the products produced, the waste from each of them can also be a business opportunity in Batam City. For example waste from electronic and electrical goods, components contained in the waste can be recycled and returned to the production process. The content contained in electrical and electronic waste itself is 50% which is iron and steel, 21% plastic, 13% nonferrous metal, and 16% other constituent elements (rubber, concrete and ceramics). The presence of metals such as tin, mercury, arsenic, cadmium, selenium, hexavalent chromium and flame retardant makes this electronic waste classified as a hazardous materials [2]. Electronics waste itself is an important source that can be used to produce metals which are the main ingredients of the electronic goods [3]. In 2014, the needs of gold, silver, tin and metals in the electronics industry amounted to 10%, 30%, 30%, and 40% [4]. Other types of waste that can be reused such as sandblasting and scrap iron / steel waste from Shipyard industry activities. Sandblasting waste from shipyard activities can produce concrete (Self-Consolidating concrete) where recycle from sandblasting (Alumina) waste is mixed with Fly Ash [5]. Looking at the potential business opportunities of the industrial waste sector in Batam and remembering that Batam City itself is a national industrial plan area, an effort to manage industrial waste is needed that can create an investment climate that supports the use of industrial waste as a resources to realize economic independence . The waste exchange is an activity that is not yet commonly done especially in Indonesia. Waste exchange itself is an activity adapted from the eco-industry concept. It is the utilization of raw materials and optimal energy without damaging the environment [6]. In addition, to aiming at recovering relatively cheap raw materials through a recycling process, this activity can also be used as the initiator of a joint office to monitor the possibility of transactions and waste traffic demanded to be transparent, so that the waste has a guaranteed security and does not cause impact on the environment.

II. METHOD

This research was started by data collection activities to obtain related trade potentials for waste in Batam City. Furthermore, in depth interviews conducted with the government / related agencies: waste user and DLH of Batam City as a waste traffic controller. The researcher also consulting with the DLH of Batam City and BP Batam City Area regarding the potential economic of industrial waste. This is done because of most industries that act as waste producers are reluctant to submit openly about the condition of the waste produced. Therefore, the researcher conducted a consultation by survey on industrial waste in Batam City. The sampling method is done by using purposive sampling, technique of determine sample with certain considerations. The purposive sampling method determines by interview with the consideration that the sample has met the criteria that have been determined previously. The respondents included:

a. Respondents from the Department of Environment and BP in the City of Batam. These respondents were chosen because of their existence as policy makers and as supervisors of waste
b. Respondents from the waste users are from the Waste Employers' Association. This respondent was chosen because of his presence as a buyer and utilizing waste.

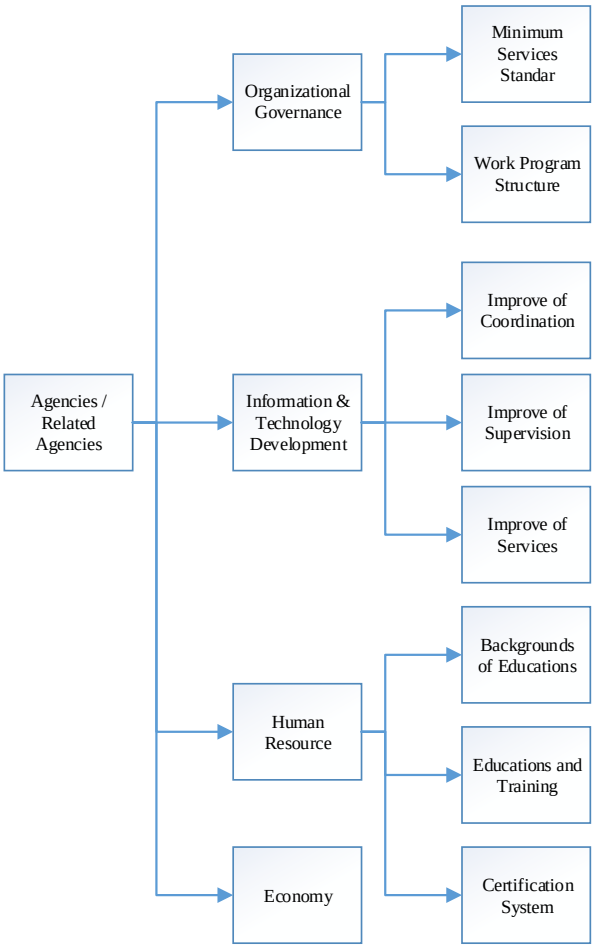


Figure 1. Hierarchy of Process Analysis (Institution).

