(In) formality in E-waste Movement & Management in the Global Economy

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TABLE OF CONTENTS

Chapter 9: CONCLUSION

ABSTRACT

This thesis unpacks the dynamic nature and architecture of the global e-waste (electronic and electrical waste) recycling network. It analyses the functions of formal (guided by regulatory apparatus) and informal sectors (usually outside the regulatory orbit) involved in waste production and processing and their structural inter-linkages to situate the process and practise of informality in e-waste in the realm of formal capitalist economy. Additionally, it investigates the impact of regulatory interventions on the waste network and the actors therein. It focuses on the spatiality of waste treatment where the narrative of the physical material starts in the formal sector of electronics manufacturing and consumption and travels along quasi-legal channels of e-scrap trade and traffic to reach the informal sector (often in developing countries) for its end-of-life management. Till date, the systemic interconnections between formality and informality in waste processing operations have not been analysed in the waste scholarship. Despite critically reviewing the widespread presence and preponderance of informality with its definite characteristics, the literature has largely disregarded its relationship with formality and the broader lexicon of production and exchange. This research addresses this important omission in the literature and examines the drivers of informality and myriad formal-informal associations in e-waste transfer and treatment in the changing contours of the global economy. The following research question guides the structure and argument of this thesis.

Main Research Question: What drives informality in e-waste movement and management?

The research follows the trajectory of the international waste stream and examines how these path(way)s are embedded in the socio-economic processes of formality and informality. It uses the qualitative field work conducted in Netherlands, Belgium and India (Delhi) in 2011 and 2012. The fieldwork covers all the stakeholders engaged directly or indirectly in the e-waste network starting with the manufacturers, consumers to the traders, collectors, dismantlers, recyclers and second-hand sellers in both formal and informal sectors as well as the state and NGOs.

The production, distribution and consumption of electronics, its waste and the recovered elements are not disjoint despite their apparent dispersion across geographical and political borders. Rather it is a functionally and organizationally inter-connected network characterised by a continuum of formal-informal material transfer, socio-economic transactions and financial arrangements between different players performing diverse functions. The analytical foundation of this study is laid by the Global Production Network (GPN) approach which follows the spatial e-waste flow in the post-consumption stage and locates the role and position of the various actors engaged in the process. It deconstructs the inter-connections between the formal and the informal actors by drawing on the rich formality-informality discourse. It uses the Global Value Chain (GVC) framework to specifically interrogate the vertical and horizontal governance patterns and power imbalances between the different players and additionally employs the idea of informal social networks from the industrial clusters literature to understand the ties of family, kinship and community between them. The study also engages with the diverse (re)valuations of e-waste and the (re)creation of secondary products that are used for further consumption and production. The value generated, circulated and captured in the waste recycling stream by the participating actors is understood using the Marxian exposition of circuits of capital. The

e-waste network is institutionally embedded in particular geographical settings, socio-cultural milieus and regulatory framework leading to spatially differential comprehensions and treatment of e-waste. The roles of the regulatory and civic initiatives in conditioning and configuring this network are scrutinised to deliberate on the different paradigms of its management.

The research illustrates that the fluidity between formality and informality in waste processing is crucial in (re)fashioning and (re)constructing waste for further use. It suggests that commodity production, consumption, waste generation and treatment are conjoined internationally in which value is created and circulated across sectoral and geographical boundaries. In effect, it reflects on the politics and practices of waste production and management and questions the design and enforcement of state policies towards eco-friendly processing of e-waste.

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Finally, to those who have faith in people, and the faithless.

LIST OF TABLES AND FIGURES

ACRONYMS

1. AC: Air-Conditioner
2. ARF: Advanced Recycling Fee
3. BAN: Basel Action Network
4. BPO: Business Process Outsourcing
5. B2B: Business to Business
6. B2C: Business to Consumer
7. CPCB: Central Pollution Control Board, GOI
8. CPU: Central processing Unit
9. CRT: Cathode Ray Tube
10. CtE: Consent to Establish
11. CtO: Consent to Operate
12. DeitY: Department of Electronics and Information Technology under MCIT
13. DGFT: Directorate General of Foreign Trade, GOI
14. DPCC: Delhi Pollution Control Committee, India
15. EC: European Commission
16. EEB: European Environmental Bureau
17. EEE: Electrical and Electronic Equipment
18. EMD: Earnest Money Deposit
19. EMPA: Swiss Federal Laboratories for Materials Science and Technology
20. EoL: end-of-life
21. EPA: Environmental Protection Agency
22. EPR: Extended Producer Responsibility
23. EU: European Union
24. EXIM: Export-Import
25. FPS: Federal Public Services (for Public Health, Food Chain Safety and Environment) of Belgium
26. GDN: Global Destruction Network
27. GIZ: German Agency for International Cooperation

28. GOI: Government of India
29. GPN: Global Production Network
30. GTZ: German Agency for Technical Cooperation
31. GVC: Global Value Chain
32. HMS: Hague Environmental Services
33. HRA: Harit Recyclers' Association Private Limited
34. HS: Harmonized Commodity Description and Coding System
35. HW Rules: Hazardous Waste Rules, GOI
36. IC: Integrated Circuit
37. ICER: Industry Council for Electronic Equipment Recycling
38. ICT: Information and Communications Technology, GOI
39. ILO: International Labour Organisation
40. IPR: Individual Producer Responsibility
41. LP: Labour power
42. IMRB: Indian Market Research Bureau
43. IT: Information Technology
44. MAIT: Manufacturers' Association for Information Technology, India
45. MCIT: Ministry of Communication and Information Technology, GOI
46. MoEF: Ministry of Environment and Forests, GOI
47. MP: Means of Production
48. MSTC: Metal Scrap Trading Corporation, GOI
49. MSW: Municipal Solid Waste
50. NGO: Non-Governmental Organization
51. NCR: National Capital Region
52. OECD: Organization for Economic Co-operation and Development
53. OVAM: Public Waste Agency of Flanders
54. PCB: Printed Circuit Board
55. PCC: Pollution Control Committee
56. REACH: Regulation on Registration, Evaluation, Authorisation and Restriction of Chemical
57. RoHS: Restriction on Hazardous Substances (Directive of the European Union)

58. SPCB: State Pollution Control Board, India
59. StEP: Solving the E-waste Problem
60. SWM: Solid Waste Management
61. TBM: Trans-Boundary Movement
62. TV: Television
63. UK: United Kingdom
64. UNEP: United Nations Development Program
65. UP: Uttar Pradesh
66. US: United States
67. VLAREA: Waste Prevention and Management Ordinance of Flanders
68. VROM: Ministry of Infrastructure & Environment in Netherlands
69. WEEE: Waste Electrical and Electronic Equipment (Directive of the European Union)
70. WSR: Waste Shipment Regulation (of the European Union)

Chapter 1:

E-WASTE MOVEMENT AND MANAGEMENT

IN THE GLOBAL ECONOMY

1.1. Reality of Informality in Waste and E-waste

In an era of growing urban population, unstable labour markets and declining formal employment opportunities, the informal economy[1] — the part of the economy that falls outside the regulatory realm of formal institutions — provides livelihood to an ever-increasing proportion of the labour force (Bhattacharya, 2007a). In many cases, the modern informal space is a dynamic extension of the formal sector in the production and distribution of goods and services. It forms a significant link in the value chain through which formal enterprises subcontract or outsource work to informal home workers, casual labourers and small manufacturers. Informal workers provide many essential services where formalised systems of service provision are absent or inadequate. An important case in point is urban waste management in developing countries where state-led formal infrastructure is woefully inadequate, with insufficient coverage and weak operational standards (Cohen, 2006; Wilson et al., 2006). The natural environment often serves as a perennial dump for such waste without any suitable mechanism of detoxification, disposal and eco-friendly treatment. It has been observed that the question of solid waste management confronts every big and emerging city in the world. In China, the annual volume of municipal waste has assumed the proportions of a crisis (Suocheng et al., 2001). In most such economies, the informal sector traditionally plays an important role in waste processing by scavenging, sorting and recycling different kinds of waste (Wilson et al., 2006). This study seeks to understand the drivers behind, and the linkages between, informality and formality in the global and local flows and management of electronic waste.

In recent times, the informal sector has been specifically involved in processing e-waste or WEEE (Waste Electrical and Electronic Equipment), particularly in Asian and African countries like China, India, Nigeria and Ghana (Chaturvedi, Arora, & Killguss, 2012; Chi, Streicher-Porte, Wang, & Reuter, 2011; Grant & Oteng-ababio, 2012; Nnorom & Osibanjo, 2008b; Prakash & Manhart, 2010). E-waste is the latest challenge to increasing waste generation and has confronted the world economy since the 1990s. Fast progress in information technology and a globally competitive market have ushered in a range of attractive electrical and electronic equipment (EEE) with very short lifespans. Abundant novel digital products flood the market and lure the consumers with increasing purchasing power to indulge in the modern innovations in EEE. As new commodities are introduced with growing frequency, the older ones get discarded rapidly. Behind the glamour and sophistication of the electronics industry lurk the menace of massive quantities of e-waste raising questions about its safe recycling and disposal. Human health and the environment are severely compromised by improper

[1] Adopting from Portes (1989), informal economy can refer to a status of labour (non-contractual, temporary, unprotected), particular conditions of work (defying minimum safety requirements, open to health hazards like fire & other accidents) and forms of management (unrecorded/undeclared transactions, tax evasion, fiscal frauds, quasi-legal nature of work).

treatment of such (toxic) waste. Use of rudimentary tools and backyard techniques by informal reprocessing activities often result in hazardous emissions, pollution and overall ecological degradation (Brigden, Labunska, Santillo, & Allsopp, 2005; Sepúlveda et al., 2010; Sinha, Mittal, Rajankar, & Sharma, 2014; Tsydenova & Bengtsson, 2011). The documentation of declining air quality and groundwater contamination in informal e-waste recycling hubs in Guiyu (China) and Agbogbloshie (Ghana) have earned notoriety at an international scale (Grant & Oteng-ababio, 2012; Hicks, Dietmara, & Eugster, 2005; Lundgren, 2012; Puckett & Smith, 2002). The expansion of production and consumption in contemporary capitalism adds to the burgeoning e-waste problem. This manifests the 'second contradiction of capitalism' (O'Connor, 1994, 1998) which embodies progressive environmental deterioration in the contemporary world economy. Heightened consumption with wasteful attitudes reflects the upsurge in consumerism, often fuelled by aggressive advertising campaigns. Mountains of WEEE result from this never-ending desire for commodities ensuring a steady flow of profit necessary for the reproduction of the capitalist system.

The e-waste generated is not 'fixed in its state and location' (Davies 2011: 191) and its international mobility is demonstrated through the illegal shipments of junk electronics from advanced to emerging and developing nations (Cobbing, 2008; Cubby, 2009; A. Lewis, 2010; Nordbrand, 2009). The latter are mainly dominated by informal hubs of manual e-waste recycling (Nnorom & Osibanjo, 2007; Shinkuma & Managi, 2010; Sthiannopkao & Wong, 2013; Yu, Ju, & Williams, 2009). Recent endeavours in environmental governance at diverse scales have attempted to address problems of waste transfer and treatment with limited success (Agarwal, 2013; BAN, 2007; Bradley, 2009). The coverage of e-waste production, consumption and its management is functionally fragmented yet relationally integrated across the Global North and South. This research investigates the dynamic organisation of spatial WEEE trajectories which encompass diverse economic actors participating in formal and informal waste processing. It examines the structural linkages and divergences between formality and informality to locate them in the lexicon of a globalised waste economy. While e-waste scholarship from multiple disciplinary backgrounds has emphasised its growing internationalisation and informalisation, it has largely disregarded the nature and drivers of informality in waste networks. Without an explicit understanding of the function, position and linkages of informality in e-waste processing with the formal electronics production and treatment, legislative interventions would always fall short of expectation. The regulatory machinery needs to fathom the reasons behind the diverse perceptions and practices of e-waste in different contexts. This thesis undertakes the essential task of analysing the architecture and governance of e-waste formality and informality to comprehend the drivers of pervasive informality at various scales. Hence, in effect, it reflects on the political economy of waste disposal and resource consumption that is embedded in specific institutional environments.

The chapter is organised as follows. The second section discusses the research questions that construct the foundation of the thesis. The third section elaborates the analytical foundation of the thesis by drawing from relevant concepts and theories that appropriately address the research questions. The fourth section focuses on the methodological approach which provides the basis of the

empirical investigation through the selection of pertinent case studies. The final section outlines the structure of the thesis.

1.2. **Research Questions**

The extensive scholarship on e-waste has ignored the nature and drivers of informality in the international network of WEEE production and processing. This research explores and analyses the political economy of e-waste by focusing on the linkages between and value generation in formal and informal WEEE economies in a particular context. It combines both theoretical and empirical lenses to appreciate the practical experience of waste management and analyse it in light of appropriate theories and concepts. The following research questions guide this project.

Main Research Question: What drives informality in e-waste movement and management?

This is broken up into the following research sub-questions to construct a consistent understanding and argument that can theoretically and empirically analyse the intricacies of the complex e-waste phenomenon.

i. How does e-waste flow along the reverse supply chain[2] from the point of its generation?

This question maps the spatial trajectory of e-waste in its post-consumption phase. It describes the physical flow of waste material and traces the multiple formal and informal agents associated with waste production and treatment. Thus it systematically charts the complex WEEE processing network globally and for the countries selected to emphasise the geographical circulation of waste, finance and value.

ii. What is the nature of transactions defining the formal – informal linkages in the process of e-waste disposal and recycling?

This question looks into the socio-economic transactions between the different formal and informal actors. It particularly focuses on the contracts between these agents which are shaped by social networks and the relational dynamics between formality and informality. This provides the basis of coordination and governance which underlie the structure and function of the dispersed activities in the WEEE network.

iii. How does the regulatory environment influence the informality of e-waste processing?

This question examines the role and impact of the broader institutional environment on the players and processes of e-waste management. So it specifically looks at how the state and civic organisations shape the orientation and configuration of the waste network within a particular socio-cultural and political background. The pertinent international conventions and national legislations are studied to critically review their efficacy and understand the reasons behind their impact. An in-depth enquiry into the regulations and the agenda of civic organisations is undertaken to look into their agenda and comprehend the ways in which they aim to change the existing scenario and facilitate

[2] Williams et al. (2008) defines reverse supply chain of WEEE as “the network of activities involved in the reuse, recycling and final disposal of products and their associated components and materials”.

environmentally sound WEEE management. In the subsequent section, the pertinent theories and concepts that are used to analyse this phenomenon of e-waste flow and management, and the nature of formality, informality and their inter-linkages are discussed.

1.3. **Analysing Formality-Informality in the Geographies and Valuation of E-waste**

The continued existence and expansion of informality, informal knowledge, spaces and livelihoods have stimulated considerable research in social science. The concept and conceptualisation of the informal sector (vis-à-vis the formal) question the rationale and principles in orthodox theories of economic development that typically stress formal industrialisation as the paramount dimension for growth and advancement of a country. This research is informed by the critical discourse on formality and informality to analyse their scope and purpose in global capital and value transfer. It examines the ambiguous separation between WEEE formality and informality and their inter-relationship. Informal ways of life and income generation are extremely heterogeneous and context-specific; hence it is necessary to focus on a definite physical space to uncover its subtleties and dynamics. Such a scholarship illuminates the particular motivations and vulnerabilities of informal sector actors which can only be comprehended in relation to the formal economy. This study incorporates a parallel understanding of state interventions and enforcement of regulations that shape and define informality.

This research applies the heuristic framework of Global Production Network (GPN) to fathom the complex and dispersed socio-economic e-waste spaces and processes in a globally connected world. This approach inspects the changing participation of particular countries and regions under globalisation and its consequences (Bair, 2005; Kaplinsky, 2004). There are multiple interpretations of waste which influence how it is treated, valued and perceived across the globe. The constellation of actors involved in and influencing the variegated WEEE landscape can be placed under the rubric of GPN and its cognate approach GVC (Global Value Chain). The formal-informal inter-connections explicit in the e-waste network can be explored through the governance practices and power asymmetries manifested therein. These relationships establish and comingle the multiple conduits of WEEE movement. Additionally, the relevant tenets of GPN and GVC are supplemented by the exposition of Marxian circuits of capital to capture the value production, realisation and appropriation in processing waste and its derivatives. Value has an important analytical purchase in the negotiation between capital and diverse forms of formal and informal labour in e-waste management.

Recent studies in the GPN genre have interrogated the transformation in the shape, value and functionings of WEEE and other forms of waste (Brooks, 2012, 2013; Crang, Hughes, Gregson, Norris, & Ahamed, 2012; Gregson, Crang, Ahamed, Akhter, & Ferdous, 2010; Lepawsky, 2014). These waste networks evolve and engage with the legislative imperatives of the state and the priorities of civic organisations which provide the socio-political and regulatory background. Decades of globalisation and the accompanying progress in information and communication technology (ICT) have deepened the inter-linkages between remote parts of the world characterised by disparate patterns of consumption, waste production and processing (both formal and informal). The spatiality of similarities and variances in waste generation and treatment are encapsulated by following the flow of waste through geographical and political territories. The GPN, along with selected concepts of its

precursor, the GVC, allow an appropriate interrogation of the practices of and participation in waste circulation and recycling.

These WEEE economic operations are embedded in and affected by the cultural perception of waste, the social fabric and the regulatory principles, among other aspects. Hence the state institutions constitute the political and legal umbrella under which e-waste transfer and treatment are regulated. Moreover, the civic organisations like non-governmental organisations (NGOs), consumer groups, labour unions and environmental lobbies are motivated by multiple facets of waste management like consumer welfare, labour conditions and implications of illegal and hazardous waste dumping. Exploring the ways in which these dimensions effectuate definite waste regimes over others is essential to decipher the overall properties and functionings of the waste system. The GPN approach analyses the role and rationale of the non-chain actors in shaping and conditioning the articulation of e-waste recycling networks and the relationship between the actors. To identify how these inter-relationships are created, maintained and enforced, the GVC framework particularly extends theories of governance that hold the diverse and distant actors and their activities together. Using the GVC approach, the particular interactions and inter-linkages between, and amidst, formality and informality are considered. Additionally, the agglomeration of informal actors around similar e-waste processing operations are underlined to deliberate on its (dis)-advantages by drawing from the industrial clusters literature.

Therefore, the analytical foundation of the thesis is laid down by the GPN framework, applied to map the multi-directional route of the waste stream and specific functions of the participating actors. This is appended by the formality-informality discourse to locate and rationalise informality in relation to the overall architecture of e-waste network. It is accompanied with the Marxian circuits of capital to explain the generation and transfer of value in e-waste within the capitalist imperative of (re)-production of surplus value and profit. Finally, the modes of governance (from the GVC framework) and clustering practices and prerogatives (from industrial clusters scholarship) are used to illustrate the nature of relationships between the economic agents in the network and their outcomes. The subsequent section discusses the spatial locations of this study and presents an overview of how the research questions are investigated.

1.4. **Research Methodology and Selection of Cases**

This research draws from primary qualitative research and secondary evidence from academic journals, organisations reports, media documentation and government assessments to develop suitable responses to the research questions. Since the focus is to analyse the international WEEE movement, it is necessary to choose a country or countries that are acknowledged as e-waste senders on a global scale. The literature indicated that the United States (US) and Europe (Kahhat & Williams, 2012; A. Lewis, 2010; Ni & Zeng, 2009) are noteworthy e-scarp exporters. The Netherlands and Belgium are selected since they are among the forerunners in eco-friendly waste management and harbour the important ports of Rotterdam and Antwerp respectively. Simultaneously, a recipient country that imports and generates substantial e-waste and has a wide informal WEEE sector has been picked, i.e. India. The other countries in this category are China, Ghana and Nigeria. While

China has attracted a lot of academic interest and been vastly documented (Wang, Ru, Veenstra, & Wang, 2010; Xinwen, Streicher-Porte, Wang, & Reuter, 2011; Yu, Williams, Ju, & Shaoa, 2010), the African countries are gradually evolving as informal recycling hubs at the onset of this project. Hence India was chosen since the author also comes from the same country and speaks the most widely-spoken language in the country, Hindi.

A qualitative approach is adopted that uses the case study method to collect primary data from the field given the dearth of credible quantitative data on e-waste inventorisation. Moreover, the predominance of informality in e-waste processing deterred even small surveys given that informal actors are difficult to locate and communicate with. Besides, the basic objective in this project is to study the spatial phenomenon of e-waste production and processing to illuminate the actors, their roles and their inter-connections within a framework of governance. A case study method that entails the detailed investigation of a singular example to reflect on a phenomenon is chosen and appropriate case(s) for conducting the field research are identified. Secondary desk research has served as an important technique throughout the project to frame research questions, decide case studies and draw evidence from.

The field research comprises of a multi-site case study which uses several primary data collection methods like documentation, semi-structured interviews and non-participant observations. It captures all the different actors along the e-waste network starting from the electronics manufacturers, consumers, collectors, traders, dismantlers, specialised recyclers and the government officials and NGO personnels. These respondents are both from the formal and the informal economy in Netherlands, Belgium (mostly formal) and India (mostly informal). While selection of a particular group of actors would have allowed a detailed understanding of that category, it would not have encompassed the entire range of participants involved in the network. Also considering a definite kind of WEEE like the ubiquitous personal computers and its accessories could have made the research endeavour easier. However, this would inevitably fail to capture the myriad categories of e-waste like refrigerators, air-conditioners, televisions, washing machines and dryers forming a bulk of WEEE due to their sheer volume and others like mobile phones with their widespread use across different economic classes and countries. Further, the national e-waste regulations combine all these different gadgets and appliances together under their coverage. Hence, in this study, e-waste refers to all kinds of electronic and electrical products.

1.5. **Structure of the thesis**

This section briefly elaborates the structural division of the chapters in this research. The thesis is arranged in order of the development and investigation of the research questions. Following this introduction, Chapter 2 draws from relevant scholarship to contextualise the phenomenon of e-waste and highlights the issues raised and inferences deducted therein. It proceeds to challenge the areas and concerns left unexplored in the existing literature to compose the research questions that can address these gaps. Chapter 3 expands on the conceptual approaches that inform this thesis by selectively extracting theories from various analytical frameworks that would be applied to the empirical findings to prepare the responses to the research questions. Chapter 4 illustrates the

methodological approach adopted by explaining the choice and rationale behind the case study selection and the fieldwork challenges and limitations. Chapters 5, 6 and 7 present the empirical findings and analyse them following the three research sub-questions. Chapter 5 attends to the first sub-question and portrays the international WEEE stream and stresses on its material and financial dimensions for the countries examined. It particularly focusses on the spatial flow and variation in e-waste processing on a global scale and the generation and transfer of value in the process. Chapter 6 ensues from the second sub-question and uncovers the nature of formal-informal linkages in the network by narrating and analysing the empirical findings from India. It looks at each category of actors involved in the WEEE phenomenon and discusses their mode of operations, inter-relationships and diverse power equations. Chapter 7 engages with the third sub-question to comprehend the impact of the regulatory environment on the e-waste network and the actors therein. It separately elaborates on and evaluates the effectiveness of the European and Indian legislations along with the international convention. Chapter 8 integrates the findings from chapters 5, 6 and 7 to analyse the driver(s) of informality in e-waste. It develops a dialogue with the existing academic scholarship on e-waste using the idea of global production networks in conjunction with the other concepts laid out in Chapter 3. It additionally weaves a wider narrative on waste recycling networks to reflect on the politics of waste generation, transfer and treatment under contemporary capitalism. The concluding chapter presents a brief recapitulation of all the chapters. It highlights the contributions of the project and explores policy implications with a scope of further research.

CHAPTER 2:

CONTEXTUALISING E-WASTE PRACTICES AND REGULATIONS

2.1. **Introduction**

The interest in e-waste is fairly contemporary, following the upsurge in the consumption of EEE (Electrical and Electronic Equipment) and subsequent WEEE generation (Waste Electrical and Electronic Equipment) from the 1990s. Since then, the subject has attracted extensive scholarship. Much of the literature on e-waste examines its different material components and the environmental repercussions of their hazardous treatment like air and water pollution (Brigden et al., 2005; Huisman, Van der Maesen, et al., 2012; Puckett, 2005). It analyses the phenomenon of illegal transboundary trade in e-scrap and its redressal through legislative restrictions (Lundgren, 2012; Ongondo & Williams, 2011; Wath, Vaidya, Dutt, & Chakrabarti, 2010). Popular debates on e-waste typically focus on the enormous growth in waste generation and its increasing informal management in the developing nations (Chi et al., 2011; ILO, COOP, & SECTOR, 2014; Streicher-Porte et al., 2005). This chapter provides a background to this research by presenting the main concerns about and characteristics of the informal economy in WEEE movement and management. It reviews the reasons and explanations behind the proliferating e-waste informality provided in the relevant academic and policy-oriented literature. Additionally, it documents the diverse regulatory initiatives for its redressal through the control of international e-waste transfer and local recycling practices. It reviews the efficacy and the impact of these legislative interventions on informality in the global WEEE landscape. It identifies the main research gaps in the existing scholarship that hinder a clear understanding of this phenomenon and proceeds to address these lacunae. The leading question that this chapter answers is: How can the current understanding of persistent informality in global e-waste transfer and treatment be improved in the existing WEEE literature?

The chapter is structured as follows. To start with, the different interpretations of e-waste are considered in the second section to outline its definitional and practical problems. The contents of WEEE including toxic elements as well as valuable components are discussed to raise questions about its appropriate management strategies. In the third section, the trends and patterns of the global e-waste stream are investigated. The various international, regional and national regulations (especially for the countries studied here) that control this transboundary flow are reviewed in the fourth section. A bulk of the e-waste exported from developed countries often ends up in informal recycling domains in the developing nations (G. Jain, 2011; Kahhat & Williams, 2012; Lundgren, 2012). The fifth section deliberates on the reasons behind the emergence of an extensive informal e-waste economy and elaborates on the different processes of formal and informal WEEE management. The sixth section describes the legislative principles that direct green e-waste management, again focusing on the countries examined in this research. In this context the notion of Extended Producer Responsibility (EPR) is introduced. The seventh section critically appraises the relevant WEEE scholarship to recognise the knowledge deficiencies in explaining progressive e-

waste informality and provides directions for a coherent analysis of the same. It results in the formulation of research questions that form the core of this study. The final section concludes the chapter.

2.2. E-waste and its Composition

An important starting point for the majority of e-waste studies is its definition. There is no standard characterization of e-waste. Though it is most commonly understood as both electronic and electrical waste, often it is narrowly classified as just electronic waste. E-waste results from a wide range of electronic products like IT (information technology) and telecommunications equipment (like computers and mobile phones) as well as consumer equipment (household appliances like TV, refrigerator, AC etc.). Electrical equipment refers to household lamps and other household appliances like electric stoves, heaters, kettles, fans etc. Electronic devices usually have Integrated Circuits or Micro-Chips[3] inside them, whereas electrical devices generally operate without Integrated Circuits. The table below lists some popularly used definitions of e-waste.

Table 1: Overview of selected definitions of WEEE or E-waste

Reference	Definition
EU (European Union) WEEE Directive (EU, 2002a)	"Electrical or electronic equipment which is waste. . . including all components, sub-assemblies and consumables, which are part of the product at the time of discarding." Directive 75/442/EEC, Article 1(a) defines "waste" as "any substance or object which the holder disposes of or is required to dispose of pursuant to the provisions of national law in force."
Basel Action Network (Puckett and Smith, 2002)	"E-waste encompasses a broad and growing range of electronic devices ranging from large household devices such as refrigerators, air conditioners, cell phones, personal stereos, and consumer electronics to computers which have been discarded by their users."
OECD[4] (2001)	"Any appliance using an electric power supply that has reached its end-of-life."

Source: Widmer et al, 2005

Multiple interpretations of e-waste render its identification and estimation difficult. While the WEEE Directive of the EU defines it as electronic and electrical equipment, the Basel Convention categorises only electronic products as e-waste. Moreover, the EU Directive encompasses all components and sub-assemblies of EEE while it is not clear whether the other two also consider them. Consequently,

[3] Integrated Circuit is a set of electronic circuits on a small plate (chip) of semiconductor material, normally silicon.

[4] The Organisation for Economic Co-operation and Development (OECD) is an international economic organisation of 34 countries founded in 1961 to stimulate economic progress and world trade.

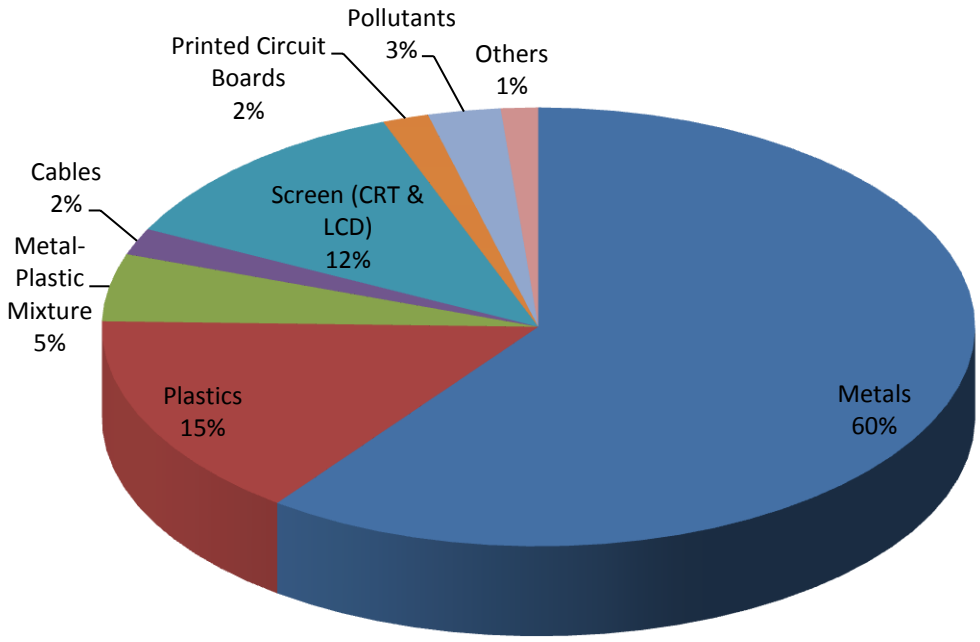
the actual scope of WEEE remains imprecise. Coupled with a definitional inconsistency, the methods for e-waste estimation vary widely between countries (Terazono et al. 2006), leading to an underestimation of the enormity of the problem. The e-waste literature suffers from a dearth of reliable data on WEEE generation, collection, proportion recycled and disposed (Huisman, Van der Maesen, et al., 2012; Ioan, Radulescu, & Popa, 2010; Kahhat & Williams, 2012; Tong & Wang, 2004). Unfortunately, apart from pointing out the lack of a common definition and the implications of divergent interpretations, the scholarship does not provide any guidance for constructing a single meaning. In this research, the most widely accepted definition of WEEE by the EU is adopted and the terms e-waste and WEEE are used interchangeably.

The consumption of EEE is particularly high in the developed or the OECD countries with saturated markets. The market penetration and usage of electronic gadgets are less in the emerging or developing economies though they have the fastest increase in domestic EEE consumption (Li & Tee, 2012). The three countries empirically studied in this research (namely Netherlands, Belgium and India) generated 4.22, 2.16 and 7.25 million tons of e-waste respectively in 2012 (http://www.step-initiative.org/index.php/WorldMap.html accessed on 03 November 2014). WEEE processing is problematic due to the sheer size of waste generation and its toxic constituents. It is also full of valuable materials which are reusable or recyclable with high resale value. Hosoda (2007) differentiates between the resource potential of e-waste, realised by its proper treatment and the pollution potential, resulting from unsafe end-of-life (EoL) management. Often the incentive to extract the valuable substances from WEEE leads to hazardous methods of removal like open burning and acid-bath treatment (Cui & Zhang 2008; Wath et al. 2011; Manomaivibool 2009). E-waste contains highly toxic ingredients like lead, cadmium, mercury, arsenic, selenium and brominated flame retardants. Its sizable volume is destined to landfills (Barba-Gutierrez et al. 2008). In the US, 70% of heavy metals in the landfills can be attributed to WEEE (Puckett & Smith, 2002). Toxins responsible for brain damage and cancer are found in consumer electronics, constituting 40% of the landfills (ibid). According to the US Environmental Protection Agency (EPA), about 80-85% of e-waste was dumped in landfills between 2003 and 2005 (Williams et al. 2008). Usually these gadgets take a very long time to degrade naturally and leachate from landfills contaminates soil and groundwater. If WEEE is incinerated, carcinogenic dioxin and furan are often released in the atmosphere and heavy metals might come out in slag and fly-ash. These have direct occupational health implications for the waste workers by exposing them to an extremely toxic and risky environment. While recycling is largely preferable, it is also considered as a postponement of the consequences of inadequate disposal through secondary products.

E-waste also presents a profitable enterprise through recycling and refurbishment. Precious metals like gold, silver, and palladium can be recovered from WEEE along with base metals like copper, aluminium, iron etc. (Hosoda 2007). The amount of gold and silver extracted from used EEE 'correspond to about 3% each of the world mine production for both metals' (Boeni et al. 2008: 2). While one of the main foci in the e-waste narrative has been on the menace of hazardous substances (Brigden et al., 2005; Ni & Zeng, 2009; Townsend, 2011; Tsydenova & Bengtsson, 2011), the business opportunities and economic benefits from reclaiming valuable metals have also received

adequate attention (Kahhat et al. 2008; Prakash & Manhart 2010; UNEP 2009; Yoshida & Terazono 2010). The illustration below shows the proportion of various materials present in e-waste by weight. It can be observed that metals (like copper, iron and steel) constitute the largest fraction followed by plastics (Widmer et al. 2005). However, this break-up is approximate since different equipment vary in material composition and based on properties like function, size and weight. Due to continuous technological upgrading in EEE and their rapid obsolescence, high heterogeneity exists even in a single appliance (Chancerel, Meskers, Hageluken, & Rotter, 2009).

Figure 1: Material Fractions in E-waste by Weight



Source: Widmer et al., 2005

The literature presents a detailed account of the diverse valuable and toxic components of WEEE. That is not to say that the scope for further research is absent in this area. In spite of extensive documentation, there continues to be a lack of proper knowledge and awareness about the actual impact of various substances in such devices during the EoL management (Lundgren, 2012). E-waste circulates globally and its management is dispersed and fragmented across territorial boundaries. The following section deliberates on the international scope and rationale of WEEE flows as illustrated in the literature.

2.3. International Movement of E-waste

Though the bulk of electronic consumption occurs in the developed nations, the resultant waste is exported to countries mainly in Asia (primarily China and India) and Africa (like Ghana and Nigeria) to avoid labour-intensive and expensive recycling in the countries of use. Advanced countries usually have binding labour and environmental regulations (Tong & Wang, 2004). In the US normally the cost

of recycling a home computer is 20 US dollars against 4 US dollars in India (Gattuso, 2005). Availability of cheap labour and absence of strict legislations provide a congenial atmosphere for exporting e-waste to developing nations where it mainly ends up in informal economies of dismantling and recycling. Reusable products are informally repaired, reassembled and recycled at reduced costs and enter the secondary markets in developing countries to provide low-priced options (Kahhat & Williams, 2009; Kahhat et al., 2008). Additionally, they bridge the digital gap by bringing in the fruits of sophisticated technology for modernisation and industrialisation of the developing countries. E-waste reclamation in the industrialising nations provides a lucrative income generating activity for the actors in the WEEE business. Of the e-waste in developed countries that is sent for recycling, 80% ends up being shipped (often illegally) to developing countries to be recycled by hundreds and thousands of informal workers (Lundgren, 2012).

Figure 2: International Trends in E-waste Export

Source: Greenpeace, Basel Action Network, 2010

The illustration above depicts the various pathways of WEEE across the world. It demonstrates waste exports from North America and West European countries to countries in Asia and Africa. E-scrap is also increasingly being exported from Australia, Japan, Hong Kong and South Korea (Cubby, 2009; Kahhat & Williams, 2009; Lau, Chung, & Zhang, 2013; A. Lewis, 2010). Latin American and East European countries are late but growing recipients of overseas WEEE (Boeni, Silva, & Ott, 2008; Kahhat & Williams, 2009). Occasionally national retailers and users sell to brokers/vendors their WEEE, which might end up being shipped to developing countries (Hosoda, 2007). It is estimated that nearly half of EEE from Japan is exported to the Philippines, China, Cambodia, Afghanistan and Malaysia as second hand products (Yoshida & Terazono, 2010). The narrative of global e-waste

circulation is not a linear traffic from advanced to developing countries. The dominant understanding of waste Transboundary Movements (TBM) from developed to developing countries as dumping has been questioned to draw attention to changing trading patterns (Lepawsky & McNabb, 2010; Lepawsky, 2014). Recent reports based on WEEE import into Ghana and Nigeria have shown that around 70% of the incoming electronics are in functional condition (Lepawsky, 2014). Contemporary evidence also reveals that WEEE trading from and between the developing world has expanded in volume and grown in frequency (Lepawsky & McNabb, 2010). E-waste entering China through Hong Kong, Taiwan or the Philippines is often re-routed to Cambodia and Vietnam (Lundgren, 2012). The rhetoric of WEEE traffic is unclear given the lack of formal research on net exports and imports creating 'critical data gaps, which include lack of data on trade flows of used and scrap electronics, flows invisible to trade statistics of many countries' (Kahhat & Williams 2012: 67).

Geographers have recently examined the issue of e-waste transfer and treatment to highlight the spatial trajectories of its movement. The configuration of the waste recycling network manifests the mobility and mutability of waste that serves as a resource for secondary goods and precious metals. It has been emphasised that the circulation of waste is motivated by economic gains particular to regions, sectors and countries (Lepawsky, 2014). WEEE exchange on a global scale and the secondary processing operations in Asia and Africa have been disentangled to locate the production of value (Herod, Pickren, Rainnie, & Champ, 2013; Lepawsky & Billah, 2011). Many academic journals, organizational and media reports have recorded the international length and breadth of the WEEE stream. They have also documented the legislative measures constructed to curb the illicit transnational e-waste traffic and explored their impact on the international circulation. These regulatory interventions constitute an area of significant global and regional policy making on e-waste and are elaborated below.

2.4. **Regulating E-waste Movement**

The following reviews the crucial conventions, directives and legislations that aim to control the e-waste flow at various scales.

2.4.1. **International Conventions**

According to the UNEP[5] (2004), the Basel Convention on the Control of TBM of Hazardous Wastes and their Disposal constitutes the 'most comprehensive global environmental agreement on hazardous and other wastes' (UNEP 2004). In the late 1980s, to counter expensive waste disposal due to strict environmental regulations, the developed world resorted to sending hazardous waste to the developing countries (Yap 2006). The Basel Convention was enforced in 1992 to check the upsurge in such illegal TBM of toxic waste. In 1998, the Convention recognised e-waste as hazardous and hence requires all exporting nations to obtain prior permission from the countries of import and transit, irrespective of the latters' signatory status (Asante-Duah et al. 1992). It currently has 180 states and the EU as parties that are obliged to guarantee that the e-waste exported is handled and managed in an environmentally sound manner.

[5] UNEP: United Nations Environment Programme.

The Basel Ban was adopted as an amendment to the Basel Convention in 1995 to completely prohibit illegal waste transfer from developed or OECD countries to developing or non-OECD countries. It applies to TBM of all hazardous waste, even for recycling, while the Convention only covered hazardous waste destined for disposal (Puckett and Smith 2002). The Ban has not been enforced yet since it has only been ratified by 79 countries and EU. For enforcement, it has to be accepted by at least three-fourth of the parties to the Convention (http://en.wikipedia.org/wiki/Basel_Convention accessed on 29 October 2014). The Basel Action Network or BAN (an international non-governmental organization against global toxic waste traffic) has identified Asia as one of the primary recipients of toxic waste trade (http://www.ban.org/about/ accessed on 2 August 2014).

Both the Convention and the Ban are replete with problems. The former is alleged to effectively legitimise hazardous waste trade without prohibiting it. The 'use of the word "control" in the Convention's title -- rather than prevention or prohibition -- was telling' (Puckett, 1997). It does not differentiate between second-hand electronic gadgets and WEEE; allowing for WEEE export to be deliberately mislabelled as 'mixed metals' or second-hand goods'. Also, the Basel principles only cover hazardous waste movement from developed (Annex VII) to developing (non-Annex VII) countries (Lepawsky & McNabb, 2010; Lepawsky, 2014). But evidence shows that intra-regional waste flows within the non-Annex VII countries are increasing. Moreover, the enforcement agencies (like national Customs) often suffer from inadequate resources compromising the monitoring of illicit shipments at the ports (Sepúlveda et al., 2010). Many countries like the US (which has still not ratified the Convention), some European countries, Canada, Australia, Japan and South Korea continue to disregard the principles of the e-waste TBM (Iles 2004). Consequently, the Basel Convention and the Ban remain largely ineffective despite being the sole international agreements on hazardous waste trade.

Due to the resounding failure of international Basel agreements, some regions, both at the receiving and generating ends, have sought to devise policies to curtail WEEE exports and imports. The Bamako Convention (on the Ban of Import into Africa and the Control of Transboundary Movement and Management of Hazardous Wastes within Africa) was enforced in 1998 by the Organization of African Unity in Bamako, Mali to prohibit import of waste (including WEEE) and substances banned or refused registration in the manufacturing country. It mandates audit of waste generated and transfer of polluting technologies into Africa (Asante-Duah et al. 1992). The biggest regional legislation, however, is framed by the EU which covers all the European Member States and is the most pioneering regulatory intervention on the issue. The following part elaborates the same.

2.4.2. **The European Waste Shipment Regulation (WSR)**

The EU has imposed the Basel Ban in WSR, making it legally binding in all EU Member States. WSR Regulation (EC) No 1013/2006 on waste shipments effected from 12 July 2007, facilitates trade of recyclables without distorting competition and violating trading rights. It controls all TBM of waste within, into and out of the EU. Depending on the property and destiny of waste, a TBM can be prohibited, allowed or subjected to specific procedures. Waste shipments for disposal are largely prohibited, except to countries of the European Free Trade Agreement (which are parties to the Basel

Convention) where it requires prior written notification and consent from the competent authorities at source, transit and destination countries. Waste for recovery is classified into the following:

i. **Annex III**- List of Wastes subject to the General Information Requirements or **Green Listed Waste** (non-hazardous waste) which can be exported for recovery to other EU and OECD countries if accompanied by an information obligation provided in Annex VII of the WSR (refer to Appendix I in page 203). The categories of WEEE in Annex III of the WSR are,

- **GC010:** Electrical assemblies consisting only of metals or alloys.
- **GC020:** Electronic scrap (e.g. printed circuit boards, electronic components, wire, etc.) and reclaimed electronic components suitable for base and precious metal recovery.

(Revised Correspondent's Guidelines No 1, Subject: Shipments of Waste Electrical and Electronic Equipment (WEEE) by European Commission, 2007)

For export to non-OECD countries, the EC asks each country whether it allows the import of non-hazardous waste and which procedures it wants to apply. Most non-OECD countries reply under the following categories.

a. Prohibition;
b. Allowed with prior notification and consent;
c. No control in country of destination;
d. Other control procedures to be followed in the country of destination under applicable national law.

These replies concerning the export of green listed waste for recovery by the non-OECD countries are registered in the Commission Regulation (EC) No 1418/2007 operational from 18 December 2007. If not specified by a country, the procedure of prior notification and consent is followed. The notification procedure requires the competent authorities (in countries of dispatch, transit and destination) to give their consent prior to any shipment. The exporter submits the notification to the competent authority of dispatch which passes it on to those of destination and transit. These authorities must convey their consent (with or without conditions) or objections within 30 days. The notification document is provided in Annex IA of the WSR.

ii. **Annex IV**- List of Wastes subject to the Procedure of Prior Notification & Consent or **Amber Listed Waste** (the hazardous waste),

Annex IVA- Waste Listed in Annex III but subject to the Procedure of Prior Written Notification & Consent

Amber listed or hazardous waste is not allowed to be exported to non-OECD countries and within OECD, export is only permitted with notification.

iii. **Annex V**- List of Wastes subject to Export Prohibition

Annex V has three parts namely Part 1 which is divided into List A (export banned to non-OECD countries) & List B (export potentially permitted) and Part 2 & 3 (only to be considered provided waste does not appear in List A or B of Part 1) which are prohibited for export to non- OECD countries (refer to Appendix II in page 204).

Imports for disposal from countries that are parties to the Basel Convention are allowed in the EU unless a specific Member State bans them on environmental grounds. All imports for disposal are subject to the procedure of prior written notification and consent outlined in the WSR. The WSR is directly applicable in all Member States but some variations arise due to the implementation of the national enforcement authorities. Notwithstanding all these efforts, much of the Europe's WEEE are exported illegally to the developing economies of the world (Lewis 2010). In the EU, trade in products is exempted under the WSR where a product is defined as for reuse without prior refurbishment, provided by General Product Safety Directive 2001/95/EC (Maxianova 2008). To escape the scrap trade watchdogs, waste is continually exported in the guise of products (Ioan et al., 2010). In 2005, 18 European seaports had around 47% of illegal materials (including WEEE) amidst waste destined offshore (Greenpeace 2009). According to the European Commission (EC) only 33% of e-waste is properly treated, 13% is landfilled and the remaining 54% flows out of the EU to the developing world. Many countries in the latter category endeavour to check the inflow of such waste in their territory. One of the major recipients of WEEE, India has also recently laid down a regulatory guideline circumscribing e-waste imports. The following discusses the nature of e-waste regulation in India and its clauses and guidelines for WEEE import.

2.4.3. **National Legislation: E-waste Rules in India**

The E-waste (Management & Handling) Rules were only implemented in India from May 2012 (under the Environment Protection Act 1986) following its notification in May 2011 by the Ministry of Environments & Forests (MoEF[6]) under the Government of India (GOI). The legislation covers all IT & telecommunication equipment and consumer electronics outlined in Schedule I of the Rules (refer to Appendix III in page 205) which excludes all lighting equipment. Prior to this, e-waste was governed under the Hazardous Material (Management, Handling and Transboundary Movement) Rules, 2008 (hereafter HW Rules, 2008). The draft E-waste Rules had a strict import clause which stated 'Every producer(s), dealer(s), collection centre(s), refurbisher(s), dismantler(s), recycler(s), auctioneer(s) consumer(s) or bulk consumer(s) shall not import used electrical and electronic equipment in India for use' (No 16 in Chapter VI: Miscellaneous in Draft E-waste Rules, 2010). However, this section is missing in the final version of the Rules. The HW Rules 2008 still direct e-waste export and import (EXIM) policies and declares that hazardous waste can only be imported if it is for recycling, recovery or reuse and NOT for disposal (Chapter IV on Import and Export of Hazardous Wastes in the HW Rules, 2008). As a non-OECD country, India's procedure for import of non-hazardous waste for recovery is compiled in the Commission Regulation (EC) No 1418/2007 which states that India abides by,

[6] Ministry of Environments & Forests in India is the nodal agency for planning and overseeing the implementation of policies on environment and forestry.

'All waste listed in Annex III of WSR is subject to 'Other control procedures to be followed in the country of destination under applicable national law'.

(Commission Regulation (EC) No 1418/2007)

Hence, in practice it allows import of all green listed waste. Additionally, the HW Rules state that the following categories of e-waste can be imported into India.

i. **PART A: List of Hazardous Wastes applicable for Import with Prior Informed Consent which are Categories relating to WEEE in Annex IV to the WSR or Annex VIII to the Basel Convention**

- **A 1180**: Waste Electrical and electronic assembles or scrap containing, components such as accumulators and other batteries included on list A, mercury-switches, activated glass cullets from cathode-ray tubes and other activated glass and PCB-capacitors, or contaminated with Schedule 2 constituents (e.g. cadmium, mercury, lead, polychlorinated biphenyl) to an extent that they exhibit hazard characteristics indicated in part C of this Schedule (refer B1110)

ii. **PART B: List of Hazardous Wastes applicable for Import not Requiring Prior Informed Consent which are Categories relating to WEEE in Part 1 List B to Annex V of the WSR or Annex IX to the Basel Convention**

- **B 1110**: Electrical and electronic assemblies
  - Electronic assemblies consisting only of metals or alloys*
  - Waste electrical and electronic assemblies scrap (including printed circuit boards) not containing components such as accumulators and other batteries included on list A, mercury-switches, glass from cathode-ray tubes and other activated glass and PCB capacitors, or not contaminated with constituents such as cadmium, mercury, lead, polychlorinated biphenyl) or from which these have been removed, to an extent that they do not possess any of the constituents mentioned in Schedule 2 to the extent of concentration limits specified therein **
  - Electrical and electronic assemblies (including printed circuit boards, electronic components and wires) destined for direct reuse and not for recycling or final disposal.

* Import permitted in the country for recycling/reprocessing by units registered with MoEF/CPCB and having DGFT[7] license.

** Import permitted in the country by the actual users with MoEF permission and DGFT license.

(Schedule III PART A & PART B of HW Rules, 2008)

E-waste with similar items (like electrical and electronic assembles) is covered under both A1180 & B1110 in the Indian legislation. Also, the EU bans the former for export to non-OECD countries and potentially permits the latter. This reveals the ambiguity in the different laws that can confound consistent application. There are several differences between the European and Indian WEEE laws.

[7] Directorate General of Foreign Trade is under the Ministry of Commerce and Industry, GOI responsible for guiding Foreign Trade or EXIM policies in India.

Unlike the European countries, India excludes all lighting equipment. Lights, bulbs and other luminaries are electrical products that contain poisonous mercury like most electronics. Hence, in the present scenario, the understanding of e-waste differs between the EU and India. Additionally regarding the EXIM policies, India permits hazardous waste imports for reuse, recovery and/or recycling while the EU forbids export of hazardous waste destined for recovery to non-OECD countries. This discrepancy between the laws of the sending and recipient countries culminates in erratic implementation. A contraband waste shipment which escapes scrutiny at the EU end can be allowed in India which also permits import of similar EEE products with or without prior informed consent. The latter accepts some second-hand electronics with a special state license. Often, disparate classifications of waste and non-uniform legal parameters on its flow lead to contradictory trade guidelines for WEEE, rendering the monitoring of transnational illicit consignments difficult. The waste stream that leaks out of the legal purview is frequently subjected to unsafe recycling. This exemplifies that the co-processes of international waste movements and local waste managements must be governed together. The following elaborates on the different practices and patterns of informality in e-waste vis-a-vis formality which is the favoured mode of WEEE management.

2.5. **Formality and Informality in E-waste Management**

Generally, the technology, infrastructure and processing environment varies between formal and informal e-waste treatment. In principle, the former is environmentally superior. Formal recycling companies are usually recognised, registered and regulated (by the state) and perform controlled technologically advanced and capital intensive methods that must abide by environmental standards and require high capital investment. In contrast, informality involves backyard manual and labour-intensive practises. Informal e-waste entrepreneurs (and workers) seldom have licenses and conduct small-scale and less sophisticated processing that can be potentially hazardous (Li & Tee, 2012).

There is a high persistence of informality in waste collection and recycling in the developing economies (Boeni et al. 2008). In China, approximately 0.7 million people derive their livelihood from the WEEE industry with 98% of them engaged informally (Yu et al., 2009). The growth of an extensive informal WEEE business in these economies can be attributed to the absence of

i. Infrastructure for appropriate waste management,

ii. Legislation dealing specifically with e-waste, and

iii. Any framework for end-of-life product take-back or implementation of extended producer responsibility.

(Nnorm & Osibanijo, 2007: 855).

Prospects of profit from waste recycling also contribute to the growth of huge informal scrap yards. Vibrant markets exist for reusable secondary EEE and precious metals recovered from WEEE in the developing context where traditionally waste is considered as a resource (C. Hicks et al. 2005). This is manifested in the case of e-waste informal players in Bangalore who exploit the ‘economies of disassembly’ by generating value (and thus yielding profits) through the dismantling and recycling of WEEE (Reddy, 2013). Often the informal labour involved is exploited by the small e-waste

entrepreneurs who have mushroomed across Asia (Iles 2004). These industrious businessmen usurp the bulk of the revenue, leaving the informal workforce just enough for their sustenance (ibid). While the governments of the developing nations as well as the waste workers are not unaware of the problems of WEEE processing, they do not want to forego the revenue generated from it. Without an overarching international consensus and strong national laws, the challenges of illicit WEEE transfer and its health and environmentally hazardous treatment are unlikely to disappear (ibid).

