

Stakeholder engagement in quattro helix model for mobile phone reverse logistics in Indonesia: a conceptual framework

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Abstract. The number of e-waste from mobile phone industry is still dominating until now. This is happened because there is no mutual commitment from all of parties i.e. businesses, government, and societies to reduce the use of mobile phone that has the shortest product life cycle. There are many researches study about firms' motivation and government's role, other discuss about actions of communities in supporting reverse logistics implementation. Unfortunately, research about engagement mechanism that involving all parties is still rare. Therefore, it is important to find the engagement model through this conceptual paper and it is expected useful to build the novel model. Through literature review, the results of this research are establishing the Quattro helix model as the appropriate structure to build the robust team by exploring stakeholder theories; mapping the engagement model either in form of collaboration or participation that consider stakeholders' role and motivation and finding six types of engagement that consider their interest; and determining the novel model of engagement through Quattro helix model for implementing reverse logistics in handling e-waste by describing the linkage and the gaps among existing model.

Keywords: Engagement, Quattro Helix, Reverse Logistics, Stakeholder,

1. Introduction

The number of e-waste from mobile phone industry is still dominating until 2025 [1]. Besides that, e-waste generation globally in 2015 is 22.5kg/inhabitant and rise to 40kg/inhabitant in 2018 [2]. The main problem of e-waste is they contain hazardous and toxic materials besides precious material and metal. For separating their content, required the high accuracy and sophisticated equipment if not it will pollute the environment.

Therefore, one of key issues in dealing with the global e-waste crises is technology for repair, refurbishment, and remanufacturing as well as recycling [3] through conducting reverse logistics (RL). Actually, some countries have tried to implement sustainable reverse logistics (SRL) for handling this problem but this activity needs specific and integrated treatment from the businesses, academics, and government as well as society involvement. Most researches study about firms' motivation and government's role, while others discuss about actions of communities in supporting SRL implementation. Moreover, they are useless if their research separates the role of all stakeholders because waste reduction initiatives will be feasible if strong political commitment from the governments and funds for conducting public educations are available [4] and other parties such as businesses and community support this program.

The need of societies to mobile phone increase significantly since some factors, such as: 1) economic development that improve the people's purchasing power that exacerbated by consumptive consumers' behaviour and affluent urban population that urge the societies to have



mobile phone more than one for communicating with others; 2) the industrial growth in term of information and technology so the firms can find many features to upgrade their electronic product easily for persuading the consumers replace their mobile phone faster; 3) the poor e-waste management and doing nothing of Government as if there is no urgent problem and he is still expecting the tax revenue from mobile phone industries.

Table 1. Communities' behaviour to mobile product and recycling program

Questions/Statement	Answers (%)					
Demografy Factors						
Age (year)	16-20 6.6	21-25 25.8	26-30 27.6	31-40 29.3	41-45 4.5	46-50 6.2
Income/month, Pocket money (million)	1-5 37.3	5-6 23	6-10 28.4	10-15 7.5	15< 3.8	
Education	Senior High School 38.7		Bachelor 47.7		Master 13.6	
Communities' behavior						
What are the communication tools are often used?	Mobile 96.9	Tablet 1.1	Laptop/PC 2.3			
How many mobile phones do you have? (unit)	1 52.1	2 41.4	3 4.6	3< 1.9		
How long is the average service life your mobile phone? (year)	1 12.1	2 24.6	3 20.5	4 15.9	End of Life 26.9	
What is the reason for replacing your mobile phone?	Outdate style 3.3	Outdate function 35.2	Bored 8.5	Damage 53		
How do you treat your used mobile phone?	Keep at home 38.6	Give to others 27.7	Thrown in a bin 9.7	Sell to the market 25.8		
Why do you not participate in waste mobile phone recycling?	Would rather give the phone to others than recycling it at low price Do not know where to send the mobile phone Mobile phone as data storage equipment Being afraid of disclosure of privacy					32.1 40.9 15.7 11.3
What is the reason for the low recycling rate?	Absence of a sound recycling system Low of environmental awareness Lack of government regulation Absence of laws and regulation					62.2 25.2 10.3 2.3
What is your preference pattern of recycling model?	Door-to-door collecting service Collecting side in community built by government Service centre and maintenance centre The reasonable of reimbursement cost					22.2 26.8 21.5 29.5
Do you know that waste mobile phone contains toxic & hazardous substance?	Know 31.8	Have no idea 35.1	Knowing very little 21.4		Very familiar 11.7	
Do you agree that consumers are the ultimate beneficiaries of product and should they afford a part of charge for the recycling of their mobile phone?	Disagree Agree, Pattern: deposit system Agree, Pattern: embedded in product price Agree, Pattern: Paying when the product is replaced It is up to government policy					23.8 26 6.8 24.1 19.3
What percentage of recycling cost can you accept? (%)	0 18.3	1-5 47.3	6-10 34.4	10 < 0		