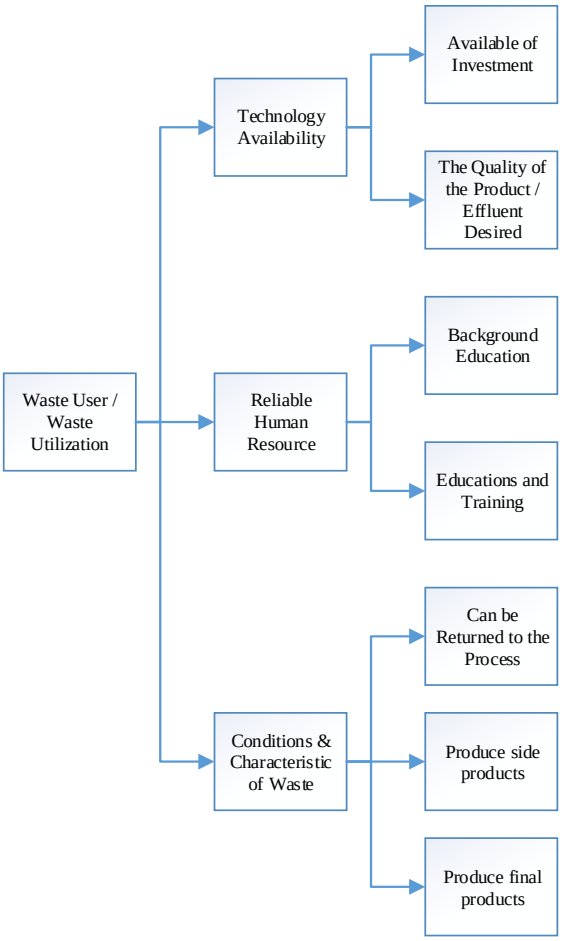


Figure 2. Hierarchy of Waste User.

Table 1
Pairwise Comparison Scale

Scale	Definition of "Importance"
1	Equally Importance
3	Slightly More Importance
5	Materially More Importance
7	Significantly More Importance
9	Absolutely More Importance
2,4,6,8	Hesitate between two adjacent values
1/1,1/3,1/5,1/9	Inverse Value

Researcher also given scale questions according to their respective interests. It will be analyzed by AHP model to find out what factors influence the formation of waste exchanges in Batam City. It can be considered by the agency / related agencies in the framework of implementing the waste exchange. The value of the scale of pairwise comparisons that must be filled out by the respondents is realized as in Table 1.

To facilitate the preparation of questions, AHP hierarchy structure is made to determine which variables are assessed following the sub-variables. The flow chart of the hierarchy analysis process is presented in Figure 1. And 2.

III. RESULTS AND DISCUSSION

In general, the movement of waste in Batam City, especially for non-B3 solid waste from industrial activities and community activities, will end up at the Telaga Punggur landfill. Whereas for solid and liquid wastes which are B3, they will end up in waste destruction. Usually this waste will be sent to Cileunsi or

Table 2.
Types of Waste utilization

Waste	Waste Utilization
Household Waste	
Bottle Plastic	Recycle and used into craft product
Plastic Bag	Recycle and used into craft product
Clear Plastic	Recycle and used into craft product
Clear Glass/Color	Recycle and used into craft product
Cardboard	Raw material
Paper	Raw material
CPU	As an second item
Monitor	As an second item
Tv	As an second item
Scrap Metal	Raw material
B3 Waste	
Accu	Recycle and alternative fuel
Fly Ash and Bottom Ash	Raw material and construction material
Steel Slag	For sandblasting and replacing iron sand in cement
Spent Earth	Recovery of palm oil and recycling earth bleaching
PCB	Recovery of precious metals
Oil Sludge	Raw material and alternative fuel
Used Catalic	Recovery of precious metals and raw material

Batam KPLI-B3 Area. The flow of waste movement in Batam City in Figure 3. In the figure, it can be seen that the liquid waste produced by the community will go to the tub or treatment plant which then will flow to the local drainage then ends up in the sea. For household solid waste (the results of community and industrial activities) after being collected it will be transported by transporters to the Telaga Punggur landfill. While for non-organic waste sorted by scavengers, then sold to collectors and then toke (large-scale collectors) from this