The increasing e-waste generation in the industrialising countries has not been matched by the development of safe treatment strategies (Oteng-Ababio 2010). The informal techniques are dominated by 'stripping of metals in open acid baths, removal of electronic components from printed circuit boards by heating over a grill, recovering metals by burning cables and parts' (Yu et al. 2010: 991). This results in disproportionate environmental burden on poor communities who process toxic e-waste without any protection and rights, constituting a gross violation of environmental justice principles. This is raised by Iles who contends that WEEE characteristically reaches areas where 'pre-existing institutional and political conditions intersect with social and economic developments to create vulnerable populations' (Iles 2004: 83). Informal methods of WEEE management entail the following processes,

a. Reuse: Second hand trading of products for use as originally designed.

b. Repair: Servicing non-functional appliances or their components to working condition, to sell them for reuse.

c. Refurbish: Upgrading appliances, externally or internally for subsequent resale and reuse.

d. Disassembly & Dismantling: Manually separating parts and components like casings, external cables, CRTs, PCBs, batteries, metals, plastics and glass for further resale.

e. Recycle: Reclaiming material streams from WEEE and converting them into secondary raw materials. Consists of primitive hydrometallurgical processes like dissolution in strong acid solutions. Plastics are manually removed and mechanically shredded for separation (by colour or density) before further grinding.

Source: Modified from (Khetriwal, Kraeuchi, & Schwaninger, 2005; Tsydenova & Bengtsson, 2011)

Disposal methods like landfilling and incineration (with or without energy recovery) are followed in both informal and formal sectors, albeit in a mechanised and safer environment in the latter. In many industrialised countries, the EoL processing of e-waste is legally entrusted on the EEE producers who might delegate whole or parts of the chain to selected and specialised partners. The formal applications of WEEE treatment can be classified as below.

a. Sorting/disassembly: Manually removing hazardous components (like batteries, mercury lamps, CRTs and PCBs) which involve separation of a product into all of its components.

b. Size reduction: Mechanical or physical processes like shredding and fragmentation which break down products into relatively homogeneous streams for salvaging reusable and recyclable components/materials.

c. Separation: Relatively sophisticated separation methods which include detoxification of the output thermally, chemically and metallurgically from the previous stage to recover materials.

Source: Modified from (Dalrymple et al., 2007; Huisman, Wang, et al., 2012)

An interesting point which is missed in the literature is the stark contrast in the level of technological sophistication in the formal production of EEE vis-à-vis the rudimentary methods and infrastructure of informal management of the same products. This exposes a crucial disparity between the investment in Research and Development for the upstream and the downstream of the product life-cycle. WEEE formality and informality are contingent on location, context, and the scale of operations. Regional and national legislations restrict informal e-waste management to divert the waste from unregulated dumping and harmful recycling. Together with the laws on waste movement, these comprise the legal mechanisms that are devised to contain WEEE in the formally regulated realm and are discussed in the subsequent section.

2.6. **Regulating the WEEE Management**

The regulations on e-waste processing are attuned to and function in conjunction with the regulations on e-waste movement. Together they affect the global trajectory of WEE and its nationally discrepant processing. Most regulations on treatment entail official systems of accountability that assign the responsibility of the same on the producer (manufacturer and/or importer), following the notion of EPR.

2.6.1. **Extended Producer Responsibility (EPR)**

Based on the 'Polluter-Pays' principle, the concept of EPR makes the manufacturers liable for the environmental consequences of their products. The definition of EPR according to OECD is:

"An environmental policy approach in which producers' responsibility for a product is extended to the post-consumer stage of a product's life cycle including its final disposal."

(Nnorom & Osibanjo 2008b: 845)

EPR has been enacted in many industries like battery, packaging and automobiles to minimise the amount of waste destined for landfills (Atasu & Wassenhove, 2012b). It considers the entire product life-cycle to connect the design and the recycling stages. It incentivises the producers to use more environmentally sound products or designs in the upstream manufacturing process since the obligation of the EoL management of the equipment rests on them. EPR approaches can either be regulatory or voluntary and are enabled through different administrative (recovery obligation, emission limits, landfill bans), informative (environmental labelling and reports) and economic (product taxes, advance recycling fees, virgin material taxes) instruments (Nnorom and Osibanjo 2008). It ideally reduces waste generation, incorporates eco-friendly designs in production, promotes use of reusable and recyclable materials and minimizes natural resource extraction. It is mandated in the EU Member

States through the WEEE (governing the eco-friendly management of e-waste) and the RoHS Directives (limiting the quantity of six hazardous substances in new or non-historical EEE). Japan has also delegated producer take-back programmes and upstream design conditions under EPR (Puckett and Smith 2002). Many other developing countries have also reproduced versions of EPR to successfully guide green e-waste management. China, South Korea and Taiwan in their national legislations have obligated manufactures, distributors and retailers to undertake reuse, disassembly or disposal themselves or pay fees to recycling management bodies.

Despite receiving considerable attention in the international policy circle, EPR is not without contention. It cannot allocate a fair share of responsibility among the diverse stakeholders in the WEEE chain. If production determines responsibility then since Asia has emerged as an important computer manufacturing region, it should shoulder its share of take-back (Iles 2004). But in reality often these Asian companies work as subcontractors to giant multinationals and only tackle a small component of production for them. The greater the number of players in the business, the more difficult it is to ascertain responsibility between the different subcontractors supplying a mother manufacturing company (Terazono et al. 2006). Additionally, the cost of EPR implementation can impose a financial burden on small manufacturers and importers (including distributors and retailers). The adverse economic implications of enforcing EPR can affect the industry's competitiveness, innovation, technological upgrading and efficient business pursuits (Atasu & Wassenhove, 2012b). Finally, just the existence of EPR is not a guarantee for environmentally safe e-waste treatment. Successfully operationalizing it requires infrastructural coverage, widespread collection channels, and consumer awareness with suitable incentives and/or disincentives. In Japan, along with EPR, the consumers are liable to pay a recycling fee during disposal and are charged for WEEE transport. Switzerland also imposes ARF (Advanced Recycling Fees) on the consumers, paid during the purchase and used towards recycling expenditure. E-waste management in other European countries (that constitute the EU) are guided by Directives, enumerated below.

2.6.2. **European Directives and Regulations**

The scale of the European market for EEE is only second to the US (Gay et al., 2006). The EU countries consume a variety of such products and generate sizeable quantities of WEEE. In 2012, 9.9 million tons of e-waste was produced within the EU (http://www.step-initiative.org/index.php/overview-eu.html accessed on 3 Nov 2014). The E-waste Directives and Regulations designed by the EU aim to uphold the principles of 'reduce, reuse and recycle through legislating take-backs or recycling systems and regulating the content of toxics' (Williams et al., 2008).

An EU Directive provides the legal basis for establishing national laws on specific issues in the Member States, without dictating the choice of methods which is left at the discretion of the national authorities. National legislations (transposed from the Directives) are targeted to achieve an end result within recommended time periods, failing which the EC (executive body of the EU, responsible for proposing legislation and implementing decisions) can take legal proceedings against the country in the European Court of Justice. A Directive is different from an EU Regulation (like the WSR) which once passed, is legally binding with immediate effect simultaneously in all the Member States and is

at par with the national laws. Approval of a Directive is typically subjected to a co-decision process where the EC prepares it in consultation with the national experts and presents it to the European Parliament and the Council of the EU for approval or rejection. The following presents an overview of the Directives applicable to e-waste management in Europe. Along with the WSR, these sets of legislations have the broadest geographical scope and currently cover 28 Member States within the EU.

2.6.2.1. **WEEE (Waste Electrical & Electronic Equipment) Directive**

Enforced in February 2003, the WEEE Directive 2002/96/EC guides the collection and recycling of the EEE in the Member States. It is based on the principle of EPR to inspire product designs that facilitate easy disassembly, recycling and recovery. The ten categories of WEEE outlined in Annex IA to the WEEE Directive are enumerated in Appendix IV in page 206.

The WEEE Directive differentiates between historical and non-historical or new waste; the former resulting from the EEE placed on the market prior to 13 August, 2005. When these EEE are replaced by equivalent products fulfilling the same function, the producers supplying them should collectively bear the financial responsibility of suitable e-waste processing, paid in proportion to their market share. For other historical waste, the financing of the treatment cost should be borne by the users, other than private households. The producers can impose an additional charge, called a visible fee on the purchasing price for 8 years i.e. until 2011 (10 years for large household appliances i.e. until 2013) to finance the treatment of historical WEEE. The non-historical waste ensues from EEE placed on the market after 13 August, 2005 and the producers have to undertake its EoL management, either by putting up individual systems or through participation in collective schemes. These EEE should have proper producer identification, date when put on the market and the WEEE symbol (crossed out wheeled bin) printed visibly and legibly and no visible fee can be levied for its waste processing.

The Directive permits the Member States to adopt stricter measures and determine the roles and responsibilities of the WEEE stakeholders which lead to variations in the national e-waste regulations. It sets a minimum collection target of 4 kilograms per inhabitant per annum from private households to be reached by 31 December 2006 but none for non-household WEEE. It also requires compliance with minimum recycling objectives to be achieved by the same date (refer to Appendix VI in page 207). A few European countries like Netherlands, Belgium, Denmark and Sweden had national legislation on WEEE management before the enforcement of the Directive (Institute for Prospective Technological Studies, 2006).

WEEE Recast: Only one third of the WEEE generated in the EU is destined for collection and suitable processing (WEEE Forum, 2011). The earlier collection target was considered inadequate given the increasing consumption of EEE. It has been raised (such that more WEEE is appropriately managed at the EoL) following a recast recommended by the EC which formally adopted the new WEEE Directive 2012/19/EU in 2012. The Member States are allowed until 14 February 2014 to update their national WEEE Regulations in line with the recast.

The collection targets of the recast WEEE Directive initially remain the same till 2015 and are then increased. From 2016, they are no longer based on per inhabitant but instead on a percentage of the amount of EEE placed on the market or the amount of WEEE generated. The recast recommends a minimum collection of 45% (by weight) of EEE put on the market between 2016 and 2019 and from 2019, 65% of EEE put on market or 85% of the WEEE generated (depending on how the Member States measures its targets). It also widens the scope of product application. From 15 August 2018, the WEEE will be divided into six new categories to the WEEE Recast, for the purpose of differentiated recovery and recycling targets. For recovery, the Member States must ensure that producers meet the minimum recovery targets set out in Annex V to the WEEE recast. For WEEE shipments, any export must abide by WSR with the additional clause that the EC has to establish rules for the exporters to prove that the WEEE treated outside EU occur in conditions equivalent to those set out in Annex V. One of the pertinent challenges of estimation for the WEEE recast is that '…..in Europe as a whole, there are no established methods for determining how much EEE is placed on market or the amount of WEEE that is generated. Without overcoming these knowledge gaps, it will be difficult to demonstrate that it will meet the new EU collection targets, or even determine how much additional WEEE must be collected in order to meet them' (Huisman 2013: 3)

2.6.2.2. **RoHS (Restriction on Hazardous Substances) Directive**

The RoHS Directive 2002/95/EC was adopted in 2003 by the EU. It applies to the EEE placed on the market after 1 July 2006 provided they fall under the WEEE Directive (except Medical devices and Monitoring and Control Instruments) and to electric light bulbs in households. It bans all new EEE containing higher than maximum allowed levels in parts per million (ppm) by weight of homogeneous material of six hazardous materials namely lead, cadmium, mercury, hexavalent chromium, polybrominated biphenyl and polybrominated diphenyl ether flame retardants. The limits do not apply to the weight of the finished product or to a component, but to a single substance that can be separated mechanically. The RoHS requires the substitution of these substances in EEE by less hazardous materials.

RoHS Recast: The RoHS Recast Directive 2011/65/EU repealed the original Directive. It was adopted on 8 June 2011 and requires the Member States to transpose the requirements by 2 January 2013. While restriction on the hazardous substances continues as in the earlier version, the EC is required to periodically review the list. Following the recast, the manufactures have to maintain technical documentation and implement production control along with a registry of nonconforming products. The finished EEE has to display the European Safety or CE mark (showing that the product is in compliance with one of the EU Directives), manufacturer's name, trademark, contact details, batch and/or serial number.

2.6.2.3. **Eco-Design Directive**

To minimise the energy consumption and other environmental repercussions of energy using and related products, the Eco-Design Directive 2009/125/EC sets an EU-wide framework to prevent disparate national legislations. It applies to domestic and imported electrical appliances placed on the EU market and covers energy-related products. It obliges manufacturers and/or importers to reduce

the repercussions of their products on the environment, including the resources consumed during production like material and water use. It requires the producers to reduce polluting emissions and increase product recyclability. It establishes a list of 10 EEE product groups (refer to Appendix V in page 206) to be considered in priority for implementation measures in 2009-2011. The measures set for minimum ecological requirement for each group of products are adopted by the Member States. Information regarding the product's energy efficiency (characteristics, performance and ways to reduce environmental impact during usage) must be visible (if possible on the product itself) to allow the consumers to make an informed decision during purchase.

2.6.2.4. REACH (Regulation on Registration, Evaluation, Authorisation and Restriction of Chemical)

The EU enforced REACH on 1 June, 2007, to be implemented in phases till 2017. REACH is designed to evaluate the hazardous properties of chemical substances that are manufactured and marketed in the EU to control their detrimental consequences. At the end of 2017, every company manufacturing or importing chemical substances into the EU in quantities of 1000 ton or more yearly has to register these substances with European Chemicals Agency in Helsinki, Finland. The quantity to be registered is reduced to a 100 ton per annum by 1 December 2013 and one ton per annum by 1 June 2018. The use of high risk substances has to be controlled and substituted by non-hazardous ones over time without affecting innovations in the chemical industry. Thus companies must identify the risks in the substances, convey their safe usage to the users and work with the other companies using the same substance. REACH is the overarching regulatory guideline that replaces and develops on earlier legislations and is considered to be the strictest law on risky chemical substances till date (http://www.nexreg.com/regulatory-services/reach-compliance accessed on 05 November 2014).

Detailed and comprehensive, these Directives are expected to have far-reaching impact. Apart from improving the environmental standards, they also entrust the private players (producers and users) with increased responsibility. Furthermore, they compel the non-EU firms who sell in the EU to abide by acceptable product rules and standards. The following focusses on the Indian E-waste Law on WEEE management to portray its scope and implementation.

2.6.3. E-waste management in India

The process of drafting the Indian E-waste Rules started in 2004 after a report on the menace of illegal e-waste imports by an NGO called Toxics Link [8](TL) in 2003. A National Level Workshop, organised by GIZ (German Agency for International Cooperation, erstwhile GTZ or German Agency for Technical Cooperation) involving MoEF and CPCB (Central Pollution Control Board)[9] raised the need for a separate legislation on e-waste. Eventually, the electronics industry represented by MAIT[10] was pressured by organizations like Greenpeace to take responsibility for e-waste treatment, storage and disposal facilities. Finally MAIT, TL, GIZ and Greenpeace drafted the Rules and submitted it to

[8] TL was the first organisation in India to address the issue of e-waste in 2002.
[9] The CPCB is a statutory organisation that provides technical support to the MoEF, GOI.
[10] Formed in 1982, MAIT represents about 90% of the IT hardware industry in India including ICT Manufacturing, Training, Design and Research & Development and associated service sectors in the country.

the MoEF in 2009. After revision, it was published in the Gazette Notification, May 2010, to invite suggestions from the stakeholders following which they were notified in May 2011 for final enactment in May 2012.

Following EPR, the law holds the producers financially and organizationally responsible for recycling of WEEE ensuing from expired products and historical e-waste (from EEE available in the market on the date of the law enforcement). Producers can operationalise EPR either individually or by joining a collective scheme. The Guidelines for the implementation of the E-waste Rules state that the producers must obtain an authorization from the CPCB on a pan-India basis. The collection targets are set at 20% of the weight of the products placed on the market in the previous financial year. These guidelines accompany the Rules and would be periodically updated. The one year window between the notification and the actual implementation of the law allow the stakeholders preparation time. In that period, the GOI took up awareness campaigns among general public and e-waste specific actors. The DPCC (Delhi Pollution Control Committee) intimated the bulk consumers (selling e-waste through auctions) and the scrap dealers (buying and processing WEEE) of the requirements of the law through a public notice in 2010 (refer to Appendix VII in page 208).

The provisions of RoHS are to be fulfilled within two years from the date of commencement of the E-waste Rules i.e. from May, 2014. The information on the constituents of the equipment must be provided in the product booklet showing the reduction in the hazardous materials in manufactured or imported EEE. The e-waste collectors and recyclers are required to seek authorization from the respective SPCBs (State Pollution Control Boards) and PCCs (Pollution Control Committees). The Rules cover all the WEEE stakeholders like the producers, collectors, (bulk) consumers, dismantlers and recyclers but not the distributors, retailers and refurbishers. A crossed-out wheelie bin symbol has to be affixed to the EEE or on the information booklet to prevent its dumping in garbage bins. The authorization requirements and the duties of the concerned authorities (CPCB, SPCB and Municipalities) have been finalised in Schedule III of the Rules.

The European regulatory apparatus has long been institutionalised in the context of high electronics consumption and waste production. Hence, the processing infrastructure like collection mechanisms and recycling techniques are comparatively stronger in Europe than India. Europe has been acknowledged as a pioneer in WEEE regulations and management practises. India, on the other hand is an emerging country with growing per capita usage of EEE and waste generation. The law in India has been inspired by European regulations and both uphold EPR in a bid to formalise the e-waste landscape. The legislative frameworks at various levels influence the overall structure and functioning of waste flow and formal and informal modes of management.

2.7. **Identifying the Gaps in the E-waste Literature**

This penultimate section evaluates the different strands of research on informality in e-waste production and processing to reflect on the issues raised and debated. It also identifies the important areas where the literature is silent or weak in its understanding of the phenomenon. WEEE research has originated from distinct and cognate disciplinary backgrounds like environmental management, industrial ecology, toxicology, developmental studies, chemical engineering and public policy. One of

the primary emphases in the literature has been on the analyses of the hazardous waste material flow and treatment methods (Tsydenova & Bengtsson 2011; Yoshida et al. 2009; Townsend 2011). Use of WEEE as resources to reclaim valuable metals and components have also attracted attention (Kakkar 2012; UNEP 2009). The repercussions of e-waste TBM and its unsafe processing have been studied along with the relevant international and national legislations (Ongondo & Williams, 2011; Sthiannopkao & Wong, 2013; Yu et al., 2010). In this context, the idea of producer's accountability throughout the products' life cycle has been reviewed using EPR (Atasu & Wassenhove, 2012a; Eik, Røine, & Brattebø, 1998; Khetriwal, Kraeuchi, & Widmer, 2009). Policy oriented studies have recommended formalisation or incorporation of the informal sector with formal recycling facilities by legislative, institutional or economic schemes for an inclusive WEEE treatment system (Huisman, Wang, et al., 2012; Li & Tee, 2012; Raghupathy & Chaturvedi, 2013). The pervasive informality in the e-waste landscape of developing countries is emphasized and the ecological consequences of the same are documented (Wath et al., 2010; Xinwen et al., 2011; Yu et al., 2010). Scholarship on WEEE legislations has portrayed the (un)coordinated and largely unproductive regulatory attempts that favour and endorse formal processing over informal undertakings.

The prevalence and prominence of informal e-waste management have been emphasised in most existing studies. However, the nature and nuances of informality that is institutionally embedded in the cross-country e-waste network have not merited sufficient deliberation. Primarily, the prevalent literature lacks an investigation of the scope, scale and location of informality (vis-a-vis formality) in light of specific legislative principles. This major area of enquiry has been left unaddressed compromising a clear comprehension of the globalized informality in e-waste transfer and treatment. Informality recycles a bulk of the waste generated and additionally generates profit from secondary circuits of value through the dismantling and treatment of WEEE (Reddy, 2013). The rationale behind the persistent presence of informality in the developing context has been elucidated by Chi et al, 2011 (733) as,

a. unwillingness of consumers to pay for disposal of their old EEEs,
b. high level of importation of e-waste as second-hand devices,
c. lack of awareness among consumers, collectors and recyclers of the potential hazards of e-waste,
d. insufficient investment to finance establish and maintain a recycling infrastructure,
e. absence of effective take-back programs for end-of-life EEE,
f. absence and/or lax implementation of e-waste specific legislation

Yet, no analytical explanation behind these patterns is offered. Despite stressing that 'the two sectors overlap at certain stages and sometimes highly relate to each other' (Chi et al. 2011: 736), these overlaps or relationships are left unexplored. The regulators' understanding of and influence on the overall constellation of the WEEE network and its formal and informal players (and their inter-relations) have not been challenged. But how and why these formal-informal linkages are developed, managed and institutionalised should be deconstructed given that they characterise the waste

recycling phenomenon. The causality behind and correlation between the above factors should be interrogated to render the e-waste narrative complete and comprehensible. Hence this thesis systematically explores how formal-informal associations inspire and propel the geographies of e-waste and the generation of value therein. It further looks into the impact of multi-scalar legal provisions on the global contours of e-waste and the preponderance of informality therein. It examines how informality and its nexus with formality endure in spite of the diverse regulatory approaches. Without a comprehensive grasp of these dimensions, the environmental degradation and occupational hazards of backyard informal recycling cannot be redressed.

The WEEE literature emphasises that although 'external and inherent attributes of informal recyclers differentiate them from formal recyclers from a range of technological, environmental and institutional criteria, in the actual recycling chain there may not always be clear splits between the formal and informal sectors' (Chi et al. 2011: 736). However, regulatory authorities fail to recognise the interconnections between e-waste formality and informality. This is exemplified by their endeavour to formalise the informal sector. They are trapped within a dualist notion of formality and informality in waste operations and strive to replace the latter with the former. To be able to target and transform the informality in WEEE, it is imperative to comprehend its primary drivers. It is crucial to fathom what guides and informs the landscape of waste processing, its architecture and the connections behind the dispersed processes and actors. However, the available research on e-waste has not investigated these aspects that condition and stimulate the predominance of WEEE informality.

These glaring research gaps are confronted here to conceptually and empirically address them. For this purpose, this study selects and investigates appropriate geographical locations as case studies that offer important lessons for holistically understanding the e-waste phenomenon. Through these cases, it first traces the international WEEE trajectory that flows across and connects formal and informal spaces. Thereafter, it reflects on the formal-informal linkages in the reverse supply chain of e-waste based on this mapping. It elucidates the roles, motivations and vulnerabilities of the multitude of informal actors and their relationships with their formal counterparts. The WEEE literature has not dissected and analysed the structural and functional nexus between formality and informality in e-waste operations. This is vital to understand the position and function of informality in the waste economy with its diverse capital and labour processes. This explains the purpose and rationale of informality in e-waste and clarifies how it relates to and links up with the broader socio-economic and regulatory environment. Again the research on e-waste has not unpacked the effect of regulations on informality that can be used to formulate informed laws and policies. So this study elucidates the impact and consequences of legislative institutions on informality in worldwide waste circulation and management paradigms. This contributes to the understanding of the myriad and complex drivers of pervasive WEEE informality. Following this line of enquiry, the subsequent research questions have been designed.

Main Research Question: What drives informality in e-waste movement and management?

i. How does e-waste flow along the reverse supply chain from the point of its generation?

ii. What is the nature of transactions defining the formal – informal linkages in the process of e-waste disposal and recycling?

iii. How does the regulatory environment influence the informality in e-waste processing?

Thus, this research charts the flow of e-waste at multiple scalar levels. It confronts the monolithic notion of informality and explores its diversities and linkages. It deliberates on how institutions mould particular socio-economic practices on waste and the notion of value embedded in it. Therefore, overall it analyses the persistent informality in WEEE movement and management within a certain legislative background to locate its drivers using a theoretical and empirical lens.

2.8. **Conclusion**

This chapter presented the context and critical overview of the comprehension of growing informality in e-waste in the literature. It does not encompass the entire spectrum of e-waste scholarship till date but concentrates on the issues relevant for this research. It identifies the fundamental knowledge gaps in understanding the diverse informal actors, their practices and linkages with the formal players in the global WEEE network. The scholarship on e-waste has observed that though endowed with unique features, the formal and informal realms of waste management co-constitute the economic system of value production from e-waste. Despite the variations in their technology, institutions and environmental outcomes, formal and informal WEEE activities are conjoined and interlaced.

This chapter established that to further the present understanding of persistent informality in global e-waste transfer and treatment in order to properly manage it requires the following exercises. An in-depth investigation of the formal-informal linkages is needed to reflect on the principal forces and factors that work together to orchestrate the complex and dense waste network. The spatial dynamics of the e-waste stream can only be fathomed by looking at the behaviours of and associations between the (formal and informal) players and the implications of their operations. They are largely guided by the socio-economic, political, cultural and legislative environment that these actors (and their interactions) are embedded in. Particularly, the regulatory frameworks governing ecological waste activities shape its overall constitution and formal-informal exchanges. Using these insights, this thesis uncovers the drivers of informality in e-waste to create a credible polemic of the phenomenon. For analysing the multiple facets that condition and are conditioned by the WEEE network, discrete and related bodies of scholarship are used to enrich and expand the comprehension of this issue. The next chapter engages with the various theories, concepts and ideas that form the basis of the conceptual analysis of the e-waste problematic.

CHAPTER 3:

CONCEPTUALLY RETHINKING FORMALITY AND INFORMALITY IN THE GLOBAL E-WASTE NETWORK

3.1. **Introduction**

The previous chapter has highlighted the major challenges and concerns of e-waste production and processing as illustrated both in the literature on the subject and through the regulatory frameworks implemented at the national, regional and global levels. An important area of enquiry, namely the analysis of the structural connections and intersections between the formal and informal realms of waste treatment, which is a fundamental feature of the international WEEE system, has been left unattended. This chapter asks the question: What concepts or theories are required to comprehend the regulatory impact on the inter-relationships between formality and informality that affects how e-waste flows and is managed? Hence this chapter engages with different strands of literature to further the understanding of the multi-faceted formal-informal linkages in the global architecture of waste movement and management and the role of institutions therein. The concepts elaborated here would be subsequently applied to examine the proposed empirical case.

From the 1990s, two inter-related analytical approaches, namely the GVC and GPN frameworks, have been developed to examine the decentralisation of production on a global scale and its economic and socio-spatial outcomes (Gereffi, Sturgeon, & Humphrey, 2005; Henderson, Dicken, Hess, Coe, & Yeung, 2002). These frameworks are used to analyse cross-country production and distribution networks across a range of sectors, like garments, electronics, and horticulture (Bair & Peters, 2006; Barrientos & Barrientos, 2002; Dedrick, Kraemer, & Linden, 2011; Dedrick & Kraemer, 2002; Dolan & Humphrey, 2000; Gereffi, 1999; Sturgeon, 2002). Waste is a relatively new addition in these studies and the international trajectory of EoL ships, used clothing, cars and e-waste has been recently documented to connect the patterns of consumption in the Global North to secondary productive mechanisms of reuse and recycling in the Global South (Brooks, 2012, 2013; Crang et al., 2012; Lepawsky & Billah, 2011; Lepawsky & Mather, 2011; Lepawsky, 2014). By transcending traditional sectoral analysis, the GVC (and GPN) approach is useful to unravel the linkages and dependencies in economic activities spanning formal and informal sectors (Kaplinsky & Morris, 2002). However, the 'theoretical and empirical attention to informality remains rather limited in the contemporary study of GPNs (Phillips 2011: 381). An extensive literature is available on the informal sector providing its theoretical foundations and locating it in the long-term political economic structures and processes (Bangasser, 2000; Gerry, 1987; Portes & Castells, 1989), which has been largely disregarded in the chain and network discourse. The current project theoretically incorporates and empirically investigates the nature of interfaces and intersections between WEEE formality and informality. Hence, along with a critical review of the GVC and GPN frameworks, this chapter expounds the discourse on formality and informality and simultaneously focusses on the production of value (derived from secondary e-waste resources) by drawing upon Marxian notion of circuits of

capital. This would demystify the capital-labour relations in formal and informal e-waste operations and explain the differential returns acquired from waste activities. However, this chapter does not provide an exhaustive account of the disciplines and discourses used. Instead, it selectively discusses the concepts and theories that are pertinent to the research at hand.

The chapter is organised as follows. The subsequent section presents an appraisal of the GVC scholarship by outlining its categorisation of (firm-level) governance and supplements it with the role of social networks in configuring informal (waste processing) clusters. The third section introduces the GPN literature as an improvement over the limitations and critiques of GVC and focuses on its recent studies on waste. It enquires into the understanding of value in GPN and develops it through the Marxist exposition on circuits of capital. The fourth section deliberates on the formality-informality discourse, stressing its emergence and various schools of thought. It demonstrates how incorporating these theories can enrich the analytical currency of the chain and network genre. The fifth section combines the different theories to develop the conceptual handle that would be used to guide the analysis of the empirical case. Finally, the conclusion summarises this chapter.

3.2. **The Internationalisation of Production: Global Value Chain Approach**

The contemporary capitalist economy is largely orchestrated by increasing internationalization of production and trade connecting remote localities and actors in a complex and variable system of functional dependency, competition and cooperation. In this context, the GVC framework (rooted in International Political Economy) provides valuable insights into the organisational decentralisation of economic operations in global industries and the diverse strategies of firms that cohesively integrate these myriad processes (Bair, 2009). The section below reviews the basic tenets of the GVC scholarship and discusses its evolution. It explains its conceptualisation of governance which is concentrated on the functioning of big firms and their suppliers. It also contemplates the role of social networks in the informal modes of governance from the industrial clusters literature.

3.2.1. **Unpacking the Tenets & Evolution of the GVC Paradigm**

The historical antecedents of the GVC approach can be traced back to the World-System theory of the 1970s, which explains the process of uneven capitalist development between nation-states through geographically unequal division of labour and the consequent appropriation and transfer of surplus (Chirot & Hall, 1982; Hopkins & Wallerstein, 1986). Subsequently, the Global Commodity Chain (GCC) approach was proposed to explain the asymmetrical distribution of returns from production and trade in the current era of globalisation. This analyses the spatial inequalities in the world-economic system and extends the scope of the latter beyond national economies (Bair, 2005).

In the 1990s, the GVC approach was developed to capture the notion of ‘value-added’ in the context of economic development and avoid using the term commodity as an ‘undifferentiated product’ (Sturgeon, 2009). It provides a heuristic framework to extensively map the geographically fragmented production arrangements within a given sector and the international division of labour within it to understand the dynamics of that sector and the consequences for the changing world economy. Value chain operations have typically emerged out of economic restructuring and transformation in

global capitalist production. The big or lead firms (usually the most influential player in the production network) strive for business competitiveness by increasingly subcontracting production, managing high-end or core functions like innovation and research, design and marketing and outsourcing labour-intensive or non-core manufacturing and services domestically or internationally in a bid to reduce costs, raise efficiency and achieve greater flexibility (Gereffi et al. 2005). The GVC approach elucidates the processes of value creation and distribution in production reorganisation and is thus emblematic of the process of globalization. It incorporates the micro level analysis of industrial upgrading and the broader developmental outcomes for specific actors, firms, regions and countries through a network-based approach (Bair, 2005; Raikes, Jensen, & Ponte, 2000). Within the global value chain, the growing dominance of particular firms over others at different nodes characterises the circulation of power and appropriation of profit.

The GVC approach analyses the supply management of a certain product or service with particular emphasis on the forms of governance that facilitate the execution of the range of economic activities along the chain. Governance is externalised in a network of independent but related firms (against the erstwhile internal governance of vertically integrated production structures) which are enmeshed in the transnational production systems. The multiple governance mechanisms in GVC manifest the ways in which firms control and coordinate production to maintain competitive advantage, create barriers to entry higher up the chains (in designing and branding) and protect monopoly profits by restricting competition. Firms improve their performance or upgrade such that they can move up the value chain where there are higher barriers to entry and greater possibilities of rent-seeking as low barriers expose them to competition that erodes profit margins. Upgrading can be elaborated as 'Industrial upgrading involves organisational learning to improve the position of firms or nations in international trade networks' (Gereffi 1999: 39) and can be achieved through product upgrading (producing more sophisticated products with higher prices), process upgrading (introducing new products or technology), functional upgrading (moving towards design and branding) and chain upgrading (moving from one industry to another) (Humphrey & Schmitz, 2002, 2008; Knorringa & Pegler, 2006).

3.2.2. **Understanding Governance in GVC**

Against arm's-length market relationship between firms, governance denotes inter-firm relationships and institutional mechanisms to achieve non-market coordination (Humphrey & Schmitz, 2001). It demonstrates the degree of organisation and asymmetrical power relations which influence the prospects for industrial upgrading and distributional outcomes (Fitter & Kaplinsky, 2001). The governance patterns are congruent with the ways chains are embedded in a particular institutional, regulatory and societal milieu and connected across varied political and spatial configurations. Situated between the macro-analysis of international trade and microeconomic theories of firm strategies (Hansen, Muller, & Pottenger, 2007), governance reflects the meso-level of industrial organisation to capture the complex forms of inter-firm linkages.

Contemporary globalization is marked by liberalised trade regimes which facilitate the flow of specialised and differentiated goods across the world. The notion of governance can describe the

novel patterns of ownership that have emerged with the practice of production fragmentation and outsourcing in a world of uneven sectoral and geographical development (Gibbon, Ponte, & Bair, 2008). Using the theory of transaction-cost economics, production network and technological capacity in firm-level learning, Gereffi et al. (2005) have extended a nuanced conceptualisation and classification of industrial governance between the extremities of market and hierarchy depending on the complexity and codifiability of transactions, and the capabilities in the supply base. Modular value chains are exemplified in cases where technically competent suppliers (called turn-key suppliers in the electronics industry in USA, by Sturgeon 2002) manage simple or complex product specifications which are easily codified without the need for the lead firm to monitor the production process. These are similar to market exchanges where many suppliers cater to several buyers in the chain but are distinct by the requirement of dense information flow in the chain. Relational value chains can be observed where complex transactions that are not easily codified are carried out through close interactions between buyers and efficient suppliers. In this case there is mutual dependence between the parties which is often 'regulated through reputation, social and spatial proximity, family and ethnic ties' (Gereffi et al. 2005: 84). Captive value chains result when low supplier capabilities, complex products and easily codified transactions require lead firm's intervention and support in the production system. Taken together, they exemplify the 'concrete practices, power dynamics and organisational forms that give character and structure to cross-border business networks' (Ponte & Sturgeon 2014: 200) that are manifested in the eventual allocation of economic activities in one or multiple nodes and the exchange of knowledge and information within them (ibid). The tactics of outsourcing without losing control over the production process are typically contingent on the market structure, consumer demand, relation-specific investment and the institutional context (Altenburg, 2006).

Hence governance in the GVC school is less about lead firms driving the chain and more about the coordination between lead firms and their immediate or first-tier suppliers (Gibbon & Ponte, 2008) and not the whole chain. It explores vertical forms of coordination by big and powerful companies to improve distant business relationships and the consequent concentration or dispersion of power (Ponte & Sturgeon, 2014). Often governance is translated into multiple relations of coordination among different nodes of the chain and influenced by external actors or non-firm entities like experts, state, NGOs and certification authorities. Gibbon & Ponte (2005) offer another conceptualisation of governance as 'normalization' where various forms of coordination are distinguished from the overall governance. Quality conventions, certifications and regulations imitate the broader normative environment in which the value chains are embedded and defy the objective assumption of quality in transaction cost economics. These norms and standards guide the nature of the resultant governance strategy adopted in the management of economic practices and interactions (Gibbon & Ponte, 2005).

3.2.3. **Role of Informal Social Networks in Governance**

GPN/GVC scholars have rarely considered informal recycling networks (exception Crang et al. 2012; Pickren 2014) where 'unlike the majority of cases studied in the literature, the global flows of these goods are not dominated by large transnational corporations' (Crang et al. 2012: 13). GVC has accorded overriding importance to the industrial organisation of firms between the extremes of arm's-

length market transactions and hierarchical integration within the firm. Increasingly firms are moving towards intermediate forms of networks from bipolar market exchanges and hierarchies to confront volatile market demand and minimise and diversify risk (Altenburg, 2006). Many scholars argue that networks are distinct governance arrangements (Powell, 1990) rather than a 'hybrid' representing long-term contractual relationships (Adler, 2001; Podolny & Page, 1998). The classification of these intermediary forms of governance by the GVC approach into modular, relational or captive has been extensively applied to research firms and their subcontracting policies in electronics, garments, horticulture and big agro-food companies (Dolan & Humphrey, 2000; Fold, 2008; Sturgeon, 2002).

But these studies are principally focussed on managing vertical chain linkages that enhance the generation, creation and diffusion of knowledge allowing formal companies can establish and shape their supply chains. The notion of horizontal or local embeddedness frequently manifested in the operations of industrial clusters are examined rarely (Humphrey & Schmitz, 2002, 2008; Schimtz, 2004). The idea of governance where a lead firm administers economic activities and profit distribution along a chain can be extended to the functions of the informal actors, (often organised in clusters). Against one lead firm strategizing on alternative governance outcomes, the repeated transactions between informal players reproduce forms of coordination, constructed through informal contracts and arrangements. Unequal power is exercised even in absence of formal hierarchy (Bair, 2009) without a singular powerful actor directing the network. Governance embodies both collaboration and conflict, like when upgrading possibilities of the weaker actors are restricted by the bigger players through creation of entry barriers into more profitable activities. Additionally, market transactions do not preclude the possibility of power asymmetries (as claimed by Gereffi et al., 2005) since the market is also a socio-political conundrum of latent hierarchies, colluding synergies and rivalries where only price signals do not determine efficient resource allocations.

Being confined to the understanding of the lead firms' manufacturing and subcontracting practices fail to sufficiently explain the modes of governance in informal (waste) operations where formal monitoring devices and measures like contracts, fines and sanctions are absent. In the absence of formal institutional arrangements i.e. operating 'outside the protective sanctions established by government and trade union' the informal or 'underground economy is particularly dependent on informal mechanisms of control' (Weiss 1987: 229). This section explores additional theories which expand the scope of governance to the realm of informality. It has been noted that 'reciprocal exchanges constitute the basis of an informal economy organised around trust-based social networks' (Lomnitz & Sheinbau 2004: 7). Studies on the nature and role of informal social networks have found that 'these mechanisms consist in a set of social connections, personal and kinship allegiances, which ensure the flow of labour market information and which connect the employer to a supply of 'trustworthy' labour' (Weiss 1987: 229). Various informal actors engage in joint economic endeavours which fundamentally requires trust (Schimtz, 2004).

Therefore these linkages are embedded in the social-cultural environment and guided by mutual expectations and dependence (Bair, 2008) where trust reduces the risk and uncertainty involved in transactions. Using the parlance of transaction costs, Williamson labels this trust as calculativeness

whereby rational economic agents reduce chances and costs of dissent and opportunism (Williamson, 2005). Granovetter (1985, 2005) negates the primacy of transaction costs by highlighting the social context and structure in which all economic transactions are engrained and constituted by networks of interpersonal ties and relationships such that 'trustworthy behaviour can be expected, normative standards understood, and opportunism foregone' (Granovetter 1995: 118). Regardless of its understanding and classification, trust represents an important element in governance structures which are not regulated by 'calculativeness, monitoring devices, and impersonal contractual ties' explicit in market transactions (Uzzi 1997: 45). Here trust is understood as extended trust which characterises complex relationships against minimal trust found in simple and direct exchanges (Humphrey & Schmitz, 1998). Like all other social relations, trust is produced and developed through time in a particular cultural and institutional context. According to Zucker (1986), trust shifts from characteristic-based, where personal attributes like family background, ethnicity and reputation support trust to process-based in which trust emerges from experience of earlier exchanges (Humphrey & Schmitz, 1998; Zucker, 1986). Alternatively, these have also been labelled ascribed trust and earned trust respectively (Schmitz, 1999). Thus social networks and structures build and maintain trust in informal interactions by lowering the costs of coordination and information exchange.

This issue has been examined mostly in industrial clusters literature like the footwear cluster in Agra, India (Knorringa, 1999), tannery cluster in Palar Valley, India (Kennedy, 1999) and surgical instrument cluster in Sialkot, Pakistan (Nadvi 1999). Clusters are 'groups of firms that are specialized within a few related industrial activities while benefiting from co-localization in a geographical sense - depending upon industry type, within the same nation, region, or even city' (Lorenzen 2002: 14). The proximity of firms fosters synergies from agglomeration presenting a foundation for upgrading and competitiveness (Humphrey & Schmitz, 2002). Knorringa (1999) studies changing inter-firm cooperation and the influence of inter-generational occupational hierarchy (or caste) in Indian societies on producer-trader relationships in shoe manufacturing. Documenting the collective action of the tanneries in Palar Valley in response to a legal order for closure, Kennedy (1999) analyses how religion and socio-cultural ties operate as regulatory control mechanisms towards successful collaboration in common effluent treatment plants. Nadvi (1999) inspects the impact of kinship, family and localness on economic behaviour and inter-firm relations in the production of surgical tools in Sialkot. He demonstrates that geographical competition and concentration favour product flow and knowledge creation that influences the trajectory of and linkages in these clusters (Nadvi & Halder, 2005). Finally, the correlation between caste-based identities and community-based relations has been teased to understand the relatively open access to informal operations by drawing from secondary literature on small firm clusters (Dwivedi, Varman, & Saxenar, 2013). Hence socio-cultural networks are mobilised in negotiating trust and enforcing reciprocity in informal economies. These relational assets are important in understanding the territorial tendencies of and institutionalised practices in informal e-waste processing networks, as proposed in the clusters discipline. Network exchanges can also be observed in decomposition and scavenging activities found in the secondary processing of EoL ships undertaken in the local agglomerations of Sitakunda Bhatiary in Bangladesh (Gregson et al., 2012). Through the mediation of trust and inter-personal ties, spatially proximate

small or medium firms benefit from a common pool of skilled or semi-skilled labour, innovations through synergy and economies of scale (Hofe & Chen, 2006). Trust can be established and reproduced over time through shared infrastructure, social similarities, exchange of resources and technology that personify clusters. Such relationships also allow clusters to access external economies for outside information, technological knowledge and experience that are crucial to the growth and evolution of clusters or 'the key linkages and networks that underpin clusters function as channels of knowledge exchange and interactive learning' (Cumbers & Mackinnon, 2004). Often local clusters fall under the rubric of a global production system which can assist or impede the cluster's initiatives and upgrading possibilities (Amighini & Rabellotti, 2006; Humphrey & Schmitz, 2002; Knorringa, 1999). Cluster formation can also have adverse implications due to free-riding and exclusion of non-members from common resources (Bathelt & Gluckler, 2005). To draw out the horizontal links articulated in social networks, the industrial clusters literature would be selectively applied to understand its purpose in informal WEEE clustering.

3.4. **Taking GVC further: Global Production Network**

Though regarded as a comprehensive heuristic framework for analysis, GVC has been critiqued for a vertical and linear conceptualisation of complex production systems (Coe, Dicken, & Hess, 2008; Henderson et al., 2002). It also suffers from a weak understanding of the role of institutions and has neglected the spatial relations in the world economy (Hess & Yeung, 2006; Rainnie, Herod, & Champ, 2011). Practically, it examines inter-firm chain ties, disregarding the relevance and influence of the non-chain actors (like the government agencies, unions and NGOs) to a large extent. To address the shortcomings of the GVC framework, the idea of GPN has been recommended, which connects multiple dimensions and scales of economic activities within the geographically dispersed network configuration. Developed by geographers, GPN advances the GVC framework to include the socio-political environment within which these networks are embedded in its analyses of the changing capitalist economy. Thus it asserts the importance of 'territoriality of institutional and regulatory contexts and state as an actor' (Rainnie et al. 2011: 159) in shaping cross-border production relations. It further elucidates processes of unequal regional development by emphasising the need to transcend predominantly state-centric economic development in face of global competition, neoliberal policies and progress in information and communication technology (Henderson et al., 2002). Though inter-related, unlike GVC (which is a firm-centred form of analysis) the GPN demonstrates that the 'nature and articulation of firm-centred production networks are deeply influenced by the concrete socio-political, institutional and cultural contexts, within which they are embedded, produced and reproduced' (Dicken 2007: 18). Variations in product and labour markets, role of state apparatus and level of industrial and institutional development of a country can both restrict and enable the functioning of GPNs. The importance of the state and its leverage towards the 'unevenness of value capture, on both the firm and the territorial level' in mediating between the different forms of governance are specially relevant in this regard (Rainnie et al. 2011: 160). The governance practices in GPN are 'the ways in which socio-spatial relations of actors are intertwined with broader structures and processes of economic change at various geographic scales' (Yeung 2005: 37). They are contingent on the socio-economic context of norms and regulations, networks of trust and reputation

and territorial arrangement (Coe & Hess, 2006). They relate to each node or site of production and the allied social division of labour which necessarily incorporates a series of non-linear relationships (Coe et al., 2008). Thus GPN in contrast to GVC accords equal footing to vertical chain and horizontal spatial ties to explore the power politics in both global and local transactions. So, it overcomes the linear and vertical construction of a production function to include the wider non-linear relationships in mapping the interaction between actors located in different or within the same node(s). The previous section on the role of social networks provides this analytical lens to explore the multiplicity of inter-personal linkages between actors posited at a particular juncture of the GPN.

Hence the GPN approach encompasses the entire gamut of chain and non-chain actors in its analyses to reflect on the spatiality of value-added activities and its dynamic constellations. It unravels the relations in and practices of transnational production arrangements and their socio-economic and institutional environment. It illuminates the labour processes involved in the creation of value along the network, the unequal exercise of power in the transfer and capture of value and the territorial embeddedness (Henderson et al., 2002). In the following section, a closer look is taken at GPN research investigating the flow of waste and the circulation of value in used and EoL goods, which is especially pertinent for the project at hand.

3.4.1. **GPN of Used Goods and Waste**

Research in GPN (as well as GVC) has largely been limited to the pre-consumption stages of raw material extraction, manufacturing and distribution (Bridge, 2008; Dedrick et al., 2011; Gibbon, 2001; Sturgeon, 2003). However, value chain in its original conceptualisation encompasses the entire range of economic activities around a product from its inception to its final disposal after use. GPN has largely bypassed the widespread practices and processes of post-consumption waste treatment, secondary material extraction and consumption (Hudson, 2008). Of late, the literature has engaged with the recycling dimension of waste with some scholars going beyond GPN's conventional usage to explore trade in discarded products like electronics, cars, clothing and derelict ships since 'geographies of recycling and the trade in used commodities are nascent economic processes which merit critical exploration' (Brooks 2012: 80). Breaking away from the focus on technology of waste management in environmental policy and urban planning (Gregson & Crang, 2010), they have explored international waste trajectories and varying (re)constructions of waste. It is contended that waste is not 'fixed in its state and location' (Davies 2012: 191) and undergoes structural transformations with shifting geographies. In the case of electronics, the multi-directional WEEE trade has been mapped globally from developed countries to Bangladesh and the creation and capture of value from informal disassembly, repair and recycling of imported WEEE and its components have been highlighted (Lepawsky and Billah 2011). This challenges the notion that value is realised only when a consumer purchases a product or service and not after it is used and discarded. It further shows that a GPN does not have a definite beginning and an end (Lepawsky and Mather 2011) where even after consumption and disposal, commodities are transformed and exchanged. The recovery of secondary resources through dismantling and disassembly of gadgets at the end of their first life-cycle connect different products, sectors and markets (Crang et al. 2012). The value derived from the

physical transformation of WEEE by formal and informal operations informs some studies in the GPN genre (Herod et al. 2013; Lepawsky & Mather 2011) that analyse the spatial life of WEEE. Apart from e-waste, GPN has also been used to explain and explore the nature and dynamics of trade in used cars, second-hand clothing and derelict ships that originate in one part of world and move to another to be reused and recycled like e-waste (Brooks, 2012, 2013; Crang et al., 2012; Gregson et al., 2010; Herod et al., 2013).

Gregson et al. (2010) 'follow the things' in the ship-breaking industry in Bangladesh to draw attention to the practise of re-working materials from EoL ships into household furniture for the domestic economy. Goods move in and out of commodity phase like the rubbish material of the ship moving into reprocessing to be demolished, separated, treated and combined into further commodities. The global movement of used garments and EoL ships demonstrates the multi-directional flows of secondary items across sectors and countries etching out international networks with complex governance arrangements (Crang et al., 2012). Brooks (2013) reveals the 'back-end' of international garments trade where the majority of the clothes donated to charities in the UK are exported to African countries (and other middle and low-income economies) to generate profit from sale of second-hand clothes. He highlights the linkages between the variable culture of (conspicuous) consumption, purchasing power and institutionalised charitable practices in the Global North and the South (Brooks, 2013). Through collecting, sorting, mending and final packaging of discarded garments, informal labour reproduces exchange-value in used clothes (with latent use-value) to produce commodities from waste. This is also exemplified in his study of second-hand cars with transnational geographies from Japan to Mozambique via Durban (Brooks, 2012) where the role and power of influential actors (extracting rent from illegal activities) and the cultural and political interplay are explored. Trade in used cars illustrates the interaction between formal and informal associations amidst different actors of the Global North and South (ibid). The importance of both formal and informal channels of reuse in the reduction of household waste in Melbourne has been underlined with the use of socio-demographic indicators to deliberate on the pattern of second-hand goods circulation (Lane, Horne, & Bicknell, 2009).

Taking this work further, Herod et al. (2013) have proposed the notion of Global Destruction Networks (GDN) which can be understood as 'networks of places where products are disassembled and their constituent parts are extracted for processing and re-use' (Herod et al. 2013: 7). Situating waste in the realm of capitalist (re)production, they emphasise the importance of labour processes in the generation and movement of value in waste products. They demonstrate that even when discarded in favour of better and trendier products, the remaining value in the products is not lost; rather transferred through GDNs. Hence, GPNs and GDNs are inherently interlinked systems of value production and distribution. The value of and in waste have been investigated (though not from a GPN perspective) by acknowledging dumping and scavenging as processes of deriving value from rubbish in a Michigan landfill (Reno, 2009) where waste circulates in different regimes of value. Pertaining to the informal e-waste sector in Bangalore, it has been presented how 'creation of extensive secondary circuits of value from circuits of e-waste' is realised (Reddy 2013: 64). But this study ignores the global continuity and connections that characterise and feed in these circuits of

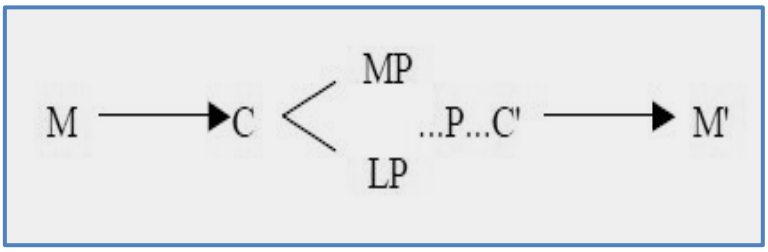
value in the e-waste landscape. Thus value has an important theoretical and analytical purchase in examining the socio-economic implications of waste movement and management within the capitalist framework. The (re)production of value in commodity production and exchange is imitated in the (re)valorisation of waste in tune with the dynamics of capital accumulation, fragmented in value chains/production networks. The GPN approach questions the distribution of value in the processes 'which at their core entail circuits of capital, and which form the nexus of functions, operations and transactions through which goods and services are produced, distributed and consumed' (Coe & Hess 2013: 4). Hence it is imperative to examine these circuits of capital wherein waste is reworked by labour. Consequently, here the original conceptualisation of circuits of capital as expounded by Marx is elaborated to demonstrate how the understanding of value in GPN can be improved by its usage.