Source: Preliminary Research in 2016

From my preliminary research found the average mobile phone replacement in Indonesia is less than three years (2.57 years) with the three-most reasons were damage, outdate function, and bored that illustrated in table 1. The short service life would lead to a large number of waste mobile phones, which could be potentially harm to the environment. From 363 respondents, most of them choose mobile phone as communication tool (96.9%) and have only one mobile phone (52.1%) although almost a half of them have two mobile phones (41.4%). From the questionnaire, the main reasons listed for why many waste mobile phones were not recycled were that most consumers did not know where to send the phones for recycling (40.9%) or they would rather give it to others, families or friends than recycle it at low price (32.1%). Moreover, some respondents prefer keep it at home (38.6%) because they are hard to find someone else who really want to use it. The survey revealed that the recycling rate of waste mobile phone is notably low. Asked what cause the low rate, 62.2% of respondents indicated the absence of a sound recycling system besides low of communities' environmental awareness (25.2%), lack of government regulation (10.3%), and absence of laws (2.3%) besides that do not know that waste mobile phone contain toxic substance. The investigation of respondents' pattern of waste mobile phone recycling indicates that 29.5% of them are willing to send their phone if they get the reasonable of reimbursement cost and the second answer is there need collecting side in community built by government so easy for them to participate in the program. Finally, related to charge for the recycling of their mobile phone, 26% agree with deposit system as the payment pattern, 24.1% agree if they pay when they replace it, and 23.8% disagree if they have to bear the cost. Thus, 4,17% of respondents are willing to pay the recycling cost for 1-5% of the product price.

Many researchers recognized the successful of reverse logistics program depend on the number of stakeholders involved and the type of engagement among them either empowerment, collaboration, or involvement. The appropriate collaborations and/or participations form is needed so the SRL program will run well. There is no research that explain the collaboration and participation mechanism inter-stakeholders at once that involving all parties i.e. manufactures, takeback operators (suppliers, distributors, retailers, service centres), consumers, and government clearly. Most of SRL collaboration researches focused on manufacture and takeback operator collaboration [5], [6]. Some papers discussed about the need of collaboration between manufacture and consumer [7]. There are a few researches concerned with collaboration among manufacturer, operator, and consumer [6], [8]. Only one papers discussed four stakeholders' involvement i.e. research of reference [12]. Therefore, by exploring the linkage and the gaps among theories and researches, this research wants to find potential alternatives a model of collaboration and/or participation in conducting RL which describes the further developments of those theories that consider all stakeholders cooperation that very relevant with current situations in Indonesia but has not emerged in the research publication.

2. Research Method

According to reference [10] for conducting systematic literature review, this research should include two steps: 1) Category selection: define and refine a topic, design a search, and locate research reports. There are three main topics of this research namely: stakeholder engagement, Quattro helix, and reverse logistics, therefore the researcher explores many papers refers to these research topics without limiting the year of publication paper. After that, they are reviewed and classified by differing their characteristics and distinguished and recorded in a prepared spreadsheet to be analysed holistically. 2) Material evaluation: validity test, crosschecked to ensure enrichment of the study such as SCOPUS indexed and journal accredited, or research quality such as it answers all research questions.

3. Results and Discussion

Intent of this section is to discuss the Quattro helix model as the appropriate structure to build the robust team by exploring stakeholder theories; the engagement model either in form of collaboration or participation that consider stakeholders' role and motivation and potential six types of engagement that consider their interest; and the novel model of engagement through Quattro helix model for implementing reverse logistics in handling e-waste by describing the linkage and the gaps among existing model.