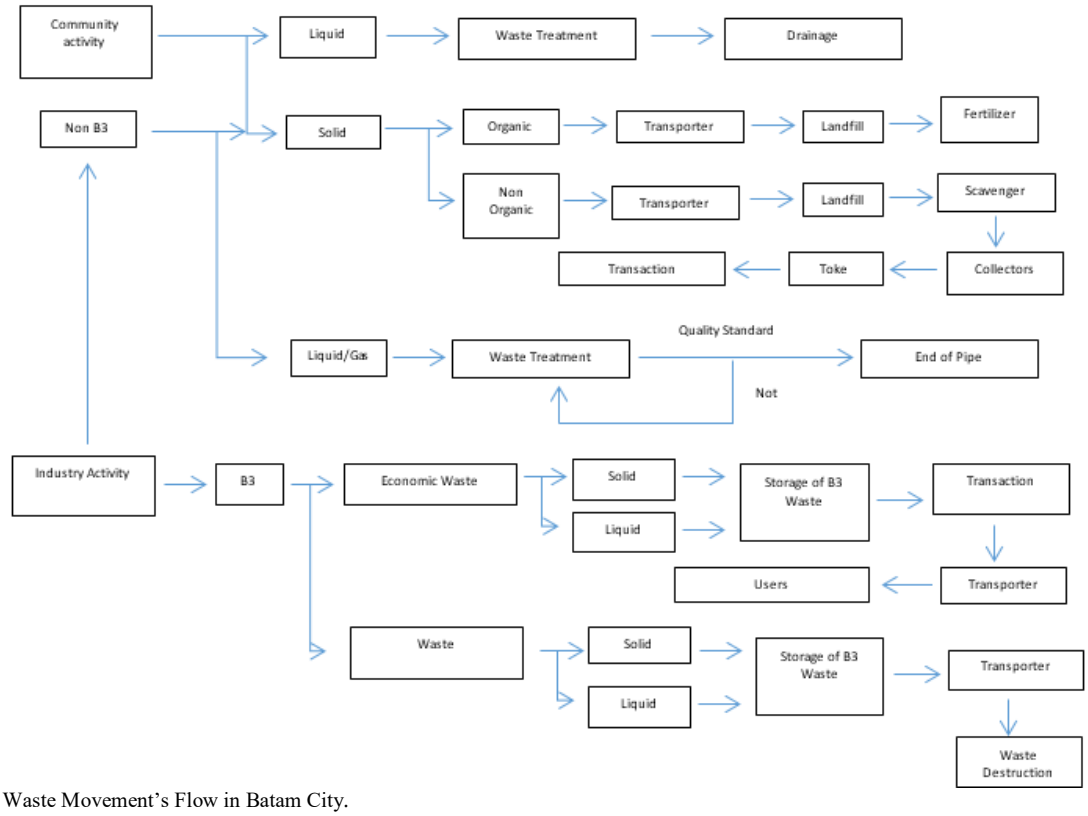


Figure 3. Waste Movement's Flow in Batam City.

Table 3.
Industrial Waste Value and Purchase Transactions

Waste	Volume	Value (Rp)
B3 Waste		
Accu	631 drum	50480000
Copper Slag	645000 Kg	97750000000
Fly Ash and Bottom Ash	-	-
Steel Slag	-	-
Spent Earth	-	-
PCB	-	-
Oil Sludge	102 Drum	40800000
Used Catalic		
	Total	97841280000

Table 4.
Value of Waste Utilization in Indonesia

Waste	Volume (Tons)	Value (Rp)
Used oil	6161131	21.6 Billion
Fly ash (high quality)	1500000	300 Million
Copper slag	800000	160 Million
Used accu	10982	39.5 Million
IPAL sludge	47815276	20 Miliion
Spent earth	3815276	-
Steel slag	700000	-
E waste	144886	-
Sludge oil	29722	-
	Total	22.1 Billion

toke the waste will usually end up as raw material by local industries or sold outside Batam City. This depends on the order and the quality of the waste. The same flow also occurs in non-B3 industrial waste. For B3 waste of economic value, after being transported by transporters, it will be utilized by waste users. In this case the transporter is usually also take a part as utilizing waste. Usually it only has screening or filtering for the process of utilizing waste, then it can be sold back to the processing industry. Whereas the screening or filtering waste will return to landfill or waste destruction if it is B3.