3.4.2. **Adding Value to GPN though Circuits of Capital**

Production and exchange of goods and services essentially embody valorisation (increase in value) of capital. These operations in the circuit of capital are spatially configured through the internationalisation of production and trade in the contemporary capitalist economy. Merchant capitalism prior to industrial capitalism exemplified the geographical expansion of capital through trade in commodities (Bryan, 1987). In the current era of globalisation, the internationalisation of production and its constitution is designed to facilitate the process of valorisation. GVC conceives value as a proportion of final price captured by a particular node in the chain (Gibbon et al., 2008). GPN combines both Marxian account of surplus value and orthodox theories on economic rent[11] (Henderson et al. 2002) and both frameworks consider rent as a source of value. But beyond these qualifications, the processes of value creation and enhancement which are systemic tendencies of capitalism have been rarely explored in the GVC and GPN traditions (Bair, 2005; Taylor, 2007). Both have seldom charted the spatial flow of value in the global contours of capital. A few exceptions in this regard are Hudson (2008), Starosta (2010), Weller (2007), Johns (2006) and Herod et al. (2013); the last one has been discussed above. Based on a Marxian critique of the political economy, Starosta argues that the functioning of a GVC (and GPN) is deeply rooted in the dynamics of capitalist social relations which is articulated in value creation and distribution. Through mapping the GPN of video games and stressing their embeddedness as a cultural product, Johns portrays the unequal value capture by firms and agents depending on their position and power (Jones 2006). Weller focuses on the Australian Fashion Week to highlight the reinforcing circuits of capital through which value is transferred and augmented in trans-sectoral associations (Weller, 2007). Therefore, circuits of capital and the co-evolution of value are inherent to the construction and configuration of GPNs. Using the lens of political economy, Hudson establishes that the circuit of capital encompasses 'labour processes as well as processes of value creation, exchange and realization, in addition to the consumption of commodities' (Hudson 2008: 422).

[11] This has been questioned by Lepawsky & Billah (2010) on the grounds that Marxian theory of value and orthodox theories of rent contradict each other.

At this point it is useful to recapitulate the theory of circuits of capital as elucidated by Marx. Value in motion is 'capital' which is not a static object or structure but a definite social relation of production between the owners of means of production and labour (Marx, 1887, 1907). The movement of capital can be traced through the circuits of capital in which capitalists employ labour power to generate surplus value from production which realises profit on exchange. Capital is constantly in the process of expanding and reproducing itself through the production, appropriation and accumulation of surplus value (Harvey 1982; Fine & Harris 1979), the extraction of which is the basis of capitalist exploitation of labour. The primary[12] circuit of capital describes this motion in which industrial capital assumes different functional forms like money capital, commodity capital and productive capital in the process of its reproduction. In capital's continuous circulation, money is the first form of its appearance (Das, 2009) which is transformed into money capital (M) when used for the purchase of inputs for the purpose of production. It is exchanged for commodities (C) which constitutes means of production (MP) like raw materials, machinery and energy and labour power (LP). On combining LP with MP under the capitalist mode of production, capital takes the form of productive capital (P) for the creation of new commodities, C'. This C' is of greater value than the original elements of production or it has surplus value i.e. the amount by which the labour embodied in the production process exceeds the value of labour power (value labourers require for their own reproduction). The commodity capital, C' is sold for money M', where M'>M i.e. the new money capital exceeds the original M, reflecting the profit accrued. A part of this excess is reinvested and enters the circuit of capital again, to further produce surplus value. The following illustration depicts the movement of the various forms of capital in its circuit in a linear form.



Hence, the circuit of capital can be portrayed as: M – C – M'

In its expanded form: M – C (MP, LP) …… P ….. C' – M' where money put into circulation to make more money is the initial capital or M. The continuous lines (–) symbolises acts of exchange taking place in the sphere of exchange while the dotted lines (…..) represent functioning of capital in the sphere of production.

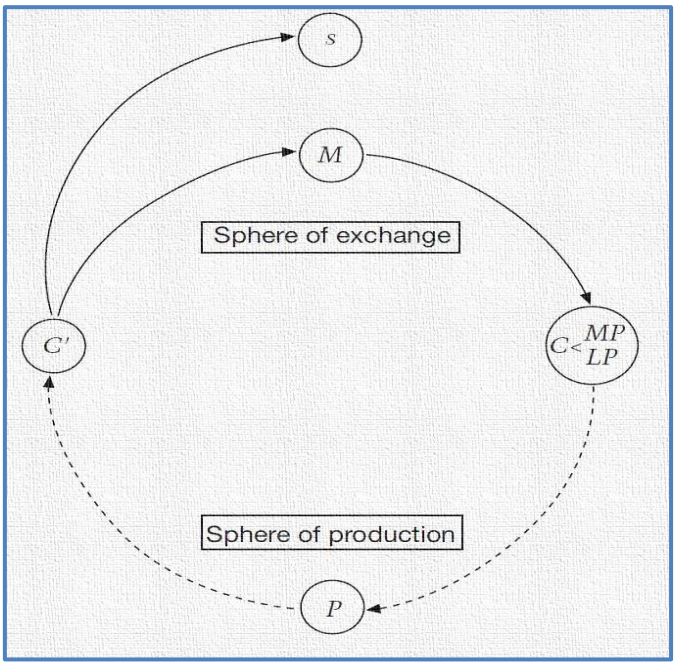
The productive capital P belongs to the sphere of production which is C (MP, LP) …… P …… C' where C'>C.

[12] There are multiple circuits of capital like primary circuit comprising of co-existing circuits of commodity, money and industrial capital, and secondary circuit constituted by built environments and fixed capital, and tertiary circuits involving social expenditures and investment in science and technology (Harvey 2009).

The money capital M and commodity capital C belong to the sphere of circulation or exchange which is C' – M'– C (MP, LP) where M'>M.

The figure below shows the ongoing continuity of the circuit of capital. Here 's' denotes the surplus value obtained from production. It is generated in the sphere of production and realised in the sphere of circulation.

Figure 3: The Circuit of Capital



Source: Marx's capital, Fourth Edition, Ben Fine & Alfredo Saad-Filho

The commodities thus produced embody a use value and an exchange value. The use value is the utility derived from consuming the commodity which satisfies human wants and needs and hence reflects a qualitative aspect of value. These commodities when exchanged in market have an exchange value which is a quantitative aspect of value that can be acquired through the payment of price. Both production and exchange function together to generate surplus value in production which is subsequently converted into profit through exchange. This process further requires reproduction of labour power as a commodity exchanged for wage, determining the social (class) relations of production (Fine and Harris 1979).

Under globalisation, the functional restructuring of production increasingly necessitate subcontracting and outsourcing which link remote communities (through participation) in a common circuit of capital. The production of a commodity and its circulation require a certain time period (Das 2009) within the circuit of capital. The fragmentation of manufacturing activities across numerous suppliers, contractors and workers ensure fast execution of productive operations at the behest of the manufacturing company as demonstrated in 'just-in-time' production. By organising and coordinating myriad cross-border economic operations in the network, the lead actor ensures timely production of specific quality and quantity of commodities. This substantially reduces the time required for the

completion of a circuit of capital, at the end of which surplus value is realised. Thus the structural disintegration of production functions beyond national boundaries (and technological innovations) to accelerate the process of capitalist accumulation as epitomized by the execution of circuits of capital. The GPN approach can investigate the spatial creation, maintenance and extension of the existing circuits of capital embedded in socio-economic relations of formal and informal employment by incorporating the Marxian framework. This is particularly useful in exploring the dynamics of WEEE treatment that is the 'hitherto neglected 'back end' of global production (which) has important implications for labour as it creates additional circuits of capital and through these possibilities for formal as well as informal employment and ways of securing livelihoods' (Coe & Hess 2013: 5). To disentangle the disproportionate returns to formal and informal labour engaged in waste recycling and refurbishing, a clear conceptualisation of formality and informality in labour market is required. The subsequent section offers a detailed synopsis of the scholarship on formal and informal economies, their respective position in the capitalist realm and their inter-relations.

3.5. **Revisiting Linkages between Formality versus Informality**

A significant observation in the GPN scholarship on waste is that frequently waste from the developed countries travel to the Global South where they are subsequently deconstructed and reconstructed as 'feedstock for secondary industries' (Gregson et al. 2012: 40). Since 'networks for used goods entail complex, multi-directional flows, often involving informal sectors……' (Herod et al. 2013: 2), the recurrent theme of informality arises in all these studies. Informality has been extensively investigated in the prolific WEEE lexicon, as elucidated in the previous chapter. However, empirical research in the GPN strain has seldom interrogated informality conceptually. It has failed to incorporate the theoretical understanding of the informal sector, lacking any comprehensive analysis of the inputs and motivations of informal labour and the dynamic formal-informal interconnections. This has been flagged up by Phillips (2011) who contends that 'despite the wealth of scholarship on informality and informal economies across the social sciences …….. the theoretical and empirical attention to informality remains rather limited in the contemporary study of GPNs' (Phillips 2011: 381). To address this issue, this part provides an extensive account of the formality and informality discourse which charts the evolution of the concept of the informal sector and/or economy[13] in the narrative of development. It explains the origin, persistence and pervasiveness of the informal sector. Furthermore, it deliberates on the relationship of informality with the formal sector and the broader political economy. To start with, the theoretical underpinnings of the informal sector are elaborated and then its different interpretations are discussed. Finally, the trend of increasing informalisation is located in the contemporary world economy to establish its analytical relevance in the context of value chains and production networks.

3.5.1. **Theoretical Underpinnings of the Informal Sector**

Informality or the informal sector constitutes one of the most debatable issues that have captured the attention of academics and policy-makers. In both its nomenclature and conceptualisation, the

[13] Here informal sector and informal economy are used interchangeably to refer to the broader notion of informal economy.

informal economy forms the dual opposite of the formal economy. Its early understanding stems from Lewis' model of labour market dualism in an economy marked by the presence of two sectors: on one hand, the formal, capitalist, industrial, modern and urban sector and on the other, the informal, subsistence, agricultural, traditional and rural sector characterised by the presence of surplus labour (W. A. Lewis, 1954). This dichotomy in the labour market justified the wage differential between the two sectors with limited mobility between them (Fields, 2004). Eventually the expansion of the urban industrial sector was to allow for the movement of the workers from the subsistence sector to their subsequent absorption in the capitalist sector. The Lewis' Model precluded the possibility of open unemployment in the formal sector and allowed for underemployment, only in the traditional sector. The reality of unemployment was theorised in the work of Harris-Todaro. In their model (Harris & Todaro, 1970), the higher expected wage rate in the urban sector, even when unemployed, attracted the rural labour (with positive earnings in agriculture) to the urban parts despite the presence of open unemployment. An increase in industrial output and rise in labour demand resulted in an increase in wage employment which would absorb the unemployed migrant labourers. However, the rate of urbanization far exceeded that of industrialization (Moser, 1978) and the problem of unemployment not only remained but escalated in the urban areas. Fields introduced the idea of an urban informal sector where the growing number of migrants, unable to find a job in the formal sector, managed a living in the margins of the modern economy through unskilled, labour-intensive, poorly-paid jobs (often family-employed) with low level of productivity (Fields, 1975). Ranis-Stewart provided for the possibility of a modern component of the informal sector with dynamic linkages with the formal sector through subcontracting along with a traditional component, acting as a refuge for the otherwise unemployed (Ranis & Stewart, 2015). It is important to note that none of the above theories attempted to explain the emergence of the informal sector. They focussed primarily on the phenomenon of rural-urban migration with respect to labour market behaviour in an economy undergoing a structural transformation from a state of low accumulation to high productivity and growth. Despite the simplistic assumption of a dualist labour market[14], these models provided an insight into the logic of the informal sector which has been fundamental in its conceptualisation in the developmental debate.

Initially the informal economy was treated as a temporary phenomenon in the course of capitalist industrialisation and modernisation. According to Marxist and Neo-Marxist theories, the informal sector constituted the reserve army of labour which would be absorbed by the expansion of capitalism (Gerry 1987). Or following the postulates of Lewis' orthodox theory, once development received ample impetus, the modern economy would grow and swallow the surplus labour in its periphery (Sanyal, 2007). Thus informality was a manifestation of underdevelopment where capitalism has not been able to spread its control fully (Portes & Sassen-Koob, 1987) and would disappear with the successful transition to an advanced capitalist economy. But following a 'take off' of the economy, this residual group which constituted the 'working poor' and comprised the informal sector, was not absorbed by the progress of the modern sector (Bangasser 2000) and even spread to industrial countries (Meagher, 2008; Portes & Castells, 1989; Sassen, 1994). The debate over its viability

[14] Dualist theories continue to influence policies on poverty alleviation through employment generation to distribute the benefits of growth in the developing countries (Heintz, 2007).

intensified over the years as informality grew in magnitude encompassing a diverse range of economic activities.

3.5.2. **Plural Representations of Informality**

The idea of informality was first introduced by British Anthropologist Keith Hart in 1971 in his paper 'Informal Income Opportunities and Urban Employment in Ghana' (Bromley, 1978). In 1972, the phrase informal sector was coined in the Kenya Report following ILO's employment mission to Kenya. Following ILO (International Labour Organisation), the informal activities are a way of doing things, characterized by 'ease of entry, reliance on indigenous resources, family ownership of enterprises, small scale of operation, labour-intensive and adapted technology, skills acquired outside the formal school system; and unregulated and competitive markets' (Kenya Report 1972, as cited in Bromley, 1978: 1033).

The various operations that have been amalgamated under the rubric of informal economy are numerous and extremely heterogeneous. Different schools of thought have provided a plethora of theories on the informal sector explaining its existence, functioning and linkages with the rest of the economy. According to the ILO, the informal economy represents an avenue of income generation subsidiary to formal production and an intermediate space between the mainstream formal system and complete unemployment. The informal sector provides minimum subsistence requirements to people who are unable to find a job in the formal sector, thus pulling them out of complete poverty or destitution. Hence with a reformist attitude, the ILO advocates state support for the sector rendering a safety net for the marginalized and vulnerable who are either excluded from the benefits of formal employment or in crisis (M. Chen, 2008). In contrast, the legalist approach (proposed by Hernando De Soto) perceives informality as a rational voluntary choice to escape the legal rigidities imposed by the intervening state with a mercantilist agenda of favouring the elite in their formal production endeavours (Whitson, 2007). Hence, people often deliberately seek employment in the informal sector because it offers more flexibility, lack of regulations and tax-savings (Maloney, 2004) and helps avoid the costs, time and effort of formal registration. De Soto advocates that the informal economy must be freed from government intervention and suggests neoliberal policies and property rights for converting the informally held properties into real capital (de Soto, 1990, 2001). Here the focus is on the innovative and ingenious informal entrepreneurs who prefer the higher independence and pay compared to the formal sector (De-la-Rocha & Latapi, 2008) and provide a capitalist growth impetus. However, it overlooks the plight of the informal labour working and living in abject poverty. The manifestation of internal dualism of the informal sector suggests that a part of it functions as a last resort and another that is preferred over the rigidities of the formal sector (Fields, 2005). Both the above approaches reflect the dualist view; for the ILO, the informal sector is backward and marginal where the fruits of formal capitalism do not reach and for the neoliberals, the informal sector is an engine of capitalist development in opposition to the existing formal mercantile enterprises.

The third branch motivated by a structural orientation, locates the informal economy in the continuum of formal-informal linkages and in the realm of capitalist accumulation. The very nature of capitalist development leads to the evolution of widespread informal economic practices. Hence the

structuralist approach rejects the simplistic assumption of a dualist labour market and posits the informality in a relation of compliance and/or exploitation with the capitalist mode of formal production. Through the years, many scholars have emphasised the interactive relationship between the formal and the informal sectors (Bhattacharya, 2007a; Daniels, 2004; Sindzingre, 2006) through decentralised production arrangements among others. Instead of an isolated condition, informality is best understood as a process which is 'the sum total of income-earning activities with the exclusion of those that involve contractual and legally regulated employment' (Portes & Sassen-Koob 1987: 31). Defined by the institutional structure of an economy, the incidence of informal employment depend on the nature of labour reforms and prevailing social protection systems (Korner, 2008). The diverse instances of informal activities fall beyond the orbit of formal legislative parameters and are consequently outside the purview of state's regulatory framework. Thus the legislative environment informs 'the scope and character of the informal economy (which) are defined by the very regulatory framework it evades' (Sassen 1994: 2289). By endorsing and labelling a certain variety of economic activities, trade and work relations as formal, the state creates this formal-informal distinction in the socio-economic realm. Examining the role of the state in the expansion or contraction of the informal sector, it has been observed that it is 'a political creation in so far as it is rooted in features of social structure which has been shaped and sustained by the state' (Weiss 1987: 216). The historically developed structure and functions of informality are contingent on the relationship between state, capital and labour. The (shifting) boundaries of state regulation define and demarcate the formal and informal space of the economy. Thus there is a constantly changing dialectic between informality and the rest of the economy with flexible frontiers between formality and informality.

The above demonstrates that the structuralists posit informality in the broader context of formal capitalist economy and regulatory institutions and outlines the myriad relations between formal and informal enterprises. The incidence of informal activities in industrialised countries has often been attributed to immigration where migrants create a backward periphery like space (characterised by the informal sector) in the advanced country. But Sassen (1989) contests that informality is not a feature of underdevelopment; rather it is an outcome of the conditions of a developed economy and its inherent structural inequalities. The structuralist branch asserts that the informal economy is closely knit into the fabric of modern capitalism (Portes & Schauffler, 1993; Stark, 1989) where informal activities are functional to and marginalized by the same. However, they have been criticised for overlooking the agency of autonomous and vibrant informal small firms and micro-enterprises successfully using social networks and mobilising required resources (Cheng & Gereffi, 1994).

A plurality of the theoretical perspectives on the informal sector allows an analysis of the various factors driving the growth of informality. Informality can refer to 'either a status of labour like non-contractual, temporary, unprotected by minimum wage convention and uncovered by non-wage benefits, or to particular conditions of work like precarious situations of health and hygiene, open to fire hazards and other accidents, defying minimum safety requirements, ignoring zoning norms and also to forms of management of some firms like unrecorded or undeclared transactions, tax evasion, fiscal frauds, not completely legal nature of work' (Portes and Castells 1989). Many formal sector jobs also bear informal labour relations with temporary contracts and inadequate or absent employment

benefits (Bhattacharya, 2007a). Often some informal activities infringe the border of illegality and Portes (1989) distinguishes between criminal and informal activities as the former producing socially illicit goods and the latter producing legal goods but in a manner which is not exactly legal.

3.5.3. **Informality in Contemporary World Economy**

This section exemplifies how informality is deeply entrenched in the contemporary construction of global value chains and production networks. The nature of informality is specific to its foundation in a particular socio-economic and political environment (Portes and Castells 1989) which is influenced by concurrent world trends. There has been an increasing shift towards informalisation spanning different sectors worldwide (Carr & Chen, 2001; Meagher, 2008) since the beginning of the economic crisis in the mid-1970s (Meagher, 1995). Informalisation embodies reorganisation towards flexible production relations leading to processes of labour casualisation and contractualisation (Standing, 2008) and a rising share of informal jobs in total employment (Heintz & Pollin, 2003). This new international division of labour emerged out of a need for cheaper labour to sustain profitability in the face of competitiveness and uncertainty in the world market (Beneria, 2001). This coincided with the advent of neoliberal ideology promoting deregulation and privatization in the labour market[15] after post-war Keynesianism in mainstream development policies was called into question following economic recession of the 1970s and a crisis of the welfare state regime (Ghezzi & Mingione, 2003). Fixed-wage formal employment was reduced and more flexible systems of subcontracting and outsourcing surfaced, making use of unregulated labour in the form of casual, temporary, off-the-books workers (Standing, 1989). Thus 'capital (has) abandoned reciprocal obligations to labour in employment contract' (Robinson 2004: 143) and there was a group of workers who were unprotected without any job stability, non-wage benefits, pension, compensation or insurance against work hazards and accidents[16]. Less state intervention in favour of market rationality saw huge cutbacks in public sector employment and investment and a sharp decline in government spending. Unemployment soared and people were pushed into the informal sector in absence of adequate formal work opportunities (Kumar, 2007). Subsequent removal of trade barriers and export-led industrialisation paved the way for globalization, marked by the ascendancy of transnational capital (Robinson 2004).

Globalization champions the free exchange of capital across borders, allowing for the internationalization of production leading to decentralised supply chains (Pearson, 2004). The contemporary capitalist economy entails organisational transformation in favour of globally distributed production networks. This post-Fordist restructuring in favour of flexible specialization against the previous mode of standardized and vertically integrated production system (prevalent in the Fordist era of mass production and consumption) has resulted in extensive outsourcing which subcontract operations previously performed internally within the firm to the informal sector. Many transnational enterprises frequently act as organisers of production (Gallin, 2001) which is carried out by a series of suppliers and contractors, mostly hiring informal labour. Apart from innovation and upgrading, the big formal corporations compete in volatile global markets by informalising specific stages of production

[15] Those conditionalities were imposed through the Structural Adjustment Programmes for debt availability on the developing countries (Gerry 1987).
[16] Labour union activism also took a backseat due to such deregulation of the labour market (Gallin, 2001).

to reduce labour costs, raise flexibility and diversify the risk of production. For the very same reasons of cost cutting and flexibility, firms outsource labour-intensive or non-core manufacturing and service activities across countries, forming internationally stretched arrangements of production and exchange. These operational and geographical shifts increasingly incorporate the informal sector in the realm of global value chains and production networks (Bhattacharya, 2007a, 2007b), embedding informality in the very architecture of spatial economic activities. Hence it is clear that the development of informality is central to the evolution and constitution of these networks with 'a dynamic structural blending of formality and informality in GPNs' (Phillips 2011: 382). The informal sector is functionally interwoven in the world production system and its socio-economic organisation today and informal patterns of employment are progressively rampant worldwide. Since 'informality spans the full geographical and sectoral breadth of work in the global economy' (ibid: 381), rather than overlooking its foundation, GPN should theoretically and empirically analyse the global connections and institutional embeddedness of informality. The participation of the informal sector and labour in value-added activities in trans-national and trans-sectoral production systems can be investigated within this approach by focussing on the 'geographical patterns of value creation, retention and capture in the global economy primarily through the conceptual architecture of chain governance and network dynamics' (Neilson et al. 2014: 1).

3.6. **Integrating Formality-Informality into GPNs**

After presenting the different bodies of literature pertinent to this research, this section collates the various concepts from each that will be applied in the analysis of e-waste production and processing network. The GPN approach provides the main foundation of the analytical framework. It conceptualises complex production and distribution arrangements as non-linear and multi-dimensional networks. Along with the network actors, it also analyses the role and relevance of the contextual actors in influencing its structure and operations. It deliberates on the position of the state (at the international, regional and local levels) and the impact of its regulatory apparatus on the nature and location of (formal and informal) waste recycling operations. Additionally, it brings to the fore the civil society (like consumer groups, labour unions, business associations and NGOs) and its influence on the spatial structure and development of the network. However, significant insights (like following actors in the chain and their governance and linkages) from its predecessor, the GVC approach are retrieved for explaining the role and position of the chain actors and their relationships of governance and differences in power.

In parallel, the horizontal embeddedness in social networks of community and kinship is highlighted to encapsulate the benefits and imperatives of informal WEEE clusters and their role in the development of trust in informal (and formal) business transactions. Thus, to extend the understanding of firm-level governance in GVCs to the instances of informal WEEE management, it is supplemented by studies on industrial clusters which emphasise the prominence of social networks in regulating informal occupations and labour market. The main analytical framework used, GPN can incorporate social networks better than GVC since it embodies spatial horizontal ties along with vertical ones.

In the realm of electronics manufacturing and the processing of its waste, it has been observed that informality occupies a significant place in the generation of value from discarded and obsolete equipment. The informal reuse and reclamation of secondary resources from WEEE leads to the creation and expansion of value which accrues disparately to the informal agents depending on the function, relative position and power dynamics in the recycling network. To reinterpret the capital-labour relations in the revaluation of e-waste, this research selectively applies the lexicon of Marxian circuits of capital. This facilitates an understanding of the creation of (surplus) value in capitalist production (by encompassing labour) and its realisation into profit through exchange. In its original form, Marx concentrated on the spheres of production and circulation without going into the realm of consumption and subsequent waste generation. Here the scope and reach of the circuits of capital is extended to encompass the inevitability of waste in capitalist production and consumption. It is essential to unpack the constituent flow and distribution of value in the material circulation of WEEE which is embedded in and guided by the social relations of capitalism. Incorporating the Marxian framework in GPN enables it to study 'how value is created, enhanced and captured, how power is created and maintained within the production network, and how agents and structures are embedded in particular territories' (Jones 2006: 153) in the circuit of e-waste.

Since informality is a recurrent feature in WEEE processing operations, it merits deeper theoretical and analytical enquiry. The rich discourse on the development of informality and the formal-informal dichotomy elucidates the diverse priorities and opportunities of the informal players and the fluidity between formality and informality. To understand the function of informality in the global e-waste architecture, the overarching notion of informality has to be disintegrated to discern the role of each group of informal WEEE actors and their respective inter-connections with the formal sector. This chapter has established that an engagement with this discipline is fundamental to investigate the informal forms of, and returns to, labour in GPN (as well as GVC) since the rise in informality can be directly linked to production fragmentation and its geographical relocation. Among the various theories discussed in this literature, the structuralist school is especially pertinent in disentangling the composite character of informality and its intersections with the rest of the economy since it rejects any separation between the formal and informal sectors and situates them in the system of capitalist expansion. This is not to say that the reformist ILO and the legalist school bear no contemporary relevance. But with a dualistic perspective, they focus on specific categories of informal actors in particular circumstances and are unable to capture the broader systemic tendencies in capitalist formal-informal relations. Thus for the purpose of this research, the structuralist approach is most useful without discounting the other two schools completely as there can be instances of both voluntary and forcible informality along the logic of the legalists and the reformists respectively. This does not indicate that they are not structurally tied with the formal sector in an either benign or exploitative relationship characterised by specific forward and backward linkages.

Since this research encompasses the entire gamut of (both formal and informal) international and national actors involved in the e-waste industry as well as non-chain actors, GPN is chosen as the primary analytical tool. In combination with the scholarship on formality-informality, GPN can explore the heterogeneous informal sector and the multiple forms in which informality exists in the WEEE

network. In this regard, the state is a crucial institution which shapes these circuits and networks and endeavours to align them to its regulatory principles. The segment of the circuits endorsed by the state are marked as the 'formal (space)' and delineated from the informal economy through its policies. It has been claimed that 'explicit theorization of the state's role has been somewhat lacking in the GVC and GPN literatures' (Neilson et al. 2014: 3). It is not within the scope of this study to conceptually expand the notion and application of state and its machineries. Rather, the spatially changing role of the state and its implications for the formal and informal sectors engaged in the e-waste network at multiple scales would be investigated. The structuralist understanding of the relation between state and (in)formality can be suitably included in tenets of GPN and examined in conjunction. Here, the state can be restored in the chain and network discourse to appreciate how state institutions are instrumental in conditioning the spatial composition of the global production functions and the socio-economic processes therein. Moreover, GPN can also inspect the relationship between state, capital and labour to challenge state's perception of informality and the fluidity between formality and informality in WEEE movement and management.

3.7. **Conclusion**

To recapitulate, the GPN framework forms the backbone of the analysis of the global e-waste recycling network with selective inputs from other social science discourses. The concepts of mapping the chain actors, their functions and location, with their governance relations are co-conceptualised from its cognate discipline, the GVC. The GPN approach lends a comprehensive understanding of the role of the state and other civil society organisations in the WEEE reverse supply chain which is embedded in specific institutional environments. The Marxian circuits of capital is used to disaggregate the generation and flow of value in e-waste and the idea of informal networks (from the literature on industrial clusters) is applied to understand socio-economic relations and modes of coordination between the formal and informal actors in the network. Finally, the scholarship on formality and informality is employed to analyse how WEEE operations are orchestrated in the context of broader capitalist institutions. It further expands on the dialectic between state and informal actors which help in comprehending the informal logic and interests in a particular context.

Therefore the research follows the material and financial stream in the global trajectory of e-waste across different actors and spaces to describe the WEEE network. Alongside, it analyses the generation and expansion of value by the informal e-waste actors and establishes informality as an inherent part of its circuit of capital. Furthermore, it focusses on the formal and informal actors between the various nodes of WEEE collection, trade, dismantling, repair and recycling and examines their interactions and power relations. It teases out the vertical linkages in the network maintained through governance mechanisms and its horizontal embeddedness in informal networks of community and kinship. It studies the rationale behind the formation of informal WEEE clusters and the mediation and institutionalisation of trust in their socio-economic transactions. It highlights the incentives of the diverse categories of informal players and their ability to capture and control the value generated from e-waste processing. Finally, the role and impact of the state is interrogated by looking at the definite legislations on WEEE transfer and treatment at multiple scales from a GPN

perspective. Hence this chapter identifies and explains the potential application of the particular bodies of scholarship that can illuminate the drivers of informal e-waste transfer and treatment and provides an appropriate response to the question outlined at the onset.

The conceptual framework constructed urges GPN to go beyond its conventional analysis of the organisation of and coordination between formal units of industrial production to focus on the nature of informality in the operational sequence of goods manufacturing and service provision. Its specific contribution lies in enriching the (GVC and) GPN through a theoretical understanding of formality and informality. This is necessary to recognize informality as an integral link in the production systems and the importance of informal labour in these enterprises and employment. It also demystifies the complex lexicon of informality and interrogates the position of the state vis-à-vis formality and informality. Furthermore, the concept of value revisited by using the Marxian exposition on e-waste instates informality in the circuits of capital to show how it plays a critical role in the overall capitalist reproduction. Finally, this framework emphasises the significance of conjoined processes of wasting and valuing in contemporary capitalism and its consequences.

CHAPTER 4:

RESEARCH METHODOLOGY

4.1. **Introduction**

This chapter elucidates the methodology adopted to study the processes of e-waste movement and management by following its spatial trajectory and the role and position of the different actors therein. The second section revisits the aim of the research along with the questions formulated to justify the selection of the methodology. Section three outlines the rationale behind the strategic choice of the methodology and consequent methods applied for the field research. Section four identifies the suitable cases and sites (from review of secondary sources) which can exemplify the material and monetary dimensions of e-waste flow across territories and actors to comprehend its socio-economic implications. In the fifth section, the elements of the different stages of primary research in Netherlands, Belgium and India are elaborated to record the categories of respondents, the information gathered and the strategies followed. The sixth section focuses on the methods of data cleaning and interpretation. Section seven discusses the experience of conducting the research, the research positionality and the limitations and ethical concerns. Finally, the chapter ends with a brief conclusion.

4.2. **Research Objectives and Questions**

This research unpacks the international phenomenon of e-waste recycling with a distinct focus on informality and the formal-informal linkages that characterise it. For this purpose, it adopts a GPN framework along with the discourse of formality-informality and the Marxian circuits of capital. It also investigates the role of institutions and the spatially disparate understanding of waste. The research question(s) framed in tune with these objectives are as follows.

Main Research Question: What drives informality in e-waste movement and management?

iv. How does e-waste flow along the reverse supply chain from the point of its generation?

v. What is the nature of transactions defining the formal – informal linkages in the process of e-waste disposal and recycling?

vi. How does the regulatory environment influence the informality of e-waste processing?

In order to interrogate the drivers of informality in global e-waste processing, the complex e-waste stream is systematically charted in the post-consumption phase. Hence, the first question maps the waste course from the point of its generation to final disposal and recycling and undertakes a description of the dispersed actors facilitating the flow. After the mapping exercise, the socio-economic transactions between the different actors are explored. These relational dynamics underlie the cohesive structure and coordinated functioning of the network. The asymmetrical power relations manifested through the different patterns of governance reflect upon the upgrading prospects of the actors. Thereafter the role of the legislative interventions on WEEE is examined to understand the

reasons behind their partial success or failure. Here the impact of different contextual actors like the state, local authorities and civic organizations are also analysed. A detailed enquiry into the regulations at the international and national scale is undertaken to decipher the motivation behind its design and enforcement. The following section discusses and establishes the choice of the methodology that is suitable for investigating the proposed research.

4.3. **Using Qualitative Research**

This section elaborates the methodology and the methods implemented in this research. The choice of the methodology is guided by the research questions which are mainly descriptive, exploratory and analytical and a qualitative line of enquiry is used for data collection and interpretation.

A significant factor that guides the choice of qualitative study is the deficiency of any credible quantification or secondary data on e-waste that can be used for a potential numerical exercise. So it is imperative to collect primary data from the field to capture the complexities of the informal space and actors. The nature of the sector renders a survey unachievable given the 'invisibility' of informality where it takes time to individually track, locate and pursue these actors. Besides, the primary objective is to explore the linkages in the formal and informal WEEE processes along with their inter-relationships rather than to test a definite theory or a pre-determined hypothesis. The aim is not to represent the entire e-waste sector and its various stakeholders, generalize the role of the actors and their activities, or make deductions about complex and constructed human experiences. Instead, it is to provide an analytical account of the nature and dynamics of e-waste management for the multiple sites studied. It focusses on the people involved, their diverse choices and priorities, the environment in which they operate and relate to one another, and their position in the wider socio-economic setting. People's perception and experience of socio-economic transactions and outcomes are subjective, plural, historically and contextually specific. Unlike the positivist quantitative approach, qualitative research rejects generalizations based on independent facts instead stressing the multiple interpretations of reality. The context of any qualitative study is a combination of different factors which individuals understand differently and interact with constantly, thereby changing and shaping their surroundings. The environment in which the actors are embedded cannot be captured through numbers and deductive logic. Instead an inductive reasoning which moves from observations at ground to discerning similar and divergent patterns is more appropriate.

There are diverse approaches that can be employed in a qualitative research. Primary data collection aids in developing a contemporary story of e-waste as it moves through people and places while changing form, shape, functionality and value. Given the dearth of previous studies, a method depending on primary research is required. The case study approach investigates a particular phenomenon in its natural environment and undertakes a contextual analysis of economic interactions, structures and processes (in the WEEE network). It examines the exchanges between and motivations of diverse groups or individuals to explain their composite relationships. It draws from a variety of primary data gathered from field observations and semi-structured interviews using open-ended questions under specific issues or themes. The latter ensures that respondents are not guided in their answers (like indexed multiple choices), rather allows them to recount their views, experiences

and expectations/apprehensions. Questionnaires and/or questions are designed to cross check and triangulate the factual responses of the participants. The queries are thematically arranged since they vary by sector, actor, and their particular role and often fine-tuned and improvised according to the responses of the individuals. The study also draws on secondary sources including newspaper articles, reports from international organizations and government documents on waste regulations and policies to either confirm or challenge the fieldwork findings.

4.4. **Selecting a Case for Field Research**

The research agenda and scope were developed from secondary desk research. In laying out the methodology, the very first exercise constituted identifying an appropriate case which will properly illustrate the procedures in and outcomes of e-waste processing to explain the underlying relations produced and reproduced therein. The existing literature on informality in e-waste was reviewed to select a country or region that is both acceptable and defensible. The choice of the field work sites was guided by many factors, while keeping in mind its feasibility and accessibility.

4.4.1. **Choosing Netherlands and Belgium**

Since the proposed project intended to explore the spatial movement of e-waste, it was necessary to select countries that were recognised as e-waste senders. Newspaper articles and organisational reports (Greenpeace, 2008; Grossman, 2006; A. Lewis, 2010) recommended the choice of the US or Europe, among which Europe was favoured. The next task was identifying a country to base the study on. Examining the international linkages in WEEE transfer channels required formulating the field research around a port which (allegedly) trades in e-waste cargo. Rotterdam was chosen since it is the largest port of Europe. So The Netherlands was selected to retrace the steps and processes of e-waste arrival in and export from the port. Belgium was concurrently picked so as not to limit the research to a single country and draw inferences from its unique peculiarities. It harbours the port of Antwerp and both these countries are among the pioneers (along with the Scandinavian countries, United Kingdom and Ireland) in e-waste collection (http://epp.eurostat.ec.europa.eu/portal/page/portal/waste/key_waste_streams/waste_electrical_electronic_equipment_weee accessed on 07 July 2013). Like other EU Member States, their national e-waste legislations have been derived from the WEEE Directive and they follow the WSR (Waste Shipment Regulation) to prevent illegal WEEE traffic. Additionally, Belgium is physically close to Netherlands with convenient travel options between them, especially with the Dutch speaking region or the Flemish part which also has all the ports in Belgium. So their geographical proximity and the sharing of a common language bespoke of not too disparate contexts and cultures.

4.4.2. **Choosing India**

To complement the case of Netherlands and Belgium suitably with a country in another region, a location acknowledged as a recipient in the global e-waste trade was required. This country should bear ample incidence of informal WEEE treatment processes and by being in another region, offer an international dimension and sufficient spatial variations. From the E-waste Summer School (held in Netherlands and Belgium and organised by StEP which is ‘Solving the E-waste Problem’ Initiative of

the United Nations University) attended in August 2010, I had learned that informal e-waste recycling is abundantly carried out in China, India and several African nations (like Ghana, Nigeria and Kenya). The review of secondary evidence also suggested that China, India and Africa are the leading sites in this regard (Bradley, 2009; Greenpeace, 2009; Schmidt, 2006). Meticulous examination of each case revealed that China is the largest centre and the African countries like Ghana and Nigeria have started gathering momentum in informal WEEE handling (Lundgren, 2012). So researching Africa might not reflect the tried and tested practices developed over time. It can potentially capture the emergence (and evolution) of e-waste processing but that requires a temporal analysis. China is a well-established instance and there is proliferating research on the country (Chi et al., 2011; Hicks et al., 2005; Liu, Tanaka, & Matsui, 2006; Ni & Zeng, 2009; Wang et al., 2010; Xinwen et al., 2011; Yu et al., 2010).

India on the other hand has not been researched extensively with limited academic work on the subject. There are some academic works and NGO reports (Chaturvedi et al., 2012; A. Jain & Sareen, 2006; Reddy, 2013; Rochat, Rodrigues, & Gantenbein, 2008; Shinkuma & Managi, 2010; Wath et al., 2011, 2010) available which albeit helpful, merely scratch the surface of an extremely intricate and intriguing phenomenon. Apart from being a recipient of international WEEE, India is also a big e-waste generator in its own right. Hence India was picked to understand the other end of the e-waste circulation internationally. The aim was not to compare between a developed and developing country though substantial differences in findings between these nations were expected. For starters, these European countries had long been regulating e-waste circulation and treatment while India (during the fieldwork in end 2011 and beginning 2012) did not even have any designated E-waste legislation. Also the per capita usage of electronics was much less in India though it was rapidly rising. Hence the country promised to provide a critical insight into the evolutionary progress in e-waste management and a global perspective without restricting the field research in a singular region. Moreover, the documentary (Manmoham, 2004) which first exposed the issue of e-waste to me is filmed in India, which is also my home country. I also have the advantage of knowing the language Hindi, spoken by a vast majority of the population.

In India, since the liberalization of economic policies in the early 1990s, there has been a proliferation of modern electronic and electrical devices. With increased demand for global connectivity and communication in all types of ventures and businesses, the government, public sector, private corporations, particularly the IT and BPO industries, require electronic products (http://www.theguardian.com/sustainable-business/india-it-electronic-waste accessed on 25 November 2013). Moreover, rapid technological improvements along with stiff competition have lowered the prices of EEE making them affordable to a larger section of domestic consumers. Continuous technological upgrading coupled with growing consumerism have reduced the life-span of these commodities and added to the recurring demand. Though the per capita consumption of EEE in India is still much less than the developed nations, the absolute numbers keep soaring with a population of 1.21 billion in 2011 (http://censusindia.gov.in/2011census/censusinfodashboard/index.html accessed on 01 July 2014). The Electronics System Design and Manufacturing industry has reported that the total market in

electronics has a Compound Annual Growth Rate of 7% between 2011 and 2012 which is expected to rise to 11.5% by 2015 reflecting the high consumer demand (Frost & Sullivan, 2014).

Thus electronics and electrical appliances have penetrated into the average Indian's life and livelihood. There has been an unprecedented escalation in the domestic consumption of EEE (BBC, 2003). This trend is not exclusive to India. Internationally, the boom in IT has established electronics as one of the principal consumption items. Taking into account only computers, mobile phones and televisions, India produced 380,000 tons of WEEE in 2007 according to the Manufacturer's Association for Information Technology (MAIT). According to the Central Pollution Control Board (CPCB), the total e-waste generation in the country is estimated to rise to 800,000 tons by 2012 (Indian Express, 2012). The following three categories of WEEE account for approximately 90% of the total e-waste generation:

a. Large household appliances, 42%,

b. Information and communications technology equipment, 33.9% and

c. Consumer electronics, 13.7%.

(Environment Protection Training & Research Institute, 2010)

The urban centers have evolved as the primary EEE consumers and the chief generators of e-waste. However, the suburbs and small townships are fast imitating the lifestyles and consumption patterns of the bigger cities and these gadgets now occupy an important segment of these smaller but growing markets. India's WEEE scenario is further characterized by illegal scrap imports and dumping from overseas. In Asia, China, India and Pakistan are the major recipients of scrap metal, obsolete gadgets and second hand electronics (Puckett & Smith, 2002). In these countries, there is a steady demand for e-waste since expensive metals like gold, copper, iron, silicon and nickel can be reclaimed from them (Greenpeace 2004).

Moreover, India is historically characterised by a vibrant and widespread informal sector engaged in all kinds of waste management activities. Almost 95% of the WEEE in the country are collected and processed by diverse informal traders and recyclers (Agarwal, 2013). That was expected to change as the country prepares to implement a new E-waste legislation in May 2012 (notified in 2011 official gazette) which mandates formalisation of all WEEE operations. Hence the transition of a country, which originally did not have any designated e-waste law, can be captured through primary research. Many formal waste recyclers are forthcoming with the new proposed regulation. So there is adequate opportunity to compare the sectoral peculiarities of waste processing along with the relations and linkages between them. All the above signalled that India is an appropriate site for the field research in addition to Netherlands and Belgium. But since the country is extremely diverse, it was also imperative to select specific site(s) for practical investigation.

4.4.3. **Choosing Delhi**

Delhi has been chosen as the appropriate site since it is proclaimed as the informal e-waste recycling hub of the country (Lundgren 2012; http://www.weeerecycle.in/city_background_e_waste_delhi.htm

accessed on 16 July 2013). However, the selection of Delhi as a case does not suggest that it represents all the informal scrap-yards in the country but instead is indicative of the WEEE operations popularly practised. It is a credible location offering information that can facilitate the understanding of similar processes in other places accounting for contextual variations.

Initially Bangalore was also considered as a second site along with Delhi. It is known as the 'Silicon Valley' of India which has been at the forefront of the ITC (Information Technology & Communication) industry in the country (Kannan 2013). But it was subsequently dropped since at the very initial stages of the primary research it became evident that Delhi is where the informal WEEE activities were concentrated. A study on e-waste informality in Bangalore asserted that 'Bangalore's informal recycling sector is much smaller than Delhi's' (Reddy 2013: 68) with a lower magnitude and prevalence of informality. Also there was serious time constraint as fieldwork in Delhi took up most of the available time. This can be partly attributed to the inclusion of all the categories of actors in the industry to gather a detailed picture of the network of people involved. The selection of Delhi was also confirmed through a feasibility exercise that consulted an independent grass-root activist working with the issue of waste in and around the capital and the waste NGOs operational there. Finally, secondary literature projected Delhi as the second largest WEEE generator (after Mumbai) in India producing 9,730 metric tons annually (Consumer-Voice, 2010).

Table 2: E- Waste Generation in Top 5 Indian Cities

Serial No.	City	WEEE (tones)
1.	Mumbai	11017.1
2.	Delhi	9730.3
3.	Bangalore	4648.4
4.	Chennai	4132.2
5.	Kolkata	4025.3

Source: E-Waste Management in India- Consumer Voice, April 2009

Delhi also reportedly receives illegally imported WEEE amounting to 50,000 tons which reaches India from China via Delhi or through Kandla port (Times of India, 2009). It is a major destination for recycling of domestic obsolete computers and those imported illegally from other countries (Schwarzer, Bono, Giuliani, Kluser, & Peduzzi, 2005). According to MAIT & GTZ, more than 90% of the e-waste in India is processed through the informal sector (MAIT-GTZ, 2007). In Delhi, there exist approximately 25,000 informal workers in different scrap yards who handle, repair, recycle and dispose roughly 10,000-20,000 tons of e-waste on a yearly basis

(http://www.weeerecycle.in/city_background_e_waste_delhi.htm accessed on 16 July 2013). Other e-waste scrap yards have been found in Meerut, Ferozabad, Chennai, Bangalore and Mumbai (Greenpeace, 2009). The scrap-yards in the bigger cities often employ a pool of migrants from different parts of the country who end up working as domestic help, construction labourers, waste-pickers and in other informal jobs. The workers in the e-waste chain are found in the suburbs in the vicinity of Delhi which fall under the NCR (National Capital Region)[17]. Hence Delhi (along with NCR) is an ideal site for interrogating the myriad facets and features of informal e-waste management.

4.5. **Collecting Field Data**

The primary field research was conducted in two phases. The first phase involved research in Netherlands and Belgium (July 2011) and the second phase was in India. These two disparate sites demanded different strategies and procedures for accessing the information and gathering the data. However, the unit of analysis was the same in both i.e. the formal and informal actors involved, either directly or indirectly, in the e-waste recycling industry. The following chronologically describes the two phases to discuss the planning and execution of the fieldwork.

4.5.1. **First Stage - Netherlands and Belgium**

Before commencing the actual research in July 2011, a preparatory phase was undertaken. Government documents and records, reports of NGOs, newspaper articles and press releases were reviewed for a preliminary knowledge of the actors involved. Respondents were identified and interview guidelines were designed. All the stakeholders (like the state agencies, civic bodies, manufacturers, consumers and processors) were targeted as participants. Multiple points of contact were approached to guarantee that the fieldwork is not solely dependent upon the availability or response of a single respondent. They were contacted mainly through email explaining the research objective with a request for information. Many emails were redirected and rerouted before contact could be made with the right person at the right department.

The first replies were received from VROM Inspectorate (Ministry of Infrastructure & Environment in Netherlands implementing and monitoring WEEE legislations) and Umicore (in Belgium), an international precious metal refining plant, salvaging complex secondary metals from e-scrap among other waste. They acted as the first entry points for further recommendations for interviewees. Thereafter, the progress of the research was largely guided by the snowballing method. The above mentioned respondents provided references. Simultaneously contact was established with other informants selected before through prior email and phone calls. The following enumerates the respondents interviewed and the information sought and eventually gathered from them.

i. **Manufacturing Company** – the Senior Manager Sustainability in Philips Consumer Lifestyle was interviewed in Amsterdam to understand the outlook of and strategies adopted by the EU manufacturers. He summarised the impact of various legislations (and their framing) on WEEE and underlined the implementation of EPR and different take–back

[17] NCR includes the metropolitan areas that encompass the National Capital Territory (NCT) of Delhi and the adjoining urban areas in the neighbouring states of Haryana, Uttar Pradesh and Rajasthan.

schemes (according to product types) and potential reuse options. He discussed the mechanisms for improving the environmental performance of EEE without compromising the commercial aspect of the business. However, apart from confirming that there exist grey channels of WEEE movement leading to illegal exports, he could not indicate the exact nature and functions of these illicit routes and actors.

ii. **Bulk Consumer** – the Head of Library and IT Services of the Institute of Social Studies which is a higher educational institute in the the Hague provided an insight into the role and behaviour of bulk consumers. He explained the methods and destinations of disposal of discarded electronic items, especially computers and its' accessories. He also highlighted the changing pattern of EEE consumption through the years.

iii. **Collector in Netherlands** – the HMS (Hague Environmental Services) was initially a part of The Hague Municipality and later a public-private partnership responsible for the collection of solid waste including e-waste. The Director detailed the methods followed during collection in the city. He delineated the division of the profit and loss between the state and the private company. He declined any definite knowledge of informal WEEE collection and export, maintaining that he is only concerned about and aware of the formally regulated waste management processes.

iv. **Producers' Association in Netherlands (Wecycle)** – the Manager of Operations of Wecycle was interviewed through Skype. He informed that the agenda of the non-profit organization was to organize nation-wide processing for the EEE manufacturers in Netherlands. It annually reports to VROM and has a total of over 1,500 members, spread across six product foundations. He described the administrative and financial strategies of the organization for compliance with the EU Directives and the environmental policies like imposing the consumer disposal levy, working through contract partners and providing logistics for e-waste transfer and treatment. He denied any liaisons with any non-compliant actor not authorised by the state.

v. **Recycler (Coolrec)** – the Managing Director of Coolrec was also contacted by Skype. Coolrec is the biggest recycler of e-scrap across Europe with headquarters in Netherlands. It has 3 treatment plants both in Netherlands and Belgium and one each in Germany and France. The respondent described the sources of WEEE and the techniques of eco-friendly management like sorting into different fractions, separating and/or removing hazardous materials and finally shredding to extract the pure items. But he was not acquainted with the specific techniques used for recycling plastic since they were sent to a subsidiary of Coolrec, PHB Recycling, where the plastic shreds are cleaned and reprocessed to create pure raw materials.

vi. **State Authority in Netherlands (VROM)** – the Performance manager of the Waste Shipment Regulation (WSR) programme at the VROM Inspectorate situated in Rotterdam was consulted. He defined the WEEE treatment guidelines laid down and followed which included mapping and monitoring the entire waste chain, containing the leakages from the

formal chain and supervising the stakeholders. Despite acknowledging the presence of an extensive informal WEEE sector, he did not know anybody in that category that can be potentially approached and interviewed.

vii. **Customs Netherlands** – the Policy advisor in Legal and International Affairs Department was interviewed in Rotterdam. The Customs is a part of the Ministry of Finance & Dutch Revenue Services and works in collaboration with the Environmental Inspectorate on the basis of a Memorandum of Understanding to control and investigate illicit waste shipments. He labelled the different categories of waste outlined in the WSR, and the enforcement policies followed for every category of waste including e-waste. He discussed the practical problems faced by the customs of Rotterdam and Amsterdam ports along with the cases of illegal waste shipments he experienced over time. He acknowledged that Netherlands is undoubtedly a WEEE sender and not a receiver. He said that the port premises are not open to public and only a special permission can grant entry in the area. Again, despite mentioning illicit actors and shipments, he could not provide the name and contact of any agent or company engaged in illegal waste consignments.

viii. **Public Waste Agency (OVAM) in Flanders** – the competent authority for designing the waste movement and management schedules for the stakeholders' and inspecting their activities. It undertakes upstream and downstream control of waste consistent with the WEEE policy parameters. Two designated personnels for e-waste discussed the scope of the organization in overseeing and issuing licenses for WEEE transport, storage, and treatment. OVAM also monitors the EPR compliance of manufacturers. Additionally it restricts the leakages from the permitted management network and coordinates with Recupel, the association of electronics manufacturers and importers, accountable for waste collection and treatment. They said that since the FPS (discussed below) is responsible for the waste in transit, they do not have much knowledge about the inspections and experiences at the ports.

ix. **Producers' Association in Belgium (Recupel)** – the Treatment Manager of Recupel was interviewed and she described the basis of the formation of the organization (non-profit and non-governmental but working closely with the government). An association of all electronics manufacturers and importers selling in Belgium, it is responsible for the collection, transport and recycling of WEEE in the entire country. It has different management bodies based on different kinds of EEE and formed by the federations of producers who take strategic decisions on budget, visible fee, and scope of these departments under the umbrella of an overall executive unit. She classified the mechanisms followed for the take-back and treatment of household and professional appliances and calculation of the visible fee. She declined any knowledge of the pre-processing stages before treatment since it was outside her job portfolio. Like in the case of Wecycle in Netherlands, she was not privy to any information about the illegal waste domain.

x. **Federal Public Service (FPS) in Belgium** – the Technical Expert of Transit Waste Control of FPS Health, Food Chain Safety and Environment pointed out that FPS is the competent authority for inspections of waste in transit i.e. wastes through Belgium. It is a federal body which follows only European legislations namely WSR and regulations pertaining to product design like RoHS & Eco-labelling. They have close cooperation with customs and harbour police in Flanders. He defined the guidelines set for e-waste export and import to and from OECD and non-OECD countries, nature and history of traffic though the various ports, and the international partnerships with other ports in Europe and across the world. He repeated that ports in Western Europe serve as important exit or transit points for WEEE overseas. He confirmed that the port is closed to public access and declined any knowledge of the illicit traders and exporters.

xi. **International Metal Refining Company (Umicore)** – the Sales Manager for Electronic Scrap in Umicore was interviewed in their special metal refining plant situated in Hoboken near Antwerp. He spoke about the sequential processes of WEEE procuring, sampling, weighing, sorting, pre-processing and end-recovery. He specified all the different precious metals salvaged from WEEE and their subsequent use as primary inputs. He also talked about Umicore's attempts at collaborating with the informal sector (mainly in India) and the outcomes and lessons learned. Finally he suggested directions to reduce the illegal export of e-waste from Europe to countries in Asia and Africa while declaring that the company has no connection with any illegal player.

xii. **Civic Organization i.e. EEB (European Environmental Bureau)** – the Senior Policy Officer for Products and Waste in Brussels shared that EEB is the sole Environmental NGO working on waste across Europe and is a collective of numerous such national and regional organizations. He imparted EEB's views on the existing European Directives and Regulations on waste (including e-waste) and their advocacy for a recast. EEB also lobbies at the national level to redefine the role of the different actors and address the ambiguous understanding of e-waste through the WEEE recast. He described the waste flow from consumers and identified weak points in the chain that need more stringent monitoring. He elaborated on issues like waste minimisation through product design and longer durability, consumer awareness, disparities among the European Member States and superiority of reuse over recycling. He asserted that waste is a serious environmental concern and should not be treated as a commercial commodity to be traded and profited from.