3.1. Stakeholders Concepts through Engagement in The Quattro Helix Model

For handling waste problems, the firms need at least the three groups of stakeholders, they are government [4], [5], [9], [11], consumer [6], [7], [12], [13], [14], [15], and retailers, distributors, wholesaler, service centre, e-waste collector, transporter, and recycler [8], [12], [13], [14], [16], [17]. The last groups will be united in term of takeback operator in this research and also used in some research [5], [18], [19]. Reference [20] divided the stakeholders into three groups, namely: the first, second, and third batch stakeholders. The first batch stakeholders are *manufacturers* that must responsible of their product once they become obsolete; *assemblers* that provide electrical and electronic product are much cheaper than the branded product; *retailers* that dominated by individual proprietary shop with exchange offers and take-back value which attract the customers to a great extent; and *raw material producers* such as smelters for various metals who buy scrap from trader and recyclers of e-waste. The second batch stakeholder is *consumers* both domestic or individual household and official consumers. The third batch stakeholders are responsible for collection, segregation, dismantling, treatment and disposal e-waste. They comprise *scrap dealers* that collect the used product from consumers; *recyclers* that dominated by informal sector; and *disposers* who responsible to the incineration and landfilling process of e-waste for secure and safe disposal. Actually, the group of stakeholders is not the most important thing, because the engagement of all parties believed will improve the businesses' SRL performance. For getting the high-quality stakeholder engagement, we have to consider nature of relationship, level of engagement, and types of communication.

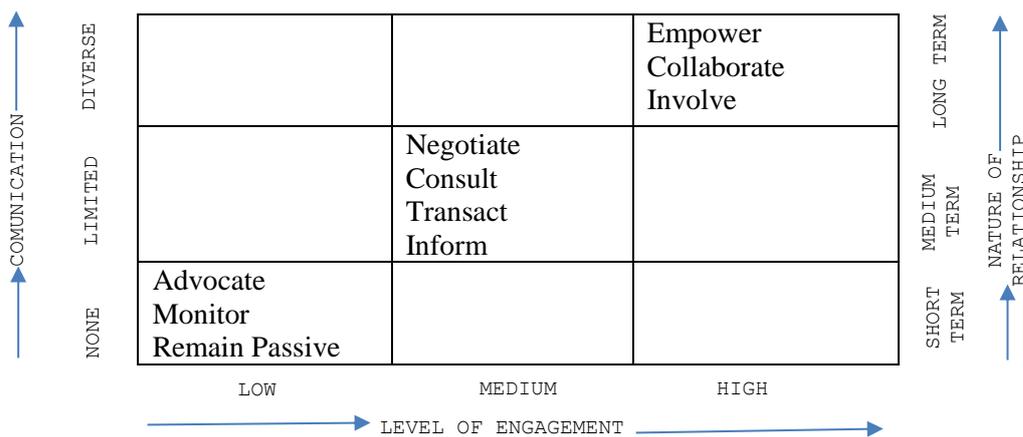


Figure 1. Different Level and Approaches to Engagement [27]

In determining level of engagement, it is needed to define the nature of the relationship. Besides that, the method of engagement should be selected that appropriate with the needs, capacity and expectation of the relevant stakeholders. Figure 1 describe the different level and approaches to engagement based on the types of communication and the nature of relationship. The owners of engagement should involve stakeholders in the design and implementation of the engagement purpose and scope (Table 2). These issues will be a guidance in determining how they are engaged. The engagement will be made as an alternative conceptualization of the Quattro helix model. The four networks might thus be described as organizing a Quattro Helix instead of a Triple Helix. The four helices in this research are occupied by private companies (manufacturers), public authorities (government), intermediaries (takeback operators), and civil societies (consumers) that established as the robust team to implement SRL.

3.2. Stakeholder Engagement Model

For implementing SRL, this study has established the four parties' engagement, namely: manufacturers, government, takeback operators, and consumers. Because the nature of relationship based on network theory is long term trust, level of engagement is high and it will use diverse communication, so the appropriate types of engagement i.e.: involvement, collaboration and empowerment.