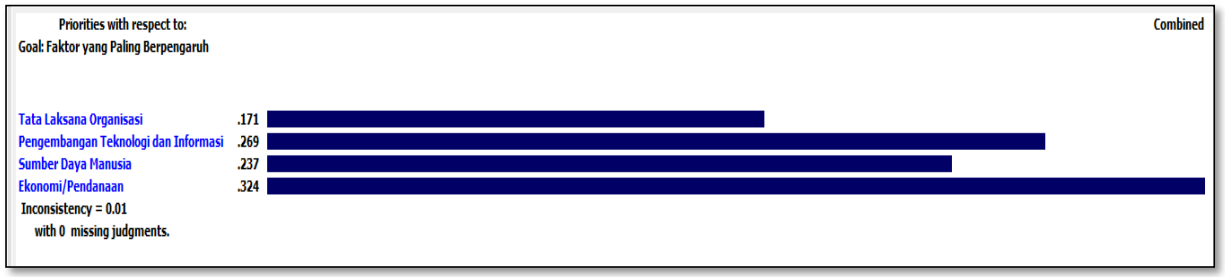
Both of waste from industrial or household waste and b3 waste still has the potential to be reused as raw material and recycled. The utilization of waste can be seen in Table 2.

Based on BPS 2010 and Energy Outlook 2010, in 2010 - 2030 the final energy demand by the industrial sector amounted to 2000 million SBM. This an opportunity for waste as a new resource. The potential for waste as an economic value item is expected by the community, especially manufacturing companies in Batam City, to implement a system of reuse and recycle. Therefore with waste exchange in Batam city, this is able to create competitive and opportunities for waste utilization companies to work with companies manufacturing in waste management.

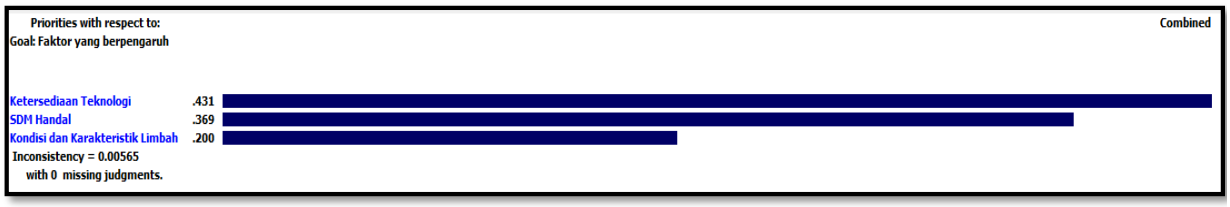
Waste exchange as a system and forum for trade in economic value that answer this challenge. The application of waste exchange, the flow of waste can be recorded clearly, especially for industrial waste with category B3 that need manifest record. It can help supervisor institutions (DLH Kota Batam). In addition, the presence of waste exchanges can help the manufacturing industry in reducing the cost of processing waste

As a general illustration to see the value and total transaction value of each waste, the volume data used comes from one or more waste-producing companies recorded DLH Kota Batam Periode: May - June 2018.

From Table 3, it can be seen for 3 types of industrial waste having a total transaction value of Rp 97,841,280,000. In Indonesia, for example, used oil amounted to 6,161,131 tons with a transaction value of



(a)



(b)

Figure 4. (a) Results of Sensitivity Analysis Influential Factors of Waste Exchange Appliance in Batam City (Respondents of Government Agencies). (b) Results of Sensitivity Analysis Influential Factors of Waste Exchange Appliance in Batam City (Respondents of waste user).

21.6 trillion rupiah. Table 4 is the value of waste management transactions in Indonesia

Tables 3 and 4 showed that the waste transaction has taken place, the formation of the waste exchange in Batam City is very possible. With the establish of the waste exchange in Batam City, it is not only as function for conducting transactions, but also as supervision of legal traffic by the relevant institutions. So it recorded well and the manifest of waste can be carried out optimally.

A. The Influence factors of the Waste Exchanges formation in Batam City

This research have 5 respondents, including Head of Batam City DLH Enforcement and Supervision Division, Head of Batam City DLH Enforcement and Monitoring Session, TPA Telaga Punggur Coordinator, Water and Waste Management Office Head in Batam City Area. Respondents from the waste user was the administrators and members of Aspel in Batam City with 3 respondents. Furthermore, the results of filling out the questions are quantified using the AHP models (Analytical Hierarchy Process) and count by Expert choice. To check the answers from experts are consistent or not with an inconsistency value limit not greater than 0.1. The results of the inconsistency ratio of each respondent could be seen in Table 5.