A pertinent feature that emerged in almost all the interviews was that nobody had any information about the illegal sector and channels of WEEE. This reinforces the covert nature of the informal actors and their activities. It also establishes the illegality of the WEEE traffic since there was an absolute dearth of evidence about the quantity of e-waste exported, imported or confiscated (the last category is not released to public). Also, it is evident that none of the interviewees belonged to the informal sector. It was impossible to track down any informal actor since they are impossible to detect. However, several informants indicated and referred to their presence and importance.

4.5.2. **Second Stage - India**

After the completion of the field research in Netherlands and Belgium, a month of preparation was undertaken for the Indian phase. This entailed examining the available secondary evidence on e-waste in India (from mainly newspaper articles and reports of NGOs) on the basis of which participants were selected and targeted. An extensive field work spanning 7 months was undertaken in end of 2011 and beginning of 2012 in Delhi. More time was spent on India to focus extensively on the informal domain of e-waste handling. The entry point to the informal waste workers in Delhi was provided by an NGO called Toxics Link, pioneering the cause and concerns of domestic and imported WEEE in India. It was contacted through prior e-mail and an interview was scheduled beforehand.

A contact (mentioned before in page 68) established through this organization assisted in accessing the informal informants. He works with rag-pickers, waste collectors and scavengers in Delhi and has been assisting the informal e-waste traders to collectively apply for a government license. Several other nodes of the processing chain and entry points (government authorities, electronics manufacturers and other NGOs) which were tapped did not yield satisfactory results. But this informant proved invaluable for initially communicating with informal participants. The latter is particularly difficult to trace and hard to converse with given their general reluctance in sharing trade details and strong scepticism about outsiders.

The immediate backward and forward linkages of every node (of the WEEE network) interrogated led to the other stakeholders and associated actors. The snowballing method and seeking references again proved effective with both formal and (especially) informal participants. The time of the fieldwork coincided with the preparation and introduction of the E-waste legislation in the country, to be enforced from the beginning of May 2012. A subsequent phase of follow-up fieldwork was conducted in India in January 2013 to understand the emerging scenario following the implementation of this regulation. It also addressed certain gaps in the earlier stage to pursue some more participants for interviews. Particularly, it followed up with the brand manufacturers and formal recyclers to document the changes in the e-waste operations since the enforcement of the legislation. Additionally, it also re-consulted some of the informal traders and a traders' collective to record their experiences with WEEE collection after the E-waste Rules mandated government authorised certificates for accessing and participating in auction/tenders.

The methods adopted were semi-structured interviews and non-participant field observations. The latter turned out to be a particularly useful to watch the daily interactions between the different participants, especially the informal ones. Sometimes these were more effective than the interviews where the respondents often became conscious and had to take time out of their busy schedule for the interview. Non-participant observation was used while attending the informal stage of an auction where the informal traders went about their usual business transactions and later explained the procedure and rationale. This research seeks to acquire an understanding of the e-waste processing phenomenon in its natural setting. Thus no experimental control or manipulation was employed to ensure that the normal operations and the day-to-day transactions of the participants were not disturbed.

The following image shows the location of the field research in India which is the NCR and also a few other sites like Bangalore, Kolkata and Pune which have sizable e-waste operations and ports of e-waste entry (Chennai, Kolkata, Kandla and Mumbai).

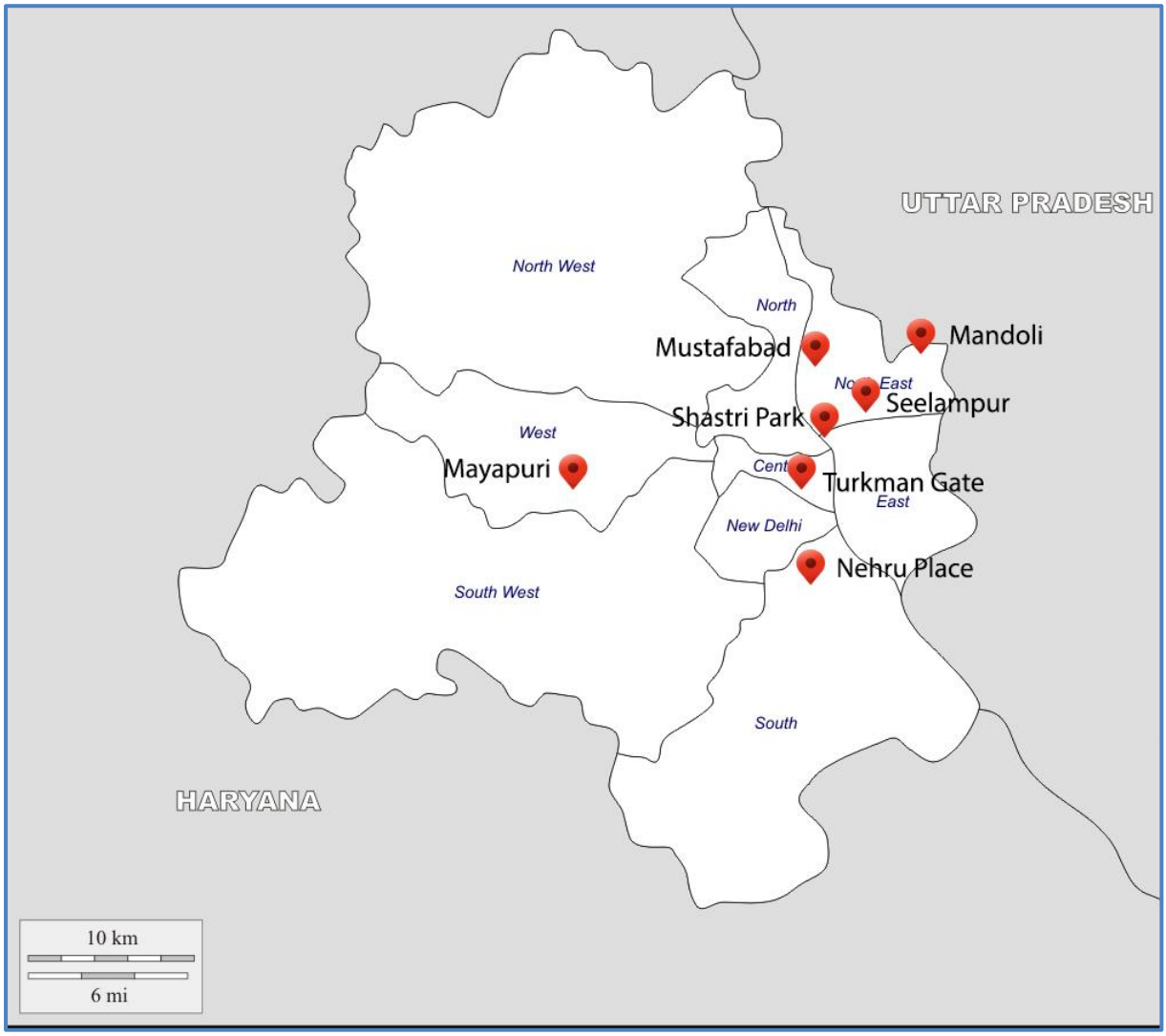
Figure 5: Map of India with E-waste Management Sites & Ports of Entry

Source: Created by Author

The subsequent map illustrates the different districts in Delhi where in various sites the informal traders, dismantlers, repairers, seconds' shop-owners and recyclers can be found and were interviewed. The main trading and dismantling sites are Mayapuri, Shastri Park, Turkman Gate, Seelampur and Mustafabad. Nehru Place houses the biggest market for second-hand computers in the country. Finally, Mandoli which is very close to the border of UP forms the venue for (mainly)

copper extraction. The concentration of the informal players in different sites would be further elaborated in the empirical chapters along with a detailed discussion. However, the participant door-to-door collectors and the waste shops were from all over the city and hence not marked here. All the brand manufacturers and formal recyclers were located in the NCR region, mainly in Gurgaon and Noida. Meerut and Moradabad (not shown in the map), the primary gold extraction sites are located in UP.

Figure 6: Delhi Map with the Interview Sites



Source: Created by Author

The table below enumerates the different respondents that were interviewed in India. The interviewees are divided into formal and informal and the second-hand shop-owners and the repairers can either be formal, informal or straddle both the sectors. After the table, the various categories of respondents in India are elaborated on.

Table 3: List of Respondents in India

	Formal/ Informal	Category	Field Sites or Details
1.	**Informal**	21 Traders	• 7 from Shastri Park • 4 from Turkman Gate • 2 from Seelampur • 2 from Mustafabad • 6 from Mayapuri
2.		13 Dismantlers	• 7 from Shastri Park • 3 from Turkman Gate • 3 from Seelampur
3.		20 Collectors and Waste Shop-owners	From different areas in Delhi
4.		18 Recyclers and Recycling Workers	• 13 from Mandoli • 5 from Moradabad
5.	**Both Formal and Informal**	16 Second-hand Shop-Owners and Repairers	Nehru Place
6.	**Formal**	6 Government Officials	• MoEF (ex-director) • Department of Environment in Delhi Government • DeitY under MCIT • CPCB • MSTC • Customs
7.		4 Manufacturers and MAIT	• HP • Nokia • Panasonic • Whirlpool
8.		4 Formal Recycling Companies	• Earthsense • SIMS • Attero • Greenscape
9.		4 NGOs	• 2 from Toxics Link • 3 from GIZ • 1 from Chintan • 1 from Sahaas

4.5.2.1. **Informal Respondents**

All the informal interviewees were questioned about their sources and methods of e-waste procurement, destinations of the WEEE, their respective backward and forward linkages in the chain and transactions with these linkages and others. The following presents a brief description of the participants, their activities and unique features, if any.

i. **Dealers** – the traders are the most important and influential players in the e-waste processing network and engage in collecting, dismantling (often through hired labour), trading and passing on WEEE for recycling. The professional bulk consumers form their main source of collection though they also have access to household and imported e-junk. They function at different scales (like locally or nationally) and levels and there are very big and experienced traders with high income as well as relatively small traders with specific functions and specialisations. Irrespective of their size and scope of operations, their main objective is to procure maximum amount and/or specific kinds of e-waste for optimum profit from selling the repaired and recovered items and elements in bulk.

ii. **Collectors** – the most ubiquitous and visible among all the various stakeholders, the door-to-door collectors or *kabadiwalas* operate in all residential neighbourhoods of Delhi and other metropolises, satellite towns and big suburbs with high EEE consumption. They are dedicated household dry waste (non-organic with reuse potential) collectors and also procure discarded electronic items when available. Though the number and volume of WEEE gathered by a single *kabadiwala* is miniscule, the aggregate amount collected by them is not negligible given their abundance. They eventually sell the junk to local or familiar waste shop-owners who in turn pass it on to the traders and dealers.

iii. **Dismantlers** – working under the traders, the dismantlers concentrate on sorting, disassembling and dismantling different kinds of rejected electronics. They also undertake repair and reassembly of e-waste parts and components to be finally sold to second-hand users. The differentiated material fractions like metals, glass and plastics go to designated traders, sometimes through middlemen. Some dismantlers practise basic recycling for reclaiming metals. Dismantling is usually taken up by young males who work manually using hammers, chisels, screw-drivers without any protective gears.

iv. **Recyclers** – these are specialised end-processers of electronics, particularly printed circuit boards to extract precious metals like gold, silver, present in minute proportions. They usually use dry and wet treatment methods to chemically salvage metals that cannot be removed by manual dismantling. The recycling owners keep shifting their units to other places when the police get the wind of their activity in a particular area. They mostly appoint male workers who are often migrant labourers from other states. This is the only branch of e-waste activity where women also participate.

v. **Second-hand shop owners & Repairers** – Nehru Place in Delhi is acknowledged as the biggest second-hand computer market in India and caters to clients from all over the

country. It acquires junk computers from household and overseas consumers, bulk users and traders and other collectors. Every shop-owner invariably engages several (depending on the scale of the business) repairers who are often trained in computer hardware. There are other small and local second-hand markets in the NCR but none to the scale and capacity of Nehru Place.

Interviews were recorded with pen and paper as usually informal participants were uncomfortable with recording. Many of them were constantly on the move. The main strategy in those cases was catching the informal players on the spot and pursuing them over a number of days, personally and/or telephonically. Some were easier to access (like second-hand shops as those are immobile) than others but on the whole, this group of participants were immensely difficult to contact and communicate with. All the conversations and observations were extensively noted on paper.

4.5.2.2. **Formal Respondents**

Though easier to access (through email and phones) than informal participants, it was still not simple to get appointment and relevant information from the formal respondents. The strategy pursued for the formal interviews was unlike that followed for informal ones. Initially the different government departments concerned were identified and then the responsible official was targeted. Sometimes, the immediate junior of the officer or someone with comparable knowledge and experience on e-waste was selected in case of non-availability of the original officer. For all formal informants, telephonic contact was preferred to emails since they can take very long to respond to emails, if at all. Also on the phone, the participant's interest in providing information could be gauged which help in planning the interview accordingly. In all instances, the phone calls were followed up with emails informing them of the research using an information sheet to introduce the research idea. They were also sent a thematic questionnaire beforehand.

i. **Non-governmental Organizations** – compared to other socio-economic and environmental issues addressed by NGOs, waste in general and e-waste in particular has received less attention. The 4 leading NGOs operating on a country wide scale were interviewed to get an overall understanding of the different processes and players involved in this trade and those influencing it (like the NGOs themselves). They were questioned on their specific and collective concerns on global waste traffic and its informal segregation and recycling. They provided an insight into the vast incidence of informal recycling in India compared to the European countries. They further elaborated on their liaison with other stakeholders in the WEEE network and their participation in the formulation of the draft of E-waste legislation and discussed its strengths and weaknesses.

ii. **Formal Recycling Companies** – the 4 main recyclers with a pan-Indian presence, all headquartered in and around Delhi, were interviewed. They shared their sources and methods of e-waste collection, the techniques adopted for non-hazardous recycling (and reuse, whenever applicable) and their principal clientele. They also talked about the challenges of expensive formal recycling in a country dominated by informal and cheap

methods of handling and disposal. They supplied information on their transactions with the domestic informal sector & overseas formal actors.

iii. **Electronics Manufacturers** – the brand manufacturers of electronic products selling in the country were contacted to understand the perspective of the producers and the potential and practicality of enforcing EPR in India. Altogether 4 manufacturers were interviewed along with MAIT that represents the IT hardware industry in India. Three of these respondents were again contacted during the follow-up stage. They discussed the prospect and deficiencies of the upcoming E-waste legislation before its implementation and afterwards.

iv. **Government officials** – there are various branches of the government at the national and state level dealing with e-waste traffic, processing, licensing and export-import. The main queries answered were on the procedure and logic behind the drafting of the legislation, roles assigned to different stakeholders, incorporation of the informal sector and future agenda on e-waste.

All the interview sites were in the NCR region and just one (Moradabad) in the neighbouring state of UP. The predominance of informal respondents in the field work required time investment but eventually yielded most of the desired results. The main gaps in information in the Indian context are the amount of EEE consumed or WEEE generated and data on export and import of e-waste. Moreover, the profit margins secured by the informal participants could not be ascertained due to lack of information. Also, the prices of discarded equipment could not be determined since they would vary depending on time, demand, type, constituent parts and their value etc. Additionally, no interview could be conducted with any exporter, importer or a middleman involved in the WEEE trade. However it is possible some trader or second-hand shop-owner interviewed might be directly in contact with the former but would not acknowledge it since the issue of waste traffic is enveloped in illegality.

4.6. **Interpreting the Data**

After the fieldwork, the task of organising the data was undertaken. This initially required deciphering the myriad information gathered by systematically arranging and deciphering the data obtained from The Netherlands, Belgium and India. The interviews (recorded and hand written) were divided in different categories, primarily by country and second by formal and informal sectors. Each category was again split into specific groups like dealers, collectors etc. for informal and NGOs, government etc. for formal. The recorded interviews supplemented with the respective notes were transcribed. Then a detailed summary of each interview was prepared and subsequently significant passages drawn for assessment later. Since many interviews were not recorded, the extensive hand-written notes provided the sole source for summarisation. These exhaustive summaries were classified into major issues that guided the original plan of the semi-structured interviews as well as those that emerged from the interviews. Some of the important themes for the informal interviewees in India were source and method of waste collection, income, working hours, immediate forward and backward linkages, previous background, education and age. Individual themes were developed for each formal respondent in Europe and India. Under each theme/issue, all the relevant quotes and

information were collated and supporting or contradicting evidence from secondary literature was compiled alongside. This ensured that the data is clean and refined. This also guaranteed that the responses of an individual or a collective against that of other(s) either in the same group or another has been compared and verified. This checks the veracity of and anomalies in the information gathered. Some instances of contradicting evidence were temporarily kept aside for consideration or outright rejection. This was the first stage of method triangulation to judge the consistency among the numerous interviews conducted.

The next step in data analysis involved identifying the main findings by investigating the broad patterns and trends that evolved from the themes. Diverse results emerged from the two phases of the fieldwork accounting for the spatial differences between the European countries and India. However, there were some conspicuous similarities like the European countries were also marked by the (relatively smaller) presence of the informal WEEE players though they could not be contacted due to their covert and underground existence. Also, it was found that e-waste was not confined within national territories and constantly moved in and out of the countries in both the cases. One aspect in which these nations clearly differed was in the improved infrastructure and mechanisms for formal collection and recycling in Netherlands and Belgium compared to India and the earlier introduction and enforcement of regulations pertaining to e-waste in the European countries. There evolved many more interesting commonalities and divergences which would be later analysed.

Finally, these findings were again compared and contrasted with secondary documentation that included those consulted during the selection of the case study and before the fieldwork along with updated and additional sources. Besides verifying the former against the latter, the latter also acted as a source of important and interesting data that were extracted for analytical purposes. All these ensured that the outcome of the research was systematically triangulated with other sources for validation or contradiction and research was conducted with reliable and credible information. Secondary research has been iteratively used during preliminary introduction to the WEEE issue, methodology to be followed, and selection of an appropriate case study, targeting specific respondents, verifying the data and/or findings from primary research and finally measuring it up against available evidence.

4.7. **Revisiting the Field Experiences**

Ultimately, the whole methodological exercise was reflected upon, from the onset of the project planning to its completion. My positionality as a researcher was instrumental in shaping my interactions with the various interviewees and is explained here. This section further recounts the challenges faced in the field and acknowledges its limitations. It also narrates the ethical concerns that arouse in the process.

4.7.1. **Researcher Positionality**

In retrospect, I contemplated how my personal attributes like age, gender, class and educational background conditioned my exchanges with the interviewees. My positionality as a researcher continuously changed in relation to the respondents during gathering field evidence from the multi-

cultural contexts of Europe and India. I admit that this is my understanding of the respondents' perception of me that influenced the information I received and could be less than accurate.

While conducting elite interviews with the state actors, reputed recycling companies, Phillips and the single environmental NGO in Europe, my identity of an Indian pursuing a PhD in a renowned UK university favoured my access to informants and information. As a foreign student, I was regarded as an outsider trying to develop an insight into the European landscape of e-waste management through people more knowledgeable and experienced than me. This led to a relatively unguarded flow of information except for those pertaining to illicit WEEE trade patterns and the actors allegedly involved. It proved advantageous that mostly people appreciated research and treated academics seriously. My inability to understand Dutch initially frustrated my efforts to understand online resources like state reports and organizational documents that were not available in English. However, since everybody was conversant in English, not speaking the language did not present a challenge during the actual interactions. My social class outwardly was not remarkably and conspicuously different from that of the interviewees and coming from another social setting and cultural environment did not really enter the dynamic of the equation. My age and gender did not particularly improve or impair my access and the quality of the interviews.

In India, the respondents' opinion of me varied in different circumstances depending on their profile, educational background and occupation and whether they belonged to the formal or informal sector. These factors differentially impacted and shaped the dialogue and communications. However, in all instances, I was treated with a degree of importance since I was not very young. In case of the formal actors (NGOs, government officials, formal recyclers and brand manufacturers), my access was eased due to my identity of a PhD student which attached credibility to my project. To a large extent, the academic vocation is treated and received positively in India. It could have been sometimes laced with a slightly indifferent attitude though never disapproved or reproached. My nationality facilitated information exchange as I was thought to have a better understanding of the diverse socio-cultural environment. Due to my affiliation to a reputed foreign university, the formal interviewees believed that my research can potentially have a wider reach and recognition internationally. Given my higher social stature, these elite players favourably regarded me compared to a researcher from a lower class and position of entitlement. They talked to me in either or both English and Hindi depending on which part of India they came from and their proficiency in those languages. It helped that I already had conducted my field work in Netherlands and Belgium. The formal actors could easily refer to the European context since they realised that I was aware of the regulatory functioning and management of WEEE in Europe. Given my previous experience in working with environmental NGOs and my familiarity with the field reports and e-waste literature elaborating the contemporary landscape of waste management in India, the NGO staff (perhaps not from a similar background) engaged in reasonably in-depth conservation with me.

In view of my experience of working and living in India, I knew that if I was introduced by a person familiar to the respondents, I had better chances of realising an interview, especially among the informal actors. I initially penetrated the informal players like traders, dismantlers and recyclers

through the grass-root activist I had earlier worked with. Afterwards, I would always request an interviewee to refer me to their colleagues. Despite sharing common attributes like nationality and language, the informal actors living in closely knit communities considered me as an outsider since I visibly came from an upper middle class background with higher educational qualifications. But gradually, with repeated visits and the time invested in lengthy conversations, they shared their concerns that were often unrelated to my topic of research. This could have transpired from my knowledge of and familiarity with the predicaments of the less priviledged due to my erstwhile NGO experience. I knew the importance of taking a personal interest in people rather than presenting an extremely professional front. Hence, in open-ended conversations, these players could share their everyday struggles due to lack of gainful employment opportunities in the country.

Some informal actors located at the hazardous end of e-waste processing were gradually convinced that I would not disadvantage their trade in any way and would not report their activities to the authorities. However, they were also careful not to divulge very sensitive information that might incriminate them. It is important to mention here that even while speaking the same language, in the beginning I struggled to understand them as their manner of speaking was quite dissimilar. I had to recurrently ask for clarification and elaboration which they responded to since I was very obviously not economically/commercially connected to their trade. People were more patient with me and mostly reiterated answers when requested. My gender might have mattered here since generally women are understood to have less business acumen. It also partially allayed suspicion since women are assumed not be capable of instigating much trouble and hence I would appear less intimidating. I refrain from judging their perception of my gender that might underlie this experience of mine. Religion never really posed any hindrance and I was invited to Muslim weddings. My knowledge of the field but social location as an outsider could have given me a unique position as an outsider-insider: that is a person interested but not directly related to the trade that somewhat helped my exchanges with the informal agents. Finally, without knowing Hindi I would have never been able to directly communicate with any of informal actors since they were mostly not very educated and could not converse in English. Additionally, I could better comprehend the nuanced complexities of the field through my observations of their personal and professional exchanges among themselves.

4.7.2. **Challenges and Limitations**

The scope and scale of the fieldwork was constrained by limited time and resources. In India, interviewing informal informants initially was a real hurdle. First of all, they were extremely difficult to locate, contact and schedule an appointment with. For example, the traders would be busy rushing about the city (and the country) in search of materials and their days were rarely planned beforehand. A meeting would only be possible after days of effort and the standard reply was '*Abhi nehin milenge*' (Not available now) on numerous occasions. The door-to-door collectors would be constantly mobile trying to geographically cover more residential areas. They had to be randomly stopped and questioned on the street. The dismantlers would only be open to discussion if their employers (traders) approved and accordingly they were interested, indifferent or averse. The recyclers were the hardest to access as their units were situated in the remote outskirts of Delhi or outside. Since the

owners of the units were generally out on business, visiting their associates, only two recyclers in Mandoli could be interviewed. Also the colloquial language used by the informal participants was initially hard to comprehend, like calling aluminium *chandi* (silver) and Central Processing Units or Central Processing Units (CPUs) *dhabbas* (boxes).

Despite these drawbacks, the informal actors gradually opened up realising that I did not pose any potential threat. Finally, I was able to form a complete picture of the e-waste flow and management from lengthy and in-depth conversations with the participants. However, some limitations of using the case study method persist in the research. The findings cannot be generalised over other e-waste processing zones in India. Since it was impossible to conduct the field work in multiple sites, the case of Delhi was used to develop a critical insight into the e-waste network. Moreover, in an effort to capture all the stakeholders in the industry, the individual focus on each individual category was compromised. Concentrating on a few groups of actors, although easier, would have portrayed a fragmented and incomplete picture. Hence the fieldwork was constructed to incorporate all the myriad actors engaged in the WEEE stream directly or indirectly at the expense of deliberating on one group over the other (albeit with a particular attention on informality). Additionally, since the WEEE issue is still nascent in India, it has not been properly documented and there is a deficiency of records on volumes, income etc. Thus the data collection was restricted by a lack of proper inventorisation of e-waste quantities. The informal workers displayed a habit of underreporting their income and/or profit and formal recyclers did not share such information. The investigation on the volume and destination of transnational shipments was circumscribed due to the inaccessibility of the exporters and importers. Though many informal participants admitted to dealing with them through several middlemen, they denied any knowledge of their whereabouts. Another area that could not be further explored was the gold recovery method practised by the recyclers in Moradabad.

4.7.3. **Ethical Issues**

The purpose of the research was explained to the informal actors before interviews. They verbally consented as informants, given their reluctance to put down their name on paper. Insisting on a signed consent would make them uncomfortable and might even jeopardise the chance of an interview. They also refused to have the conversations tape-recorded and hence all their interviews were extensively noted. The (formal or informal) informant's approval was sought before taking photographs. For the formal participants, verbal or written consent was sought according to their preference. If they were willing, the conversations were tape recorded while taking notes to aid the transcribing later. Otherwise the conversations were noted down on paper. All participants were assured of complete confidentiality and anonymity and hence their names have been codified and not revealed in the research, only the group or organization they belong to.

Lack of recognition and approval by the state has made the informal actors sceptical of sharing any information. According to the traders and the recyclers, in the past, outsiders had reported them unfairly and unfavourably in the media. The impending E-waste Rules had made them more cautious, insecure and reticent. Almost all the informal traders I interviewed wanted an assurance that their business will not be affected by talking to me (*kaam bandh to nehi ho jaiga?*). There were no gate-

keepers in those areas and every participant had to be coaxed and convinced separately. Many were reluctant to allow photography. One day I took a few photographs in Mayapuri in West Delhi. The next day, I was called by some workers in Mayapuri who took exception to my photography and wanted to talk to me in person. I had to convince them that I would not use the photographs in my research or any public domain. Since this research entailed exploration of informality and illicit boundaries e-waste circulation, it posed several ethical considerations. The ethical norm followed by the University of Manchester obliged me to report any illegal activity in India. However, during the fieldwork the informal WEEE trade in India was not deemed illegal as the E-waste Legislation was not yet implemented.

4.8. **Conclusion**

This chapter summarised and validated the methodological approach that informs this project. It has described the organization of the research starting from the use of a qualitative case study. There can be a variety of methods and strategies used to examine the formal–informal connections in the WEEE flow. However, given the available resources, this methodology is appropriate and effective, though it can be potentially improved. This research uses a micro-level case study to understand and analyse a macro-level phenomenon where the actors are the unit of analysis. It incorporates the entire range of direct and indirect actors and covers several sites to capture the international dimension of the WEEE phenomenon. It also classifies e-waste as an aggregate of all the electronics and electrical equipment, though the new Indian Legislation does not include lighting equipment in its purview which is covered by the European Regulations. During the field work, particularly in India, some differences in WEEE management were observed depending on the nature, size and weight of the gadgets. But there were adequate similarities between them which provided the basis for combining them in a single category like constituent ingredients (metals, plastics and glass) and the same players. Additionally, the regulatory interventions and state policies do not separate between them. Hence, in this research e-waste is regarded as a composite collection of the diverse EEE of different brands, configurations and models.

Analysing the research questions required specific use and application of both primary and secondary data collected. The first research sub-question (answered in Chapter 5) dealing with charting the e-waste stream in its reverse supply chain has necessitated the use of both. While secondary WEEE literature is consulted to understand the spatial flow and variations in waste management, the European and Indian narrative of waste movement has been constructed from field observations and interviews. The second question on formal-informal linkages (answered in Chapter 6) has predominantly drawn from fieldwork findings. It has also used non-academic reports like newspaper articles and organizational documents, to a lesser extent. The third question (answered in Chapter 7) on regulatory impact on the e-waste network uses primary material gathered from fieldwork along with documents on laws and policies by the state and state-affiliated bodies. The use of multiple sites, data sources and methods of collection from distinct categories of formal and informal respondents ensures the consistency of the quality of data. Additionally cross-checking with the secondary

literature establishes the methodological rigour of the research. The subsequent chapters present the findings of the field research in tune with the research questions designed.

CHAPTER 5:

MAPPING THE INTERNATIONAL E-WASTE FLOW

5.1. **Introduction**

In this chapter, the international trajectory of e-waste is analysed to track its movement and understand its structural composition and spatial configuration. Hence the chapter responds to the first research sub-question i.e. how does e-waste flow along the reverse supply chain from the point of its generation? Before analysing the multifarious dimensions of the global WEEE stream, it is imperative to map the pathways (and actors) through which it travels. By methodically following its course from the point of generation, this chapter provides a detailed chart of waste circulation. The dynamic conduits of the material stream in the post-consumption phase are neither linear nor unidirectional (Lepawsky and Mather 2011); rather they are structured along complex relational networks connecting multiple actors and spaces. The multi-directional trail of e-waste is studied using a GPN approach which examines its geographical constitution, network organisation and institutional embeddedness. The fieldwork conducted in Netherlands, Belgium and India (in 2011 and 2012) informs and substantiates the analysis of the international linkages and features of WEEE movement and management system.

The articulation of the e-waste network depicts that it functions as a continuum of formal–informal institutions and relations. The globally diverse understanding of waste results in spatially different perceptions and processes of treatment. The nature of waste management considerably differs between countries yielding variable returns to the waste practitioners. The expanse of the e-waste flow constitutes processes of disparate value creation and capture. Rather than merely presenting a disposal and management concern, waste is also regarded as a resource used to produce vital commodities. This has encouraged the conception of e-waste as capital (which generates value in motion) in comprehending the incentives behind second-hand commodity production and material reclamation from WEEE. Such an insight strengthens the organic orientation of the network narrative by illuminating the practices of production disintegration and associated value creation.

The chapter is organised as follows. The second section draws upon the existing e-waste literature to elucidate the trends in and routes of international waste circulation using evidence from media and organisational reports. The third section explores the rationale behind this global flow across countries to reflect on the specific national cultural contexts that underline the politics of resource and waste management. The fourth and fifth sections recount the cases of Europe (Netherlands and Belgium) and India respectively to highlight the spatial variation discussed in the previous section. They concentrate on the material and financial streams to describe the general waste transfer and treatment in these countries. The subsequent segment uses and expands this description to analyse the global phenomenon of e-waste production and processing within a framework of Marxian circuits of capital. The seventh section explains the GPN of e-waste by mapping its progress en-route to its EoL management, explores its sectoral and scalar expanse and elaborates how applying the notion of

e-waste (as capital) augments the GPN theorisation of value. The conclusion underscores the main findings and the concepts used in this chapter.

5.2. **Spatial Flow in the E-waste Network**

This section features the course of the international e-waste transmission by drawing from secondary literature. Much of this movement is covert, quasi-legal or completely underground, illustrated by, 'the quantities of grey market exports are difficult to estimate but are certainly significant……. It has not proved possible to get any hard data because grey export is, by definition, not declared' (ICER, 2004: 7). Thus the challenge of documenting the illegal waste traffic is that it is under the radar and undetected by authorities controlling, restricting and banning such trade. There is practically no data or research on the quantity of such flows (Davies, 2012; Kahhat & Williams, 2012; Lepawsky & Billah, 2011). This deficiency in data compromises the understanding and characterization of e-waste exports (O'Laoire Russel Associates, 2011). The fieldwork also showed that there is no record of the volumes of waste exported and imported. The internationally standardised Harmonized Commodity Description and Coding System (HS)[18] for classifying traded products (developed by the World Customs Organisation) do not distinguish between new and used EEE, rendering it difficult to detect shipments of obsolete electronics (Lepawsky and McNabb 2010; Puckett 2005). Lepawsky and McNabb (2010) used a proxy of trade in battery from the United Nations Trade Database, COMTRADE to assess the magnitude and direction of waste circulation. However, this proxy does not suitably represent international WEEE pathways as trade in battery scrap also include lead acid batteries from automobiles which might not follow the same route (Kahhat and Williams 2012). Despite the dearth of information to quantify e-waste traffic among countries, frequent reports in journals and media by environmental watchdog organisations expose the prevalence of illicit e-scrap movement globally (BBC 2010; Cubby 2009).

In 2003, approximately 23,000 tons of 'undeclared or grey market' e-waste (primarily monitors) and 10,000 tons of TVs (classified as hazardous waste) were illegally transported from the UK to the Far East, India, Africa and China (ICER 2004). Overall 2,500 tons of used EEE and illegal WEEE left Denmark in 2005 for overseas destinations, mainly West Africa and the Middle East (Nordbrand 2009). A study by VROM in 2007 showed that 28% of businesses were engaged in unlawful transboundary shipments of WEEE from Netherlands (VROM Inspectorate 2007 cited in Maxianova, 2008). Waste brokers in European countries routinely export junk EEE by disguising them in containers as second-hand products (often computers) for donation in the developing countries (Customs-NL, Rotterdam, 6 July 2011; FPS, Antwerp-Berchem, 8 July 2011). These containers also include equipment which are wrapped, labelled and placed in the front few rows to conceal the junk electronics behind. ICER (Industry Council for Electronic Equipment Recycling), 2004 reported that an exporter was shipping four containers of 40 feet every week loaded with e-scrap. The European ports are used as transit points for sending obsolete electronics to offshore locations from the US and Canada (ibid). Given the volume of commercial consignments leaving busy seaports regularly, a

[18] The HS is followed by almost 200 countries, representing about 98% of world trade.

handful of shipments are checked and thus there remains a high possibility of contraband products escaping customs scrutiny.

Of the 5-7 million tons of discarded computers and peripherals collected for recycling in the US, up to 80% are shipped to China, India and Pakistan (Li and Geiser 2005). A waste broker in the US admitted to exporting 10,000 computers and monitors abroad every month (ICER 2004). Waste recycling companies in advanced countries have been found guilty of selling obsolete gadgets overseas. A Colorado waste recycling company was taken to court in 2011 and charged for illegally disposing and smuggling e-waste (ICE 2012). According to the EC, 54% WEEE from EU gets exported overseas and only 33% is properly treated with the remaining 13% heading to landfills (Ioan et al. 2010). The pattern of world e-waste trade is not restricted to one-way traffic where the developed countries dump waste on the developing nations. There is ample evidence of WEEE flows between countries in the global south and within Asia and Europe (Lepawsky and McNabb 2010; Iles 2004; Shinkuma and Huong 2008). Second-hand electronic appliances like TVs and PCBs from Japan are traded into China, Philippines and Vietnam for reuse and recycling (Yoshida and Terazono 2010; Shinkuma and Huong 2008). Studies conducted in Ghana, Nigeria and Liberia have reported that roughly 70% of the imported EEE are functional, albeit with short life-spans (Lepawsky, 2014). Countries like Hong Kong, Malaysia and Singapore form major ports of entry, exit and transit. E-scrap trade also involves movement of parts and components as well as materials extracted. Such waste traffic is rampant despite various international agreements as well as regional and national legislations against it.

A major global concern with regard to toxic e-waste transport is the ramification on human health and environment in recipient countries which are often emerging economies. Unlike the advanced European Member States, very few of these nations have designated WEEE legislation, producer take-back schemes and established formal infrastructure for e-waste recycling (Nnorom and Osibanjo 2007). In the latter, the informal economy has historically played a significant role in recycling traditional waste (Wilson et al. 2006) like paper, glass and plastic. Obsolete electronics are also primarily dismantled and reprocessed in the informal sector, frequently with dire occupational and health hazards from unsustainable management practices (Lundgren, 2012; Wath et al., 2010).

5.3. **Spatial Variation in E-waste Management**

The dynamic geographies of e-waste have been portrayed above by recounting myriad instances of global WEEE transmission between countries. This section draws from the scholarship on e-waste to explore the reasons that potentially drive and motivate this phenomenon despite the policy initiatives, regulatory interventions and enforcement mechanisms designed to control it.

The international e-scrap trade can be attributed to a combination of socio-economic, cultural and institutional differences between the sender and recipient countries (ILO et al., 2014). One important factor is the price difference in WEEE treatment and disposal. In the developed countries, there is ample economic incentive for ‘processors of commercial WEEE to sell on equipment, components and materials that are uneconomic to process or repair rather than pay for these items to be disposed of or recycled’ (ICER 2004: 16). According to the US EPA, exporting WEEE to Asia is ten times

cheaper than recycling it in the US (Lundgren, 2012). Hence, in a flourishing global waste market, traders and recyclers continuously search for locations where commercial benefits are high with modest investment (ILO et al., 2014). An effective way of reducing costs is the use of cheap manual labour for dismantling and recycling operations. The miscellaneous electronic gadgets flooding the market pose a real hurdle for the development of any standardised model of automated recycling (Iles 2004). EEE has 'complex composition and huge logistical challenges' which can 'render the complete recycling chain uneconomical, depending on the product type' (Sepúlveda et al. 2010: 37). Thus, it demands labour-intensive removal and recovery of valuable parts from the junk in a cost-efficient manner that can occur in developing and transition countries, frequently characterised by cheap labour and slack environmental and health standards (ILO et al., 2014; Roman & Puckett, 2002). In such nations, there exists a readily available unemployed workforce willing to work informally at very low wages given the lack of adequate employment opportunities. In Sweden, the standard cost of formally recycling a home computer is 10 euros while it is only 1.5 euros in the informal sector in India (Nordbrand 2009). Moreover, the electronic gadgets typically contain precious metals like gold, silver, platinum and copper which have high resale value (Sinha- Khetriwal et al. 2005). The increased prices of virgin raw materials have pushed up the demand for secondary raw materials required for domestic manufacturing industries.

Informal recycling and repair are profitable since they satisfy the demand for relatively inexpensive second-hand electronics for consumers who cannot afford brand new ones, like in Ghana (Oteng-Ababio, 2010). Lagos, the largest port in Africa receives 'large-scale importation of second-hand electronics' and is known as the 'computer village' for the whole of West Africa (Nnorom & Osibanjo 2008: 1475). There is high demand for functional or repaired spare parts of EEE components for the domestic electronics industry in emerging nations like China (ILO et al., 2014; Yu et al., 2010). Hence, informal waste collectors buy e-waste from domestic and overseas consumers (Yang, Lu, & Xu, 2008). Such shipments are escalating due to the 'rising demand for second-hand products in Asian and African countries, and because of increasing prices for precious metals and other materials that can be recovered from such equipment' (Maxianova 2008: 270). The extensive WEEE processing industry in Guiyu (in Guangdong Province of China, one of the most notorious informal recycling sites globally) has been valued at US$ 72 million (Hicks et al., 2005). Moreover, the informal e-waste enterprises offer income-generating opportunities as waste is traded among collectors, processors, second-hand dealers and consumers. Small entrepreneurs are attracted by the low investment required for starting waste trading. Informal e-waste handling also creates employment for manual sorting, segregating and recycling (Wath et al., 2010).

The above factors are reinforced by strict legislative requirements for eco-friendly waste processing in the developed countries. There exist disparate institutional restrictions in advanced and developing countries with very strict environmental regulations in the former and relatively lax policies in the latter. Even the regulatory frameworks in place in the industrialising countries are not duly enforced (ILO et al., 2014). As the regulations become more stringent in the advanced nations, there is a growth in the volume of e-waste that is exported illegally. Gattuso (2005) has argued that due to a ban on desktops from municipal landfills in the US, the e-scrap export has increased to countries without

such ban. Thus, many so-called ‘recyclers’ in reality act as scrap brokers since environmentally safe WEEE treatment is expensive when one is forced to abide by prevailing green standards. In countries with lenient environmental laws and standards like China and India, an increasing amount of e-waste (both from domestic sources and overseas imports) is informally processed (Widmer, Krapf, Boni, Sinha-Ketriwal, & Schnellman, 2005).

Sometimes the scrap traffic is rationalised in the name of transferring innovative technical knowledge to the industrialising world. Many contend that this would bridge the digital gap by bringing in the fruits of sophisticated technology which can be imitated and learned from (Ongondo, Williams, & Cherrett, 2011; Williams, Kahhat, Allenby, Xu, & Junbeum, 2008). Through recycling technologically superior products the emerging economies would eventually adopt a technocratic route to industrialisation and development. The working second-hand items which are discarded in the advanced economies would provide inexpensive opportunities via secondary resale markets to those otherwise deprived from usage (Agarwal et al. 2003). Primarily computers which are quickly deemed obsolete due to rapid technological improvements in the Global North can contribute to digital learning for poorer communities worldwide (Nnorom & Osibanjo, 2007; Nordbrand, 2009; Williams, 2005). However, though reuse is ideally an environmentally friendly concept, the items designated for reuse very soon reach their EoL and their addition to waste is merely postponed for a short period (Puckett and Smith 2002). Since it is not illegal to export secondary EEE, these are rarely tested for functionality and often completely junk devices find their way in developing nations (Nnorom and Osibanjo 2007). Many importing countries allow waste trade as this provides a business opportunity for cheaper secondary material and employment for the poor (Y. Chen & Wu, 2010), as well as reaping the benefits from charitable donations. Thus, a coupling of economic forces, legislative guidelines and technological advantages ensure that there is seldom a dearth of interested scrap dealers, waste traders and big recyclers who find e-waste dumping and recycling rewarding.

While the different dimensions portrayed above induce the international WEEE movement, they also contribute to different management practices in diverse geographical settings and socio-cultural environments. Despite the presence of a unified e-waste stream worldwide, waste is perceived and handled in different ways in diverse spatial contexts. The disparate understanding of waste results in nationally distinct treatment mechanisms. This can be further attributed to the level of industrial development, institutional organisation and the history and practice of resource and waste management in a country or a region. In Asian and African nations, EEE is put to secondary use and would be hoarded and almost never thrown away like in Europe. In the US, stockpiling occurs due to the availability of space to store unused goods and the lack of feasible take-back services (Ongondo & Williams, 2011).

The nature of participation of different countries in the WEEE network depends on their socio-economic fabric and cultural and political institutions which influence the formation of markets around e-waste. ‘While e-waste recycling in developing countries is largely uncontrolled and purely market-driven, in developed countries it is organised and based on the principle of EPR’ (Tsydenova & Bengtsson 2011: 55). The two subsequent sections examine the WEEE management scenarios in the

countries studied to understand the variances in their e-waste management paradigms. They undertake a comprehensive mapping of the WEEE network between and within these countries.

5.4. **E-Waste Network in Europe**

The course of WEEE in Netherlands and Belgium are almost identical involving similar practices and policies directed by the national legislations translated from the European WEEE Directive in 2004. The regulation governing waste shipments in EU is the WSR. In 1998, the Disposal of White and Brown Goods Decree under the Environment Management Act in Netherlands introduced the principle of producers' responsibility in e-waste treatment. Following the enactment of the WEEE Directive and based on it, it was updated into the Electrical and Electronic Equipment (Management) Decree (BEA) and the Electrical and Electronic Equipment (Management) Regulations (REA). Similarly, in Belgium the 3 regional regulations on e-waste were implemented through an Environmental Policy Agreement in 2001 and later transposed separately for Flanders, Wallonia and Brussels-Capital Region. Flanders amended the Waste Prevention and Management Ordinance or VLAREA to match the Directive's requirements. VLAREA expanded the list of WEEE categories in the Directive by introducing gardening tools, other electric and electronic tools, and large and small household appliances not for household use. It further increased the collection target of 4 kg per person annually for household WEEE (to be reached by 2006) which was already reached before 2004 (OVAM, Mechelen, 8 July 2011). So Belgium, Netherlands (as well as Denmark and Sweden), had designated e-waste legislations before the WEEE Directive and made only limited additions (Selin & Van Deveer 2006). These two countries are also among the pioneers (along with the Scandinavian countries, the UK and Ireland) in the collection and management of e-waste whereas other EU Member States typically lag behind them[19]. There are other EU Directives related to electronics production like RoHS and Eco-design Directive which stress on green electronics design (discussed in chapter 2).

5.4.1. **Material Flow**

After the use and disposal of EEE by commercial and residential consumers, the e-waste in Europe gets divided into two streams. One is the formal network of material movement and another is the leakages into the informal sector. A B2B i.e. business-to-business or commercial bulk user has to directly discard old or obsolete devices to the producers' collective scheme in charge of the organisation of WEEE collection and treatment. In Netherlands, Wecycle is the executive organisation on behalf of all the electronics manufacturers and/or importers, conducting nation-wide collection and high-grade recycling. Its counterpart in Belgium is Recupel which operates in the entire country on the basis of individual voluntary agreements with the concerned industrial sectors and the governments of the 3 regions. In the case of a B2C i.e. business-to-consumer or household user, the following are the three options for disposal of EEE.

[19] For details on the environmental performance of the MS with regard to waste management, see http://epp.eurostat.ec.europa.eu/portal/page/portal/waste/key_waste_streams/waste_electrical_electronic_equipment_weee

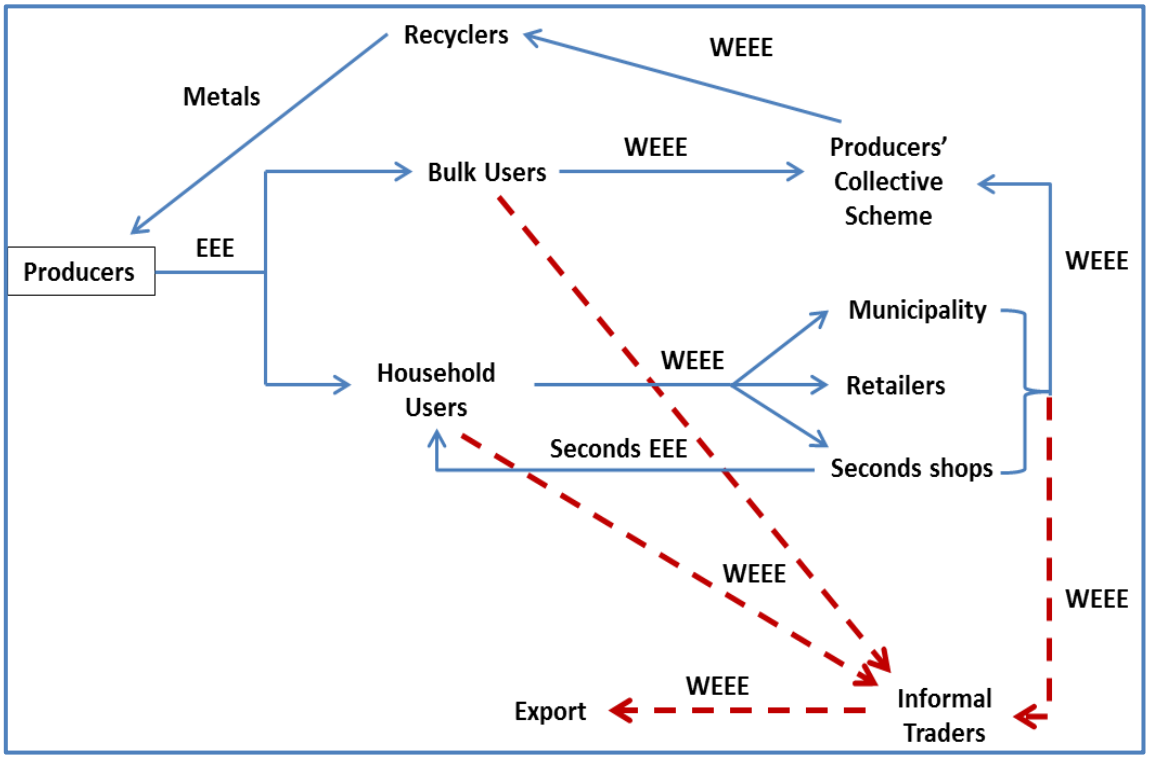
a. If a product is in working condition, then it can be donated to a charity or used goods centre where it can be repaired and sold in the second-hand market at a reduced price.

b. If the product is not working, then it can be disposed free of charge in one of the designated collection points, called container parks, run by the municipality.

c. If the product is not working and the consumer wishes to purchase a new one, it can be returned free of charge to the retailer.

The municipalities are responsible for the establishment and maintenance of container parks for collection. Retailers have to accept old appliances against new ones from customers and hand over the former to the producers' association. Once the appliances are discarded by consumers, the formal waste stream splits up into working (or repairable) and non-working equipment. Reuse centres are allowed to visit the collection points to pick up discarded goods in working condition. The former are repaired if necessary and sold in second-hand shops. The products which cannot be reused have to be environmentally disposed and recycled by authorized recyclers chosen by the producers and approved by the state. The producers' organisation collects non-working WEEE, transports and stores it in warehouses, where it is eventually sorted into various product categories for recycling.

Figure 6: European E-waste Flow and Actors



Source: Created by Author from field research

The above diagram schematically depicts the circulation of EEE, WEEE and its extracted parts in Europe (extrapolating from Netherlands and Belgium). After the disposal of EEE by both commercial

and household users, e-waste gets divided into two streams i.e. the formal and informal channels. The continuous lines illustrate the formal channels of waste flow and the broken lines denote the informal (also mostly illegal by the violation of national e-waste regulations) routes.

At the recycling plant, the WEEE is first weighed and registered. Thereafter, it is depolluted to separate and remove hazardous parts like Batteries, Chlorofluorocarbons, Cartridges, Mercury, Glass, Asbestos, Wood and Paper. The depolluted material is shredded and then passed through specialised separation techniques like magnets for ferrous metals, eddie currents for non-ferrous metals and heavy plastics, and sieves for TV and monitor glass, to name a few (Coolrec, Netherlands, 26 July 2011; Recupel, Mechelen, 8 July 2011). Pure materials like metals (iron, aluminium, copper, etc.) and plastics (with further processing) are destined for the international market as inputs for new production cycles. There can be dedicated international metal refining companies like Umicore in Belgium, recycling complex materials (containing valuable metals) including 30,000–40,000 tons of e-scrap every year (Umicore 2011). It recovers and sells 17 metals like precious metals (silver, gold, platinum, palladium, rhodium, iridium, ruthenium), special metals (indium, selenium, tellurium), secondary metals (antimony, tin, bismuth) and base metals (lead, copper, nickel) in the international metal market. Only a small proportion of WEEE is incinerated and landfilled and the majority is reused, refurbished, and recycled.

The formal channel of e-waste collection and treatment is in accordance with national regulations and monitored by the relevant environmental authorities (VROM in Netherlands and OVAM in Flanders, Belgium). In Netherlands, Wecycle collected a total of 134 million kilograms of e-waste in 2013 which amounts to about 8 kilograms per resident (Wecycle, 2013). In Belgium, Recupel collected 10.41 kilograms of Belgian WEEE per capita in 2013, adding up to a total of 115.5 million kilograms (Recupel, 2013). However, a substantial part of the WEEE also escapes into the informal channels. Comparing the EEE placed on the Dutch market per inhabitant with its collection, Huisman (2013) observed that 19% of WEEE created per capita in 2011 remained undocumented and unaccounted for. In Belgium, the corresponding figure is 30% in 2011 (Huisman, 2013). Of the missing WEEE, a part is hoarded by users and lies in attics and garages where it can be stored for a long time. Another ends up in waste bins along with household waste but periodic inspections have shown that it is not a sizable amount (OVAM, Mechelen, 8 July 2011). Often retailers, second-hand shops and business users directly sell to traders without handing over the waste to regulated and permitted channels (VROM 2011). These junctures of the chain are very difficult to examine and there is no data on the quantity of such WEEE (ibid). The traders often act as waste brokers, participating in illegal WEEE export overseas. But there is no quantification of the amount of e-scrap that allegedly leaves the ports like Rotterdam and Antwerp for overseas destinations. The port authorities report the cases of illegal consignments to the relevant environmental authorities who treat the information as confidential. However, there is adequate evidence collected from the field interviews (VROM, 4 July 2011; Customs NL, 6 July 2011; FPS, 8 July 2011; EEB, 13 July 2011) which suggest the presence of a wide network of waste traders, processors, exports and importers who engage in illicit waste traffic.