Table 2. Level and Methods of Engagement [27]

No.	Level of Engagement	Methods of Engagement
1	Remain Passive (No active communication)	<ul style="list-style-type: none"> • Stakeholders concern expressed through protest • Letters • Media • Website
2	Monitor (one-way communication: stakeholders to organization)	<ul style="list-style-type: none"> • Media and internal tracking • Second-hand report from other stakeholders possibly via targeted interviews
3	Advocate (one-way communication organization to stakeholders)	<ul style="list-style-type: none"> • Pressure and regulatory bodies • Other advocacy efforts through social media
4	Inform (one-way communication organization to stakeholders, there is no invitation to reply)	<ul style="list-style-type: none"> • Lobbying efforts • Bulletins and letters • Brochures • Reports and Websites • Speech, conference, and public presentation
5	Transact (limited two-way engagement: setting and monitoring performance according to terms of contract)	<ul style="list-style-type: none"> • Public private partnership • Private finance initiative • Grant-making • Cause-related marketing
6	Consult (limited two-way engagement: organization ask question, stakeholders answer)	<ul style="list-style-type: none"> • Survey • Focus group • Meeting with selected stakeholders • Public meeting • Workshop
7	Negotiate (limited two-way engagement: discuss a specific issue or range of issues with the objective of reaching consensus)	Collective bargaining with workers through their trade unions
8	Involve (two-way or multi-way engagement: learning on all sides but stakeholders and organization act independently)	<ul style="list-style-type: none"> • Multi-stakeholder forum • Advisory panels • Consensus building processes • Participatory decision-making processes • Focus groups • Online engagement tool
9	Collaborate (two-way or multi-way engagement: joint learning, decision making and actions)	<ul style="list-style-type: none"> • Joint projects • Joint ventures • Partnership • Multi-stakeholder initiative • Online collaborative platform
10	Empower (new forms of accountability: decision delegated to stakeholders; stakeholders play a role in shaping organizational agenda)	Integration of stakeholders into governance, strategy and operation of the organization

3.2.1. *Involvement*. “Participation is defined as mental and emotional involvement of a person in group situation in which encourages him to contribute to group” [27]. Social (civic or citizen) participation has been defined as “a process in which individuals take part in decision making in the institutions, programs, and environments that affect them” [25]. The type of participation will be adjusted with involvement, empowerment, and partnership characteristics. Reference [26] identified five levels of participation with relates to the stance an organization promoting participation, namely: *information*,

merely telling people what is planned; *consultation*, offering some options, listening to feedback, but now allowing new ideas; *deciding together*, encouraging additional options and ideas, and providing opportunities for joint decision making; *acting together*, not only do different interest by deciding together, they form a partnership to carry it out; and supporting independent community interest, local groups or organizations are offered funds, advice or other support to develop their own agendas.

3.2.2. *Collaboration*. Collaboration model is used to simplify the complexity of relation and interorganizational interaction [21]. Collaboration between organizations is supported by many factors, among others; confidence (trust) between the parties, an effective method of communication, interpersonal relations, and leadership. There are at least six issues in processing collaboration between organizations [22], namely: managing aims; compromise; communication; language; democracy and equality; power and trust; and determination, commitment, and stamina. In collaboration, all parties work together and build a consensus to reach a decision that results the benefits to all of parties. The relationship between the parties is ongoing and therefore collaboration is dynamic and interdependence. As a dynamic concept, collaboration is an incremental process through several stages [23], namely (1) The floating vision of collaboration that explains the common interest, (2) Approaches to visioning in the form of equalization understanding and collective experience that documented in the form of operating principles as a reference of how stakeholders work, (3) Appreciative inquiry, which is a tool to find a better way, effective and constructive covering (4): discovery (finding the best), dream (vision wish generated), design (visible proposal), deliver (application design).

Reference [21] explained the characteristic of jurisdiction-based model is active and opportunistic collaborative. All actors assume that the activities as part of their own job but the activities follow pattern from outside. Therefore, bargaining and negotiating is the important instrument in this model. Bargaining generate unilateral concession and mutually beneficial solution. The horizontal dimension explains the process creating policy and governance. Nobody has a power to determine strategy other actor because each actor has strategy and operationalization severally. While, The Top-down model emphasizes the central government control vertically to regional and local government. From this model appear a dilemma how to realize the national government program through local government that legally independent. Therefore, the most important aspect in this model is local government voluntary in conducting central government program. Reference [21] stated that the successful collaboration if it impresses cross function integration [24]. It comprises of bureaucracy function, across of policy arena, and government level that member (societies and NGO) participate in problem solving and implementation process. The three models are: vertical collaboration reflects on relations among inter-government institutional and societies, non-governmental organizations in top down relations; horizontal collaboration shows relations among interorganizational in the same level; while, partnership linkage is depicted as blending vertical-horizontal relation for generating effective arrangement.