Table 5.
Inconsistency Ratio

Responden	Inconsistency Ratio
P1	0.05
P2	0.05
P3	0.05
P4	0.05
P5	0.05

Based on Table 5 above it is shown that there is no more than 0.1 inconsistency ratio in each respondent. It can be said that the answer from the expert is consistent.

Based on Figure 4 the results of sensitivity from respondents of government agencies, the highest value for priority factors that need to be considered in the formation of the waste exchange in Batam City is economic / funding factors with a value of 0.324. The lowest value in this sensitivity result is organizational management with a value of 0.171. Economic factors are considered to be the most important factors to consider in optimizing the application of the waste exchange in Batam City compared to other factors. It because the economic factor can directly influence the effectiveness of the implementation of program. Because one of the objectives of the establishment of the waste exchange in Batam City to improve service and supervision, by an institution, budget constraints can lead to limited service quality. This condition causes the task and function of program actors to be less optimal, because they do not get incentives as expected, which in turn can lead to program failure.

For the results of sensitivity originating from respondents who use waste, based on Figure 5, it can be seen that the availability of technology has the highest priority with a value of 0.431 and the lowest priority is the condition and characteristics of waste with a value of 0.200.

The availability of technology affected the quality of product and the effluent produced. At present (as mentioned above) technology for waste utilization activities is still very limited as in copper slag waste. It only filtering to remove the impurities. Based on the results of interviews, the main factors application of technology is taken into consideration are the availability of investment.

The influence factors of the formation of the waste exchange in Batam City are funding / economics, technology and information development, quality of human resources, and organizational governance. The application of the waste market in the city of Batam is expected to guarantee the safety and maintain the quality of the environment and provide solutions industrial, especially manufacturing industry to process their waste. It is not only through the screening or combustion stage because in the waste market, the task of the waste user is to process and manage the waste from the company / producer as well as clean and complete self-generated waste. For this reason, the application of waste exchange to the utilization of waste companies is the availability of technology, reliable human resources and the conditions and types of waste.

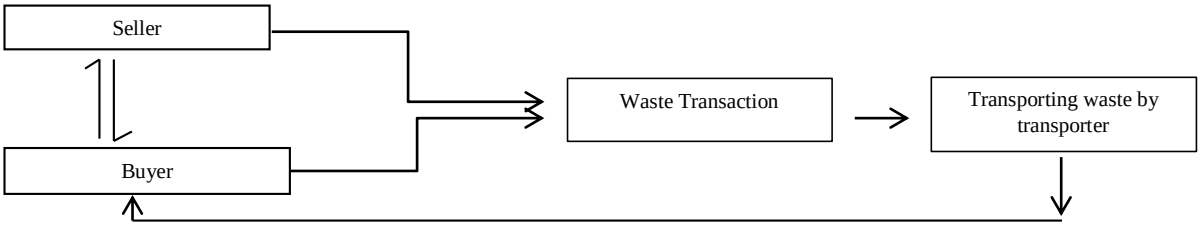


Figure 5. Existing Conditions of Waste Exchange Activities in Batam city.