5.4.2. **Financial and Information Flow**

In Netherlands, the local authorities like the municipalities bear the cost of running the container parks. The producers' responsibility begins the moment when consumers return their WEEE to the municipal collection facility or the retailer. The municipalities might sponsor the transport and subsequent sorting of the collected WEEE by type of equipment while the producers pay the treatment costs. The division of financial responsibility of WEEE treatment is similar in Belgium. But in this case, the producers' organisation also undertakes collection, conducted through contract partners who also transport and recycle. The electronics manufacturers/importers pay for the logistics and get refunds against the valuable materials from household WEEE (recovered by the recyclers) which goes towards running the producers' collective scheme.

According to the WEEE Directive, for the non-historical waste (waste from EEE placed on market after 13 August, 2005), the manufacturers are obliged to entirely finance the collection and treatment and specific roles are assigned to civic authorities, retailers and consumers. The producers have to establish the infrastructure for the EoL management of e-waste. When historical WEEE (waste from EEE put on market prior to 13 August 2005) is replaced by equivalent products, the producers marketing these products collectively bear the financial responsibility of suitable disposal, paid in proportion to their market share. For the treatment of other historical waste, the household consumers are required to make an extra contribution that appears as a separate item on the bill during new EEE purchase. The producers thus include an additional charge[20] called visible fee or disposal levy to price of EEE for 8 years (10 years for large household appliances) since the implementation of WEEE regulation in 2005 i.e. till 2011 (2013 for large appliances). Afterwards, this contribution is transferred to their scheme of collection and recycling. No visible fee is permitted for new WEEE or non-historical waste.

The e-waste management policies in both the countries differentiate between household and bulk consumers for historical waste. In Netherlands, while the household user can discard old appliances free of charge, the professional user has to pay the recycling company. Hence, for the professional consumers, the producers finance the management of non-historic WEEE while for historic waste, the monetary onus rests on the user. In Belgium also, there are two types of consumer contribution for historical WEEE, which are

a. **All-in contribution for Household Appliances** finances the processing costs of discarded appliances and the administrative cost of Recupel (like reporting, audits etc.) and

b. **Administrative Contribution for Professional Appliances** covers the administrative costs of Recupel but not the operational costs for WEEE recycling. The latter are calculated when the equipment is discarded and is paid by the end-user.

A professional appliance (like servers, mainframes, industrial kitchen equipment, photocopiers more than 35 kilograms, etc.) is differentiated from a household appliance by its weight and power. Anything that is intended to be used in a household (with a comparable use in organisations) is considered to be a household appliance (like laptops, TVs, domestic refrigerators, photocopiers less

[20] The amount is determined by the producers depending on the product nature, size, weight, contents and the costs involved in recycling, approved by the government authorities.

than 35 kilograms, etc.). The professional equipment straightaway pass to the producers' collective scheme and then to recyclers against a payment determined by the nature and weight of the professional products. The recyclers chosen by the producers' association do not refund the value of the recycled materials from professional WEEE to the latter since the cost and value of recycling business WEEE accrues to the B2B users. However, the recyclers have to report the amount of materials recovered to the producers' association.

By the WEEE Directive, the EEE put on the market after 13 August 2005 should have proper producer identification, date and the WEEE symbol (crossed out wheeled bin) printed visibly. The imposition of the visible fee during purchase is intended to make the consumers aware of the costs involved in the EoL processing of the equipment. The producers annually report to the government the volume of products put on the market, taken back, selected for reuse, separate collection figures for household and non-household WEEE and the recovery of materials from recycling and reuse of appliances and components. They are also liable for notifying the concerned state departments. WEEE leakages from these formally regulated channels are motivated by profit as shipping e-waste to countries in Asia and Africa yield higher returns compared to environmental disposal and recycling (VROM, Rotterdam, 5 July 2011).

5.5. **E-waste network in India**

Prior to May 2012, India did not have any designated legislation on e-waste which was covered under the Hazardous Wastes Management, Handling and Transboundary Movement Rules, 2008 (hereafter HW Rules). The new E-Waste Management & Handling Rules (hereafter, E-waste Rules) mandates that e-waste processing can only be undertaken by licensed recyclers (recognised by the government) and holds the producer responsible for ensuring the eco-friendly collection, treatment and disposal of e-waste (DPCC 2013). Many formal e-waste recyclers are coming up in response to the opportunity presented by the enforcement of the E-Waste Rules. However, during the period of the field research (end of 2011 and beginning of 2012) which was before the implementation of the Rules, formal recycling facilities accounted for a minute share of the total e-scrap treated in the country with the informal sector historically dominating the collection and management of different kinds of waste along with e-waste. From May 2011, the preparation for implementation of the E-waste Rules was underway.

5.5.1. **Material Flow of E-waste**

The material flow of e-waste in India starts with its procurement from the household and professional consumers in the nation and abroad. There are three sources of e-waste collection which are elaborated below along with the methods of collection.

a. **From Overseas through Imports -** Discarded electronic gadgets as second-hand goods and components for reuse (with or without repair) are exported from the US, European countries, Korea and Singapore into India (Nehru Place shop-owners, New Delhi, 2012). The HW Rules (derived from the Basel Convention) continues to guide the EXIM policy and prohibits the import of e-waste. But junk e-scrap still comes in the guise of reusable products sent for charity purposes.

The common Indian ports of entry are Kandla, Kolkata, Mumbai and Chennai (Formal Recyclers and Informal Traders, NCR, 2011 & 2012) from where the goods are largely headed to Nehru Place in Delhi, the country's biggest second-hand market for computers catering to different parts of the country. The other second-hand markets in the capital are Laxmi Nagar in East Delhi and Wazirabad, located further east near the state border of UP. The second-hand shops sell their scrap to the informal e-waste dealers[21].

b. **From Indian Bulk Consumers through auctions & tenders-** WEEE from the bulk consumers constitutes one of the primary sources of e-waste. Commercial users like government offices, corporate houses, educational institutions, hospitals and financial companies periodically hold open auctions or float tenders once their used products (old electronics along with furniture, paper etc.) reach the EoL. Since e-waste originates from numerous public and private undertakings all over the country, it is impossible to assess and ascertain the volume of e-waste auctioned. There is no central databank which maintains records of e-waste traded in auctions that is primarily procured by the informal traders and the formal recyclers. For small and local companies and offices which do not conduct auctions, the door-to-door collectors amass the WEEE sold.

c. **Indian Household E-waste through door-to-door collection-** There is no designated dumping site for discarded electronics in India. Household WEEE is collected by informal door-to-door waste collectors who are called *kabadiwalas*. They buy dry waste like paper, bottles, plastic and everything else (along with discarded electronics) which can be reused and/or recycled. The amount of household e-waste is considerably less than commercial WEEE as domestic consumers usually exchange their old equipment with the retailers when they buy new ones. Items that cannot be exchanged are seldom thrown away and working appliances are often given to relatives, neighbours, household helps or simply hoarded in the attics. Small parts from gadgets like wires and plastic casings can be mixed with MSW (municipal solid waste). After purchasing the used electronics from a residential locality, the *kabadiwalas* in turn sell them to the neighbourhood or the nearest waste (*kabadi*) shop along with all other kinds of waste. The shops then sell their e-waste to specialised informal dealers. Household WEEE from other cities and towns gets channelized to Delhi through a series of middlemen, brokers and traders. Big waste dealers in Seelampur (biggest trading market of e-waste in India) in East Delhi have linkages with *kabadi* shop-owners in different cities and towns who buy e-waste from the local door-to-door collectors and send it over to Delhi.

The informal sector customarily dominates the collection of e-waste from all the three avenues. Apart from the auctions and tenders held by commercial users, the formal recyclers have not been able to penetrate in any other supply source. Even in the auctions and tenders, the informal waste traders overshadow their formal counterparts by the virtue of their extensive information network and ability to pay more. The latter can be attributed to the higher returns obtained from informal repair and resale of second-hand EEE for which there is a ready clientele. The formal recycling business ethics dictate that they only repair electronic products if requested by the client who demands the refurbished goods

[21] The terms waste traders and dealers are used interchangeably in this thesis. Unless otherwise mentioned, these are all informal sector actors.

to be returned to them. However, there have been allegations that the formal recyclers also sell in the seconds' market and to informal traders (Formal recyclers and Informal dealers, NCR, 2011 & 2012). Collected junk materials are often exchanged between the two. After procuring the electronic gadgets, the formal recyclers either repair and return them into use for consumption or recycle them to extract metals which re-enter into production. Out of the four recyclers interviewed, three of them mentioned that they sell the PCBs to Umicore for recycling (Formal Recyclers, NCR, 18, 25 and 30 April 2012).

In informal scrap trading, the e-waste is stored in warehouses (*godam*) or wherever space is available like on the streets or inside houses. The dealers typically sort WEEE into working and non-working products with the former (with or without refurbishment) heading to the second-hand markets in Delhi and the neighbouring states. Functional CRT monitors from TVs and desktop computers containing picture tubes are re-gunned (to replace the electron gun in the picture tube) to manufacture local TVs[22] (EMPA, 2004). The non-working items are disassembled by dismantlers working under the informal traders who also run dismantling units in their warehouses. The part which cannot be repaired and reused is broken down into constituent metals (like iron, aluminium and copper), plastic and glass. Non-working CRT monitors yield lead and glass on dismantling. Glass goes to the glass industry in Firozabad and Saharanpur (in UP which is adjacent to Delhi) renowned for making bangles and other glass items. Plastic is destined to Mundka in West Delhi which is Asia's largest plastic recycling centre (Gill 2009). The metals are bought by big businessmen (*byapari*) from Mayapuri in West Delhi which is the largest scrap market in India, dealing in all kinds of scrap like metal, automobile parts, electronics & electrical gadgets, furniture, glass, etc. which are auctioned from the factories. The recovered metals eventually reach the mills through a series of middlemen and flow back into production. A very small percentage of materials, primarily the various kinds of PCBs, go into actual recycling in Mandoli & Loni in East Delhi and Meerut and Moradabad in UP where copper and gold are chiefly extracted using chemicals. Copper is also derived from the wires and cables, either by scraping the plastic outside with a knife or open burning. Many informal traders reported exporting (through layers of middlemen and sometimes formal recyclers) PCBs abroad to Umicore which uses sophisticated technology to reclaim precious metals from PCBs and sells them in the international metals market (Umicore, Hoboken in Belgium, 30 June 2011).

The evidence presented here indicates that the physical stream of e-waste and its components cover formal and informal economies of production, consumption, disposal and waste management. The network is neither closed nor exhaustive i.e. not all the metals recovered from e-waste go into electronics manufacturing. It is linked with the broader economy in which the differentiated material streams ultimately get inserted as secondary raw materials for a fresh cycle of production.

5.5.2. **Financial and Information Flow**

E-waste management in India functions commercially where the actors are driven by prospective monetary gain. The auctions and tenders held by bulk consumers invite quotations from interested buyers and the highest bidder acquires the materials or '*lot leke aate hain*' (Informal Trader, Delhi,

[22] They are sold in Bhagirath Palace, a large market of electrical and electronic goods and Lajpat Rai market in Delhi.

2012). Often informal dealers collectively bid in these forums or '*pool bana lete hain*' (Informal Trader Delhi, 2011) to combine their resources and reduce competition. The value of the products is contingent on its physical condition (used to judge functionality) and its weight (to gauge the quantity and value of its constituent parts). These are assessed by experienced traders and the value ascribed by them fluctuates within a certain range. Similarly, for door-to-door collection of household WEEE, there is no fixed price which depends on the bargaining powers of both the parties. Even at the stage when it is sold to a waste shop, the prices are undetermined and the waste collector sells to the waste shop owner as long as he can make a reasonable profit (between 50-100 INR per transaction depending on the product or roughly 0.80-1.61 USD).

When dedicated dealers buy e-waste from waste shop-owners, the variation in prices is limited. The working equipment fetches a much higher price as they can be sold in the second-hand market. An operational colour monitor from a desktop is sold at Rs.800-900 apiece against a defective one which only earns Rs.200-300 apiece. Thus, often a desktop monitor is traded at Rs.500-600 without definite knowledge of its actual working condition. For a non-functional gadget, the weight and composition of metals (mainly) and plastic determine its value and the functionality of the product is no longer of concern. The prevalent market rate for metals governs the price of metal containing parts like PCBs. The prices for a computer depend on the model, the configuration, the capacity and the physical condition of the equipment. The most expensive part is the PCB which contains precious metals like gold and copper. The price of a mobile board is around Rs.2200 per kilogram, that of a chip board is between Rs.500-700 per kilogram and a mother board varies between Rs.250-330 per kilogram depending on the amount of gold available. Towards the end when constituent metals and plastic are recovered and sold, the prices are relatively stable. The following lists the prices as reported by the informal waste traders and workers in Delhi (at the start of 2012).

i. HIPS (high impact polystyrene sheet) plastic - Rs.20-30 per kilogram
ii. ABS (Acrylonitrile - Butadiene - Styrene) plastic - Rs.30-40 per kilogram
iii. Iron - Rs.20-22 per kilogram
iv. Aluminium - Rs.90-100 per kilogram
v. Copper - Rs.350 per kilogram
vi. Brass - Rs.250-270 per kilogram
vii. Gold - Rs.28,000 per *bhori* (1 bhori equals 11.664 grams)

These prices fluctuate along with the changes in the national metal market. The formal recycling companies also sell extracted materials at these prices. However, all the formal recyclers in the NCR suffer from the dearth of input i.e. e-waste and perform well under their full capacity. As mentioned earlier, they are unable to compete with the informal sector in securing an optimum quantity of WEEE from the consumers. Collection is the foremost activity relating to e-waste management and competition is highest during procurement. This operation dominates the bulk of the informal dealers' initiative and enterprise and they maintain networks with the bulk users, government officials, formal recyclers and informal agents like other traders, waste-pickers, door-to-door collectors, etc. The wider the set of connections of a waste trader, the more extensive is his information base. Accurate and

timely information is vital for collection since word of mouth is the predominant way of finding out where and when auctions are being held, the actual content of the items on offer since all discarded goods are sold together like office furniture, files, computers, typewriters, fans etc. The dealers have to be aware of the reserve price (minimum asking rate below which there will be no sale) for the materials to be auctioned and the relevant contact person selling the goods to be able to create liaisons beforehand. Since auctions and tenders are often conducted simultaneously in multiple locations (both inside and outside Delhi), they have to decide on their participation in one auction over another, depending on the prospect of profit. Sometimes, they delegate the task to their sons or close relatives to attend on their behalf.

Auctions and tenders are increasingly becoming more competitive with the participation of traders from all over India in e-auctions usually conducted by MSTC, a GOI (Government of India) enterprise under which an interested buyer has to register. Information regarding auctions and tenders are generally available on the internet (websites of individual companies or common ones like tendergov.in or tenders.indiamart.com). But only a miniscule number of auctions (usually big corporations and major government offices) are declared through the internet and the small and medium enterprises publish the news in the local papers and through letters to traders they have sold to before. The informal traders annually subscribe to weekly magazines (like Auction News Journal) which list the various auctions in an area over a period of time (Informal Trader, Delhi, 2011). Thus, the dealers depend on their myriad resources to track the auctions in the city (and beyond) and choose between overlapping auctions. The news for auctions is mostly obtained at the last minute and even then they can be delayed, postponed or altogether cancelled. The high incidence of informal e-waste operations stems from the traders' expertise in collection which is where the formal recyclers fail. By the latter's own admission, they cannot compete with the informal sector whose success can be largely attributed to its widespread networks of information and access to secondary markets.

The discussion of WEEE processing in Europe and India illustrates how the countries differ in their e-waste management procedures. The territorial distribution of the network manifests the nature of waste production and processing that can be attributed to the definite character of that space and the priorities of the people. Thus the European e-waste landscape has a much tighter institutional regulation. But in India, there is a higher degree of informality in the waste management patterns. The informal sector in both the cases is connected through a complex structure of international brokers, exporters, importers and middlemen who consider waste as a resource. Hence, while in Europe, e-waste treatment is paid for by producers and consumers, in India the informal traders/dealers buy and derive profit from WEEE.

The distinctive feature of the Indian political economy is the existence and nature of the dynamic market in second-hand electronics and the high demand for such products. The informal players successfully exploit this demand by disaggregating and assembling WEEE to make functional goods and components. They identify and tap markets which effectively cater to the consumers of used goods. The formal sector being incapable of accessing and benefitting from these profitable channels, lose out to the informal sector. In India, conventionally waste has been remodelled to produce useful

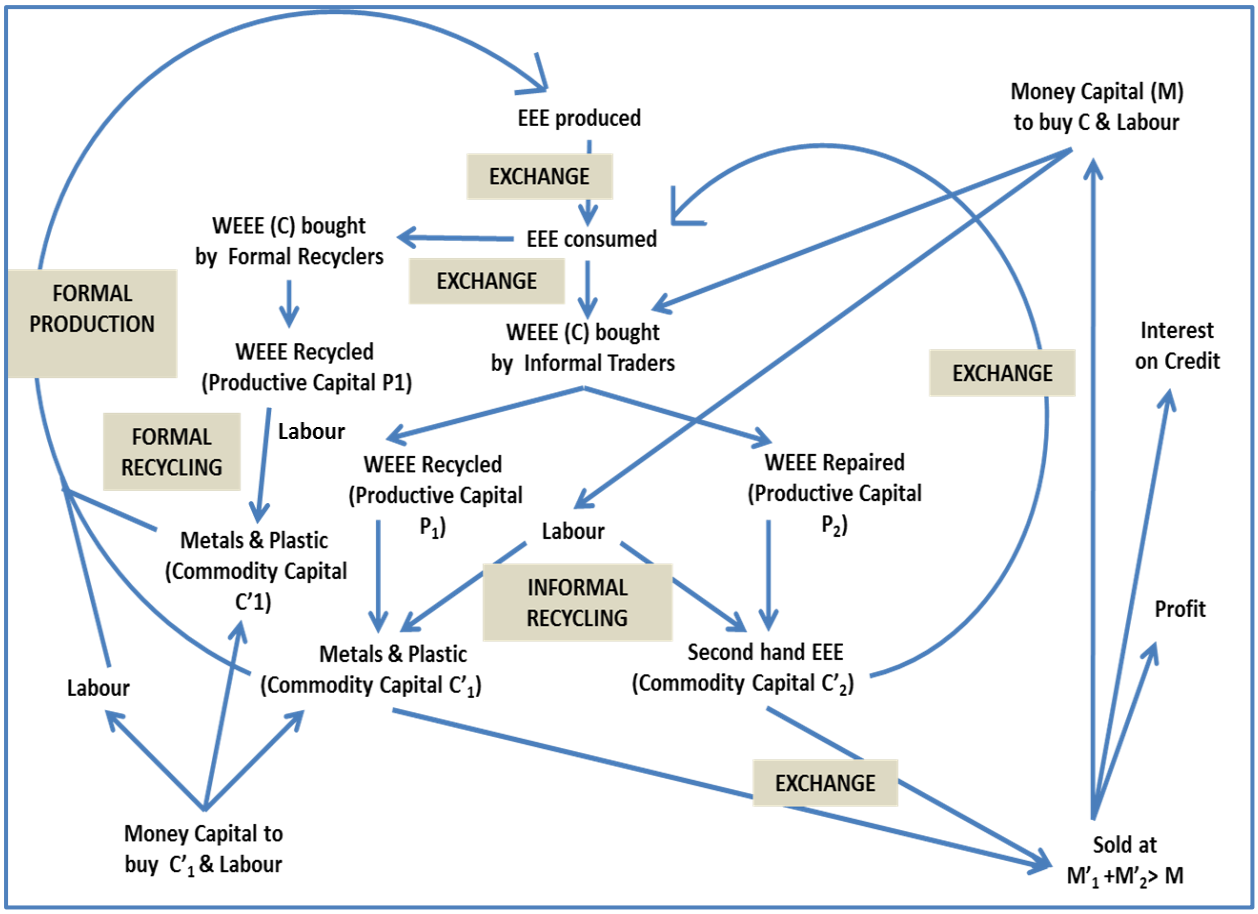
items, for instance paper bags from old newspapers. Similarly, rather than being dumped as redundant waste, WEEE is informally repaired and recycled whereby it moves into formal manufacturing and consumption again in the form of extracted metals and second-hand electronics. Thus, the formal and informal sectors of electronics production, consumption and waste operations are connected nationally, regionally and internationally. The particular channels of material movement outlined by using the cases of Netherlands, Belgium and India establish that the formal and informal e-waste sectors are mutually dependent. In addition to the widespread network of linkages, material flow and knowledge transfer representing the formal-informal nexus, there are definite patterns of continuity between the two sectors. While the informal recycling domain needs the formal manufacturers to produce the EEE, the formal players similarly require the informal sector to extract and salvage components in a cost-effective way from WEEE in order to re-enter the production chain.This will be further demonstrated in the next section which illustrates how value is produced by the continuum of formal-informal e-waste operations. It reveals the capital-labour relations in the geographies of WEEE and the creation of value therein in light of the Marxian notion of circuits of capital.

5.6. Understanding E-waste as Capital

Here e-waste is conceptualized as capital whose value expands as it flows from the consumers along its reverse supply chain through formal and informal economies. The e-waste stream travels along the circuit of capital simulating various forms of commodity capital and productive capital in different moments of its collection, disposal, and repair and recycling. Starting with the process of production, the formal manufacturers produce EEE. With the internationalization of production, this process might entail numerous informal practices of assembly, component manufacturing, etc. in different parts of the world. Hence, while the design and marketing of the EEE is carried out by the big brands, the informal suppliers, labourers, contractors and sub-contractors are involved in the overall process of manufacturing. The surplus value generated during manufacturing yields profit when these electronic gadgets are sold in the market. Consumers in different countries buy these appliances and discard them after use.

In e-waste processing in India, this WEEE is purchased as commodities by formal recyclers and informal dealers using their money capital. It includes both domestic and overseas junk electronics which are imported through waste brokers. While these products have exhausted their use for the consumers discarding them, they still have dormant use-value from the labour embodied in them during the initial process of manufacturing (Brooks 2013). To convert this use-value into exchange-value such that they can enter the market as commodities again, labour-power is employed by traders (purchased with money capital) to segregate and repair the products and/or their parts. The illustration below schematically represents the circuit of e-waste as capital which creates additional capital in its network of production, exchange, circulation and reprocessing. The rectangular boxes below denote the socio-economic processes of production and exchange that are the guiding principles in capitalist production. These functions perpetuate the circuit of e-waste recycling which is a continuation of the electronics manufacturing network.

Figure 7: Value Creation & Flow in the Spatial EEE, WEEE & Used EEE Networks



Source: Created by Author

The formal recyclers use money capital (M) to buy labour and the commodity WEEE. The arrow connecting Money capital (M) to the formal recyclers has been omitted in the diagram for simplicity. The WEEE formally recycled using labour is the productive capital (P_1) which under the social relations of capitalism yields metals and plastic. The informal traders also follow the same procedure to derive differentiated material stream from WEEE. The recycling can be performed by traders themselves or specialised recyclers who buy the main recyclable items like PCBs from the traders. These extracted materials from WEEE reprocessing are commodity capitals (C'_1) which are exchanged in the international market for a value higher than that of the components bought, thus generating surplus value. The increased money capital (from the start-up M) acquired from selling the recovered items is divided into a profit of enterprise (obtained by deploying e-waste for productive purposes), payment of interest (against any credit) and a part which is reinvested to purchase commodities again (WEEE and tools like hammer, chisel, screw-driver etc.) and labour to reinitiate the circuit. The substances derived from WEEE recycling enter the production cycle again as raw materials like precious metals, glass and plastic (obtained by selectively stripping the residual labour in PCBs by using new labour), which take the form of productive capital. Consumers buy these new EEE, yielding money capital (in excess of the original) for the manufacturer which (s)he throws into

production again. When these electronic appliances are discarded after consumption, they are subsequently bought by waste dealers as a commodity to transcribe the same circuit of capital, which becomes an ongoing process. Additionally, a part of WEEE bought by the informal traders constitutes the WEEE to be repaired (P_2) to generate second-hand EEE (commodity capital C'_2) which when sold yields money capital in excess of the start-up. However, these secondary EEE (mainly computers) do not solely serve the purpose of consumption but also of productive capital when used by small and medium business enterprises in India for production or service operations creating value and subsequently profit. When these turn into waste, they are bought again by formal and informal recyclers and traders. The materials derived from WEEE processing are not just constrained within the orbit of electronics but enters in and contributes to multiple other circuits of capital at an international scale. This encapsulates how the value of electronics and its waste is transformed within the circuit of WEEE production and treatment globally. The processes entailed within the circuit are aligned to the overarching principle of value creation and enhancement under capitalism. The formal and the informal sectors of waste disposal and management are connected with networks of international commodity production and consumption. Hence, there are conjoined circuits of capital (of electronics manufacturing, trading and production of used electronics and finally e-waste recycling) described by the global e-waste network that is expanded below.

5.7. The Global Production Network of E-Waste

Currently, using the waste conduits charted in this chapter (and the creation of value therein by both formal and informal players in the production, distribution, consumption and reprocessing of electronics and e-waste), the GPN of WEEE is discussed. This first projects the internationally stretched life cycle of e-waste and subsequently critiques the GPN approach for its under-developed conceptualisation of value in waste.

The global e-waste stream is configured along composite and continuous relational nexuses through which material, finance and value flow across diverse geographical actors and spaces. Along with the actors directly participating in WEEE management, those external to its orbit also influence its constitution and properties through civil society participation and political priorities. The role and efficacy of the state is significant in its design and implementation of the regulatory framework. It provides the legal environment in which such activities are embedded and conditioned. Thus, rather than the simple economic representation of industrial organisation common in value chain analysis, the concept of production network suitably captures the phenomenon of e-waste by emphasizing the interdependencies between economic, socio-cultural and political dimensions (Levy 2008). Here the GPN approach is used to study the WEEE trail with its intercontinental linkages and variations in its spatial characteristics and relations.

The connections in the international organisation of e-waste processing are non-linear, multi-scalar and institutionally embedded, transcribing a production network. While consumption and disposal are the proximate sources of WEEE generation, the beginning of the physical material can be traced to the formal sector of electronic manufacturing producing myriad gadgets. Household and commercial users regularly purchase and upgrade their EEE leading to a massive and steady waste generation.

This WEEE is not ‘fixed in its state and location’ (Davies 2011: 191) and the geographies of WEEE is stretched internationally like other waste mobilities (Brooks 2012a; Brooks 2012b; Gregson and Crang 2010). E-waste travels globally along the path of least resistance (Puckett & Smith 2002) covering the formal realm of waste management (characterised by strict environmental legislations) to end up in informal processing operations (usually outside the regulatory orbit) in the emerging and developing economies. In these informal realms, WEEE is traded, repaired and recycled crafting second-hand electronic products and extracting valuable materials. The resources retrieved from e- waste like plastic, glass and especially metals often return to the formal sector of manufacturing (Umicore 2011; UNEP 2009; Weidenhamer and Clement 2007) located nationally or internationally. WEEE trading is not restricted to the countries researched. Used computers from Australia are disassembled in Philippines after which some parts get exported to China, from where the PCBs are imported back to Australia for sophisticated recovery of precious metals (Tong & Wang 2004).

The ‘production, circulation and transformation of wastes as physical materials’ (Gregson and Crang 2010: 1033) illustrate that rather than signifying an end point in economic processes, waste is recurrently inserted in fresh cycles of production and consumption through reworking and refabrication (Brooks 2012a; Crang et al. 2012). ‘Used objects are devalued by cultural and political processes in advanced consumer societies’ and ‘re-produced as commodities that are systematically traded through global networks’ (Brooks 2012: 80; Gregson, Metcalfe, & Crewe 2014). This demonstrates the multiple channels and linkages in the commodity-waste couple which travels through the porous boundaries between formality and informality. E-waste does not represent the end of the trajectory of electronic commodities and there is no definite beginning or an end to its global production network (Lepawsky and Mather 2011). The processes of electronics production, consumption and the management of its waste in different countries are not isolated but intrinsically linked through a network of formal and informal agents performing diverse functions. Together, these actors and their activities create a single system characterised by material transfer, socio-economic transactions and financial arrangements. While the dominant control of the system lies with the producers, the informal sector is also a site of capital accumulation that influences the price rates and profit margins in the WEEE business. Hence, the network has multiple locations (formal and informal) of capital accumulation which reinforces the position and significance of informality within it.

The e-waste recycling network exhibits that spatial differences exist in the global perception of e-waste despite being fundamentally inter-connected within a singular network marked by indivisible formality and informality. Definite actors in particular economies attach differential value to WEEE accruing to the processes of trading, repair, dismantling and recycling. As the physical material moves along its network, it is transformed, reworked, revalued and reused. Material conversion of EEE and WEEE is possible due to the spatial relations between and processes of formal and informal productive (both primary and secondary) activities. Compared to the value generating operations in EEE manufacturing, the ones in reprocessing junk electronics differ considerably. The secondary production in WEEE treatment encompasses recycling (PCBs), repairing (whole EEE or its parts), dismantling and reassembly. During recycling, the latent labour embodied in the PCBs (from the original stage of manufacturing) obstructs effective metal recovery, Hence additional labour-power is

deployed to chemically salvage the metals after partially stripping down the existing labour to extract value from dysfunctional PCBs. Similarly in dismantling operations, the technologically sophisticated and intricate binding of the whole equipment poses an impediment in breaking it down. Consequently, EEE is mechanically fragmented into constituent metals, glass and plastic which gets rid of a part of the dormant labour (which originally assembled the various parts and materials during manufacturing) embodied in electronics and is achieved by employing extra labour. However, if the EEE (or its parts) is repairable then the refurbishing operations do not destroy the existing labour contribution but further build upon it by repair (maybe combined with reassembly) for the resale of functional electronics and the components. Hence, in the process of EEE restoration, the residual labour in the gadgets is further added upon and not eliminated. Though it has been recognized that 'waste conversion is a part of the production process' (Tong et al, 2011: 32) the complex and variable labour processes generating value through WEEE treatment have not been deconstructed.

Extending the Marxian Labour Theory of Value to the realm of waste processing, it can be debated that the production of commodities from e-waste has the underlying purpose of surplus value creation, enhancement and extraction. GPN scholarship aspires to fathom the process of valorisation in the dynamic institutions of capital and labour in the contemporary expression of capitalism. However, it fails to distinguish the myriad processes of value formation and extraction and examine the organization of capital and labour that characterizes waste management in a capitalist economy. This research challenges the GPN perspective on value that underpins repair of and metal recovery from e-waste. GPN is unable to comprehend the various modes of labour involvement in (re)valuing and (re)fabricating WEEE that is followed in the secondary phases of production. It is essentially limited to value constructed in primary production. Through the conceptualisation of e-waste as capital, it can be recognized how value is generated by distinct labour functions which differ from that in conventional manufacturing stage. The analysis of value in e-waste within the Marxian Labour Theory of Value differs from and improves the understanding of value in the GPN framework. It demonstrates how value is embedded in the product beyond the manufacturing phase rather than a mere exposition of the financial flow through formality and informality in the network. With such acumen, the GPN of electronics and e-waste can be posited within the broader capitalist economy.

Thus an elucidation and application of the Marxian circuits of capital locates the generation and movement of value within the global network of e-waste. It demonstrates that the GPN of e-waste embodies integrated and multiple circuits of capital that 'form the nexus of functions, operations and transactions through which goods and services are produced, distributed and consumed' (Coe & Hess 2013: 4). Informality is incorporated in the circuit of capital through reworking and remodeling waste into reusable products. It has been illustrated that while the electronics manufacturers generate and accumulate value and (most) profit from production, the informal sector also plays an important role in the creation, circulation and distribution of value through distinct and also similar labour processes. This questions the GPN impression on metal retrieval and value created and transferred along the global contours of e-waste as capital. The operations involving valorisation of WEEE executes perpetual circuits of capital and satisfies the pursuit of profit required for capitalist development.

Hence the GPN approach should develop a theorization of value that can grasp the international division of labour and the divergent regimes of value in the international waste processing systems.

5.8. Conclusion

The mapping of the international e-waste network extends the popular focus from conventional processes of manufacturing which culminates in consumption. Typically (useless) waste is considered as the opposite of (useful) commodity. But by highlighting the mutability between commodity and waste, this chapter asserts that they cannot be physically and conceptually delineated. It further validates that the commodity production and waste management in Europe and India are consolidated in a common network where formality and informality perform diverse functions. By mapping the course of WEEE, the integration and interdependence between formality and informality on a global scale can be appreciated. This is one of the most significant findings of this chapter. The value ascribed to WEEE is sectorally and geographically divergent, inducing its spatial movement. Contrary to the postulates of waste dumping, many (informal) actors derive value and profit out of the waste trade and recycling. The e-waste network is structured within a globally competitive market of commodity production and waste treatment within the broader framework of neoliberal governance.

Effectively, this chapter charts the reverse supply chain of e-waste to highlight the seamless circulation of waste in multiple directions on an international scale. It has observed that one of the main drivers of informality in WEEE processing can be located in the dynamics of the secondary consumer markets in developing nations. By taking into account the potential second-life of electronic products, the informal sector caters to this market in India. It realises the demand for cheaper EEE by recognising WEEE as a raw material and capitalising on its resource potential. The European landscape primarily conceives of e-waste as an unwanted by-product of electronics production and consumption. Much of what is perceived as ‘junk’ in the European countries finds its way into nations like India with dynamic secondary EEE markets. Therefore, it is economically profitable to illegally export e-scrap to locations where it is informally repaired and recycled than to formally and environmentally dispose it through the producers’ collective scheme. This unpacks the phenomenon of WEEE production and processing by explaining the underlying process of value transformation through waste management paradigms.

This chapter employs the concepts of GPN to follow the e-waste trajectory and the understanding of formality and informality to establish the continuity between the two in the network. It further uses the circuit of capital interpretation to reveal the distribution of production and inter-connections between the formal manufacturing and recycling industries and the informal, frequently backward operations. Therefore, another finding derived here is that production is not only undertaken by the manufacturing companies, it continues in the post-consumption phase by formal and informal dealers and recyclers. The uninterrupted motion of electronics and its waste captured by the circuits of capital approach shows how informality realises profit from the production of commodity capital for market exchange. Hence, informality assists the process of capital accumulation in the electronics industry. The internationalisation of capital is exemplified in the global patterns of waste movement and management within conjoined formal and informal WEEE network. These formal-informal linkages

characterise one of the crucial foundations of the dispersed yet functionally integrated e-waste landscape. The next chapter concentrates on this aspect and analyses the architecture of the network organised around and by formal-informal relations. It focuses on the particular forms of connections between the formal and informal WEEE sectors that define and inform the overall coordination and specific operations therein.

CHAPTER 6:

FORMAL – INFORMAL LINKAGES

IN THE E-WASTE NETWORK

6.1. **Introduction**

Following the trajectory of the WEEE stream, the last chapter has described the material and financial flow in the international e-waste network. The transboundary geographies of waste connect formal and informal sectors through the production and exchange of reused and recycled goods. It has been demonstrated that informality in e-waste disposal and recycling dominates the Indian landscape before the enforcement of the E-waste Rules in May 2012. The secondary literature consisting of reports and assessments by NGOs also bears testimony to this (Chaturvedi et al. 2012; MAIT-GTZ 2007). Informal WEEE practices also exist in the tightly regulated countries like Netherlands and Belgium in Europe, albeit on a lower scale. This chapter investigates the heterogeneous informal sector in the e-waste network to overcome the 'enduring preoccupation with the formal economy and the lingering view of large multinational firms as the foremost point of interest and relevance' (Phillips 2011). It discusses the different WEEE informal and formal actors and their socio-economic exchanges. Thus it responds to the second research sub-question: What is the nature of transactions defining the formal – informal linkages in the process of e-waste disposal and recycling? The primary research conducted in Netherlands, Belgium and India (Delhi) along with relevant secondary sources informs the exposition of this chapter.

The socio-economic relations between the WEEE actors constitute the governance structure which guides the spatial organisation of the network. They characterise the functioning of the diverse formal and informal contracts and/or agreements. The power wielded by the actors in influencing the outcomes of these negotiations to their favour determines the value capture and control. It has been observed that 'for the understanding of the configuration of any network, the flows of power and information may actually be more important than those of money and utilities' (Thorelli 1986: 39). The informal agents derive differential returns from e-waste management corresponding to their relative position and power. This chapter engages with the governance practices and power asymmetries to move beyond the conventional inter-firm dynamics and hierarchies typically studied in the chain and network literature (Crang et al. 2012).

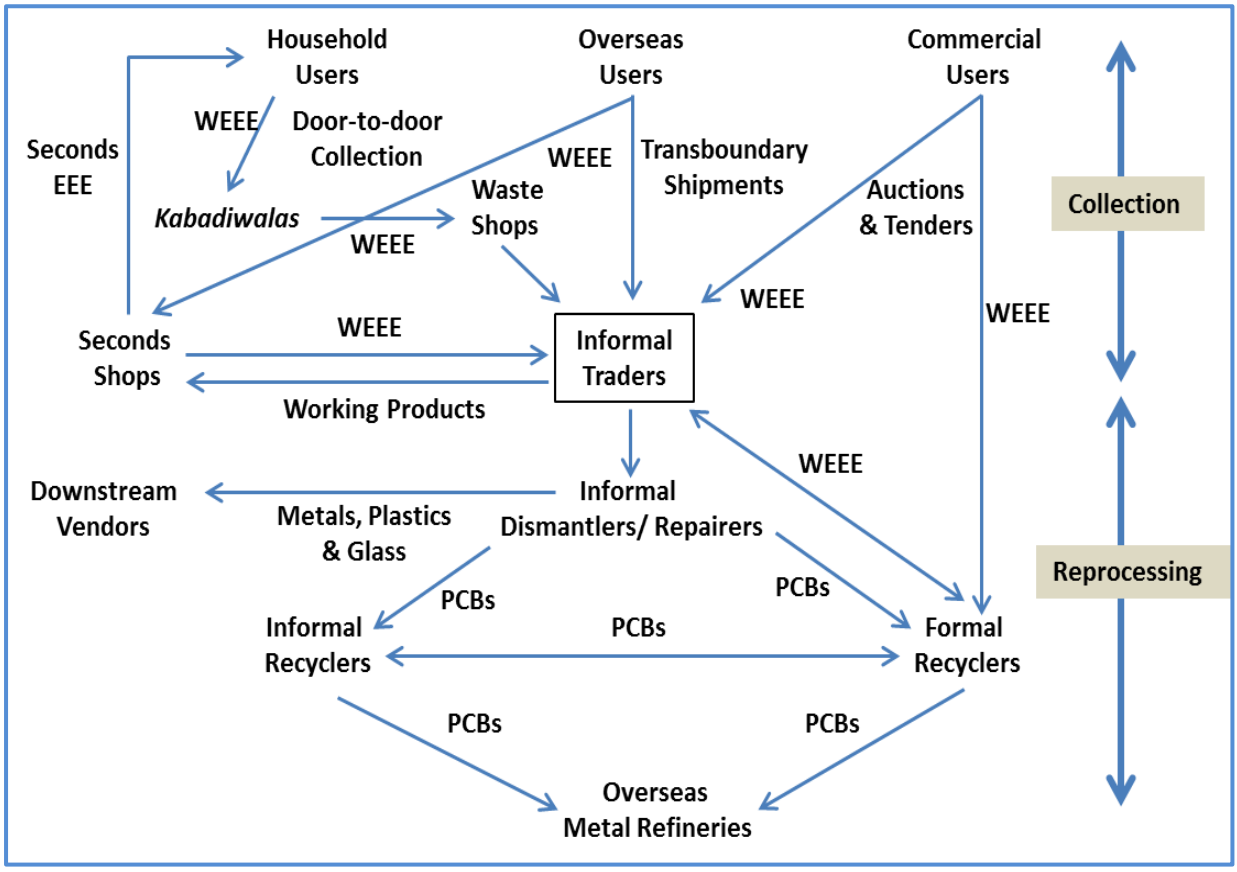
The chapter is organised as follows. The next section deliberates on the different players in the Indian e-waste network with the aid of a schematic diagram and discusses each category separately. The inter-linkages between the actors portray their functions in waste treatment and position amidst the forward and backward linkages. The third section analyses the nature of the relationships holding the network together. It reflects on the governance of WEEE informality and the power structures and investigates the associations between formality and informality in India. The fourth section analyses how the field evidence on horizontal relationships confronts the GPN perspective of trust and lateral

ties in the network. The chapter ends with a conclusion which summarises the main findings and the concepts used to drive the chapter.

6.2. The Actors in the Indian E-waste Network

This section focuses on the Indian e-waste players. The following diagram depicts the varied actors contributing to the network. The categorisation of the distinct group of actors is based upon their definite role in waste processing like collection, dismantling, repairing, recycling etc. However, multiple operations are often carried out by a single group and several groups frequently undertake a specific activity.

Figure 8: Indian E-waste Actors



Source: Author's creation from field research

E-waste management can be broadly divided into collection and reclamation which include sorting, dismantling, refurbishing and recovery of precious metals. It is conducted by predominantly informal (and formal) actors located at various junctures of the network. The figure represents the complex and multiple channels of waste flow between formality and informality with no well-defined separation between them. The informal dealers collect e-waste from the household, commercial and overseas users using varying methods of procurement. They hire dismantlers and repairers and sell the working products (with/without repair) to the second-hand market. The seconds' shops can either be formal or informal. The informal traders sell the recyclable components like PCBs to designated

formal and informal recyclers and segregated metal, glass, plastic to downstream vendors. The formal and informal recyclers sometimes export the PCBs to specialized metal refineries abroad like Umicore in Belgium. Hereafter, the individual groups of players involved are separately considered.

6.2.1. **Informal Actors involved in E-waste Collection**

In Delhi, the informal traders, dismantlers, recyclers and second-hand shop-owners organise and operate in geographically proximate clusters which facilities easy communication, resource exchange and mutual learning. Contrary to their clustering practices, the *kabadiwalas* (door-to-door waste collectors) and waste shop-owners are dispersed in various parts of the city since the earnings in their trade accrues from geographical spread and extensive coverage of the residential areas. The *kabadiwalas*, waste shop-owners and the informal traders/dealers are primarily the players engaged in e-waste collection. The second-hand shops and formal recyclers perform the dual function of procuring and reprocessing WEEE.

6.2.1.1. **Traders**

Informal e-waste trading is practised widely in Delhi. One of the oldest e-waste dealers in the city commented, 'E-waste is traded everywhere in Delhi, in every lane and every alley' or '*Puri Delhi mein trading hoti hain, har gali mein hoti hain*' (Informal Trader, Shastri Park, 07 April 2012). In the early 1990s, only two others, apart from him, practised WEEE trading (Informal Traders, Shastri Park, 01 March & 07 April 2012) with high profit levels without much competition. Progressively the margins dropped as trading became popular. The main clusters dealing in e-waste in Delhi are Seelampur, Shastri Park & Mustafabad (in East Delhi specialising in computers and accessories), Turkman Gate (in Central Delhi dealing in all kinds of electronics) and Mayapuri[23] (scrap market of automobile waste, metals, industrial spare parts and WEEE). These areas developed following the slum clearance and decongestion drives during the state of emergency in 1975 when Turkman Gate, an old Muslim stronghold in Old Delhi was targeted (Tarlo, 2003). Those evicted were later rehabilitated in different colonies through urban settlement programmes (Verghese, 2010) and allocated small plots of land. Shastri Park, Mustafabad and Seelampur emerged as resettlement colonies in the trans-Yanuma region. At present, all three are largely inhabited by informal working class Muslims (Sarkar, 2010). Mayapuri was designated as an Industrial Area to rehabilitate the evictees from Motia Khan during the emergency. A Sikh trader bought land in Mayapuri after his shop in Lajpat Nagar was burnt down in the anti-Sikh riots in 1984[24] (Informal Trader, Mayapuri, 12 May 2012). Gradually Mayapuri organically emerged as one of the biggest scrap markets of the country with 3,000 shops and 10,000 workers (Nandi, 2013). According to the President of Mayapuri Industrial Welfare Association, 'E-Waste recycling is one of the biggest yet unorganised industries in India and Mayapuri is one of the many hubs,' (Kumar, 2012). The traders in all the sites are primarily Muslims except Mayapuri, which also has Hindu traders. Out of 21 traders interviewed, 7 are Hindus out of whom 6 operate from Mayapuri

[23] In March 2010, there was a radiation leak in Mayapuri from the Cobalt 60 pencils in a Gamma cell irradiator auctioned by the Delhi University's Chemistry department to a scrap dealer on February 26, 2010. It led to the death of one person and severe injuries for seven others.

[24] This was considered a response to the assassination of the then Prime Minister Indira Gandhi by her Sikh bodyguards.

and one from Seelampur. This suggests partially religion and community based clustering since all the sites are dominated by Muslims, except Mayapuri. There was only one Hindu dealer in Seelampur who was called *bhai* or brother as is customary among Muslims. The map in Chapter 4 (Figure 6 on page 75) can be referred to understand the locational distribution of the various clusters discussed here. The table of Indian respondents in Chapter 4 elaborates the number of actors interviewed in every category.

Ten of the dealers have earlier traded in traditional waste like household, automobile and metal scrap or repaired electrical products like old TVs, radios and electric motors. This facilitated their transition into WEEE dealing from the early-1990s when they grabbed the opportunity presented by the increasing e-waste production. Two of them are former *kabadiwalas* (one in Turkman Gate and another in Mayapuri). The other 7 are erstwhile dismantlers and 2 are second generation traders in Mayapuri. Many of the young traders in Shastri Park (5 out of the 7 interviewed) who are between 25 to 30 years old, have been dismantlers who received hands-on training. They continue to dismantle the equipment while expanding their trading business and hiring other dismantlers. The traders in Turkman Gate, Seelampur and Mayapuri are not involved in dismantling and hire more dismantlers than those in Shastri Park and Mustafabad. The second generation traders can be found in Turkman Gate and Mayapuri who receive at least secondary education and often help their fathers in accessing auction information through the internet. Those in Shastri Park are first generation traders with at least primary education and many have moved to Seelampur to expand their business. The scale of operation in Shastri Park is somewhat less than that of the other trading sites. Seelampur has developed as a dedicated WEEE trading center of computers and accessories in Delhi (A. Jain & Sareen, 2006; Kakkar, 2012). Mustafabad is a relatively new trading location.

A threshold capital investment that permits buying bulk e-waste is required to venture into trading. Traders additionally need a warehouse (*godam*) for storage and dismantling. So they 'rent a warehouse and start trading' or '*Godam liya aur trading chalu kar diya*' (Informal Trader, Seelampur, 01 April 2012). The warehouse is where the trader can be found or enquired of when he is away to procure WEEE, often outside Delhi. Collection forms the informal traders' primary initiative and enterprise. They pick up e-waste from local waste shops in different neighbourhoods around the city. They participate in auctions and/or tenders where quotations are invited from interested buyers and the highest bidder purchases the WEEE. All kinds of waste like furniture, paper, wood and electronics are auctioned together and according to a trader in Turkman Gate, they 'cannot afford to be picky about what they buy' or '*Jo milta hain le lete hain*' (Informal Trader, Turkman Gate, 06 April 2012). After obtaining the materials from auctions/tenders, they sell specific items to specialised traders. Dealing mainly with the heavy electronic equipment like air-conditioners, coolers, refrigerators and medical equipment themselves, the traders of Turkman Gate & Mayapuri sell computers to the traders in Shastri Park and Seelampur.

Apart from material sourcing, the traders also sell dismantled products like metals, plastic and glass. A vendor in Shastri Park buys plastic from all the traders in the area and a couple of others buy iron, aluminium and copper (Informal Traders, Shastri Park, 01 March 2012). So 'The informal recycler

breaks up waste, sells the copper to one guy, the plastic to another, the PCBs to yet another. These guys amass their material and sell it to an exporter who then passes it on to a recycling plant often located in a developed country.'

(Watts in Guardian 2013)

The traders are extremely reluctant to reveal the details of their income or profit. However, some of them shared that they earn between 25,000 INR to 50,000 INR (about 404.8-809.7 USD) monthly and many of them own cars (Informal Traders, Shastri Park, Seelampur & Mayapuri, 2012). The majority stressed that their income varies considerably and it is impossible to ascertain an average income. The only Hindu trader in Seelampur declared, 'In this business, profit and loss is not important as long as you can continue the business'. He dislikes auctions/tenders due to heavy competition. Instead he has 100 small junk dealers employing 10 or more *kabadiwalas* and supplying materials to him from all over the country. He exports PCBs abroad and claimed that he deals with the exporters through brokers and middlemen. He refused to divulge the export destinations and contacts, remarking that the brokers refuse to share such information fearing that their role as middleman might be terminated. Another trader in Mustafabad reported exporting motherboards to Africa and Singapore through brokers and denied any knowledge of the actual exporter(s) involved (Informal Trader, Mustafabad, 03 April 2012).

***A Warehouse in Mayapuri, New Delhi*:** Photograph by Author

Delhi acts as a popular destination for e-waste from the rest of the country (IMRB International, 2010)(Toxics Link, Delhi, 28 September 2011; GIZ, Delhi, 09 April 2012). A group of informal traders in Pune are called '*delhiwalas'* or the 'Delhi-people' who regularly ferry WEEE from Pune to Delhi (GIZ, Delhi, 14 March 2012). Every day 2-3 truckloads of junk electronics arrive in Seelampur from

different towns and cities (Informal Traders, Seelampur, 16 April 2012). One trader who visits Calcutta once a fortnight to obtain WEEE, said,

"There is no serious e-waste dismantling in Calcutta. I bring the materials to Delhi and sell them here. The recyclers from Moradabad collect PCBs from me".

(Informal trader, Shastri Park, 21 March 2012)

He declared that there are many traders like him who bring e-waste to Delhi from different places. Two rare traders revealed that they used to receive imported computers coming in through the ports of Mumbai & Chennai (Informal traders, Shastri Park and Mustafabad, 14 March 2012 and 03 April 2012). Along with others, he would buy the materials (mostly monitor and CPUs). A forty-foot long container with 2000-3000 items would come twice every week but now that source has become very uncertain. Overall, auctions/tenders are the main WEEE sources. The traders occasionally have a 'setting' (prior understanding) with an agent/officer of the auctioning company who might reserve a part of the material to be sold. He sells it to his favoured trader who shares some of his profit with the former (Informal Trader, Shastri Park & Turkman Gate, 21 March & 06 April 2012).

6.2.1.2. **Door-to-door Collectors and Local Waste Shops**

Along with the players in the seconds' markets, the *kabadiwalas* are the most visible e-waste handlers. Most of them are rural migrants, pushed out of a stagnant agricultural or non-farm sector or left in the hope of a better urban living despite having positive earnings in their rural locale (Kabadiwalas, Delhi, 07 March 2012 & 12 January 2013). Out of the 20 interviewed, only 4 were from Delhi. The other 16 either migrated to the capital in search of remunerative jobs, the lack of which landed them in waste picking or they came to join the trade introduced by a relative, neighbour or a friend in a similar vocation. In Delhi, they come from states like largely UP (Uttar Pradesh), also Bihar, Jharkhand, West Bengal, Orissa, and Chhattisgarh (http://www.gobartimes.org/content/trash-life, accessed on 3 September 2012). They can be found carrying waste in residential neighbourhoods on bicycles, sometimes attached with a cart. They normally demarcate territories between themselves and pay for access to the RWA[25] (Residents Welfare Association) areas. They buy paper, plastic, glass bottles, electronics and all other discarded items from households and eventually sell to a waste (*kabadi*) shop-owner.