Reference [17] developed a series of procedures for implementing contracts between manufacturers and retailers to maximize individual and total profits through the reverse supply chain i.e. revenue sharing, collect payment support, and transportation cost support. The contract is analyzed according to: 1) the manufacturer proposes a set of contracts that can be considered by the retailer; 2) the retailer evaluates the proposed contracts and chooses the one that is expected to maximize profit; 3) they adjust the parameters of the best contract to achieve the mutual goal of the supply chain.

3.2.3. *Empowerment*. The key issues of empowerment are new form of accountability, decisions delegated to stakeholders, and stakeholders play a role in shaping organizational agenda [27]. The methods of engagement are integration of stakeholders into governance, strategy and operations of the organization. Reference [28] stated that Chinese government has made effort to tackle problems associated with the recycling and disposal waste mobile phone. By engaging the communities through empowerment program such as green box program or recycled old-for-new activity as well as the willingness to pay, will regulate consumers' economic responsibility and awareness. Not only treat communities for engaged in handling waste mobile phone but also businesses must have an active role to seek a breakthrough for reducing e-waste by providing storage point, disposal center, environmental friendly design [12], [14], [18].

3.3. The Proposed Model of Stakeholder Engagement in Sustainable Reverse Logistics

The collaboration and participation model from previous study can inspire to develop a new stakeholder engagement model for implementing reverse logistics. Figure 2 endeavor to create the comprehensive model of stakeholder engagement in SRL that involve the all of main parties i.e. manufacturers, government, takeback operator, and consumers for filling the research gap or potential future research in SRL. As mention above, the proposed model involves only four parties as the main actors in conducting RL activities. Each party must play its role for reducing the number of e-waste. Society must reduce the desire to replace their mobile phone. The businesses must have a method to maximize the use of electronic product by recycling, refurbishing, reusing, and repairing. Government must control the businesses' behavior in gaining the benefit and provide the societies to handle their own e-waste. However, government needs support from the two parties, societies and businesses to jointly overcome the e-waste problem because government is powerless if must handle it alone.



Figure 2 Stakeholder Engagement Model in Quattro Helix Model for RL Implementation

4. Conclusions and Future Work

The research gap shows there is a big opportunity to study about stakeholder engagement model in RL for handling e-waste problem. The Quattro helix model (manufactures, government, takeback operators, and societies) is the appropriate structure to build the robust team to implement the SRL program and keep all parties reach their goals. The new model, stakeholder engagement in SRL must be made clearly so this research must find six types of collaborations and/or participation i.e. government to manufacturer, takeback operator, and consumer; Manufacturer to takeback operator and consumer; and takeback operator to consumer. For future research, the importer, NGO, and e-waste agency will be considered as a part of takeback operator because they often influence either positive or negative to the successful the SRL implementation. The researcher also should aim to test the new model, to ensure whether the new model appropriate to be implemented in developing countries.

5. Acknowledgements

This study would not possible without support material and non-material from LPDP - The Ministry of Finance, The Ministry of Research Technology and Higher Education, and Mercuru Buana University. The author also would like to thank to my research partner for helping me to explore the papers.

6. References

- [1] Andarani, P and Goto, N., 2014, Potential E-Waste Generated from Household in Indonesia Using Material Flow Analysis. *J Mater Cycles Waste Management*, **Vol. 16**:306-320
- [2] Balde, C.P., Kuehr, R., Blumentha, I.K., Gill, S.F., Kern, M., Micheli, P., Magpantay, E., and Huisman, J. 2015, J. 2015. E-Waste Statistics: Guidelines on Classification, Reporting, and Indicators. UNU-IAS
- [3] Nnorom. I.C. and Osibanjo, O., 2010. Overview of Prospects in Adopting Remanufacturing of End-of-Life Electronic Products in the Developing Countries. *International Journal of Innovation, Management and Technology*, **Vol. 1**, No. 3,
- [4] Yudoko G, 2007, Integrated Municipal Solid Waste Planning and Management (IMSWPM) in Developing Countries: A Conceptual Framework, *Jurnal Manajemen Teknologi*
- [5] Bernon, M. and Cullen, J., 2007, An Integrated Approach to Managing Reverse Logistics, *International Journal of Logistics. Research and Application* **Vol 10** p. 41-56