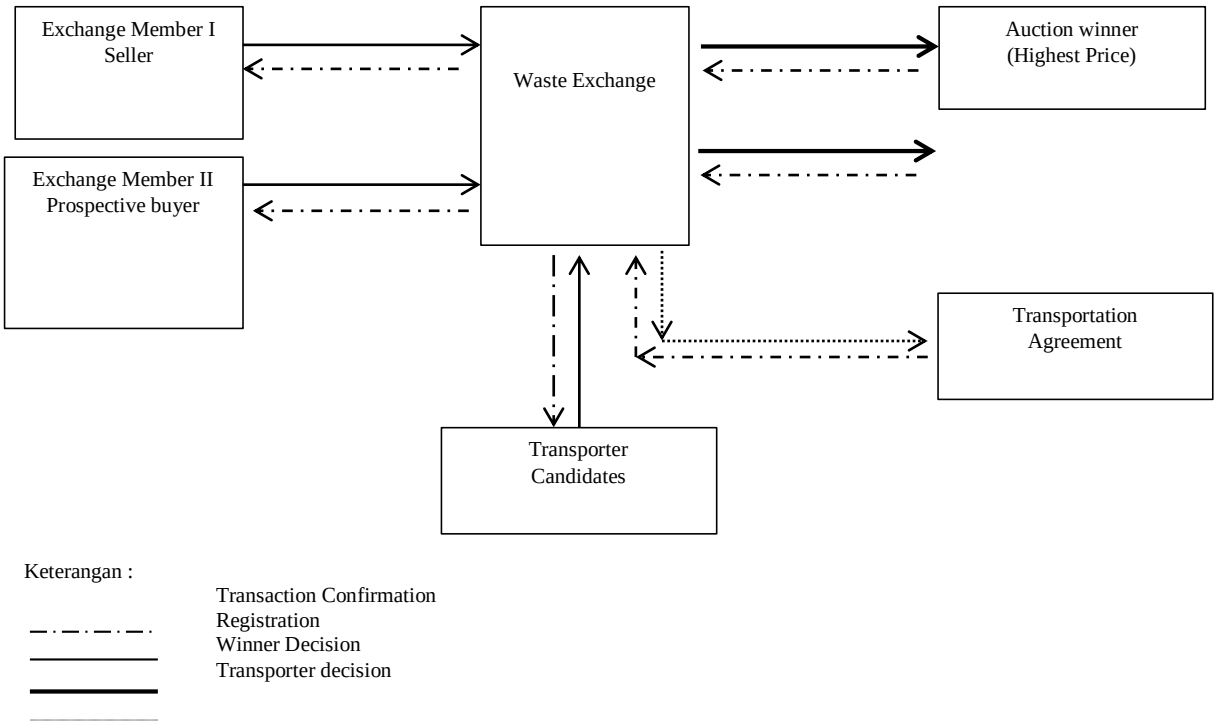


Figure 6. Waste Trading Process through Waste Exchange System.

B. Existing Conditions and Plans for the Waste Exchange

Based on the results of interviews, the waste exchange in Batam City was carried out directly by the buyers and sellers (Figure 5). It done by ordering orders to the producer / manufacture industry. Waste utilization companies usually carry out advertisements or offers to waste-producing companies regarding their existence as users of waste. This transaction process usually has the disadvantage, they must pay extra for their company's advertising processes. In addition, trade in waste can be not open to all parties. It has the potential to create a monopoly by certain companies. The formation of the waste exchange in Batam City is intended to facilitate of waste trafficking. The trading process is carried out openly through an application, so all of interested parties can access it. The process of trading waste through the stock exchange system in Figure 6. An open trading system is expected to be able to create conducive trade and minimize the existence of monopolistic practices of trade by certain companies. Because the trade carried out on the exchange is directly monitored by the division of the supervisory institution, the information data regarding the quality and characteristics of the waste is much guaranteed.

Waste Exchange system certainly has several benefits from the producer, the user of the waste or the supervisor institution. The advantages are:

1. Waste producer
   a. Reducing waste treatment costs
   b. Helps overcome the problem of waste
   c. Help manufacturing companies to lead to zero waste
   d. Help companies to get ecolabel so that product marketing can compete globally
   e. Free of cost in product / waste marketing
   f. Tax Reduction
2. Waste user/utilization of waste
   a. Creating new business opportunities
   b. No need to spend extra funds in terms of company service loop
   c. Get the desired type of waste quickly and precisely
   d. Can choose the type of waste according to the desired characteristics
   e. There is quality assurance from the producing company
   f. Free administration fees
   g. Tax reduction
3. Supervisor Agency (Batam City DLH)
   a. Assisting the tasks of the Batam City DLH in terms of waste manifest
   b. Waste has a sequential and clear track record
   c. Facilitate the monitoring system
   d. Minimizing the occurrence of environmental pollution