For the *kabadiwalas*, the chances of upward mobility are limited but not non-existent. They can progress into the category of a waste shop-owner and in rare cases, that of a trader. For the former, they require a physical space that would serve as a shop to store all household waste (mostly crammed into a tiny room with spillage outside). Capital and space might restrict their entry into the shop-owner category (Kabadiwalas, Delhi, 07 March 2012 & 12 January 2013. Especially in Delhi, procuring even a small space is very expensive since real estate is a flourishing business. The collectors are free to sell to any waste shop (depending on favourable piece rates) that buys from a large number of easily replaceable collectors. Sometimes, the traders (like in Seelampur) directly buy from the *kabadiwalas* without the intermediate shop-owners. In these cases, the traders influence the

[25] RWA is a civic body representing the interests of the residents of a specific urban or suburban locality.

terms of the deal. The MCD (Municipal Corporation of Delhi) imposes fines if the waste is scattered outside the shop premises. The shop-owners are sometimes harassed by the police who demand bribes for allowing operation in an area. These shops in turn sell their e-waste to specialised dealers when price variation is limited within a range. The prices for computers depend on the model, the configuration, the capacity and the physical condition of the equipment.

6.2.2. **Actors involved in E-waste Reprocessing**

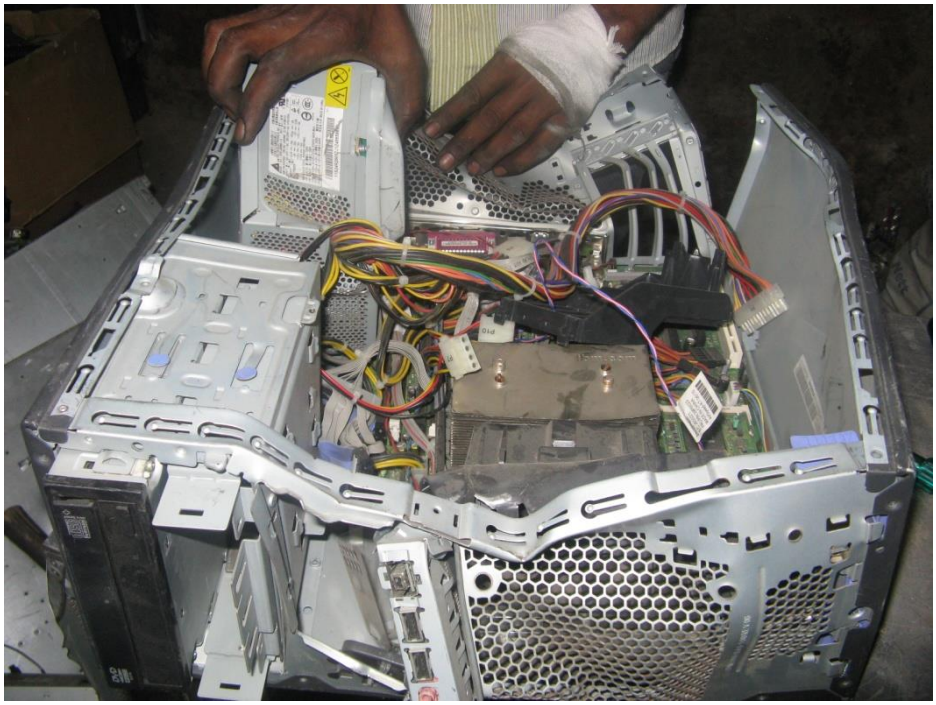
The dismantlers physically separate e-waste into differentiated material streams. The recyclers focus on chemical extraction of precious metals from PCBs. The dismantlers are also proficient repairers and fix broken computers or parts to assemble a working computer. The second-hand shops hire dedicated repairers to carry out refurbishing, usually at an advanced level than the dismantlers. However, the former purely concentrate on repairing and not separating constituent elements from WEEE like the latter.

6.2.2.1. **Dismantlers & Repairers**

The primary activities in e-waste processing are manual segregation, disassembly and dismantling performed by dismantlers hired by the trader. Shastri Park is particularly reputed for dismantling. A twenty year old dismantler in Shastri Park started working almost 10 years ago. He works for 10 hours every day and earns 5000 INR (roughly 78.75 USD) monthly (Informal Dismantler, Shastri Park, 10 March 2012). Every dismantler learns on the job and his income depends on his experience and skills. In Seelampur, a 16 year old dismantler who started 2 months ago, earns 2500 INR (about 39.46 USD) whereas a 15 year old working for 2 years make 3500 INR (about 55.25 USD) per month working around 8 hours a day (Informal Dismantlers, Seelampur, 01 April 2012). One 27 year old dismantler in Turkman Gate has been in this job for the last 14 years and earns 9000 INR or roughly 142.15 USD each month (Informal Dismantler, Turkman Gate, 06 April 2012).

All the 13 dismantlers and/or repairers interviewed work between 8-10 hours per day and earn on a monthly basis. They are aware of the selling price of the different materials but not their sources, destinations and potential profit. Many dismantlers later move on to trading but dismantling also functions as secondary work for people in between or in lookout for jobs. A dismantler (engaged in removing copper from wires) in Shastri Park works in a garment shop in Jama Masjid area which is undergoing renovation. Hence it is comparatively easy to shift between sectors but only for young dismantlers performing relatively simple tasks. The older and more experienced dismantlers do not usually change sector. Another dismantler has come to the capital after graduating from Agra district and works in a supermarket. He also doubles as a repairer of computer chargers and hopes to move on to a better job soon (Informal Dismantler, Shastri Park, 21 March 2012). The dismantlers work in the warehouses in Shastri Park, Seelampur, Mustafabad and Mayapuri which are poorly ventilated (usually without windows) or right outside as in Turkman Gate and Mayapuri. They sort, segregate and repair the junk electronics and sometimes assemble computers using the reusable components from the scraped ones (with Pentium III or IV processor). They ‘repair and refurbish the dysfunctional products and sell them’ or ‘*bekar bigri maal chalu karke bech dete hain*’ (Informal dismantler,

Seelampur, 10 March 2012). The non-working and non-reusable computers (usually with Pentium I or II processor) are completely scraped as they seldom have any use as second-hand products.



***CPU Dismantling in Shastri Park, Delhi, 2012*:** Photograph by Author

The dismantlers are also predominantly Muslims but instance of Hindu dismantlers hired by Muslim traders were also observed. Out of 13 dismantlers, 12 were Muslims and only one was a Hindu dismantler working under a Muslim trader in Turkman Gate. Hindu traders also prefer hiring Muslim dismantlers as 'starting from a very young age, they are adept in all kinds of artisanship' (Informal Trader, Shastri Park, 07 April 2012). They believe, 'Muslims do intricate work (*meenakari kam*) much better than others and are expert dismantlers' (Informal trader, Mayapuri, 12 May 2012). None of the dismantlers observed uses any Personal Protective Equipment like gloves, masks or helmets and works with simple tools like hammer, chisel, screwdrivers etc. They are usually male since their job requires physical strength and force to rip the EEE apart. They are usually hired from the same locality as the traders such that demand and supply are matched in proximity (Informal traders, Seelampur & Turkman Gate, 06 & 16 April 2012). Sometimes they can belong to the traders' family residing in the neighbourhood town or village (Informal Traders, Shastri Park & Mustafabad, 21 March & 03 April 2012).

The dismantlers also perform basic metal extraction like manually removing copper from wires and cables using knives and pliers to pull out the copper. The gold rich components (like chips, Integrated Circuits or ICs) are separated from the PCBs by holding them with a tong to the heat of a torch flame. This loosens the bond between the lead solder (with a lower melting point) and plastic and then the PCB is tapped on the ground or hammered to take out the components. The solder is retrieved, cleaned and sold and the PCBs are passed on to the recyclers. None of the traders interviewed

practised PCB burning which causes severe air pollution. But in several warehouses in Shastri Park, workers were observed heating PCBs and when approached, refused to talk.


***Copper Extraction and Dismantling in Turkman Gate, Delhi, 2012*:** Photograph by Author

Dismantling CRT present in old monitors and TVs is another environmentally hazardous activity since it contains lead. Its disassembly and re-gunning are labour intensive processes and it is used in manufacturing local TVs sold in Bhagirath Palace and Lajpat Rai Market in Old Delhi known for local electronics. So old TV monitors are preferred to the new flat screens TVs. The dismantlers work under close supervision of the traders who give practical instructions on the complex disassembly of EEE. The young dismantlers are initially dependent on the traders but prospects of upgrading are not closed to them as quite a few advance into trading. Dismantling helps in acquiring technical know-how and in forging networks which opens up potential marketing and sourcing channels. There can be additional opportunities of upgrading for the dismantlers by graduating to complex processes (more intricate sorting, disassembly and repair), and products (more complicated gadgets).

6.2.2.2. **Recyclers**

Though traders frequently retrieve copper from wires and cables, it is mainly recycled in Mandoli and Loni (located at the outer edge of East Delhi) and gold in Moradabad and Meerut in UP. Many recycling units shifted from Mandoli to Loni in 2012 which being closer to UP escapes stringent police control (Informal Traders, Shastri Park & Turkman Gate, 14 March & 06 April 2012). The recyclers in Mandoli are mainly Hindus (Informal Recyclers, Mandoli, 10 April 2012) and operate in small rented plots in a field next to the village Tila Shahbadpur. The recyclers demarcate their plots by bare brick walls which have gradually increased in height to shield the work going on inside (GIZ, Delhi, 09 April 2012). They are usually absent from their units, busy procuring PCBs from informal traders or selling salvaged materials onwards. The recycling units are located far away from the eyes of the authorities. The map in Chapter 4 (page 75) further reinforces this to show that Mandoli is located at the fringe of Delhi near the border of UP. It is difficult to access from nearest bus station, requiring almost an hour and a half in the car on a muddy and broken stretch to reach the area. The recycling owners normally use two-wheelers for commuting.

They primarily hire migrants with an overwhelming majority from Bihar (Informal recycling workers, Mandoli, 10 April 2012) that is one of the most impoverished states. The latter extract copper from PCBs using dry burning and wet extraction in acid bath resulting in toxic fumes. In the first case, PCBs are roasted in open pits to retrieve the continuous layer of thin copper foils laminated. The charred plastic is removed by hand and the thin copper layers are sold to the factories at Rs.350 per kilogram or roughly 5.6 USD. In the wet extraction method, the PCBs are boiled in caustic soda (NaOH) solution and scrubbed with a big flat brush to remove the paint. Then they are put into a solution of nitric acid (HNO_3) and sulphuric acid (H_2SO_4) for a few hours. The copper dissolves in the acid as copper sulphate or '*Copper pani ban jata hain*' (Informal Recycling Workers, Mandoli, 10 April 2012). Fine iron wires are dipped in the acid solution and the copper settles at the bottom as sludge/residue. The iron wires turn the colour of copper indicating its separation. The acid is decanted and the sludge is dried in the sun and ground to powder. From the copper layers and the powdered copper, the nearby factories make copper bricks. The residual ashes from burning and the acid from wet bath are dumped locally.

***PCBs in Acid bath and Cleaning PCBs in Caustic Soda Solution in Mandoli, Delhi, 2012*:**
Photographs by Author

Out of the 10 recycling units visited in Mandoli, only two recyclers (from Bihar) were present on the day of the visit. One is 23 years old and employs 9 labourers to extract copper. The second recycler (25 years old) extracts gold using 5 workers but refused to share the actual procedure. He asked, 'Madam, what will you do with this information?' or 'madam, *itna janke kya karogi?*' (Informal Recycler,Mandoli, 10 April 2012). He sells the recovered gold in Chandni Chowk market in Old Delhi for Rs.28,000 per *Bhori* (about 10 grams) or about 441.24 USD. All the 5 women interviewed live in adjoining areas and earn Rs.100 per day or roughly 1.6 USD compared to the men who receive 4000-7000 INR monthly (about 63.11-110.43 USD). The recyclers randomly choose among the women at

the established wage rates and they are usually hired for less skilled operations like sorting and cleaning of PCBs. Cleaning requires the usage of dilute NaOH solution which has a stinging sensation and can cause severe chemical burns if concentrated. Recycling provides ad hoc work to women on a daily basis. While the men are tied to a single unit, with more stable jobs, the women are called in when extra hands are needed and paid less than men. Highly asymmetric power relations exist between the recyclers and the male employees. Despite toxic working conditions and long hours, the workers do not receive adequate remuneration though recovering copper is a profitable enterprise. They use bare hands to handle burnt PCB plastics, remove charred copper strips and decant acid from big drums. They mostly lack chances of improving their position in the recycling business. The men recycling workers occupy the most casualised and vulnerable position in the ladder of informality. Despite earning less than their male counterparts, the female workers are not totally dependent on or tied to a single recycler which accords them a better power relation. They are easily replaceable and free to seek other ad-hoc albeit low paid and unskilled work. Thus, frequently, power negotiations are not necessarily contingent upon economic considerations alone. The recycling end of the e-waste network is environmentally detrimental and a health hazard (Toxics Link & GIZ, Delhi, 28 September 2011 & 09 April 2012). The owners of these units order open burning to be carried out at night to reduce visibility of the fumes and avoid smoke detection. A couple of workers from Bihar taking out copper from charred plastic complained that their eyes itch and burn from the fumes and ashes and they would shift to any other job if possible (Informal Recycling workers, Mandoli, 10 April 2012).

The town of Moradabad and Meerut (the latter known for gold jewellery production) in neighbouring UP specialises in gold extraction from PCBs. They also remove brass and copper from e-waste and other industrial waste. Moradabad is situated at a distance of 167 kilometres from Delhi on the banks of Ramganga, a tributary of the Ganges. It is renowned for manufacturing brass utensils, ornaments and handicrafts in small household units and is inhabited by 45.5% Muslims according to the census of 2001[26] (http://www.aicmeu.org/Muslim_Population_Distribution_in_India.htm, accessed on 11 November 2013). Labelled the Brass City (*Peetal Nagri*), it has a booming brassware industry and is its biggest exporter in the country. The household units working on brass faced serious competition from big factories and slowly shifted to e-waste and other kinds of waste recycling. From their traditional skills and expertise in crafting brassware, they developed techniques to salvage precious metals from WEEE. They usually collect PCBs from the traders in Delhi and use either cyanide or mercury amalgam to chemically extract gold (refer to Appendix VIII in page 209).

Gold extraction is carried out by family run units with conventional proficiency in working with precious metals. Here unpaid family labour organised around gendered and generational relations are prevalent where the women and children undertake the easier tasks of cleaning, sorting and the men are in charge of the burning and actual extraction along with the buying and selling of the items. Here the power differentiation among the different members is exercised in a patriarchal and familial form rather than that in a wage relationship between an employee and employer. Before chemical

[26] By the census 2011 and 2001, Muslims constitute 13.4% of India's total population.

treatment of the PCBs, they are charred at high temperature. To avoid detection, the burning takes place in the nearby forest away from the residential zone. Nobody would divulge the technique of gold removal to safeguard their comparative advantage and steadfastly conceal the actual reclamation procedure. The recycling operations in Moradabad reflect the informal characteristics listed by the ILO like reliance on indigenous resources, family ownership of enterprises, small scale of operation, labour-intensive and adapted technology, skills acquired outside the formal school system and unregulated and competitive markets (ILO, 1972) except the ease of entry.

***Children working in their home & a Blast Furnace in a local factory, Moradabad, Uttar Pradesh, 2012*:** Photograph by Author

Copper and brass are also separated from industrial waste (along with e-waste) which is burnt and pulverised. Then the powdered mixture is repeatedly washed by the shore of Ram Ganga to obtain copper and brass. Small extraction units (called *bhattis*) melt these in blast furnace for recasting or '*Galne ke baad dhalai ho jati hain*' (Informal Recyclers, Moradabad, 10 May 2012). In the factories, the (usually male) workers have regular pay and unequal power relationships between the employer and employee. The recast metals are eventually sold to metal traders and mills from where they return into manufacturing processes. The majority of people in Moradabad is engaged in the business of either gold, brass or copper extractions while only a few people work in the big brass factories (Informal Recyclers, Moradabad, 10 May 2012).

6.2.2.3. **Seconds shops**

The repair and refurbishment of computers are concentrated in the second-hand electronic shops in Nehru Place, South Delhi. It is the largest second-hand market for computers and peripherals in India, popularly called Computer Bazaar. Named after the first Prime Minister of independent India, it was originally a market for fabric and clothes. Business in computers started since the mid-1990s and now accounts for more than 50% of the business (Seconds Shop-Owners, Nehru Place, 05 March 2012). Every brand and variety of computers and accessories are retailed there. The area consists of numerous small and big shops selling and repairing old computers, accessories and parts, refilling printers and engaging in every other conceivable activity related to computers. It also deals in software and along the main lanes, men offer software to the passers-by. The shops are of different sizes (not necessarily indicative of the scale of business), usually located in the basements or on the

first floor with the ground floor occupied by the brand retailers. Rents are tremendously high in the area and even the smallest of shops pays a rent of 15,000- 20,000 INR per month (about 236.93-315.88 USD).

Laptop Repair Shops in Nehru Place, Delhi, 2012: Photographs by Author

***A Seconds-Shop and Printer Cartridge Refilling in Nehru Place, Delhi, 2012*:**
Photographs by Author

Out of 15 respondents from Nehru Place, 3 shops claimed that repair of second-hand computers constitutes more than half of the computer business in the area, catering to clients in Delhi and

beyond (Seconds Shop-Owners, Nehru Place, 2012). The main customers are small and medium BPOs (Business Process Outsourcing) and other small companies in the country. The author witnessed two men from Kashmir who came to buy used computers in bulk during an ongoing interview. Walk-in customers like students, professionals and households seeking to buy or repair computers are also common but form a miniscule of the total business turnover. The shops in Nehru Place collect used computers from a variety of sources. Six shops interviewed import computers from overseas but did not disclose the contacts of the importers and business particulars like monthly turnover and profit margins. Four of the shops procure computers either from informal traders in Shastri Park and Seelampur, or auctions or both. They have known and dealt with the traders for a length of time and their business transactions are marked by easy but respectful camaraderie.

Two other shops (one also importing) collect computers from customers like call centres and local enterprises. Three shops only specialise in laptop repair and do not participate in buying and selling and one did not specify. The skilled repairers hired are often vocationally trained in hardware and software, like 4 repairers against two who learned on the job. Sometimes the shop-owner might have less technical know-how than his employees. There is enough demand for repairers and hence adequate jobs, permitting them to choose between numerous shops. Simultaneously, there is no dearth of repairers looking for potential vacancy and the shop-owners can hire anyone satisfying the job profile. Almost equivalent power relations are observed between the shop-owners and the repairers.

6.2.2.4. **Formal Recyclers**

The formal recycling companies cater mostly to the B2B (business-to-business) sector and buys WEEE directly from those preferring green disposal and eco-friendly reprocessing (Formal Recyclers, NCR, 25 & 30 April 2012 & 16 January 2013). They use automated, semi-automated or manual operations but lack the requisite technology for precious metals recovery and export the PCBs to refineries abroad. Only one formal recycler (namely Attero) among the four companies operational in the NCR region (in 2012) claimed to use a sophisticated smelter (Attero Recycling, Noida, 16 January 2013). The remaining components like glass and plastics are sold for further refining and reprocessing. According to an assessment report on e-waste generation and collection in Delhi,

'……..all the formal recyclers are sourcing their raw material (i.e. used electronic products) from the corporate segment only. Most of these recyclers tie up with the institutions and sign a contract to pick up their used electronic products after fixed time periods depending upon the extent of usage and disposal of electronic products by the organisation.'

(Chaturvedi, Arora, Khatter, & Kaur, 2007: 23)

The recyclers are unable to realise the full capacity of optimum operation since they lose out to the informal sector in procuring WEEE. They occasionally employ informal dealers to boost their collection. One informal trader who earlier worked for a formal company in NCR recounted that he attended auctions, collected, inspected, conducted cost analysis & resold junk electronics but left the company due to inadequate remuneration (Informal Trader, Mustafabad, 03 April 2012). One formal

recycler plans to tie up with NGOs working with *kabadiwalas* to ensure sufficient e-waste input (Formal Recycler, NCR, 30 April 2012). Another formal recycler maintains,

"Environmentally safe e-waste recycling is a profitable venture as there is cross-subsidisation between the processing of different equipment. However it is impossible to pay as much as the informal sector or the fraud formal entities that make a higher profit by reselling e-waste in the informal market".

(Formal Recycler, NCR, 18 April 2012)

The formal recyclers admit that informal sector reaps the advantage of their connections and robust methods of collection throughout the country. Additionally, the latter have little infrastructural and operational costs which are covered easily. Their recycling cycles are shorter and the profits are quickly realised. It has been noted,

"With roughly similar recovery rates as compared to formal recyclers, lower compliance costs and the ability to externalize significant environmental costs enable the Indian informal recycling sector to out-compete the formal sector state-of-the-art recyclers, in bidding for e-waste".

(Chaturvedi et al., 2012: 205)

The formal recyclers maintain that consumers lack awareness even after the enforcement of the E-waste Rules. They want the manufacturers and GOI to ensure that WEEE is properly collected and channelized to the formal recyclers. The state should incentivise the formal recovery and recycling industry since eco-friendly WEEE processing requires investment in sophisticated technology which puts the formal players at the disadvantage compared to the informal. They accuse the bulk users who sell WEEE of not caring about the reliability and credibility of the buyer as long as the best rates are offered. Every company openly criticizes the business ethics and operations of its competitors and doubts their credibility. There is cut-throat competition and a huge turnover rate as constantly good professionals with established contacts for collection are lured by rival companies (Formal Recyclers, NCR, 18 & 30 April 2012). An official in the Department of Environment, Delhi Government mentioned that a recycler was threatened by the local mafia against entering the e-waste recycling business in Noida (GOI, Delhi, 27 March 2012). Some companies have been forced to shut down or sold over the years due to dearth of WEEE. All the four recycling companies interviewed said that they are just breaking even in the business and have not secured profits yet. The formal recycling industry is very competitive and every company tries to establish a reputation in the market for a profitable business.

The discussion of the different WEEE players in India reinforces the importance of informality in e-waste operations. Apart from the ones reviewed here, many secondary informal labourers are also involved like the workers loading and unloading electronic gadgets, small transporters and middlemen. Many of the informal waste dealers and handlers are closely associated with the formal sector and the international WEEE players. They maintain effective ties with the formal recyclers with frequent transfer of material and information between them (Informal Traders, Delhi, 21 March & 01 April & 06 April 2012). Often the formal recyclers sell e-waste in the seconds' and the informal market (Kandhari and Sood, 2010). They have been alleged to use rudimentary methods of recycling and hire informal recyclers to learn traditional extraction methods. Finally, both export PCBs to foreign

companies specialised in sophisticated metal recovery. The substances salvaged from e-waste return to domestic or international production processes. The informal dealers and second-hand shops in India also procure WEEE from overseas through importers and waste brokers. Thus the local Indian communities working with waste are integrated with various national and international entities involved in the reverse supply chain of e-waste.

6.3. **Linkages in the Indian E-waste Network**

The Indian e-waste network is characterised by a high degree of informality since compared to a range of informal actors, there are few formal recyclers with limited operations. Some reports claim that a thriving informal business has grown around WEEE in the country (MAIT-GTZ, 2007) with a 'new economic sector evolving around trading, repairing and recovering materials from redundant electronic devices' (Widmer et al., 2005: 438). Though WEEE informality appears as a series of disjointed and scattered e-waste activities performed by different actors, the interfaces and relations between them cement the apparently fragmented system together. The following analyses the governance structures that contribute to the network's unfailing organisation. Forms of vertical relationships characterise the coordination between the different categories of informal actors which is enmeshed with horizontal linkages that bind the actors in the same category together. Both are crucial for the successful functioning of the network since the first one ensures the cohesion between the different nodes sequentially arranged in the network while the latter preserves the integrity of a particular group or node. Without the former, the consecutive e-waste operations would not impeccably follow one another and without the latter, the role and efficacy of a definite activity like trading or recycling would fail.

6.3.1. **Interaction and Coordination in the Indian Informal E-waste Network**

The traders are crucial for the seamless execution of the various operations in the network. They are the most prominent players, controlling the transaction of material and (largely) finance along the chain. Previous experience in traditional waste collection and repair and resale of old electrical equipment gives them an advantage in waste trading. Over time, they have grown familiar with the other actors in the informal waste initiatives and the functioning of the second-hand EEE market. A big waste dealer in Mustafabad mentioned,

"I've relatives and clients all over India who collect WEEE from *kabadiwalas* and different companies. So I have a 'circle' of contacts. Sometimes I get 5,000,000 INR (about 79214.18 USD) worth of materials in a month and sometimes only 200,000 INR (roughly 3168.56 USD)."

(Informal Trader, Mustafabad, 03 April 2012)

The traders maintain active liaisons with the bulk users, government officials, formal recyclers and other informal agents and brokers linking them to exporters or importers. The older traders (between 40 to 50 years) have long-standing networks and can procure more WEEE. The younger traders in Shastri Park (mostly erstwhile dismantlers) are more familiar with the intricacies of the complicated equipment. They often buy their computers from the older traders in Turkman Gate and Mayapuri and simultaneously develop their informational base and network.

The informal traders mostly collaborate with each other. The author visited an auction on 16 November 2011, a detailed account of which shows the traders' cooperation and occasional disagreements. Habitually, an auction is completed in two stages; the first one is official among the registered buyer(s) and the seller and the second is informal, among the buyers. A list of items to be sold is provided beforehand. To dissuade the non-serious participants, a security deposit called EMD (Earnest Money Deposit) has to be submitted by the interested buyers to the auctioning party. The value of EMD depends upon the worth of the materials and is around 10% of the total value. Usually the deposits of the 3 highest bidders are withheld for a fortnight. In case the highest bidder does not pay the agreed amount within a fixed time, the offer is made to the second highest bidder. If he refuses or fails to pay, the offer goes to the third highest bidder. If he is also not interested then the auction is held all over again with fresh deposits.

***Labourer loading materials after an Auction in Delhi, 2011*:** Photograph by Author

Traders often form a collective or a 'pool' (*pool bana lete hain*) to restrict competition and combine resources during bidding. These are formed on the basis of previous business contacts and personal ties. These traders have earlier worked together themselves or with a common colleague and/or might be a part of the community or even the extended family (Informal Trader, Turkman Gate & Mayapuri, 2012). Normally their assessment of the value of the products (y) is much more than the reserve price (x i.e. the minimum price at which the company is ready to sell) i.e. $x<y$. They bid collectively under the name of one trader and buy the materials (at the official price p) such that $x<p$ or $x=p$ and $p<y$ to make a profit on the deal. After the official auction, the informal dealers bid amongst themselves. At this stage, they again form sub-groups to curb competition. A group of 5 may be broken into 3 (A, B & C) and 2 (D & E). Suppose the group of two bid and buy from the other group at the intermediate informal price q where $x<p<q$ and $q<y$. Now D & E bid among themselves and the person (E) who attributes highest value to the 'lot' takes the materials home (*lot leke jate hain*) at the

final informal price r where q<r. Then the amount (q-p) i.e. the difference between the intermediate informal price (q) and the official price (p) is shared equally between A, B, C and D or at the proportion in which they have invested. Additionally D gets (r-q) i.e. the difference between the final informal price (r) and the intermediate informal price (q). The trader (E) who has finally bought the materials may profit or even suffer a loss depending on his judgement and the market situation. Tensions between dealers and conflict of interests are kept in check by mutual understanding. In rare cases, a group might fall apart (*fut jate hain*) due to excessive inter-bidding. In the auction attended, 10,000 Standing Fans, 74 Typewriters, 25 CPUs (Central Processing Unit), 60 Printers, 30 Monitors, 24 Voltage Stabilisers, 30 Air Coolers, 50 Tables and 50 Chairs along with some miscellaneous cables have been bought for 301,786 INR (roughly 4,778.80 USD). The second bid was quite close at 282,000 INR (4,464.55 USD) and altogether 20 buyers participated on the first day. The traders deemed this to be a particularly good auction since the proportion of EEE was very high compared to the other items.

***A Dealer talks with his client while dismantling in his warehouse in Shastri Park, Delhi, 2012*:**
Photograph by Author

In recent times, competition in the auctions has increased and the margins between the traders' valuation (y) and the actual auction price (p) have declined (Informal Traders, Shastri Park, Turkman Gate and Mayapuri, 14 March, 06 April & 12 May 2012). By forging collectives, the dealers are still able to make a profit (Informal Trader, Mayapuri, 12 May 2012). In a tender, quotations are invited (against a list of items) which are submitted in a drop box. The latter is opened on a stipulated date and the material goes to the trader with the highest quotation. Here also pools are formed between the traders and one trader outbids the others in the pool. A trader who frequents auctions said, 'We

form pools and afterwards settle between ourselves. Hardly anyone cheats' or '*Pool banake aspash mein fukar lete hai. Bahut kam log beimani karte hain*' (Informal Trader, Turkman Gate, 06 April 2012). One trader in Shastri Park mentioned that he preferred buying WEEE in the direct auctions where he has face-to-face interaction with his competitors. In e-auctions, the bidders are invisible and it is impossible to form pools. Forming collectives helps in reducing risks and collating finance and information. The dealers use their experience to judge the potential functionality and reparability of the used electronics. In case of completely non-working goods, the weight and value of the constituent streams are assessed.

Every trader owns or rents a warehouse which serves as storage, workplace for dismantlers and a quasi-office. This is where WEEE samples are checked and deals are decided. All items are carefully inspected and negotiations are mostly amicable. Materials are weighed on the weighing machine which is a mandatory fixture in every warehouse. Experienced dismantlers occasionally give their opinion but the final decision is made between the dealer and his client. The prices of different metals and various types of plastic are fixed at the current market rates and not open for bargaining.

***Second-Hand Computer Shops in Nehru Place, New Delhi, 2012*:** Photograph by Author

The seconds' shop-owners in Nehru Place are close and long business associates of the traders who commonly sell their reusable and repaired goods to the latter. The former in turn sell their e-scrap to the dealers. Only 2 among the 15 shop-owners interviewed were Muslims and hence religion is not a guiding factor in forging close business ties. The shops buy junk electronics from importers and would not divulge any details despite admitting that they receive materials from abroad. Many shops in the area immediately said on approach, 'We do not import anything' (Seconds' Shop-Owners, Nehru Place, 2012) and refused to talk. Three shops admitted that access to imported WEEE is important for business (Seconds' Shop-Owners, Nehru Place, 09 & 30 March 2012). According to a co-owner of a shop, business in imported WEEE is extremely profitable and he would prefer every junk foreign computer to find its way into India. The owner of another requested the details of a UK company or agent willing to deal in discarded computers since he does not have any business links there. None of these shops disclosed the contacts of a source and maintained strict confidentiality with each node in the network protecting its backward and forward linkages. The big shops are significant players in the

network connecting the use, disposal and export of discarded electronics from developed economies to its import, resale and subsequent consumption in India. The exporters and importers are completely invisible to the consumers and have no interface with them.

Household WEEE is periodically picked up by the informal traders from Turkman Gate and Mayapuri from the waste shops (Waste Shop-Owners, Delhi, 10 March 2012). The *kabadiwalas* have congenial relations with each other and in case of disputes over territory separation (as reported by 4 out of 20), they resolve it together. The waste shops are situated in local alleys, by-lanes and on or near the main roads. The ones near educational institutions and offices cater directly to the users who bring their WEEE themselves to the shops or sometimes ask the shop-owner to pick up the bulky and heavy waste or '*kabhi kabhi bhari maal hum utha late hain'* (Waste Shop-Owners, Delhi, 10 March 2012). *Kabadiwalas* are seldom tied to a shop and deliver their recyclables against a good price. Reasonably competitive markets ensure that the deals are fair and to the satisfaction of both the parties (Waste Shop-Owners & Kabadiwalas, Delhi, 07 & 10 March 2012, 12 January 2013). The *kabadiwalas* work autonomously despite being situated at the lower nodes of the WEEE network with little influence over others. Even when they borrow money from the shop-owners, they are not necessarily obliged to sell their waste to them or '*kissi ko bhi bech shakte hain*' (Kabadiwalas, 07 March 2012 & 12 January 2013).

The traders and recyclers periodically exchange news on WEEE demand and supply (Informal Traders, Shastri Park & Seelampur, 21 March & 16 April 2012). Recyclers from nearby Mandoli frequently pick up PCBs from the traders in Delhi. From the more distant Meerut (70 kilometres away) and Moradabad (167 kilometres away), they usually visit Delhi for a couple of days to procure PCBs. Sometimes a relative of a recycler stays in Delhi and routinely collects PCBs from the dealers and sends them over. One recycler in Moradabad has a brother who is a trader in Seelampur. During an interview in Shastri Park, the author observed an old recycler (65 years) from Meerut who came with his son to a trader. Though the recycling area in Mandoli is in the outskirts of Delhi, the approach road is very difficult and only the people living and working in that area venture there (Informal Recyclers, Mandoli, 10 April 2012). This preserves the secrecy of the recycling operations and techniques. The recyclers always visit the traders and never the other way around though everybody is accessible by phone (Informal Traders, Shastri Park, Seelampur & Mustafabad, 21 March, 03 & 16 April 2012). Their units are juxtaposed in a big barren field in the outskirts of Delhi. This is where the workers come looking for jobs which would have been difficult if the units were distributed in different parts of the city. This exhibits one of the benefits from clustering habits of the informal recyclers.

The traders maintain regular contact and share information regarding sources of collection, quality of gadgets, reuse and/or repair potential. Along with the dismantlers, they are often socially related based on family or neighbourhood ties which act as additional checks on dishonesty, moral hazards and opportunism. Geographical proximity, community and kinship relations and sometimes religious affiliation can independently or simultaneously contribute towards establishing of social networks in the WEEE trade. It is customary to hire or partner members of the immediate or extended family like a nephew practising dismantling under his uncle or two brothers sharing dealership. The traders keep a

watchful eye on the new and unknown dismantlers to avoid theft of valuable components like chips or gold pins (Informal Recyclers and Dismantlers, Shastri Park & Seelampur, 21 March & 01 April 2012). Once these dismantlers become familiar, the trust bond deepens between them. Much of the traders' power can be attributed to the strength of their networks and combined working habits enabling them to control the WEEE collection to a large extent. They also decide how much e-waste would be allocated for repair, disassembly and recycling and fix the price margins. They appropriate much of the value generated from the secondary production processes which grant them a favourable position in the network vis-à-vis the other actors. Their networking skills can be observed in auctions where they successfully pool resources. This sharing of burden and benefits form the fundamental dynamic of relational networks observed in clusters. The map in Chapter 4 (figure 6 on page 75) displays the clusters in various parts of Delhi where traders, dismantlers, recyclers and second-hand shop-owners are concentrated. Most of the trading/dismantling sites are nearby except Mayapuri. Nehru Place is also close to the trading venues while the distant recycling centre, Mandoli is located at the very border (with UP) where law enforcement is lax.

Both dealers and recyclers liaise professionally to reduce transactions costs due to uncertain and complex product specifications. The power distribution somewhat tips in the favour of the traders since they have a bigger quantum of WEEE collection, operation and clients than the recyclers. The recyclers exhibit a definite preference for hiring migrant workers who often introduce others from the same area into the profession (Informal Recycling Workers, Mandoli, 10 April 2012). Kabadiwalas frequently initiate members of the family or community into waste collection. Entry into these services is not restrictive but can be facilitated by caste and community identities which underpin many social relations and interactions. All the informal WEEE players are linked to each other through direct and indirect arrangements which guarantee that each node safeguard the other in its own interest. They engage in indefinite and recurrent transactions which instil reliability and trust between the actors, strengthened through living and working in close proximity. Long term working relationships minimise chances of deceit. All the actors are largely orchestrated by the traders who play a vital role in directing and facilitating the network. They sometimes extend credit to people they have known for a long time but otherwise prefer to work with immediate cash transactions (Informal Traders, Shastri Park & Seelampur, 10 March & 16 April 2012). Thus they also assist the financial flows in the network. But without the high degree of interaction and coordination between the other players, they cannot ensure the efficient functioning of the system. In the next part, the exchange relations between the formal and the informal sectors are examined to understand their linkages and the distinct characteristics of each.

6.3.2. **Competition and Cooperation in the Indian Formal- Informal Linkages**

In India the formal recycling companies and the informal waste dealers share the same material source of auctions/tenders. The formal and the informal players compete and/or collaborate depending on different forums of collection and recycling. During collection, there is fierce competition between the formal and informal parties as demonstrated before. The informal sector scores by the virtue of extended informational base and trustworthy liaisons with other traders and company

contacts. Additionally, the latter can access e-waste from households while the former miss out on household WEEE (GTZ and BIRD, 2007).

Four informal traders stressed that there is no stability and security in WEEE trading due to uncertainty of waste collection, increasingly competitive auctions and constant technological upgrading in electronics (Informal Traders, Shastri Park, Turkman Gate and Mayapuri, 10 & 14 March, 06 April & 12 May 2012). They suggested that collaboration is imperative to survive in the business. However, the formal recyclers have very little coordination between them and are busy snatching materials from each other and spoiling potential deals of others (Formal Recyclers, NCR, 17 and 18 April 2012). All the four recycling companies have been established recently and do not have a shared history of working or collaborating together. This is confirmed by 2 of the 4 formal recyclers interviewed. One of them narrated,

'Last Friday (30 March 2012), a big private company confirmed the sale of 15 tonnes of e-waste. On Tuesday (3 April 2012), I called to find that it has been sold to one of my competitors since he was giving the 'best rate'. The company did not even inform me. I am definite that I'll find the e-waste in the informal market in 10 days. Both my competitor and my company have authorised licenses so license-wise we are the same. But I have proof that this formal recycling company has sold to the informal sector earlier. There is no point in reporting to the authorities since only money matters in this business' (Formal Recycler, NCR, 17 and 18 April 2012).

Hence the level of mistrust and rivalry between the formal recyclers wreck any possibility of cooperation. This is in stark contrast against the cooperation and reciprocity predominant among the informal players where Muslim and non-Muslim actors are often found to work harmoniously. Though religion is not the chief cohesive factor, it does have a bearing since within the same religion there are more social interactions for weddings, religious festivals and other occasions. However that does not imply that business relations are established and forged on the basis of religion alone. In the auction attended by the author, 4 of the traders were Muslims, the fifth one and the person with whose name the auction was entered (different from the five) were Hindus from Mayapuri. During the lunch break, food was bought and shared by all the traders together[27].

Compared to the north which is dominated by informal operations, the formal recycling industry, according to one respondent, performs better in the south of the country (Formal Recyclers, NCR, 25 April 2012). The north lacks awareness and social responsibility while culturally the south is more law-abiding (ibid). As one formal recycler confirms, 'In Delhi, ethics is pathetic and every deal is under the table. Even with the implementation of the E-waste Rules in sight, e-waste is still ending up in the (informal) market (Formal Recycler, NCR, 18 April 2012). The traditional presence of a huge second-hand market in Delhi and the proliferating informal recycling sector impede the profit and success of formal WEEE enterprises. Since the preparation for the E-waste Rules started in May 2011, a year before its actual implementation, the informal traders were losing out in collection as the lack of government authorization rendered them ineligible for participation in auctions/tenders. However, it

[27] In the Indian context, it is frequently quite rare for Hindus and Muslims to eat together due to rigid and orthodox religious boundaries and convictions.

has been alleged that sometimes the formal recyclers procure WEEE from these forums and sell them in the informal market with a mark-up. An e-waste trader and an engineer from Alighar Muslim University who has been a erstwhile employer of a couple of formal recycling companies stated,

'Now the government departments demand certificate from informal traders for auctions/ tenders. But I reroute e-waste from registered formal recyclers to the informal dealers. The former usually do not recycle all the materials they receive and resell the working ones to the informal market for more profit. Since I have established links with the formal companies and they trust me, I make use of their certificate to buy the materials. They normally charge 20% of the bidding price for using their certificate. I have picked up 4 lots in auctions in the last 3 months in this manner. I return the non-working items to the formal recyclers and resell the rest to other informal traders. I also broker links between recycling companies willing to lend their certificate to junk dealers and demand a cut for such negotiations.

(Informal Trader, Mustafabad, 03 April 2012).

The Centre for Science and Environment (CSE) reported on Attero (Kandhari and Sood, 2010) illegally selling to the informal sector but Attero denied the charges. A big informal dealer in Seelampur claimed that he periodically buys e-waste from a couple of formal recycling companies in NCR without naming them (Informal Trader, Seelampur, 16 April 2012). Thus with the impending e-waste legislation, the competition between the formal and informal actors for procuring WEEE is potentially transforming into more covert alliances. This suggests that the regulation might be result in more surreptitious associations between formality and informality instead of formalising the e-waste operations. Whereas before the enforcement of the law, the two sectors were competitors in WEEE collection, now they have started to cooperate. However, such linkages do not assign them equal power positions as the informal traders often depend on their formal counterparts to access e-waste. In recycling, the formal and the informal actors continue collaborating with each other as before. Formal recyclers find it cheaper and easier to sell the PCBs to the informal recyclers since the former rarely possess sophisticated recycling infrastructure (Formal Recyclers, NCR, 2012 & 2013). They also hire informal recyclers to learn the traditional methods of metal extraction. PCBs are sold overseas to special metal refining companies and informal recyclers sometimes send their PCBs through the formal recyclers. The informal traders primarily act as the organisational link between the two sectors. The linkage is characterised by trust which evolves and reinforces with time. While the formal actors deny any association with the informal sector, the informal players never divulge the name of the particular formal contact despite acknowledging shared business ties. Within the informal sector, there exists a common knowledge and perception of a person's reputation and background. For a newcomer, it requires time and a possible introduction by an existing actor to fit into the community (Informal Traders, Delhi 21 March & 16 April 2012). If any party is caught cheating by the other members, then he loses the support of his cluster. This is manifested in auctions when heavy inter-bidding between informal traders' collectives leads to a break-down of the mutual agreement. But as evidenced by the traders, such incidents seldom happen. Once identified as a unreliable trader, one loses the opportunity to form pools with his colleagues at auctions. This is costly to the

trader concerned and is generally avoided (Informal Trader, Turkman Gate, 06 April 2012). There is no evidence of clustering within the formal recyclers though all of them headquartered in NCR to access the mature e-waste market in Delhi. Their recycling plants are located outside NCR where cheap land is available.

There is also competition between the dealers since they procure WEEE from the same sources and contacts. But it is not close to the level of rivalry between the formal recyclers. The informal networks keep expanding with time and as more traders enter into the business. Still older contacts and ties are held in high regard and seldom jeopardised or diluted. Each player is confident that the other party will not disclose the nature and details of their transaction. The informal entrepreneurs are not subservient to their formal counterparts though in the changing regulatory landscape, the dealers sometimes have to depend on the formal companies to source WEEE. The E-waste Rules require every authorised collector to liaise with a certified recycler to sell their e-waste to. An informal group of traders (HRA or Harit Recyclers' Association, discussed in chapter 7) tried to tie-up with a formal recycler as required by the new law. The formal sector uses the informal to lower the costs of technologically sophisticated reprocessing and access the second-hand electronics market. Thus previously, these two sectors did not have explicit power over each other, rather in particular circumstances they worked together to achieve the shared aim of a profitable business from e-waste. However, the law might place the formal actors at a definite advantage over the informal.

6.4. **Challenging GPN notion of Horizontal Trust Relations in the E-waste Industry**

The above section shows how trust is embedded and mobilised in informal waste clusters through localness and networks of family and kinship. Trust is exploited to ensure that horizontal ties in informality foster growth and development. Multi-dimensional in nature, it emerges and strengthens over time and facilitates achievement of individual and/or collective goals. It constitutes an important medium and consideration for the selection of suitable informal business colleagues/partners. The informal social relations are endowed with social capital through which connections and reliable contacts can be developed. Thus divergent associations between potentially 'trustworthy' partners are pervasive and socio-culturally embedded in informal networks. Heterogeneous formation and functioning of trust in informal institutions differ from the legal sanctions in formal activities enforceable by the state. Complex combinations of trust relations remain entrenched in relational networks coalescing around informal values, norms, contracts and arrangements. Hence, the absence of the state provisions that legally protect economic transactions in formal domain does not breach or limit the dynamic linkages in WEEE informality.

Exploring the specific personal and profession profiles of the individuals in these categories, it can be established that conventional notions of trust building present in the GPN and clusters literature are not always pertinent. Many scholars within the GPN genre looking at industrial as well as informal clusters have noted that caste and/or religion based identities' develop trust mechanisms that socially control chances of deceit and risk of opportunism. Here the empirical findings contend that caste and religion do not constitutionalise trust in WEEE informality. The organization of trust in the e-waste clusters is quite dissimilar to that in Agra footwear clusters by Knorringa (1996, 1999). Knorringa

notes that ‘Agra's footwear industry, like most craft-based industrial cities in northern India, is characterised by a caste-based antagonism between an artisanal community that makes the footwear and a trader community that sells’ (Knorringa 1996: 4). Consequently, the shoe-producers, tanners and the actors channelizing shoes to niche markets are trapped in contentious caste and religious fractions that encumber better learning and competitive exchanges between them.

However, there is no proof that in WEEE networks caste (traditionally structured occupational hierarchy determining social status across generations) impedes the evolution of trust. Hindus across caste identities and ethnic affiliations participate in different informal e-waste operations. The perceptible lack of hostility nurture inter-mingled vertical and horizontal solidarity between the e-waste players (across and among nodes). This is supported by the fact that informal actors generally collaborate beyond mere professionally compatible exchanges. Interpersonal ties also exist between them as all productive activities are fundamentally embedded in social institutions (Granovetter 1985, 2005). The inseparability between the social and economic spheres enhances the trust dynamic across caste and/or ethnicity. Another significant inference reached is that religion does not influence close business associations as Muslim traders amiably conduct business with Hindu recyclers in Mandoli and Muslim recyclers in Moradabad and Meerut. They all have reciprocal behavioural expectations from one another irrespective of their religion. This is reflected in auctions where most of the informal traders prefer to collectively participate in face-to-face interactions based on inter-personal or earlier business relationships. In the auction visited (documented in section 6.3.1.), different Muslim and Hindu traders, labourers and the author shared lunch indicating that religious prejudices, divisions and dissonances do not mar their occupational liaisons in WEEE dealership. The long-term business colleagues invite each other in weddings regardless of religions. Such socially organised inter-personal alliances might be based on common caste and religious affiliations but do not impair trust formation in informal clusters. Thus trust functions as a relational capital that allows informal actors to overcome the socio-economic constraints and outshine their formal counterparts. Inter-communal informal relationships across different castes and religions gain legitimacy in developing network capital that can be effectively used for gains from trade. GPN maintains that common religious identities inspires and infuses trust and claims to confer equal weightage to both vertical relationships and horizontal linkages. However, it misses out on this significant aspect of horizontal coordination beyond caste and religious differences. As described here, inter-communal trust-based networks are socially, culturally and functionally embedded in the political economy of WEEE networks that touch down on specific local spaces and actors. Such networks are contingent on and entrenched in the definite nature of the waste trade, the ambivalent quality of and value in electronic products and the institutional environment that surrounds diverse waste activities. Examining the complexity and multiplicity of the constitution of trust in spatially different contexts would increase the analytical rigour of the GPN approach.

6.5. Conclusion

This chapter analysed the formal and informal interactions in the e-waste network that ensure its smooth execution. Intertwined with these linkages are unequal and implicit power dynamics that

influence the degree of control exercised by the actors. The traders are the main lynchpins and power brokers in the waste business which is manifested through the strength of their networks and their capacity to extract rent. 'The differential power relations and positions of market participants influence their level of choice and agency as traders' (Brooks 2012: 86). The robust market for used electronics in India is exploited by the informal traders and the seconds' shops. These players also straddle the fluid boundaries between formality and informality by liaising with the formal recyclers. One of the major findings from the analysis of the various WEEE actors is that the traders play a central role in orchestrating the network. Simultaneously it is observed that the changing regulatory framework in India is altering the reins of power between the formal recyclers and the informal traders and resulting in the benefit of the former.

While the e-waste scholarship has asserted the intersections and inter-dependence between formality and informality (Chi et al., 2011), it has not expanded on the nature and impact of the connections. The elaboration of the informal actors exhibits how and why some actors transcend the sectoral margins. Particular gains accrue from informal clustering practices due to spatial concentration of traders and dismantlers, recyclers and the seconds' shop-owners due to familiarity, trust and recognition among, between and beyond clusters. Strong social networks institutionalised around family, community and ethnic ties make these clusters competitive and effective. However, the *kabadiwalas* and the waste shop-owners are geographically dispersed since clustering would be counter-productive to their trade. This does not imply a lack of coordination between them but absence of strong social affiliations. While the other categories also have personal relationships, the waste collectors and shop-owners have more professional ties. There is a marked absence of any collaboration between the formal Indian e-waste recyclers, another significant dimension unearthed here. Both the sectors are connected to international material circulation through the import of WEEE from and the export of metal rich PCBs to Europe and other overseas destinations. Though Delhi is the field site, it does not mean e-waste operations in the other big Indian cities are completely dissimilar following the account of the traders frequently traveling beyond the capital. But it is definitely the place where such activities are concentrated in a highly organised informal network.

This chapter has re-established the continuity between formality and informality by disintegrating these sectors into the specific actors and highlighting their liaisons. It has portrayed that WEEE formality encompasses informal traits and practices and has thus instated informality at the very core of e-waste operations. The formal and informal players and their activities co-habit overlapping spaces in the network and they either function together or at cross purposes. The nexus between the two demonstrates that the two sectors are not just conjoined but mutually dependent and potentially competing and coordinating. These connections also exist in the Europe but on a lesser scale and within a more formalised environment. In Europe, the producers manage WEEE under the regulation and supervision of the state. While the Directives and the transposed national legislations direct formal WEEE recycling, there are also illegal e-scrap shipments overseas. The fieldwork in Europe (2011) revealed that the international waste brokers bestride both the sending and the recipient countries benefitting from the supply and demand dynamics of obsolete electronics. They connect cross-country e-waste stream and are clandestine and impossible to track. The formal practices of

production, circulation and consumption of EEE in the Global North are closely associated with informal WEEE reuse and recycling in the South as in the case of used garments and cars (Brooks, 2012, 2013). To elucidate the formal-informal associations in the e-waste processing network, this chapter has made use of the concepts mainly from GPN and GVC by mapping the position and function of the informal players in the network. It has also drawn from the formality-informality discourse to fathom their linkages and liaisons. It further uses the understanding of governance patterns from GVC to highlight the nature of these relationships that facilitate the structural and functional cohesion of the different WEEE actors and their activities. It has simultaneously applied the literature on clusters to stress the clustering patterns and their advantages. The next chapter looks into how the regulatory environment affects the functioning of the e-waste network and the activities of and relationships between the myriad agents therein.

Chapter 7:

REGULATING E-WASTE MOVEMENT & MANAGEMENT

7.1. Introduction

Chapters 5 and 6 have presented the nature and architecture of global and national e-waste circulation and management. They have analysed the roles of and relationships between the formal and informal actors operating at multiple scales of the waste network. This chapter examines the factors that explain and shape the WEEE trajectory and the linkages therein. The objective is to investigate how the legislative apparatus affects and orchestrates the e-waste landscape and the ways in which the formal and informal players are integrated in it. So effectively, it addresses the research question: How does the regulatory environment influence the informality in e-waste processing?

Regulations pertaining to e-waste can be broadly classified into two overlapping categories. The first comprises of international conventions, regional directives and national legislations that monitor the international WEEE trade. The second directs domestic waste processing into green channels of formal management and restricts its leakage into the unchartered informal domain of hazardous treatment. So this chapter explores how regulations influence the waste stream and its management through formal and informal spaces and/or actors and their intended and unintended consequences. The chapter is based on fieldwork findings in Netherlands, Belgium and India and documents on laws, policies and governmental and non-governmental evaluation reports.

The chapter is organised as follows. The following section narrates the functions and experiences of the non-chain actors responsible for implementing the WEEE movement legislations. These actors provide spatially specific regulatory dimensions to govern waste transfer and are discussed separately for the European and Indian context. The section also identifies the challenges and constraints faced in operationalising the regulatory guidelines. In the third and the fourth sections, the legislative interventions by the state actors on national WEEE management in Netherlands, Belgium and India are studied respectively. National e-waste comprises of domestic generation as well as e-scrap imports, particularly in the case of India which is one of the major recipients of overseas junk electronics apart from being a substantial generator of domestic WEEE. The fifth section records the outcome of the legislations and remarks on their shortcomings from the accounts of the actors. Additionally, it focuses on the role of the civil society in influencing the legalities and geographies of the e-waste system. The sixth section analyses the impact of the overall regulatory efforts. Finally, the chapter ends with a conclusion which compiles the major observations and the concepts used here.