- [6] Bernon M and Rossi S., 2011, Retail Reverse Logistics: A Call and Grounding Framework for Research, *International Journal of Physical Distribution and Logistics Management* **Vol 41**, No 5, pp. 484-510
- [7] Sharma S and Singh G., 2013, Reverse Logistics: Design Implication on The Basis of Product Types Sharing Identical Supply Chain Member Motivation, *Uncertain Supply Chain Management I*, pp 33-44
- [8] Agrawal, S., Singh, R.K., and Murtaza, 2016. Prioritizing Critical Success Factors for Reverse Logistics Implementation Using Fuzzy-TOPSIS methodology. *J Ind Eng Int* **Vol. 12**: 15-27
- [9] Sheuh, Jiuh-Biing, 2014. Green Supply Chain Collaboraion for Fashionable Consumer Electronic Products under Third-Party Power Intervention – A Resource Dependence Perspective. *Sustainability*, **Vol. 6**, 28832-2875
- [10] Neuman, W.L., 2006. *Social Research Methods: Qualitative and Quantitative Approaches*. Pearson International Edition, Sixth Edition, United State
- [11] Santos R.F. and Marins F.A.S., 2015, Integrated Model for Reverse Logistics Management of Electronic Products and Components. *Information Technology and Quantitative Management, Procedia Computer Science* pp. 575 – 585.
- [12] Vereecke A and Muylle S, 2006. Performance Improvement Through Supply Chain Collaboration in Europe. *International Journal and Production Management* **Vol. 26** No. 11 pp 1176-1198
- [13] Gloria M and Talavera V, 2008, Supply Chain Collaboration in The Phillipines. *Journal of International Business Research*, **Volume 7**, Special Issue 2
- [14] Budijati, S.M 2016. Model of Reverse Logistics Management Closed Loop and Opened Loop as well as Consumer Behavior Accomodation, UGM
- [15] Nnorom I.C., Ohkwe J., and Osibanjo O, 2013, Survey of Willingness of Residents to participate in Electronic Waste Recycling in Neigeria – A Case Study of Mobile Phone Recycling, *Journal of Cleaner Production* 17, pp 1629 – 1637
- [16] Migliano J.E.B., Demajorovic J., and Xavier L.H., 2014, Shared Responsibility and Reverse Logistics Systems for E-Waste in Brazil, *Journal of Operation and Supply Chain Management* **Vol 7.**, No. 2., p91-109
- [17] Yoon S.W and Jeong S.K, 2016, Implementing Coordinative Contracts Between Manufacturer and Retailer in a Reverse Supply Chain, *Sustainability Journal*, **Vol. 8**, 913
- [18] Aitken J and Harrison A, 2012 Supply Governance Structures for Reverse Logistics Systems, *International Journal of Operations and Production Management*, **Vol 33.**, No. 6, pp 745-754
- [19] Sauza R.G., Climaco, J.C.N., and Sant’Anna, A.P., (2016), Sustainability Assesment nd Prioritisation of E-Waste Management Option in Brazil, *Waste Management* 57, pp. 46-56
- [20] Borthakur, A and Sinha, K 2013, Electronic Waste Management in India: A Stakeholders Perspective. *Electronic Green Journal*, 1 (36)
- [21] Agranoff and Mc Guire, 2003. Collaborative Public Management: New Strategy for Local Government. P 35
- [22] Huxham, Chris and Vangen Siv, 1996, Key Themes in The Management of Relationship Between Public and Non-Profit Organization, *The International Journal of Public Sector Management* **Vol 9**, No 7
- [23] Munt, Richard, 2003. Building Collaboration, Stronger Families Learning Exchange, Bulletin No. 3 p6-8
- [24] Cullen J., 2010, Tools to Manage Reverse Logistics, Cranefield University
- [25] Heller, K., Price, R. H., Reinhartz, S., Riger, S., Wandersman, A., and D’Aunno, T. A., 1984. Psychology and community change: Challenges of the future. Monterey: Brooks/Cole
- [26] Wilcox D, 1994, Community Participation and Empowerment: putting theory into practice, *RRA Notes Issue* 21, pp 78-82, IIED London
- [27] AA1000 SES, 2015. Accountability 1000 Stakeholder Engagement Standard
- [28] Yin, J., Gao, Y, and Xu, H., 2013. Survey and Analysis of Consumers’ Behaviour of Waste Mobile Phone Recycling in China.