Although the waste market system has several advantages for each part, the disadvantage is the absence of both legislation and local regulations that regulate the

waste trading process. So when the waste market will be applied to the local area, it does not yet have a legal protection. It can impact on the practice of monopoly. The mechanism of trade through the trading floor has been presented in Figure 4.11. The implementation of the waste trading at the Exchange is basically done with the approach of implementing securities trading on the stock exchange. The implementation is carried out by using trade facilities that are carried out automatically using computer facilities where the system will be directly supervised or controlled by the relevant government institutions. Trade in waste exchange can only be done by Exchange Members (AB). Where the exchange member who conducts transactions on the system / application already has a user ID and pass given by the supervisor institution after fulfilling administrative requirements. In trading process, exchange members (sellers and buyers) can carry out the bargaining process. Furthermore, the bidder with the highest price is declared as the part of entitled to proceed with the next transaction. The seller and buyer make a certain agreement on the transaction settlement process and waste transportation activities. The waste transportation agreement process is also carried out on the waste exchange. Prospective waste transporter can register as a fleet on the exchange system by having a transporter permit from the local service. The winning decision of the shipping fleet is selected by the exchange system based on the completeness of the administration and suitability of the type of waste needed. All of these processes are carried out openly through the application of the waste exchange. In the waste exchange system, all waste from industrial activities can be traded.

The exchange system can select or classify the type of company based on the type of capital or business permit of the company. The purpose of this classification is to support data on the volume of waste that will be traded on the exchange. Exchange members are responsible for all transactions carried out on the exchange both for their own ior the customers. Exchange members are responsible for the settlement of all exchange transactions on behalf of the relevant exchange members as listed in the List of Exchange Transaction.

C. Opportunities for Implementing of Waste Exchange

Opportunities to apply the concept of waste exchanges in Indonesia are listed in the regulation PP No. 9 of 1999 concerning B3 Waste Management, which in article 9 paragraph 1 and 2 "Every person who does business and / or activity that uses hazardous and toxic materials and / or produces waste B3 is obliged to reduce B3 waste, process B3 waste and / or stockpile B3 waste and if the reduction activities as referred to in paragraph (1) still produce B3 waste, and B3 waste can still be utilized, producers can use it themselves or submit their utilization to waste users B3 ". In addition, PP 101 of 2014 concerning B3 waste management "Every transfer of B3 waste is accompanied by manifests to ensure management is carried out according to the principle of cradle to grove".

For the Batam city area itself, there is Batam City Regional Regulation Number 04 of 2016 concerning Environmental Protection and Management and Batam City Regional Regulation No. 8 of 2003 concerning Environmental Damage Pollution Control. Where the duties and authorities of the regional government in the protection and management of the environment include fostering and supervising the compliance of the person in charge of the business and / or activities towards environmental licensing and legislation. Of all existing regulations, mandate and strategic objectives and key performance indicators of Law No. 32 of 2009 concerning environmental protection and management and Law No. 18 of 2008 concerning waste which is reducing the burden pollution, reduce the rate of environmental damage, and increase the capacity of stakeholders are the goal. This indirectly requires all parties, both the community and agencies to conduct eco-efficient environmental management and the existence of good partnerships between the government and the community.

With these opportunities waste exchange can be applied in Batam City to help facilitate the duties and functions of local governments in environmental management and supervision. The laws and regulations can be used as opportunities for waste market activities:

a. Republic of Indonesia's Law No. 32 of 2009 concerning Environmental Protection and Management
b. Republic of Indonesia's Law No 18 of 2008 concerning Waste Management
c. Presidential Decree of the Republic of Indonesia No. 61 of 1993 concerning Ratification of the Basel Convention on the Control of the Transboundary Movement of Waste and Their Disposal
d. Government Regulation of the Republic of Indonesia Number 85 of 1999 concerning changes to Government Regulation Number 18 of 1999 concerning Management of Hazardous and Toxic Waste.
e. Batam City Regional Regulation Number 04 of 2016 concerning Environmental Protection and Management.
f. Batam City Regional Regulation No. 8 of 2003 concerning Environmental Damage Pollution Control.

IV. CONCLUSION

Batam City has the potential to use waste, especially for economic value. This can be seen from the ongoing sale and purchase of waste transactions from the shipyard, electronics and household waste.

The factors that influence the formation of the waste market in the city of Batam are:

Government agencies:

a. Economy
b. Provision of technology and information
c. Human Resources
d. Organizational governance

Waste users:

a. Availability of technology
b. Reliable human resources
c. Conditions and characteristics of waste

Formation of waste exchange in Batam city is needed a strategy to prepare and develop information infrastructure. In addition, the functions and obligations of the waste market supervisory institution, the producer of waste (industry) and the utilization of waste must be

clear and explicit. Legal clarity and regulations are also important instruments in supporting the formation of waste exchange, especially in the city of Batam. Because until now there is no legal protection of regarding the trade of waste.

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