7.2. Operationalising the E-waste Movement Regulations

In the post-consumption phase, much of the WEEE finds its way into informal recycling realms in the emerging economies and less developed countries as evidenced in chapters 5 and 6. One of the primary regulatory goals is to contain waste circulation within eco-friendly and legally acceptable

channels and stop its unsafe treatment. Internationally, Basel Convention and Ban prohibit e-waste TBM from developed to developing countries for disposal and recycling purposes. However, these instruments have not proved very effective. Here, the procedural and administrative mechanisms for enforcing the different WEEE movement legislations (in the countries researched) are elaborated.

7.2.1. Implementing the Waste Shipment Regulation (WSR) in Netherlands and Belgium

This section documents the role of the state agents (in Netherlands and Belgium) and their experience in the implementation of the WSR which covers all the Member States in the EU. WSR is designed to prevent the illegal TBM of hazardous waste (including e-scrap) from and to European countries. Its successful application requires monitoring the WEEE stream in and out of the seaports by controlling the cargo containers and freight shipments. The Netherlands and Belgium house the busiest ports in Europe i.e. Rotterdam and Antwerp respectively. These boast of heavy traffic of container shipments and tonnages of cargo. Rotterdam is the largest container port in Europe and handles almost 450 million tonnes of cargo annually (http://www.portofrotterdam.com/en/Port/Pages/default.aspx accessed on 24 July 2014). There is also heavy passage through the port of Rotterdam which is connected to busy shipping routes. Antwerp is the second largest port in Europe with international trade and commerce routes with a cargo turnover of 117 million tonnes in 2013 (http://www.portofantwerp.com/en/publications/statistics/maritime-cargo-turnover-2013 accessed on 23 July 2014). It is claimed to be the 'leading European port for shipping services to and from the Americas, Africa, the Middle East and the Indian subcontinent ……..' (http://www.portofantwerp.com/en/containers accessed on 24 July 2014).

The following account is based on semi-structured interviews in 2011 with the WSR Performance Manager of VROM (Ministry of infrastructure and Environment) and Customs Policy Advisor (Legal and International Affairs Department) in Netherlands. Additionally, Senior Experts in OVAM (Public Waste Agency in Flanders), Inspector of Federal Public Services (FPS) of Belgium and Senior Policy Officer Products & Waste in European Environmental Bureau[28] (EEB) have been consulted.

In the Netherlands, VROM is the nodal agency for the implementation of the WSR in conjunction with Customs. It follows the WEEE trail from the point of its generation, collection, management and export. It also oversees the private and public players engaged in the e-waste network. Apart from the registered actors (like the transporters, retailers and recyclers), there are numerous domestic and foreign traders without state permits or licenses who participate in covert waste traffic across and beyond the country. Targeting/controlling them is extremely difficult since they mostly function underground and frequently escape the official radar. VROM coordinates with the customs authority (the lead agency at the point of entry and exit) at the ports. Customs in Netherlands functions under the Ministry of Finance & Dutch Revenue Services and looks after security, safety and protection of the environment apart from fiscal issues. Cases of illicit TBM of WEEE intercepted by Customs are reported to the VROM which contacts the exporter (perhaps based in another EU country) and

[28] Created in 1974, EEB is a federation of more than 140 organizations operating at the local, national, European and international levels

initiates the take-back procedure. Customs annually submit a detailed record of their activities and findings to the VROM.

While in Netherlands, there is a single environmental authority (VROM) enforcing the e-waste laws and policies nationally, in Belgium, enforcement is on a regional level. Belgium is divided in three regions: Flemish Region or Flanders (the Dutch speaking region), Walloon Region or Wallonia (the French speaking region) and Brussels which is the Capital Region. Each region has a separate Environmental Policy and a separate enforcement authority. OVAM is the competent authority in Flanders working on environmental policy and waste management since 1981 and has incorporated e-waste in its mandate in 1999. The counterparts of OVAM, i.e. the Public Waste Agencies in Wallonia and Brussels, govern all policies on waste in their respective regions. They are individually responsible for e-waste movement in their regions but are not concerned with the export and import of waste into Belgium. The FPS for Public Health, Food Chain Safety and Environment is in charge of inspecting waste TBM at the federal level i.e. cross-border transit of waste. It only follows the European legislation, WSR (not applicable to waste movement within Belgium) and regulates the transit of wastes in and out of the country. It functions in cooperation with the customs, harbour police and the environmental agencies of the three regions. Since all the seaports in Belgium are located in the Flemish region, FPS has especially close collaboration with OVAM. In Flanders, FPS adheres to OVAM's decision on hazardous waste based on VLAREA. VLAREA, the Waste Prevention and Management Ordinance of the Flemish Government has been enforced on 1 December 2004. It implements the WEEE Directive in Flanders (covered in Chapter 3, Section 5 of VLAREA) where WEEE is considered to be hazardous unless it has been disassembled and depolluted. For example, if batteries are removed from a Printed Circuit Board (PCB), then it can be shipped as a green listed waste under WSR (refer to Chapter 2, page 28). But a whole piece of electronic equipment is always deemed hazardous and cannot be exported to OECD countries without notification.

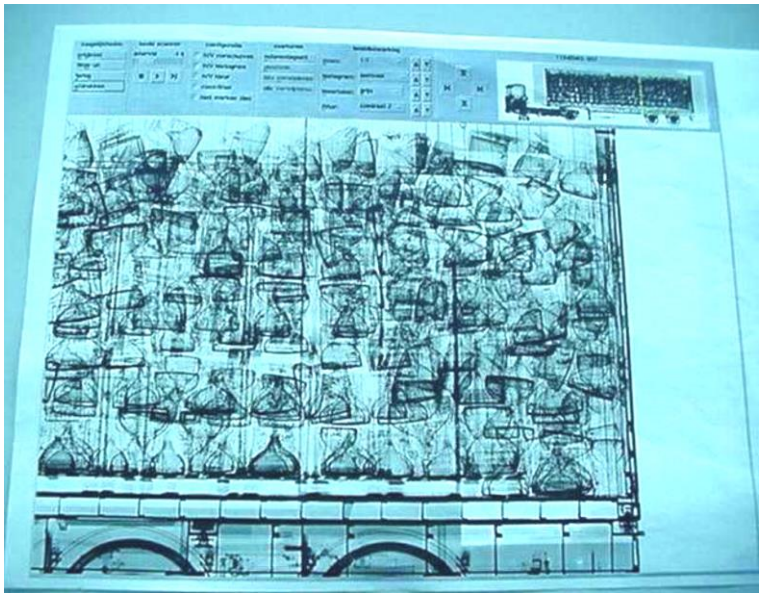
OVAM supervises the circulation of e-waste inside Flanders and the upstream and downstream stakeholders like the producers and/or importers on one hand and traders, transporters and recyclers on the other. There are well established grey markets for valuable WEEE, such as large household appliances, desktop computers, TVs and mobiles and substantial leakages occur along the chain. Amounts of B2B (business-to-business) WEEE reported to be collected and treated do not reflect the expected amounts of B2B e-waste produced and is a potential source of malpractice and illegal exports to non-OECD countries (Bio-Intelligence Service EC 2010). Often the business user disposes the equipment to a third party who might sell the appliances on for export (ICER, 2004). According to Coolrec, the WEEE Recycling Company in Netherlands, the informal traders involved in illicit e-traffic buy straight from the B2B consumers (Coolrec, Skype Interview, Eindhoven, 26 July 2011). The VROM also reports of leakages from the formally regulated WEEE channels since all the small retailers and second-hand shops in the country cannot be monitored (VROM, Rotterdam, 4 July 2011). Moreover, illicit traders from other countries export e-scrap from Netherlands to their compatriots in foreign locations.

The ports act as final check points for traffic in e-scrap and require stringent monitoring; a task undertaken by the Customs in Netherlands and the FPS in Belgium. In the ports, customs adhere to the WSR to monitor contraband e-shipments. The WSR declares,

'If a customs office of export or exit from the Community discovers an illegal shipment, it shall without delay inform the competent authority in the country of the customs office……'

(Article 38 (7) in the WSR)

Whereas in the draft version of the regulation, it said that "In case of an illegal shipment……". Going by the final legislation, the customs are only obliged to take action provided they discover an illegal shipment and in many countries the custom authorities do not proactively detect them. While countries like the Netherlands, Belgium, and Denmark perform well on trafficking control, other countries like Germany and United Kingdom lag behind (Customs Netherlands, Rotterdam, 6 July 2011). This is also confirmed by Coolrec, which closed its operations in the UK in 2009 since the market was not stimulating enough and it became difficult to compete with non-compliant recycling companies exporting junk electronics (Coolrec, Skype Interview, Eindhoven, 26 July 2011). This is supported by 'It has also been found that the UK is the dominant European exporting country, followed by France and Germany' (Lundgren 2012: 17). Since the customs in Netherlands is very strict, frequently traders and exporters try to dispatch contraband goods through other less rigid ports in the EU. Custom inspections are time consuming and exporters avoid Rotterdam which eventually results in economic and employment loss for the port and the customs must take into account their economic onus along with enforcement responsibilities. Though the personnel from Customs in Netherlands reported Belgium as having sound trafficking control, the FPS officer in Belgium confessed otherwise. According to him, countries like Germany (contributing 80% of the illegal trade through Belgium), Switzerland and United Kingdom use the Antwerp port to ship e-scrap from Europe (FPS, Antwerp-Berchem, 8 July 2011).



Photograph through an X-Ray Scanner by Customs Netherland, Rotterdam in 2011

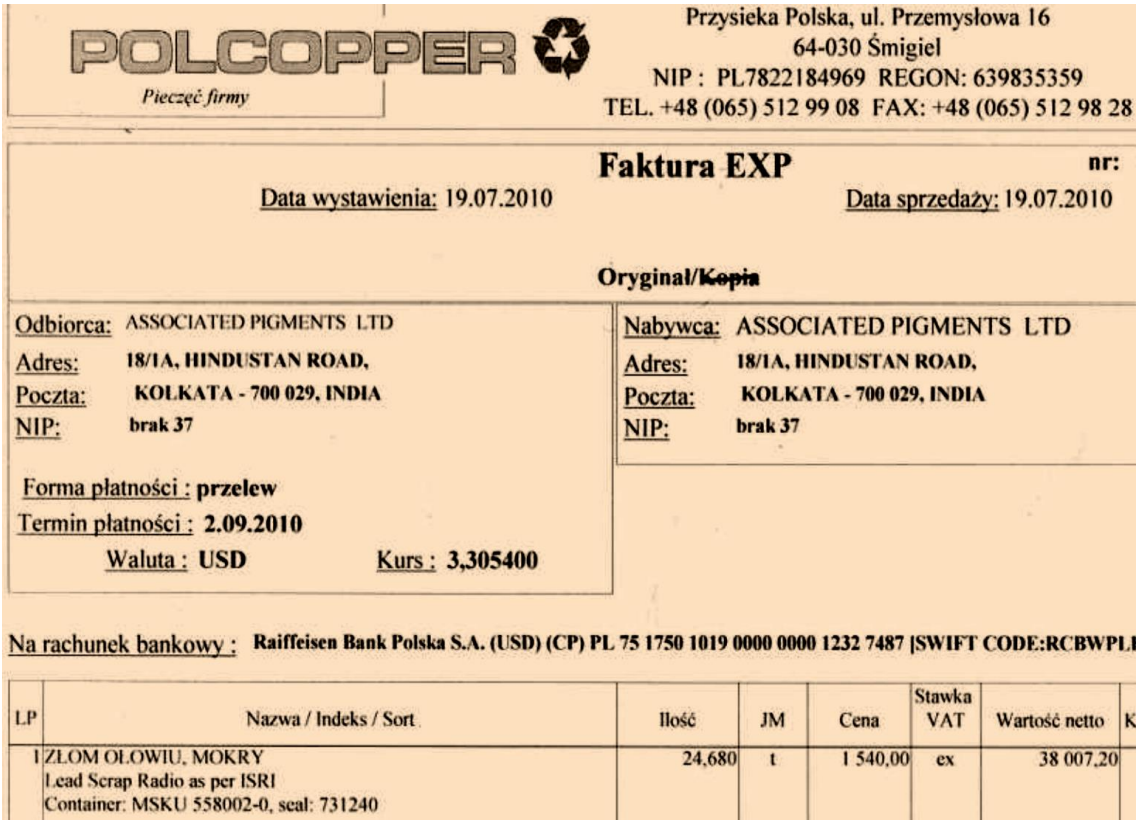
The photograph above depicts the image of an electronics consignment through the X-Ray scanner in Rotterdam. Customs has developed a selection technique to check potentially contraband consignments without disrupting legitimate trade and commerce. The Dutch customs follow a system of analysis using risk assessment indicators. For export, the Customs Declaration Form (Single Administrative Document, used in the EU) is submitted electronically to the Customs office of Export based on which risky consignments are identified. It is then checked for risk profiles (developed from intelligence records) using search parameters with algorithms (confidential information). Designing the risk profile is complicated and the customs tariff code is one of the search parameters. The Common Customs Tariff based on the World Customs Organization's HS was enforced on 1 January 2012. Chapter 85 in the HS Nomenclature is on 'Electrical machinery and equipment and parts thereof; sound recorders and reproducers, television image and sound recorders and reproducers, and parts and accessories of such articles'. However, the customs tariff for old EEE is the same as new products and additional parameters have to be used to target potentially risky consignments. When no risk is detected, the Customs automatically process the declaration and the shipment is cleared after levying the relevant duties. If a container is deemed risky by the filtering system, then it is detained until the supporting documentation is verified and/or a physical inspection is conducted. In the latter, the container is run through an X-Ray scanner. This determines whether to carry out an on-the-spot check. If it is found to contain goods prohibited for export, its clearance is suspended and the container is seized.

In Belgium, the Annex VII documents (refer to Chapter 2 page 28) for exporting green listed (non-hazardous) waste to EU and OECD countries are checked by the federal inspectors to confirm that they are in accordance with the law. Under Annex V of WSR (refer to Chapter 2 page 29) there is both hazardous and non-hazardous WEEE (categorisation depends on OVAM). Hazardous ones cannot be exported to non-OECD nations but can be exported to OECD nations with prior notification and consent. Often exporters try to bypass the notification requirement by using an Annex VII document for hazardous waste. Illegal scrap trade is often disguised as appliances for reuse or second-hand goods which are not subject to waste regulations. Non-compliance with the notification procedure and non-declaration of hazardous waste are commonplace (Customs Netherlands, Rotterdam and FPS, Antwerp-Berchem, 6 and 8 July 2011). The customs has a system for filtering every container declaration but are primarily concerned with drugs and weapons and waste is not their first priority (ibid). The absence of explicit environmental safety and quality control at the ports is a critical structural weakness in the current control mechanism. According to the European Environment Agency (2009), an illegal waste TBM can occur under the following circumstances,

- transporting any waste subject to the Basel Export Ban out of the EU or the OECD;
- transporting waste without notifying the authorities of source and destination when such a notification is necessary;
- falsifying any documentation regarding waste loads or not declaring waste on documentation;
- mixing certain types of waste;
- classifying hazardous waste as non-hazardous ('green-listed');

- shipping waste whilst falsely claiming that it comprises second-hand goods and is therefore not subject to waste regulations.

On average, 30-50 illegal waste (not just WEEE) shipments are detected regularly in the seaport of Antwerp which has 15-20 terminals or quays with only 2 federal inspectors overseeing them (FPS, Antwerp-Berchem, 8 July 2011). Once the customs filter identifies a suspicious container, it is scanned through the mobile scanner. Trained and experienced inspectors decide which containers should be opened for physical inspection. Usually 90% of their inspections reveal contraband goods which are detained for take-back of the container. The legal export of notified waste to other EU and non-EU countries has grown by 4 times between 1997 and 2005 (European Environment Agency, 2009). Notified waste consists of hazardous waste and problematic waste, the latter are those that can potentially damage the environment but have not been defined as hazardous by the existing regulations. To restrict illicit waste TBM and successfully impose the regulations across Europe, the Member States collaborate among themselves and internationally (particularly Asia & Africa) through exchange programmes and joint enforcement operations. Over the years, international cooperation and knowledge transfers have improved implementation practices but have not managed to tackle the problem of illicit hazardous waste traffic completely.



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LP	Nazwa / Indeks / Sort	Ilość	JM	Cena	Stawka VAT	Wartość netto	K
1	ZŁOM OŁOWIU, MOKRY Lead Scrap Radio as per ISRI Container: MSKU 558002-0, seal: 731240	24,680	t	1 540,00	ex	38 007,20	

Copy of Illegal Lead Scrap Radio Export to India
seized by Customs Netherlands, Rotterdam, 2010

The image above is a replica of the document (in Polish) seized by Customs, Netherlands exporting lead scrap radio to be send to Associated Pigments Ltd at 18/1A, Hindustan Road, Calcutta in India.

According to the VROM, illegal e-scrap export to non-OECD countries still continues. Dutch traders import discarded electronics from neighbouring countries and export them overseas via Netherlands. Even though compliance with the regulations has improved greatly, export of hazardous WEEE remains an enduring problem (Directorate of Implementation VROM 2011). As far as Customs in Netherlands is concerned, 'the main risk is export without permission' (Customs Netherlands, Rotterdam, 6 July 2011) in monitoring WEEE shipments. Often hazardous waste is relabelled as second-hand goods (not covered under Basel Conventions and WSR) to escape detection at the ports.

Containers with e-waste seized by Customs in Netherlands, Rotterdam, in 2011(left)
And FPS, Belgium in Belgium on 15 July 2011(right)

Despite both Netherlands and Belgium being largely competent in arresting illegal traffic, they suffer as transit points for hazardous waste from the US and other European countries. It was suggested in the interviews that if the fieldwork was conducted in other EU counties, a different and perhaps darker picture of the international trade in e-waste would have emerged.

7.2.2. **Enforcing Export-Import Policies on E-waste in India**

Through the E-waste Rules, 2012, the Indian government proposes to control hazardous WEEE imports into the country and regulate its flow through proper management passages. The Indian HW (Hazardous Waste) Rules, 2008 administers e-waste import. It allows import of equipment for reuse and recycling and prohibits import for disposal and dumping. In 2011, MoEF sent a blanket notification to all the ports in India banning WEEE imports. According to the MoEF Director, e-waste import is discouraged and over the last 3 years, not a single license has been issued for importing second-hand EEE (MoEF, New Delhi, March 2012). However, the licenses granted earlier are still valid. Now there is a virtual ban on all imports of used EEE unless special clearance is sought and granted from the MoEF. MoEF grants permission for export and import application which are then upheld by the customs which checks illegal consignments. Whenever any used EEE is imported for repair or refurbishment, a NOC (No Objection Certificate) has to be taken from the MoEF to ensure that it is not for dumping. Only with a NOC, the customs releases the consignment. Examples of NOCs by the

MoEF to the customs for WEEE import are provided in Appendices XI, XII, XIII in pages 211, 212 and 213 respectively. In the following cases, NOC is given apart from special circumstances.

a. Return after repair- exemption claimed on the grounds that it is not import but rather re-import. Then it is cleared and no duty is imposed.

b. Import after complete replacement- duty imposed on the replacement charges.

c. Foreign goods coming for repair in India- will be exported after repair and hence exempted from NOC.

For checking incoming or outgoing shipments, Customs draws up a risk management profile based on the Bill of Entry[29]. At first, an Appraiser looks at the Bill of Entry and decides whether the shipment should be subject to inspection. Then it is sent for verification to the Assistant Commissioner who if required, passes it on the examining officer in the shed who conducts the actual physical examination. All incoming consignments are filtered, and based on certain criteria and instructions, are screened. The examining officer checks whether there is 80% residual life in the EEE, failing which, they are considered as e-waste. The year of manufacture & model number are checked and the standard depreciation of value, efficiency, and functionality of the product are determined. This officer is usually an engineer, who judges the physical condition of the goods and the relevant documents. The official requirement is that 10% of all imports through airports and seaports should be mandatorily inspected and the equivalent figure is 5% for exports. But the government trade statistics do not differentiate between imports of new and old computers and peripherals and it becomes impossible to ascertain the share of imports of these two categories (Sepúlveda et al., 2010).

According to an Assistant Commissioner, Customs (New Delhi, 8 May 2012), the system of WEEE examination is still at a nascent stage and the infrastructure and expertise are under-developed. Also investigating a large number of shipments is time and resource intensive. The levels of efficiency and awareness in all the ports of the country are not identical and some of the ports are not even aware of the impending E-waste Rules. When an incoming consignment is deemed illegal then it is not cleared and detained in the shed. The importer or the agent is asked to get a NOC from the MoEF; otherwise the consignment is sent back. If the party concerned is reluctant then it is confiscated by the customs and passed on to the MoEF's jurisdiction. According to the ex-Director of MoEF, the seized consignments are auctioned to registered traders by the MoEF. Goods are normally retained at the port for a month. Often the recipients of the consignments are unknown as traders do not come forward to claim the goods once they are deemed illegal.

According to an informal e-waste trader in India (New Delhi, 2012), imported electronics especially computers reach the computer bazaar in Nehru Place. Companies from Nehru Place bring in containers full of e-waste from abroad. When these containers are blocked in the port, they claim that as new companies they are unaware of the import legalities. The containers are released after paying

[29] Shipment Bill or Bill of Entry is a statement of the nature and value of goods to be imported or exported, prepared by the shipper and presented to Customs.

a penalty. Then they close the existing company and open a new one for the next round of imports. This is also corroborated by the following,

'If a consignment of second-hand computers is found without a licence, traders manage to get the material by paying a penalty. "It is rare that such goods are confiscated," an e-waste trader said. There is a chance, though, that the goods of repeat offenders are confiscated. But there are ways to avoid that, too—change the company's name for instance. "We pay a chartered accountant Rs.10,000 every month to register a new name for our company. That way, there is little chance that the computers we import are confiscated," the trader said.'

(Down to Earth, 2010)

According to the NGOs working on WEEE in India, the informal traders frequently report how imported e-waste is mis-declared at the ports and escape customs scrutiny to reach the informal sector (GIZ, Toxics Link, New Delhi, 2012). Additionally, used EEE is allowed to be imported to recognized non-commercial educational institutions, registered charitable hospitals, public libraries, and government bodies. Many traders in Delhi procure old computers for educational donation for instance, without actually establishing a school. The Foreign Trade Policy permits import of second-hand computers which are not more than 10 years old (See Appendix IX in page 210) for NOC for used IBM servers and storage devices), besides computers as donations. The second-hand electronics which are almost 10 years old are very close to their EoL and might not have 80% residual life in them. The fact that the junk EEE can be deliberately mislabelled as used goods is also not taken into consideration. This loophole is regularly exploited by exporters trafficking e-scrap internationally, as expressed by Customs, Netherlands and FPS, Belgium. Identifying the actual WEEE amidst all these becomes immensely difficult, not least because the Indian Customs Tariff categorises new and second-hand computers under a single head[30], like other EEE. Though the NGOs admit that it is a big step to have a designated E-waste Law enacted, the law still has many shortcomings. The major loophole in the regulation is the lack of any severe import prohibitions that was originally in the draft regulation but was dropped in the final version. In fact, a member of the drafting committee (anonymity request) revealed that some parties were strongly in favour of legalising WEEE import but retracted in the face of opposition from the green lobby. This was to help the formal recyclers achieve economic feasibility in recycling since they are not getting enough e-waste to run a viable enterprise.

However, there are contradictory opinions regarding illegal WEEE import into the country. According to a member of the CII (Confederation of Indian Industry),

"The non-governmental organizations have over-hyped the e-waste issue. If India imports second-hand electronic products then it is not being used as a dumping ground as environmentally safe recycling will be practised. Otherwise, it is a matter of concern" (New Delhi, 22 March 2012).

As far as exports are concerned, PCBs are exported to international metal refining companies like Umicore in Belgium by both formal and informal recyclers in India (Informal and Formal Recyclers,

[30] Such goods are covered under of ITC HS CODE List and India Harmonized System Product classification codes.

NCR region, 2012). There is no regulation which monitors PCB export. Sometimes, the EEE from which the PCB is extracted could have been imported in the first place. Despite official governing and monitoring, WEEE imports into India persist.

Thus the informal e-waste economy engaged in the international WEEE flows violates the regulations at the regional and national levels. Mostly, the informal is conflated as the illicit/illegal by the state apparatus. Regulatory authorities regard formal economic activities as legal. But formal commercial users sell discarded electronics to illicit waste brokers who supply these items to domestic and overseas locations and benefit from these clandestine global and national markets. Moreover, the government authorised formal recyclers undercut the heavy cost of eco-friendly WEEE processing mandated by the existing statutes by moving the waste to informal recycling domains. The custom authorities checking the illegal waste traffic at the ports are largely encumbered by their inadequate resources and capability. This prosaic role of the state machinery explains how and why the informal waste brokers successfully pursue illicit e-scarp trade.

The expansive and continuous geographies of WEEE are internationally stretched along the global routes of illicit e-scrap traffic without any real separation between formal and illegal (Hudson 2014). The organization of informality is attached with and related to the formal economy, rendering their boundaries blurred and flexible. The supposedly and outwardly legal formal entities and the informal/illegal players (depending on state perception) and their changing relationships characterise the international and national channels of WEEE. These portray the spatial complexities and implications of formal and informal (frequently manifested as legal and illegal) associations that underlie capitalist growth and development as argued by Hudson (2014).

7.3. **Operationalising WEEE management in Netherlands and Belgium**

This section narrates the operations and experiences of the various stakeholders who effectuate the different national WEEE management legislations (see Chapter 2) translated from the European Directives. Some of these actors are directly involved in the e-waste production and processing network while others belong to government departments and institutions that supervise those directly involved. This section collates evidence from semi-structured interviews with Senior Manager Sustainability in Phillips Consumer Lifestyle, WSR Performance Manager in VROM, Netherlands, Senior Experts in OVAM, Flanders, and Senior Policy Officer Products & Waste in EEB in 2011 apart from other secondary evidences.

Starting with the electronics manufacturers, the very source of the products, the Senior Manager Sustainability of Phillips Consumer Lifestyle (Amsterdam, 5 July 2011) opines that since the implementation of the e-waste legislations, there have been significant changes in the electronics manufacturing industry. REACH is the over-arching regulation on chemical substances that requires the producers to know the nature and amount of substances used in a product and register these with the authorities.

‘Earlier it did not matter what was in a product. Nowadays you have to ensure that your products meet energy efficiency requirements, RoHS and account for the different substances used, their properties and hazards’ (ibid).

According to an U.S. engineer, ‘RoHS is probably the biggest change in electronics in 50 years’ for the global electronics business (Selin & VanDeveer, 2006: 14). It is applicable from the design point of view, while the WEEE addresses the EoL processing of e-waste. RoHS also facilitates environmentally benign waste disposal and recycling by controlling the quantity of the hazardous substances in electronic items by mandating substitution by safer options. However, the RoHS Directive states,

‘Exemptions from the substitution requirement should be permitted if substitution is not possible from the scientific and technical point of view or if the negative environmental or health impacts caused by substitution are likely to outweigh the human and environmental benefits of the substitution. Substitution of the hazardous substances in EEE should also be carried out in a way so as to be compatible with the health and safety of users of EEE.’

(Point 11 in RoHS DIRECTIVE 2002/95/EC)

Hence in absence of suitable replacements, the hazardous substances continue to tarnish the EEE despite RoHS. Another critical issue reported by Phillips is that in all the national waste legislations, the producer is deemed to be the manufacturer or importer of the product into the country and not into Europe as outlined in the WEEE Directive. The Member States have changed the European definition into a national definition to have someone within their national territory to impose the legislation on. But there is a shift in how companies function in the contemporary production and distribution networks. Earlier, the manufacturer had a sales organisation in every country that was the legal entity for product import, tax payment and sale to the distributors and retailers. At present, companies are consolidating and simultaneously servicing several countries from one central sales organisation. So essentially, a distributor (in a country that does not house the singular sales outlet) is the first entity to import the EEE and place it on the national market. Hence the distributor is effectively the importer and has to meet the recycling obligations and not the actual manufacturer. The manufacturer is only responsible for WEEE management in the country where the sales organization exists. For example, Apple supplies its products from Ireland and Mediamarkt in Germany imports them. Hence Mediamarkt is the official national producer in Germany and is required to follow WEEE Directive but has no knowledge of the substances in the EEE. This challenges the efficacy of the EPR system since the responsibility of the production and recycling phase is no longer on the same entity in the WEEE network. This can compromise the producers’ incentive to design products that can be easily disassembled and recycled at the post consumption stage.

The VROM in Netherlands adapted the WEEE Directive into the BEA Decree and the REA Regulation from RoHS Directive in July 2004. It checks the regulatory standards for new equipment like the presence of hazardous substances (following RoHS) and energy consumption (following Eco-Design Directive). Transporters, traders and professional waste recycling companies are also certified along with the dismantlers (separating metals and plastics) and the producers. All these entities report to

VROM which monitors the collection and recycling targets. OVAM in Flanders implemented the WEEE Directive in Flanders by amending VLAREA (refer to page 4) in December 2004. The other two regions of Belgium have their own regional decrees translated from the WEEE Directive. In all the three regions of Belgium, Recupel is the sole compliance scheme or producers' organization with the responsibility of collecting, transporting and recycling WEEE. It enters into voluntary agreements with the environmental agencies of the three regions that approve the charters drawn up by Recupel with its contract partners for collection and recycling (OVAM, Mechelen in Belgium, 8 July 2011). The Senior Experts of OVAM pointed out a glaring discrepancy in the EPR principle enshrined in the WEEE Directive. According to Article 9 of the WEEE Directive 2002/96/EC, in the heading of 'Financing in respect of WEEE from users other than private households', it is declared that,

'….For WEEE from products put on the market before 13 August 2005 (historical waste); the financing of the costs of management shall be provided for by producers. Member States may, as an alternative, provide that users other than private households also be made, partly or totally, responsible for this financing. Producers and users other than private households may, without prejudice to this Directive, conclude agreements stipulating other financing methods.'

This allows the producers to circumvent the financial onus of historical waste by placing it on the professional users (i.e. users other than private households) by a different financial agreement. The latter has to pay the cost for WEEE management depending on the nature and weight of the appliances. The contribution for Professional Appliances (paid at the time of purchase) covers the administrative costs of Recupel but not the operational costs for waste management. So basically, the EPR is not upheld for historical waste used by professional users. Once the fractions like metals, plastics are reclaimed from the treatment facility, they are sold to the international market since it is no longer a waste, rather a product at that time. While OVAM in Flanders implements the national e-waste management legislation, the RoHS and Eco-Design Directive are enforced by the federal authority in Belgium since they govern the parameters for product design in the entire country. OVAM reports that

'The electronics manufacturers are not happy with the reuse of the EEE since they want to sell more products. In their ideal world, everything goes for treatment and nothing is destined for reuse. Also, they also want to prevent exports. It is all about green image and they are not pleased with the pictures of hazardous informal recycling in Asia and Africa' (OVAM, Mechelen in Belgium, 8 July 2011).

It maintains that the big international producers are compliant to the legislation and they are on the board of Recupel. Usually the small importers are reluctant to join Recupel since they have to quarterly declare the type and the number of household products (also weight for professional appliances) put on market. This is an additional administrative burden for small companies (also considered as producers by the national WEEE regulation).

The EEB has been a part of the WEEE Directive formulation as well as the recast. It is the sole civil association working on waste, 'Since waste is not a sexy topic' (Senior Policy Officer Products & Waste, EEB, Brussels, 13 July 2011). It contends that responsible e-waste processing should not

merely focus at end-of-pipe solutions but incorporate product specification policies and resource efficiency agenda. It prioritises reuse and recycling over incineration and landfilling and promotes sustainable use of appliances. It champions waste minimisation through design improvement like increased durability of goods ensured through legal minimum warranty schemes. It also supports high collection rates based on WEEE generated, eco-design provisions and financial incentives towards better product design. According to EEB, if the real environmental burden is integrated in every product price, it becomes economically meaningful to have products with longer life-span. Consequently, producers will design products that allow software upgrades, especially in computers and related equipment. Also reparability should be an important criterion along with the availability of spare parts.

Abiding by the polluter-pays-principle, all the stakeholders involved in the e-waste network should be held proportionately accountable. The consumers pay the price of the appliances but should be incentivised to discard the EEE properly, mainly in countries with a weak collection infrastructure and mechanism. However, at present, the retailers and/or distributors are not incorporated into the system to boost collection. They should be integrated as collection points to make it more convenient for the end-users. Particularly against distant and inaccessible collection options, the consumers can easily reach nearby supermarkets and retailers. The problem with current waste legislation is it essentially concentrates on the producer, deeming them responsible and neglecting others. Little regulatory effort is directed into increasing the consumer's awareness and the role of the visible fee is minimal. It was designed to show the consumers the cost of EoL treatment of EEE. At present, it simply funds the take-back scheme of the producer. Hence there is a difference between the intention of providing information and the real purpose of separating a part of the product price and dedicating it towards processing. It is also in very small print with no explanation and fails to deliver sufficient message to the consumer to change/modify consumption habits. The cost information can be accompanied with environmental information to drive more sustainable consumption behaviours (Senior Policy Officer Products & Waste, EEB, Brussels, 13 July 2011).

7.4. **Indian Experience in WEEE Management**

This section focusses on the enforcement of E-waste Rules in India. The NGOs working on e-waste dumping from overseas and its hazardous treatment have been pressuring the GOI (Government of India) for drafting the E-waste Rules, 2012. One NGO reported that without a proper legislation in place, it was impossible to organize a dialogue with the stakeholders (Toxics Link, New Delhi, 16 April 2012). But the law is not clear on the financial system necessary to implement EPR, which affects the development of a workable model. It allows two forms of EPR, collective and individual, without any instructions for their application. Hence the e-waste 'loop is not closed' according to former MoEF Director (New Delhi, 2 May 2012). In India there is no collective EPR yet. Usually the brand manufacturers support IPR (Individual Producer Responsibility) to realise the benefits of investment and improvement in environmental design. Some brands support collective EPR which promote shared costs and benefits while IPR is more expensive. But the cost of IPR is nullified in the long run with an efficient take-back system, which requires drop-off locations, warehouses and WEEE

transport. According to all the four manufacturing companies interviewed, every producer is ready to take-back their products provided the established infrastructure yields results. Many have introduced take-back programmes and arranged for drop off points which can be expanded in a phased manner. But the current ones are not properly utilized since the response is abysmally poor. They are now planning to revisit the existing model and restructure it without expansion. Frequent collection bins for large home appliances like fridges, washing machines and air-conditioners are not feasible due to weight and size, making the reverse logistics expensive, which the company has to incur. According to the producers, the responsibility should be equally shared between the producer, the consumer and the state and every stakeholder should be covered in the Rules.

None of the big manufacturers have come up with appropriate collection mechanisms, despite the one year preparatory time (Director, MoEF, New Delhi, 14 February 2012). However, some of the manufacturers have expressed interest and enquired of the modalities of the Rules (Senior Environmental Engineer, CPCB, New Delhi, 28 March 2012). The Rules differentiate between the categories of dismantlers and recyclers which are unique to the Indian law as in every other country, a recycler is always considered to be the dismantler. This has been developed for the informal actors, many of whom practise manual dismantling and not recycling so that, 'you are not taking away the job of many people with a stroke of the pen' (ibid). The erstwhile head of e-waste management in the Delhi Government (Senior Scientific Officer, Department of Environment, 27 March 2012) feels that the producers, especially the big international brands, are not serious about embracing EPR. The Department of Electronics & Information Technology (DeitY) under the Ministry of Communication and Information Technology (MCIT), GOI has been involved in the research and development of eco-friendly and economical WEEE treatment methods. According to its Additional Director (New Delhi, 13 April 2012), alternative techniques must be devised to support any legislative framework. The National Metallurgical Laboratory has successfully recovered 90% of metals from WEEE and another project on metal extraction from PCBs is ongoing in Pune. However, these initiatives have not been conveyed to the informal sector with which there is no communication yet.

The Rules mandate that anybody planning to undertake WEEE collection, dismantling and/or recycling must acquire state authorization. The Current Master Plan of Delhi prohibits any hazardous activity like WEEE dismantling and recycling within the city limits. The informal traders seeking government license for collection and storage are distressed due to the bureaucratic complications and delays. According to E-Wardd, an informal dismantlers' association in Karnataka, it took four years to register with the CPCB (Kandhari, 2010). In Delhi, two informal groups have taken permission from DPCC, namely, Chintan Environmental Research & Action Group and E-Waste Harit Recyclers Association (HRA) Private Limited for collection centres. Chintan, an environmental NGO working on MSW in Delhi, has launched a door-to-door WEEE collection scheme with waste-pickers. HRA is a company of informal e-waste traders hoping to legalise their operations under the new Rules.

A couple of NGOs (Saahas and Toxics Link, New Delhi, 28 September 2011) think that WEEE informality has not been adequately addressed in the Rules, and there are no incentives for formalisation. Some members of the drafting Committee feel that the interests of the informal actors

were not represented in the Rules formation. It is claimed, 'The Rules fail to integrate the informal sector in the collection, segregation and dismantling of e-waste' (Manzar, 2011). The focus was on creating a green e-waste management model with the formal sector with a distinct discomfort in accommodating the informal sector in the Rules. The formalisation procedure requires an application for Consent to Establish (CtE) and subsequently Consent to Operate (CtO) from the State (See Appendix X in page 214 for the CtO of HRA). In Delhi, it took the HRA over a year to clear the first step of CtE. Chintan applied later than HRA but was granted approval before as they are a familiar NGO (GIZ and HRA, New Delhi, 09 April 2012). Only after Chintan got the certificate, was the application of HRA considered. The HRA was certified for WEEE collection, segregation and storage but not for dismantling and recycling which circumscribes their revenue opportunities. Many stakeholders believe that a legislative approach is not enough by itself since 'people behave in tune with economic values and incentives with regard to e-waste processing' (Confederation of Indian Industry, New Delhi, 22 March 2012) which is manifested in the flourishing growth of informal e-waste processing.

The electronics manufacturing industry represented by the Manufacturers' Association for Information Technology (MAIT) participated in the Drafting Committee of the E-waste Rules. It thinks that the Rules and the Guidelines must be revised (MAIT, Delhi, 22 May 2012). The Guidelines are intended as explanatory notes since WEEE is a novel concept in India and quite different from any other type of waste (Senior Environmental Engineer, CPCB, New Delhi, 28 March 2012). In fact, the E-waste Rules are the only ones in the country to be supplemented with guidelines to facilitate its interpretation and implementation (ibid). But the collection requirement of 20% set out in the Guidelines is very high according to MAIT. Without establishing the mechanisms for proper waste flow and treatment, it is too early to set collection targets for the producers. The issue should be reviewed in a year's time and then parameters can be set to arrive at workable targets. At this nascent stage, the industry needs to institutionalise the logistical, administrative and operational modalities. Also the requirement of a collection centre in every city with a population of more than or equal to 5 lakhs (half a million) is problematic as the producer can have collection point bins, mobile vans, and even virtual collection schemes.

Besides, just the manufacturers cannot guarantee e-waste collection from the consumers. Admittedly, the bulk consumers are mandated to sell WEEE to an authorised party but there are no punitive measures to penalise an errant disposer. Though according to the CPCB, the E-waste Rules oblidge them to maintain records (Form 2 for 'Maintaining Records of E-waste handled/Generated' in the E-waste Rules, 2011) on the quantity of e-waste generated and the certified collector/recycled it has been send/sold to. However, there is no ground implementation of this clause. There are also no checks on household consumers to dispose the used good through green channels. The manufacturers have to collect a sizable amount for the economic viability of recycling. A sustainable model that recycles an optimal quantity of e-waste for obtaining a reasonable salvage value is not yet developed. The responsibility of the producer has limits since consumers cannot be forced to return their products. Often the formal recyclers lack adequate e-waste to run a profitable venture. Indian consumers do not consider environmental parameters in their decision making. The manufacturers,

formal recyclers and the NGOs, all opine that the GOI should have sensitised the consumers and familiarised them with the hazards of unsafe e-waste management.

7.5. **Impact of the WEEE legislations on network stakeholders**

This section investigates the shortcomings and/or inconsistencies in the WEEE legislative framework at the international, regional and national levels. Many countries have refused to subscribe to the Basel Agreement since the 'vague definition of hazardous waste permits countries to modify the list to suit themselves; it is more an instrument for monitoring rather than preventing hazardous waste TBM and several countries are reluctant to surrender their self-government or this profitable source of income' (Houben & Ustailieva 2007: 4).

Contradictory definitions and ambiguous interpretations result in imprecise distinction between hazardous and non-hazardous waste in the national laws based on the Basel Convention. Additionally, the Convention mandates that waste exported should be recycled in the destination countries in an environmentally sound manner without clarifying what defines or informs 'environmentally sound'. Many environmentalists are concerned that the Basel Convention has no teeth and institutionalises waste trade since the 'participation and adherence to its standards is voluntary' (Kilcoyne 1992: 51). One of the largest exporters of hazardous waste, the United States[31] has signed but not yet ratified the Convention[32]. Even countries (like Canada, Japan, Australia, and South Korea) who are parties to the Convention often flout it since it is not legally binding (Iles, 2004). Greenpeace has claimed that the 'Convention is providing license to criminal activity' (Houben & Ustailieva 2007: 4). According to Jim Puckett (coordinator of BAN[33]) there is a 'lack of political will' to block e-waste transfer from developed to developing nations (Bradley, 2009). In India, the second-hand shop-owners in Nehru Place receive used computers from America, Europe and South Korea. Regularly junk computers very close to their EoL are sent to the developing world as second-hand EEE, unless destined to be disposed, does not come under the Basel definition of hazardous waste. Hence after the Basel Ban, previously obsolete items are being exported for recycling under the guise of usable products exempted in the Ban. The coordinator for greener electronics at Greenpeace International observes, 'The common way exporters get round existing regulations is to re-label e-waste as second-hand goods for recycling,' (Bradley, 2009).

This is borne out by a five week joint global Customs initiative across Europe and Asia Pacific (Operation Demeter III) in 2013 which seized more than 7,000 tonnes of illegal hazardous waste including e-waste (World Customs Organization, 2014). In 2008, Greenpeace discovered high contamination of lead and dioxins in an e-waste yard in Ghana and reported similar findings in WEEE dump sites in China and India (Bradley, 2009). What should have been a ban, has 'turned out to be an administrative regulation on hazardous wastes with escape possibilities' (Houben & Ustailieva 2007: 5). Also, there is a high incidence of South-South trade in e-waste which is overlooked in the Basel

[31] Estimates from the recycling industry show that out of the total e-waste collected for recycling in the US, 50% to 80% are shipped off abroad (BAN/SVTC, 2002).
[32] Haiti has also signed but not ratified Basel Convention.
[33] *BAN or the Basel Action Network is a charitable organization that aims to prevent toxic trade in toxic wastes, toxic products and toxic technologies, that are exported from rich to poorer countries.*

Convention and Ban which only pertain to North-South trade (Lepawsky & McNabb, 2010, Lepawsky, 2014). Thus, the Basel (Convention and Ban) remains largely ineffective despite being the sole international agreement on hazardous waste trade.

At the regional level, the design and execution of the WSR suffer from several loopholes. For instance, the inclusion of some wastes in the 'green listed' category of the WSR like Electronic scrap e.g. PCBs, (refer to GC020 in chapter 2 on page 28). Though considered non-hazardous, PCBs are frequently subjected to unsafe recycling in the informal realm. There is inconsistent understanding of product vis-à-vis waste in the WSR since waste in Europe can be used as product in other countries. Moreover, product standards are not universal, reuse can be risky and final disposal might not always be environmentally sound (BiPRO, 2007). WSR does not have uniform product/waste distinction with non-differentiated Customs Tariff code for both EEE and used EEE (possibly waste). The EEB and BAN want all non-tested electronics to be branded as WEEE, the export of which is in flagrant contravention of the Basel Convention (EEB, 2011). Disparate implementation of the WSR in the various European countries reduces its efficacy in arresting the e-scrap traffic. Without uniform TBM policies and enforcement across the EU, illicit traders would exploit the discrepancies between the qualities of control mechanisms of the various European ports. By legally restricting WEEE leakages, chances of waste diversion to sub-optimal treatment can be blocked. However, without the WSR, Customs checks and its International Partnership Programmes, undoubtedly more e-waste would be destined to emerging nations. Therefore, the impact of the regulations on the international movement of e-waste is limited, partially due to imprecision and inadequate resources for enforcement. This facilitates the formal-informal nexus, not just between Europe and India but also globally by allowing e-waste to slip out of the formal domain into the informal.

At the receiving end, India allows import of waste electrical and electronic assemblies (including PCBs, electronic components and wires) destined for direct reuse and not for disposal (refer to B1110 in chapter 2 on page 30). As mentioned earlier, it is not easy to distinguish between WEEE and used EEE that will eventually become waste. Customs inspections cannot ascertain whether an EEE item is destined for reuse or for recycling/disposal. The reuse of PCBs is rare in India where it is mostly recycled using acid or open-burning (Informal Traders and Formal Recyclers, New Delhi, 2012).

To improve e-waste management in Europe, the EEB lobbied for revising the collection targets in the WEEE recast. Equal collection target from private households in the original WEEE Directive implies that all Member States have the same pattern of EEE consumption. The EEB pushed for upscaling the target based on the e-waste generated. The criterion for collection in the WEEE Recast says,

'….. collection targets should be based on the amount of WEEE generated where due account is taken of the differing life cycles of products in the Member States, of non-saturated markets and of EEE with a long life cycle. ….. According to current estimates, a collection rate of 85% of WEEE generated is broadly equivalent to a collection rate of 65% of the average weight of EEE placed on the market in the three preceding years.'

(Article 16 in WEEE Recast DIRECTIVE 2012/19/EU)

But it is difficult to determine how much EEE is placed on the market annually since there is no singular method of evaluation across the different European countries. Similarly, there is no accepted procedure for calculating the amount of WEEE generated. The EEB also proposed a revision of the prevalent recycling and recovery targets since everything sent to the treatment facility is considered as recycled. Reclaimed materials from recycling should be monitored rather than the input. The WEEE recast has still not addressed this issue. Even the manufacturing company, Phillips, find that the recycling requirements are very generic in the WEEE Directive like,

"….. Member States shall take appropriate measures so that producers do not prevent, through specific design features or manufacturing processes, WEEE from being reused, unless such specific design features or manufacturing processes present overriding advantages, for example, with regard to the protection of the environment and/or safety requirements".

(Part of Article 4 on Product design in WEEE DIRECTIVE 2002/96/EC)

According to Phillips, (Amsterdam, 5 July 2011) "It is a very nice Article but doesn't mean much". It does not lay down the principles or the guidelines that should be followed to achieve resource efficiency. The predominant recycling technique is shredding and recyclers recycle anything that is not banned by RoHS. EEE is designed following some basic standards like minimising the amount of metal inserts in plastics, marking the plastics for easy identification and separating the mono-materials. He added that there is no incentive for developing and upgrading environmental designing in the EPR principle. Every manufacturing company bears the recycling cost of its share of the EEE market and not its own products since it is economically unviable to separate one's product from the general WEEE stream. If a company gets its products back, it logically should invest in improving its design for quick disassembly and material extraction. Also, there exists trade-offs between different phases of a product's life-cycle. Changes in design for greener recycling might enhance the energy consumption in other phases of the product lifecycle. The most energy intensive stage of a product is the manufacturing or the use phase. If a producer tries to increase the recyclability of its products by using more metals, then the life-cycle impact of the material extraction phase rises sharply. There also might be a trade-off between EoL cost and the energy consumption in a product's use phase. Like mercury lamps/bulbs which consumes less energy during use but releases poisonous mercury during recycling. Thus by focussing on EoL, EPR misses out on the effect of the entire lifecycle cost. The issue of relative superiority of IPR and EPR resonate also in India. The application of collective EPR in Europe and India suffer thus,

a. The take-back scheme under EPR is collectively financed by the producers on the basis of their market share, irrespective of the volume of their products returned.
b. The variations in the recycling costs between brands are disregarded.

Relatively, IPR fares better in overcoming these problems as exemplified in Japan where producers collect and recycle just their own products (a barcode distinguishes between the different brands). Hence, the producers have an incentive for improving environmental design of the products. Even when the producers collaborate to share the administrative and logistical expenses, this system

'guarantees a fair cost allocation between producers …… since the recycling costs of products are differentiable and can be correctly assigned to the right producer' (Atasu & Wassenhove, 2012: 412).

In India, the manufacturers and the NGOs allege that the E-waste Rules are a mere replication of the European WEEE Directive. While some aspects of the European legislation should be emulated, the Rules should be aligned with the Indian reality and practices. The CPCB admitted that the law has been largely inspired by the European Directives (CPCB, New Delhi, 28 March 2012). But there is no well-established infrastructure for WEEE collection in India. The consumers have no incentive or obligation to environmentally dispose e-waste. One of the producers disclosed that customers demand money to return old EEE. Every phone call requesting a free pick up invariably enquires, 'How much will you pay for it?' (Brand manufacturer, NCR, 5 January 2012). When the company explains that they do not pay for e-waste, rather channelizes it properly following state regulations, the users lose interest in handing over the used EEE. In the last six months, there has been just one phone call by a person who wanted money in return (ibid). Another producer pointed out that it is unfair to expect the household users to discard electronics free of charge since the government departments themselves sell WEEE through auctions. The auctioned e-scrap is bought by registered formal or informal traders but there is no guarantee that it would not be passed on to an unauthorised informal player (Brand Manufacturer, New Delhi, 8 January 2012).

As pointed out by EEB (Brussels, 13 July 2011), retailers and distributors can play a crucial role in the absence of sufficient collection points. But the Indian Rules do not involve these players in its purview. The Indian government should partake in establishing a credible collection structure that can cater to the massive population of 1.21 billion in 2011 (http://censusindia.gov.in/2011census/censusinfodashboard/index.html accessed on 01 July 2014) distributed over an area of 3,287,590 square kilometres. There should be a visible fee or disposal levy on the product price during purchase to finance EEE processing. The Indian government officials and NGOs believe that the manufacturers are not proactive in setting up a collection system (Agarwal, 2013) while the manufacturers hold the state responsible for not briefing the consumers. Also in the Rules, the refurbishers are left out and their expertise and functions are not considered in a society where reuse and repair are culturally entrenched. Responsible reuse and repair substantially reduce waste generation and lower virgin material extraction for production of electronics appliances.

7.6. **Analysing the Impact & Efficacy of the WEEE Regulations**

This section analyses the state's failure to guide the waste flow and the responsible behaviour of the actors. The primary reason is the state's perception of informality. The informal actors are either considered illegal or performing environmentally undesirable activities by the state. The regulatory machinery considers some actors 'formal' if they have government authorisation and the remaining as 'informal'. Essentially, this manifests which section of actors is acknowledged as credible workers/entrepreneurs by the state and offered due rights and protection. This priviledge is not extended to the informal actors who are effectively criminalised through laws and ordinances. Legislative apparatus monitors the actions of the formal economy and distinguishes it from the unregulated informal sector. However, there exist myriad intersections between the formal and

informal spaces, as demonstrated in Chapters 5 & 6. The informal also mediate and interact with the formal for finance, space and technology. The legislative demarcation between the two sectors is not manifested in reality and the state only creates this distinction between them by proactively branding one against the other.

The informal actors would not disappear following the enforcement of the Indian regulation and might go further underground to evade the authorities. They forge covert linkages with the formal sector and broker surreptitious business deals. E-waste is not just an environmental or legislative issue but an economic and livelihood concern too. While there is a high incidence of informality in India, it is not completely absent in the European countries. Most e-waste regulations are uncomfortable in accommodating informality (Agarwal, 2013). The Indian NGOs assert that the Rules completely ignore the informal sector and with no initiative or enthusiasm to incorporate informality through innovative interventions. Here, the slightly awkward and inexplicable relationship between the green lobby and the informal actors should be mentioned. Though the NGOs somewhat represented the interests of the informal actors before the Draft Committee, they did not raise all the important points. For instance, the law allows licenses for premises for WEEE collection and dismantling. However, according to the informal traders and collectors (New Delhi, 2011 & 2012), very little profit is derived from collection and storage if they cannot conduct basic dismantling and disassembly to separate the material components. A dismantling license requires evidence of an agreement with a certified recycler for recycling the dismantled items. Given the nature of the hazardous recycling techniques typically practised in the informal sector, any authorization for recycling is an illusion. The HRA is trying to bargain with the formal recyclers in this regard, but complain that the terms and conditions proposed by the latter are not in their favour (HRA, New Delhi, 09 and 15 April 2012). Thus the NGOs ended up voicing the opinion of a select group of self-styled informal leaders who were not cognizant of all the concerns & incapable of fathoming the consequences of the law.

Finally, informality is a political issue in which the informal actors need to negotiate a legal space. Typically law and policy makers target the formal sector and ignore the informal thereby overlooking the connections and the continuity between them. The informal sector and its functions should be taken into consideration as it forms an intrinsic part of the WEEE network. Informality is conspicuous in its absence in both the European and Indian regulations. While the WSR alludes to informality in terms of illegal waste activities, it does not suggest ways in which the enforcement agencies can monitor the stakeholders and the informal WEEE channels converging to the ports. In India, the legislation does not even have a single mention of informality. By exclusion, the state is complicit to presence of informality in the spectrum of e-waste. It effectively strengthens the relationship between formality and informality since after the implementation the law, informal traders who independently procured e-waste earlier, are tying up with the formal recyclers. Thus the state aims to transform informality into formality without realising that they function together and support one another. This regulatory weakness is exploited by informality, which successfully occupies and utilizes the space created by the state. Rather than outlawing or disregarding the informal practices, they should be incorporated in designing an eco-friendly waste processing model. It has been noted that ‘an abrupt

abolishment of the current informal system would be counterproductive due to the mature network that is already well-established' (Chi, Streicher-Porte, Wang, & Reuter, 2011: 731).

7.7. **Conclusion**

This chapter sought to understand the influence of regulations on the e-waste network. It demonstrates that the WEEE stream is a complex outcome of different regulatory interventions which moulds the trajectory of waste stream and behaviour of the participating actors. The formal and informal sectors work in tandem in the global and national circulation and management of e-waste. The spatial movement of e-waste and its hazardous recycling continue unabated despite the regulatory efforts to control, manage and govern it. The regulations addressing the waste flow guide its treatment (like the E-waste Rules in India) and/or work in conjunction (like WSR & WEEE legislations in Europe). What is not environmentally processed in the country is likely to be exported overseas to destinations allegedly conducting toxic treatment.

This chapter has questioned and challenged the state's dualist understanding of the role of informality in the e-waste industry. The state views waste as a cost allocation exercise and not as a commodity with value. Using EPR, it places the EoL responsibility on the manufacturers who control the manufacturing stage, but not the dynamics of the entire network. The latter simply raises the price of the electronics which is finally passed on to the consumers. On the other hand, the informal sector is guided by the market imperatives and provides an economic incentive which overrides the legislative requirements or restrictions, tipping the system in favour of informality. The regulations miss that used EEE represents a source of value for the informal actors and suffers from a misguided notion of the nature/value of waste which has a market. The logic of the informal sector is different than that of the regulators and it is not concerned with safe waste disposal. Waste management is a capitalist process of value creation and profit generation. The India legislation imitates and reproduces the global and OECD understanding of waste and standard of treatment. This essentially compromises the position of informality and consequently the entire WEEE recycling industry. There is a need to create legitimate spaces and enabling conditions for the informal players such that they can realise their potential in the political economy of waste management. A legislation which is a mere duplication of the European Directives, without being contextually relevant and culturally sensitive, will remain largely ineffective.

The observations reached in this chapter are as follows. First, the processes of manufacturing and waste management are fragmented globally according to specific spatial features and functional requirements. This displays the contextual variation and embeddedness of the WEEE network that partially influence the international trajectory of the waste material. The most important inference reached here is that the legislative frameworks at various scales essentially drive the formal-informal relationship. By overlooking the existence of booming markets around used and recycled EEE and the treatment of waste as a resource, the state pushes WEEE into the domain of informality and consolidates the close association between formality and informality. Along with the findings from chapters 5 and 6, this chapter reiterates the dualist perception of the state which facilitates in shaping and driving the formal-informal intersections in the e-waste network.

The state is only interested in the issues of legality, formal participation and penalty for non-compliance or violation. The Indian law mandates the producers to undertake WEEE collection without establishing adequate infrastructure to support the endeavour. Neither has the regulatory machinery advocated the cause and necessity of green waste disposal among the consumers. This has allowed the informal sector, with its widespread collection networks and liaisons with the formal sector, to procure the bulk of the e-waste generated. As mentioned before, even the government offices sell their WEEE to the informal sector revealing a contradiction between preaching and practice. On the contrary, in Europe the WEEE collection system is better institutionalised with the state playing an active role through local municipal authorities. Consumers are environmentally conscious and aware of the ills of unsafe waste processing. The European electronics market is also saturated with latest innovations and models with minimal demand for second-hand products. Repair and reuse are less entrenched in the socio-cultural environment of the Western European countries. A substantial proportion of WEEE is collected and recycled by the formal companies, mandated by the national legislations. This does not suggest that informality is absent in the European context but it is definitely not as widespread as in India. In India, the lack of a collection procedure and adequate consumer awareness provides opportunity for the development of WEEE informality. Moreover, the legislation prioritises the formal recycling industry and does not address the reality of pervasive informality. Its initiatives prove counter-productive since there is little understanding of the interconnections between formality and informality in the structural constitution of WEEE.

This chapter applies the GPN framework to discern the role of the state and civil society in influencing international and national e-waste processing. It illustrates how civil society and its relationship with the state and the WEEE actors guide law formation and policy enforcement. The state has to respond to the demands of an active and conscious civil forum which pushes for eco-friendly e-waste management. Such non-governmental associations create pressure on the state to introduce regulatory provisions, enact their clauses and address their weaknesses by constant lobbying and advocacy. In the WEEE Recast, EEB pushed for differentiated e-waste collection for the various Member States based on the quantity of EEE placed on the market or the amount of WEEE generated in Europe. In India, the international and national NGOs persuaded the government for a designated e-waste law in consultation with the other stakeholders (except informal players).

Hence, the state and the civil society play a crucial role in inducing the configuration and functioning of the waste system depicting its embeddedness in regulatory and socio-cultural institutions. The chapter also draws from the formality-informality debate to understand how the state machinery reinforces their relationships in WEEE circulation and processing. It has illustrated how after the enforcement of the Indian Rules, the informal has become illegal. Even when the informal try to formalise, it is faced with administrative hurdles and bureaucratic problems. Assimilating the informal sector in evolving a green e-waste management programme can be a step towards managing massive WEEE generation and high recycling costs. Then both the formal and the informal sectors can capitalise through mutual cooperation and state support without bypassing the environmental agenda.

Chapter 8:

UNPACKING THE DRIVERS OF (IN) FORMALITY IN THE GLOBAL E-WASTE NETWORK

8.1. **Introduction**

The last three chapters have shown the territorial patterns and practices in the global WEEE network using the fieldwork findings. They have documented the various (formal and informal) e-waste actors involved in generating value from e-waste, their inter-linkages and the impact of the institutional framework in which they are located. The cases of Europe and India offer different infrastructural, technological, legislative landscapes which guide their relative position in the organizational and functional architecture of the WEEE network. Despite the substantial variations in their e-waste management mechanisms, they are spatially and relationally connected in the global waste production and processing network.

This chapter theoretically and analytically explains the observed formal-informal continuum and the overriding significance of informality in the spectrum of e-waste treatment. It emphasises the socio-economic, cultural, and regulatory factors that contribute to the informality in such networks. It uses the empirical trends and analytical outcomes from the previous chapters to answer the research questions. It integrates the myriad WEEE issues, processes, agents and environments to comprehend what drives e-waste informality, the primary question that this research has set out to answer. While the study has mainly drawn inferences from site-specific field observations and enquiries, its principal observations and interpretations can be extended to disentangle other international recycling systems within a particular regulatory framework. The following reiterates the research questions, each of which focuses on a specific dimension of the global network of WEEE processing.

Main Research Question: What drives informality in e-waste movements and management?

vii. How does e-waste flow along the reverse supply chain from the point of its generation?

viii. What is the nature of transactions defining the formal – informal linkages in the processes of e-waste disposal and recycling?

ix. How does the regulatory environment influence the informality of e-waste processing?

The structure of this chapter flows from the above questions. The next section deliberates on the global e-waste stream and demonstrates how its transfer and treatment is integrated in the realm of international production and value generation. The third section deconstructs the notion of informality to elucidate the informal actors, their incentives and vulnerabilities, and their location vis-a-vis the non-informal players. The fourth section focuses on the intersections and interfaces between formality and informality in the Indian context by analysing inter and intra-sectoral governance in the light of the GVC theory. The fifth section evaluates the role and impact of the regulatory and civic institutions on the network actors and processes to express the purpose and target of the WEEE legislations and the

socio-environmental agenda on waste. The sixth section appraises the GVC understanding on power and governance to reflect how the phenomenon of e-waste transfer and treatment throws up new directions and arguments in this regard. The penultimate section assimilates the above three sections to emphasise the fluidity between formality and informality in the global WEEE landscape and elucidates the drivers of informality therein. The last section concludes with the main points.

8.2. **Following E-waste Globally along its Reverse Supply Chain**

Charting the course of e-waste reveals the ubiquitous presence and influence of the informal economy in WEEE handling and processing. Recalling the fifth chapter that mapped the international waste trajectory, it can be noted that e-waste formality and informality function at tandem. Territorially dispersed sectoral players participate in miscellaneous waste activities executed at multiple locations and scales. There is no absolute separation between these sectors in the network and all e-waste operations can be placed in a spectrum of varying degrees of informalisation. The disintegration and decentralization of production are not restricted within the electronics manufacturing phase and encompasses the fragmented practices of waste management. In this section, the value generated and appropriated from e-waste is located in the rubric of the international capitalist economy to reinforce the continuity and connections between formality and informality therein.

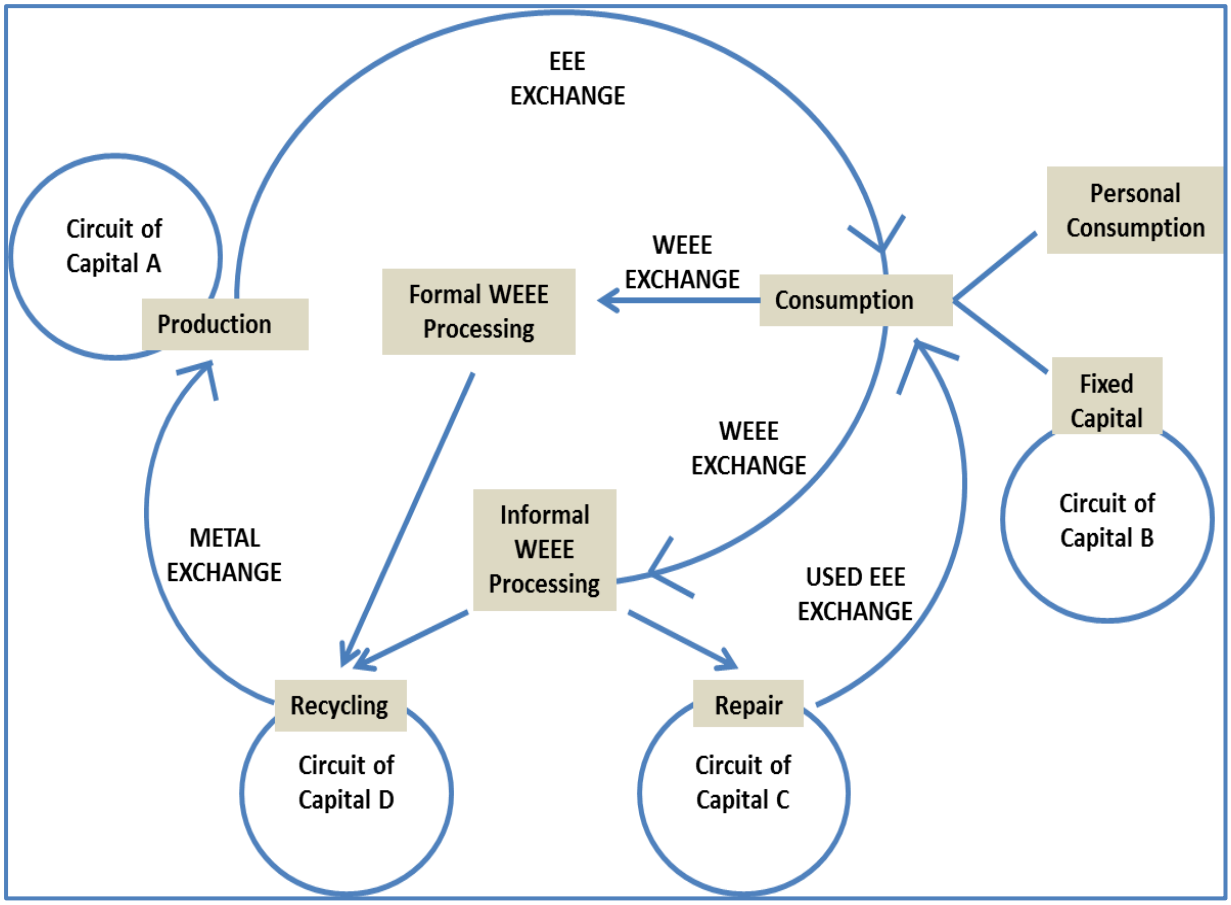
8.2.1. **Spatial Creation and Transformation of Value in E-waste**

The contours of e-waste circulation are structured along multiple and self-perpetuating circuits of capital. The exposition of e-waste as capital reveals the true purpose of waste production and treatment in the capitalist economy which is to derive profit from international and national market exchange of waste and its derivatives. Marx's circuits of capital retrieve the focus on production and facilitate the analysis of value creation and distribution without falling into the trap of economic reductionism (Taylor, 2007). This venture confronts the issue of the invisibility of labour and its relationship with capital in value creation.

The following diagram condenses the illustration in Chapter 5 (Figure 7: Value Creation & Flow in the Spatial EEE, WEEE & Used EEE Networks on page 100) to depict the different circuits of capital that are described by electronics production, consumption, repair and recycling. The rectangular boxes denote the socio-economic processes of production that form one of the guiding principles of the capitalist system. To start with, the phase of EEE manufacturing charts the Circuit of Capital (A) creating surplus value from production and eventual profit for the producers. In the EoL management of WEEE, the processes of (formal and informal) recycling and informal repair trace the Circuits of Capital D and C respectively. The repaired items are purchased by consumers in second-hand markets. Consumption can be divided into two categories, the first one for personal consumption which yields use-value for the user and another as fixed capital. Companies use ITC equipment, coolers, ACs and other electronic items in their business. These EEE constitute the fixed capital that aids the production of goods and services. Hence EEE bought and used as fixed capital yields surplus value and secures profit through market exchange. Hence there is yet another Circuit of Capital (B) embedded in the network. When EEE is discarded in favour of more sophisticated electronics, the formal recyclers and informal traders buy them at the auctions/tenders. The used

electronics are then repaired or recycled to fashion secondary products and materials that are sold for further production. This portrays the continuity between these different circuits that characterises the ongoing economy around electronic products and wastes.

Figure 9: Circuits of Capital in the Spatial EEE, WEEE & Used EEE Networks



Source: Created by Author

There are variable notions of value attached to WEEE by the diverse actors. While the brand manufacturing companies consider e-waste as a cost and concern for environmental management (following the waste legislations), the informal players treat the same as a resource. The consumers in European countries have to pay for ecological treatment of WEEE, in the form of a disposal levy or visible fee during purchase. In contrast, the Indian consumers actually receive money for their old and obsolete electronics that are bought primarily by the informal actors who use inexpensive labour for its recycling. This elucidates the variations in the labour regimes and wages in Europe and India where in the latter, abundant cheap labour is available for low cost repair, refurbishment and extraction of metals while in the EU, repair and extraction costs are substantial since labour has a higher valuation. This illustrates how the relative costs of capital and labour differ in different spatial and institutional contexts and result in diverse forms of e-waste informality in the advanced and industrialising nations. Since the Indian informal labour deployed for WEEE repair and recycling is inexpensive, the resultant second-hand equipment and recovered materials are also cheaper than those in Europe. Given that

wage labour is expensive in the EU, the final prices of repaired electronics are not as low as in developing countries. Also, the majority of European consumers prefer the latest innovations and models in electronics. This exemplifies the varied preferences in and habits of consumption in different countries and validates that there is no universal understanding of 'quality' and 'value' which are socially constructed and contested concepts (Raynolds, 2002). The Indian electronics landscape is marked by the presence of a vibrant local market for used electronic goods and components which caters to a steady demand for such products. These markets supply to a distinct group of domestic consumers who are unable to afford new electronics and buy low-priced second-hand gadgets for personal consumption and business purposes. This is echoed in the following,

'…….in globalization, not all consumer markets are global and not all products are produced for a global market. Rather, alongside and as part of globalization, there are significant and growing consumer markets in certain countries in the South…….Whilst these consumers may lack the purchasing power to buy global brands and thus are largely invisible as consumers in academic accounts of globalization, they constitute a huge and important market for a parallel set of domestic-facing firms, also largely invisible in accounts of globalization.'

(Gregson et al. 2011: 55)

The above explains the rationale behind the widespread incidence of WEEE informality as outlined by Chi et.al, 2011 (refer to Chapter 2, Section 7). These authors enumerated a set of observations without providing any analytical clarification. The insight developed here unravels the reasons behind the consumers' reluctance to pay for WEEE disposal, lack of effective take-back schemes, import of EEE for secondary uses, and inadequate formal infrastructure for e-waste processing in the emerging and developing countries. Given that the electronics users stand to gain by selling their discarded EEE to informal collectors rather than giving them to the formal take-back systems free-of-charge in the developing context, the manufacturers are reluctant to invest in elaborate and expensive management infrastructure. Mostly, the consumers prefer to dispose their old gadgets informally. E-waste export from industrialised countries is partially motivated by the potential profit from the secondary processing of WEEE in these nations where many importers, middlemen, and traders reap the benefits from the price variation between the sender and recipient countries.

The application of the Marxian circuits of capital clarifies how the European and Indian institutional environments result in different relative costs of capital vis-à-vis labour. This contributes to the disparate valorisation of e-waste between these countries. Thus the understanding of value in WEEE is rooted in social structure and institutionally constructed. The resource potential of e-waste is capitalised by the informal economy which mechanically and chemically transform waste into useful commodities. Moreover, the informalised labour regime allows the employment of workers in hazardous health conditions of recycling, which were seen in the recycling units in Mandoli, Loni, and Moradabad. This can be similarly observed in the ship-breaking industry in Bangladesh where derelict ships are broken down for secondary manufacturing of furniture for the domestic market (Gregson et al., 2010).

8.2.2. **Analysing the Global E-waste Production and Processing Network**

The diagram also illustrates that the WEEE recycling network is directly conjoined with that of the electronics production network. Without the production of EEE, WEEE cannot exist and the metals separated from WEEE go back to the manufacturing of electronics and other goods. The transformation of functional or reparable WEEE into reusable EEE embodies an innovative production process. Thus e-waste processing itself constitutes stages of secondary production involving diverse usage of capital and labour. This illustrates that WEEE is a material input in production which forms an integral aspect of waste recycling. At multiple points across the length and breadth of the network, commodities are produced by reprocessing waste through formal and informal waste activities. Therefore, the e-waste recycling network should be recognised as a production and management system, and not a waste disposal one, which is sustained by a continuum of formal-informal functions and relations. Hereafter whenever the WEEE network is mentioned, it includes both production and processing networks.

The multi-directional waste traffic has numerous global and local linkages where formal actors are connected with informal actors, waste brokers, and middlemen. Various expressions of formality and informality are observed in the multiple conduits and processing mechanisms of WEEE. The discarded appliances enter the international e-waste circuit connecting and integrating the national players with the broader waste network. Despite substantial variations in the contextual treatment procedures, both the formal and informal sectors access and control waste as a resource that creates value. Essentially the formal recycling companies pass on certain segments of WEEE treatment, particularly secondary metal extraction, to informal actors in order to bypass huge expenditures in eco-friendly recycling technology. Casualization of e-waste management allows the formal to reap profit and cut down costs by making use of backward informal recovery using cheap labour. Hence, in effect, the formal recyclers outsource or subcontract the labour-intensive and environmentally hazardous management mechanisms to the informal recyclers. The Indian recycling companies also reach the domestic secondary markets directly or indirectly through the informal actors. This is also enforced by the structuralist school which shows how informality is interwoven in the capitalist economy and is frequently used to further the interests of the formal sector. It also emphasises the various ties between the two sectors which is exemplified in the WEEE network. Formality and informality are seamlessly integrated in the e-waste stream which constitutes a (secondary) supply chain and therefore circumvents efforts to regulate it as waste. The sectoral continuity in the waste flow and functions relates to the definite interests and imperatives of the actors. The subsequent section decomposes the heterogeneous informal sector to elucidate its spatial connections and relative position in the global WEEE network.

8.3. **Investigating the nature of (in) formality in E-waste Production and Processing**

Here, the nature of informality in e-waste processing is unravelled using the established postulates on the informal sector. The GPN literature has neglected the question of informality though the contemporary global networks constitute myriad instances of informalisation. The recent proliferation of GPN studies in used goods and recycled materials has emphasised the presence and significance

of informality in the international architecture of WEEE. However, the popular dualist understanding of informality and its connections with formality is left unchallenged, which perpetuates the notion of segmented labour markets (see Heintz and Slonimczyk 2007; Heintz 2007; Sindzingre 2006) in the GPN inspired academic and policy circles.

The empirical research in India has revealed that e-waste informality provides diverse benefits to the different players. For the big informal trader and waste dealers amassing substantial profit, the informal sector is a desirable choice over the formal as they do not have to file taxes or abide by labour regulations and zoning standards. The dealers are aware of the quasi-legal nature of their activities and zealously guard information about their contacts, income, and records of their accounts. Hence they prefer the independence of and flexibility in informality to avoid the costs and constraints associated with formal registration. This is akin to De Soto's (1990) idea on informality where informal entrepreneurs opt to work outside the binding legalities of the formal system to circumvent its bureaucratic rigidities (Maloney 2004). But the state bureaucracy also leaves such activities unaddressed despite labelling them illegal. Often the informal is confused with illegal. But, though these operations breach legal boundaries at times and occupy an intermediate position between 'informality and legality', they are not 'immoral' because they break no basic moral codes (Bromley, 1990). The traders are dynamic autonomous entrepreneurs 'producing legitimate products without proper permits and legal status because they lack the resources and/or the incentives to comply with the burdensome and excessive rules and regulations necessary to become part of the formal economy' (Chaturvedi et al. 2012: 206).

Working directly under the waste dealers are the young male dismantlers who often upgrade into trading later. For the distant kith and kin of the traders visiting the city in search of better livelihood options, sorting, dismantling, and repairing can act as provisional employment. This echoes with the residual understanding of informality by the ILO where workers take up informal jobs till they land a better alternative (Bangasser, 2000). However, for a select group of dismantlers who ultimately aspire to trade in e-waste, this work serves like an apprenticeship before breaking into trading. Hence sometimes they save money to raise enough capital for venturing in informal enterprises (Bromley, 1978) in e-waste. This has a parallel in Bangladesh where in the furniture sector that has emerged from Sitakunda ship breaking yards,

'The workers in these refurbishing workshops are all either skilled craftsmen or akin to apprentices learning their trades. Most are migrant workers from Chandpur and Noakhali districts, and are typically recruited through kinship networks.'

(Gregson et al. 2010: 10)

Conversely, the *kabadiwalas* (door-to-door waste collectors) are often forced to enter the informal domain as a last resort. Many are migrants from the towns in neighbouring and distant states and want to join the urban labour market for potential employment. However, they are not absorbed by the modern sector, which is marked by the lack of adequate employment opportunities (Gerry 1987), and take refuge in the informal sector. As poor waste collectors they have a marginal existence in the bigger cities with limited income, low skills and productivity, poor education, small scale of operation

and labour intensive technology. The incidence of informal waste collection is often a poverty driven activity. For the *kabadiwalas*, the sector acts as an intermediate space of income generation between the mainstream formal system and complete impoverishment. This is related to the ILO's economic-reformist approach to informality where participants lacking formal income avenues are compelled to turn to the informal sector to meet their subsistence requirements (Chen, 2005). This exposes the dualist understanding of the ILO which disregards the essential linkages of the informal *kabadiwalas* with formal production and eventual consumption. This group is intrinsically a part of the broader conjoined formal-informal economy and form an inferior position of power and influence in the waste network.

The *kabadiwalas* form the lowest strata in WEEE management along with informal workers (mainly migrants) in the recycling units of Mandoli and Loni. In recycling, the choice is between informality and abject poverty and the working condition is worse than that of waste collectors. Fumes from acid and burning render the immediate environment acrid and unpleasant, which is one of the reasons why these recycling units are often located at the fringes of the city where there is weak imposition of law and order. For these semi-skilled and unskilled workers, recycling offers the sole chance of making a living where other alternatives of earning are almost non-existent. Here again, informality provides the singular source of meagre income against absolute unemployment. This links with the original perception of the informal sector where the uneducated and unskilled participate for basic survival with relatively low access to formal education and employment. On the contrary, the owners of the recycling units voluntarily choose to work informally since they know that they can never meet the requirements of environmental standards in formal operation. The dealers also prefer to exercise their agency and independence in business and deliberately remain informal. Reflecting the argument of the legalists, they are inventive and ingenious, tapping sources of collection, forging networks, and hunting new and rewarding markets for their products. But while this approach captures the intent of informality for the traders and recyclers, it neglects the plight of the *kabadiwalas* and the recycling labour who are marginalised without any decision making power in their trade. 'Even after migrating to cities with the hope of improving their economic standards, they are still at a disadvantaged position in the face of concerns like competition among peers, absence of minimum wages, lack of access to credit, lack of recognition by the authorities and lack of access to social protection schemes, all of which contribute to their vulnerability' (Chaturvedi et al. 2010: 3).

At both national and international levels, there are numerous waste brokers exporting and importing e-waste illegally. These players in the WEEE stream are by and large invisible and affiliated to the visible informal actors through numerous middlemen and other agents. The presence of these intermediate actors ensures the secrecy of the trade and contacts. They belong to the informal economy which overlaps the illegal domain of contraband shipments and are situated at both ends of the transboundary flow of hazardous waste. In India, they liaise with their counterparts and the shop-owners of second-hand electronics in Nehru Place. These shops do not disclose the exact source of their business (e-scrap import from abroad) but otherwise run a legitimate venture. This shows that rather than complete illegality, there is limited compliance in informal markets (Tokman, 2001). While both the ILO and the legalist tenets explain certain features in the informal e-waste management, their

assumption of dualist labour markets cannot grasp the overall nature of the phenomenon. The formal and informal domains in e-waste are interconnected by specific forward and backward linkages as outlined by the structuralist school (Portes & Castells, 1989; Sanyal, 2007; Sassen, 1994). Many of the informal actors are tied with the formal sector in an either benign or unequal relationship in waste collection and recycling. A combination of competitive and collaborative relations characterise these formal-informal associations. There exists a complex dynamic between these sectors with flexible boundaries allowing persistent movement of actors, EEE and WEEE, and recycled goods between them.

In the global e-waste flow, informality is subsumed within processes of electronics production, consumption and exchange in contemporary capitalism as proposed by the structuralist tenets. WEEE informality is shaped and mediated by the broader institutions dominating the local, regional, and global arena (Rakowski, 1994) like international waste conventions, national and regional regulations, and civic agenda and awareness on e-waste. The structuralist exposition captures the quasi-legal nature of the informal sector by expounding on how some informal activities infringe the border of illegality in hazardous waste export-import. They reject the notion of dualism and emphasise the formal-informal continuum in the constitution and functioning of the WEEE network. However, the structuralists overlook the agency of informal actors like the autonomous traders and the recyclers and consider them to be hapless victims of formal capitalist exploitation. While possibilities of unequal access to legal power structures and resources might partially impair their potential, the informal dealers and recyclers are dynamic entrepreneurs and 'mobilise resources and overcome barriers through reciprocal ties (ethnic networks) not only to survive, but also to grow and prosper' (Cheng and Gereffi 1994: 198). This is not unique to India. In Dolai Khal in Bangladesh there is a huge concentration of metalwork repairing and rebuilding by the informal sector, where also 'the way they do the work, the places they select for running their ventures, the materials they use or deal in, the sources from which those materials are collected - all contain elements of novelty' (Amin 1987: 621). Thus, even in the absence of sophisticated technologies, the traders' and recyclers' innovative and industrious abilities are manifested.

8.4. **Governance and Uneven Power Relations in the E-waste network**

The governance between and within formality and informality bind the complex WEEE system together and are expressed in the ways the different players are linked. On the one hand, these coordination mechanisms play out in the vertical constellation between diverse categories of economic agents and on the other hand, they also reflect the horizontal embeddedness of these actors in definite socio-economic relations of community and kinship within the same group or category. Imagining the e-waste architecture in a global lattice, vertical governance displays how trading, dismantling, and recycling are latitudinally organised to ensure the smooth progression of the network. The horizontal embeddedness exhibits the longitudinal linkages that shape and unite one individual activity like trading or recycling within a cluster and beyond. However, these are not mutually disengaged but feed into each other. The international expanse and character of the WEEE network entail numerous intersections across the formal and the informal domain. These multi-faceted

interfaces and associations are maintained through particular governance forms found in the reverse e-waste supply chain. The following first elaborates the cohesive forces and the power differentials among the actors in different vertical nodes of the network. The second part discusses the multiple forms of interactions between the actors organised in clusters and their socio-cultural association which is grounded in a specific institutional environment. Lastly, the liaisons between the Indian formal and informal e-waste actors are deliberated on.

8.4.1. **Vertical Networks of Governance and Power in Informality**

Against a singular 'lead' formal actor directing or managing the e-waste network, the informal traders play a central role in influencing the WEEE material and financial flow and delegating the tasks along the chain. However, they are not the epicentre of power as each actor functions concurrently and sequentially to effectuate the final network structure.

The dismantlers separate the complex gadgets into discrete material streams for their subsequent use in production. They are often in a captive relationship with the traders which is exemplified by 'one-way dependency of suppliers, high levels of supplier monitoring and high costs of switching for suppliers; characterized by high informational complexity and ease of codification but low supplier capabilities' (Gibbon and Ponte 2005: 6). Applying these features to the relationship between traders and dismantlers, it is observed that the new dismantlers have low or medium skill levels and continue working for the same trader till they have picked up the tricks of the trade. Frequently changing jobs from trader to trader counters the trust gained and time invested in the relationships. When a particular dismantler works under a trader for a considerable length of time, the captive relation changes into a more relational one as the former expands his expertise and becomes capable and trustworthy and the power dynamics against the dismantlers lessen.

The *kabadiwalas* channelize the waste from household and small companies into the system, often intermediated through the waste shop-owners who gather WEEE from the former. The relationships between the *kabadiwalas* and waste shop-owners are best characterised as modular with little or no monitoring of the former, who are skilled and operate independently. Modular relations allow for speed and flexibility in transactions with low asset specificity and easy substitutability between parties (Gereffi et al. 2005; Sturgeon 2002). It practically functions like a market except for the density of knowledge flow regarding the potential worth of the transacted WEEE. There are also enough buyers (shop-owners) and sellers (*kabadiwalas*) involved and switching is rather inexpensive. Though the gradient of power supports the shop-owners, the latter is not at their mercy. Modular association also exists between the waste shop-owners and the traders though it sometimes borders on relational when traders favour shop-owners they have been doing business with. They hold relatively more power over the shop-owners due to more resources and choices. When they buy e-waste directly from the collectors or particularly hire some for this purpose, the latter are tied to the former in a captive and hierarchical power relationship. The repairers in the secondary market of Nehru Place also share modular ties with the seconds' shop-owners. They mend and refurbish the EEE for sale and are endowed with skills, education and other employment opportunities. The repairer and the shop-owner cater to each other's asset requirements but remain easily substitutable.

The recycling workers specialise in hazardous and complicated metal recycling that cannot be retrieved by simple dismantling. The male workers in the recycling units are linked to the owners in mostly captive relationships in the (chiefly) copper recycling units of Mandoli and Loni. These workers are completely reliant on the owner for material supply and the eventual sale of the salvaged items. They seldom have any chance of landing a better job and continue in unhealthy working environment. Their exploitation is perpetuated in an informalised labour regime where the owners of the recycling units exercise power and control. However, in the same environment, for a typical female worker, a modular link with the recycler is common. The female labourer[34] works on a daily basis and is not dependent on a single recycler and can switch to other low-paying and less skilled jobs. In Moradabad, captive linkages are observed between the (usually male) recycling workers and the factory owners. In the household recycling units, the hierarchies and power inequalities predominant in a patriarchal society is reproduced with the male head deciding, delegating and supervising the gold extraction tasks.

Between the traders and the recyclers, there are relational ties which are 'complex interactions and highly incomplete contracts … relations need to build to a considerable degree on trust and reputation. Relational value chains are also characterised by mutual interdependence and high levels of asset specificity' (Altenburg 2006: 503). These players have symbiotic and long-standing linkages despite geographical distance (recycling units are located remotely). Both are expert judges of the quality of PCBs and rely upon each other to reap maximum gain from the most profitable end of WEEE processing. Correspondingly, the second-hand shop-owners in Nehru Place interact as equals with the informal traders and recyclers and share relational coordination. These three categories of players occupy the higher tiers in informality and enjoy liaisons with the formal sector, which accords them greater positional power compared to the other informal players.

Thus in Indian informality, multiple modes of coordination are prevalent in separate and related strands (Gibbon et al. 2008) in the WEEE network. They are flexible and fluid, shifting with time, and not limited to a singular form. The motivations and vulnerabilities of the actors are reproduced in the nature of governance and power imbalances. Near reluctant participants (like *kabadiwalas* and recycling workers) occupy a subordinate position relative to the voluntary informal traders, recyclers and seconds' shop-owners. The myriad informal relations oscillate between balanced power sharing in relational affiliations to asymmetrical power hierarchies in captive linkages. The operational analysis of the informal institutions in the literature shows that 'Informal arrangements, transactions, and contracts are supported by mechanisms such as personal and repeated exchanges, trust, and reputation' (Sindzingre 2006: 66). There are diverse governance patterns built around trust and reciprocity observable in trading and recycling clusters that is the focus of the next part.

8.4.2. **Horizontal Social Networks in Informal Clusters**

The horizontal linkages in the same tier of the informal WEEE operations and the ancillary functions are closely intertwined with vertical relations of governance. The interactions between a specific

[34] This study has not proceeded to examine these gendered relations in recycling as it is outside its immediate scope.

category of informal actors in the clusters are configured primarily along relational social networks assisting participants to 'learn new skills or acquire knowledge, gain legitimacy, improve economic performance, and manage resource dependencies' (Podolny & Page 1998: 62). This relational governance relates to the one in the preceding section but denotes the basis of lateral exchanges and interactions within a singular group and hence is referred to as horizontal linkages. Each category of traders, recyclers and the seconds' shops are found in different but concentrated clusters. These clusters help in expanding their informational base, co-developing technology and accessing a common pool of labour. They increase the collective bargaining power of the members derived from the power of association (Bathelt & Gluckler, 2005). These strategic alliances guard the groups' interest against outsiders and buffer them against market vagaries (Granovetter 1995). Generally, the clusters facilitate the actors' overall business prowess from co-location where the members engage in face-to-face communication and everyday shared experiences. This is reflected in Nadvi's (1999) findings in the surgical instrument clusters in Sialkot which stresses the importance of localness that is understood as,

'….social association formed by being 'located' within the local community or neighbourhood. Individuals do not need to be related by common lineage or kin ties to form social bonds with each other. These can, and are, developed over years of living and working together in a narrow and confined community space. ……. Through such regular interaction a social reputation is built up, which can act as valuable collateral in local economic and social transactions.'

(Nadvi 1999: 155)

Apart from co-location or 'localness', strong family and kinship ties are also crucial elements in developing clusters. Traders prefer partnering immediate or extended family members and frequently hire dismantlers related by kinship. In Moradabad, household units run gold recycling enterprises. Business in the second-hand shops in Nehru Place continues down the generations in the same family or close kin. There is no instance of a female trader, recycler or seconds' shop-owner and the WEEE industry is essentially male dominated. These families are typically male-headed households and are patriarchal, patrilocal and patrilineal. Though Nadvi (1999) differentiates between family lineage and kinship ties, here they are considered as equivalent. So kinship here does not refer to caste since it was evident that members with different caste affiliations work together. Rather, it implies family beyond the immediate circle which includes the wider unit of familial relationships. However, collective behaviour is not just restricted within clusters and has significant spill-overs. For instance, the dealers particularly collaborate with different clusters exhibiting that clustering is not the sole aspect in forging bonds. Given their strong reliance on contacts and information channels, the dealers need to network beyond their clusters.

In such instances, trust establishes and conditions integrity and mutual respect in business. The GVC literature also endorses this: 'trust and reputation might well function in spatially dispersed networks where relationships are built-up over time or are based on dispersed family and social groups' (Gereffi et al. 2005: 84). Most of the dealers and recyclers form a closely knit group of familiar socio-economic agents. Despite not always living in a common trading and recycling cluster, goodwill and credibility in

the circle of informality is a significant consideration. It is motivated by concerns of reputation and image which play a vital role in repeated informal exchanges. This does not however suggest that trust is the soul foundation of informal networks but acknowledges it as a powerful determinant in negotiating complementary social behaviour.

In WEEE informality, the actors deal in complex electronic products with variable functionality which cannot be easily measured and codified. But instead of deceiving the other party, there exists a mutual expectation of trustworthiness premised on shared support systems maintained over long-term interactions. The seller in a transaction might turn into the buyer in the consecutive exchange and would not prefer to be at the receiving end of deceit. Hence it is in the interest of both the parties to largely play fair. As pointed out by Nadvi (1999), local civic traditions and community forms encourage co-operative economic behaviour, since such functions are socio-culturally grounded in human networks. Especially informality is contingent upon the 'interaction between the local social networks and the resource environment of small businesses' (Cheng and Gereffi 1994: 199).

The nature and degree of trust vary temporally in social networks and stretch beyond minimal trust common in simple exchanges and direct transactions (Humphrey & Schmitz, 1998). According to Zucker (1986), trust changes from characteristic-based to process-based or from ascribed to extended trust (Schmitz, 1999). Ascribed trust is based on having a trading background (belonging to a trading family or having practised it before), a common colleague or a partner in business or good reputation. Extended trust emerges over a length of time from doing business together and repeated interactions. Both these varieties inform cluster and community formation of traders, recyclers, and seconds' shop-owners. This is observed where the 'local networks of inter-personal relationships, trust and institutionalized practices' (Yeung et al. 2006: 525) bring about an agglomeration. However, clusters do not always prove to the beneficial for everybody if the majority excludes some members. For instance, in the auction forums in India, some informal traders are considered *beiman* (untrustworthy) and nobody wants to form a collective with them.

Informal e-waste processing is performed in a normative rather than a legal environment where the actors abide by customary and established conventions. While there exists legal sanctions with guarantee in the market, within a network association, the sanctions are normative involving trust and reciprocity (Powell, 1990). Following convention theory, 'rules are not decided prior to action, but emerge in the process of actions aimed at solving problems of co-ordination' (Gibbon and Ponte 2005: 6). Conventions reflect reciprocal behavioural expectations which are essential without any assurance of quality in traded EEE. Additionally, they forge 'relationships of power and norms of behaviour such as trust, reciprocity, reputation and peer pressure that reduce the threat of opportunism' (Sturgeon 2003: 209). So under the prevalent norms of trust and reliability, the informal actors do not normally envisage scheming behaviour from the other party. Long term inter-personal relationships mediate business where price is an inadequate signal of quality. Such coordination in informality evolves gradually in indefinite, sequential transactions towards solving the uncertainty in quality.

8.4.3. **Linkages and Governance between Formality and Informality**

The organizational structure of e-waste management entails both formality and informality aligned together and working in unison. Multiple behavioural relationships exist between the two sectors which are investigated here to deliberate on their governance patterns. The nature of material, financial, informational and knowledge exchanges between the formal and informal (re)produce different associational linkages which are mediated by their surrounding socio-economic and political environments. The possession and exercise of power among formal and informal players are orchestrated in the arenas of sectoral and relational overlaps between these two realms.

The very premise of formal and informal interactions in India is strict confidentiality. While the informal traders and recyclers admit to working with the formal, they never expose the name of particular companies. Every formal recycling company steadfastly maintain that they have no connection with the informal players and insinuate that the rival companies covertly associate with informality. The mode of governance between them borders on relational since both parties interact with those they trust and consider discreet. Their surreptitious alliances are contingent on calculative interests and familiarity through previous transactions (Adler, 2001). Hence the constitution of trust is not remarkably different from that within the informal clusters. However, it occasionally differs between the pre and post-legislation scenarios.

Before the implementation of the E-waste Rules in India, the formal recyclers and the informal traders would compete in WEEE collection through auctions/tenders with typically the informal outbidding the formal. Some formal companies would hire informal dealers with strong contacts and networks on their payroll to improve their collection base i.e. use the informal actors to further their business interests. However, the informal employee working under a formal company was not dependent on the employer and in cases of disagreement and dissatisfaction would quit. There existed relational association among the informal traders and formal recyclers. In fact, the formal occasionally was in a lower bargaining position given that they required the informal agents to access the seconds' markets and sell WEEE on the terms set by the informal. However after the Rules was enforced in India, the tables turned on the comparative bargaining powers of the formal and informal players. The informal actors are now unable to access the auctions/tenders since they do not have the requisite government license. They have to pay the formal for using their state approved license to procure WEEE. Thus the formal has a hierarchical position since the informal is dependent on them for acquiring the waste material. The formal are in a position to dictate or influence the deals to their benefit. Also under the present situation, there is a heavy demand for WEEE from the informal traders who now compete (rather than collaborate) among themselves to obtain the waste from the formal traders. The formal takes advantage of this situation and sells the waste with a mark-up or charge heavily for the use of its government authorization. Hence after the law, the formal occupy a privileged position in the socio-economic sphere of waste processing by virtue of undertaking 'legitimate' business ventures vis-à-vis the informal. The formal traders largely control the commercial WEEE sources with many informal buyers lining up to buy from them. As a result, the relationship between the informal and formal has changed from one of lower power asymmetry to a more unequal one. Earlier, the alliance between them was more by choice than by necessity and compulsion for the informal. Now the formal enjoys a dominant relationship. Understandably, the law not only changes the relationship between the formal

and the informal, it also affects the cooperative ties within the informal. Previously, the informal traders were collectively participating in auctions/tenders and now they often individually compete for WEEE from the formal companies. Hence, the erstwhile strong bonds between the informal traders are being substituted by tension and antagonism.

But the Indian legislation has not changed all aspects of the relationship between formality and informality as manifested amidst formal and informal recyclers. The informal are still hired by the formal for the former's expertise in metal reclamation. Their artisanal skills are cheaper than cost of establishing smelting plants for hi-tech and eco-friendly recovery. Essentially, the formal recyclers subcontract particular stages of the treatment to the informal sector illustrating the spatial fragmentation and decentralisation in waste management. However, this practice is illegal since the hazardous processing techniques in informality contravene the regulatory principles on WEEE treatment. Proper implementation of the legislation on the formal recyclers would result in punitive penalties. The dependence of the formal on the informal recyclers for their craftsmanship endures and does not alter massively after the law, given its lax enforcement. The informal recyclers are not in a dearth of formal employment in the recycling industry and can choose between many formal companies interested in using their talents. The rivalry between the formal companies themselves continues but is likely to aggravate given many more upcoming companies in the post-legislation period. A few of the companies are planning to hire informal *kabadiwalas* for entering the household waste domain. As a result, these door-to-door collectors could end up in a subservient position with little bargaining power in such cases. At the international level, the liaison between the waste brokers supplying to the informal sector would also persist since both need the other to carry on their trade. The importers and their agents are dominant international players and have a massive scale of operation, albeit concealed. The importers also auction their consignment to a big group of traders with the power dimension favouring the former. After the enactment of the Indian law, given the dearth of materials from domestic professional consumers, the traders are more desperate to access this uncertain but profitable source of bulk WEEE. One such shipment, even when shared, takes care of their need for raw materials over several months.

In Europe, the e-waste recycling chain is structured around the WEEE regulations that make the producers legally responsible for waste collection and recycling. The producers are the most important and influential players in the network. Their power is derived from the management and monitoring of their contract partners and their decision in granting these contracts. They control the participation of their contract partners and hence have the capacity to include or exclude them. In European countries, civic conventions and environmental awareness result in consumers disposing e-waste in a responsible manner. Overlapping this normative environment of compliance by producers and consumers, there is an opposite disposal route into the grey channels of informality. These leakages generate profit for the informal waste brokers and traders who export e-scrap overseas. Crang et al. (2012) and Pickren (2014) have observed that global flows of EoL products are marked by the absence of big corporations and are coordinated from the middle through a spatially brokered form of governance. These quasi-legal channels are exploited by the exporters and importers who function sequentially and inter-sectionally making it difficult to trace and assign responsibility. The international

network of e-scrap transfer maintains strict confidentiality of each node. The waste brokers and the middlemen exercise power by controlling illegal WEEE avenues and collaborating with their transnational counterparts. They derive rent from their ability to evade the regulatory regimes. The WEEE transnational shipments circumvent existing political and economic institutions like trade in used clothing, car and shipping trade (Brooks 2012a) through solidarity and relations of overall perceived trust.

8.5. **Deconstructing Regulatory Interventions on E-waste**

This section investigates how the spatial WEEE organization is configured by the legislative environment. The WEEE laws and policies are formulated on the basis of the regulator's perception of the roles and responsibilities of the different stakeholder(s) to identify the key player(s) who can ensure eco-friendly practices in the network. According to the Polluter-Pays-Principle, the main contributor to environmental pollution is the producer and hence is legally held responsible for administering and financing eco-friendly waste processing. The EPR principal (discussed in Chapter 2, Section 4.4) is thus enshrined in most regional and national e-waste legislations. The producer is also the most visible actor with the largest scale of operation and profit margin in the network and can be penalized for non-compliance. In Switzerland and Japan, consumers are also mandated to financially contribute towards the EoL management of WEEE.

To fathom the legislative rationale, its reading of the complex and non-linear e-waste network should be examined. For the legislators, waste represents an unwanted by-product with a cost, the burden of which is imposed on producers to account for the social cost of its treatment. They consider waste to have negative value and design EPR with such an understanding. Yet, for the informal traders and formal/informal recyclers, waste represents a resource that can be worked upon to transform its value into profit. The commodity-waste couple, that shows that they are the same material at different moments of time, establishes waste as a secondary good and raw material or input for recycling. Thus, the existence of parallel local markets in India can be attributed to,

'The considerable price difference between the new and used EEE makes the consumer to go for the purchase of the second hand EEE in developing countries like India, which may be one of the factor for the growth of E-waste recycling market in India. E-waste recycling is a market-driven and growing industry in India.'

(Wath et al. 2010: 25)

Similar domestic markets characterise many other developing countries (Grant & Oteng-ababio, 2012; Kahhat & Williams, 2009; Nnorom & Osibanjo, 2007; Williams et al., 2008). In Bangladesh, comparable secondary furniture markets have emerged from wood and metal recovered from EoL ships (Gregson et al., 2012, 2010).

Thus there is a crucial mismatch between the law-makers' and the recyclers' understanding of value in e-waste. The regulators fail to appreciate WEEE informality as a site of surplus value creation and capitalist accumulation. Figure 9: Circuits of Capital in the Spatial EEE, WEEE & Used EEE Networks (on page 153) exhibits that they only target the manufacturing phase of the electronics, encapsulated

by the Circuit of Capital A and overlook the rest. However, they are not completely unaware of the presence of informality as demonstrated by their intervention to transform it into formality. Informality is not isolated and comprised of exclusively informal actors; the formal recyclers in India maintain undisclosed linkages with the informal to profit from secondary e-waste markets. This is precisely why a significant part of the WEEE generated in Europe evades regulatory control to reach such markets in industrialising countries. In India, the legislators tacitly tolerate this sector evidenced by first, the state's reluctance to completely ban import of used EEE and second, the practice of auctioning WEEE prevalent in government departments. Thus the mandate of EPR, preconditioning the free return of EEE to the producers, is not even upheld by the state. According to the E-waste Rules, the household and bulk consumers are required to

'…….ensure that e-waste generated by them is channelized to authorized collection centre(s), registered dismantler(s) or recycler(s) or is returned to the pick up and take back services provided by the producers.'

(Chapter 1, Section 6.1 on Page 27 of the E-waste Rules, 2011 by the GOI)

But there is no legal and economic (dis)incentive developed to enforce it. The household users sell e-waste to the informal *kabadiwalas* and the bulk consumers auction it to the highest bidder where the informal traders often procure the WEEE surreptitiously. Indian (central and state) government offices, hospitals, educational and financial institutions themselves auction the e-waste. Also the imported WEEE seized at the ports is eventually auctioned off. The bureaucracy is reluctant to forego the revenue of the informal e-waste enterprises and merely drafts a law on paper to formalise them. It refrains from depriving the informal waste production network of the raw material. An analogy can be found in Ghana which is an emerging and hazardous informal WEEE recycling centre. The Ghanaian state has cancelled import duty on used computers to 'bridge the digital divide' (Grant & Oteng-ababio, 2012: 2). In the Indian context, there is no serious engagement by the state to promote green informal treatment through subsidisation and infrastructural support. This is particularly illustrated in the case of HRA where it took the collective of informal traders more than a year to clear the first step of government clearance.

In Europe the local municipalities manage collection centres and in some cases transport the collected WEEE to the producers' association. In Netherlands and Belgium, mostly the manufacturers/importers abide by the take-back decree as they do not want to lose access to the European market. The Indian state would never similarly foreclose the international and national manufacturers of electronics. There is also a disposal levy or visible fee on EEE to finance waste management in Europe. Hence the institutional imperatives and the socio-cultural practices function in vastly opposite directions between Indian and Europe, expressed as,

'Unlike the European E-waste system where consumers need to pay for the disposal of their E-waste or return them free of charge to recycler, consumers in India, however, expect to receive payment for their E-waste, which is viewed as a potentially valuable resource.'

(Wath et al. 2011: 261)

Hence it is not just the informal sector which escapes formality; the legislators also make at best feeble attempts to bring it within the regulatory domain. This signifies a broader socio-political decision on informal (waste) sectors and actors. The state can be seen as a sphere of regulation and reproduction to understand '……the role played by the state in shaping who is a worker, and what it means to be a worker for particular individuals and groups of people' (Coe & Jordhus-Lier 2011: 223). The labour laws enacted by the state institution protect the workers by regulating minimum wage, safe working condition and trade union rights. However this priviledge is not accorded to the labour in informal employment since they are not acknowledged by the state. This is not just about the informal actors in e-waste but about the entire gamut of informal labour. The Indian Economic Survey (prepared by the Ministry of Finance), 2005-2006 acknowledges this and pronounces under '**Indian labour laws and labour markets**',

- **10.12:** Indian labour market is characterized by a sharp dichotomy. A large number of establishments in the unorganized sector remain outside any regulation, while the organized sector has been regulated fairly stringently. It can be reasonably argued that the organised sector has provided too much of job-security for too long, while the unorganized sector has provided too little to too many.
- **10.13:** Various studies indicate that Indian labour laws are highly protective of labour, and labour markets are relatively inflexible. These laws apply only to the organized sector……..

(http://www.domain-b.com/economy/ecosurvey2006/social_sectors/indian_labour.pdf accessed on 25 November 2014)

Thus the formulation of the Indian E-waste Rule manifests the contested processes of institution building where powerful actors influence and promote institutions in their interest (Quark, 2011). It reflects the outcome of the lobbying by the environmental pressure groups and promotes the interests of the formal recyclers. The environmental organizations comprise of national and international NGOs like Greenpeace, GIZ and Toxics Link. They are solely concerned with the agenda of environmental degradation and not the human health hazards in informal WEEE practices. They do not advocate for workers' health, safety and training from the state or themselves. The workers' safety is instrumental only as far as it damages the environment. Alongside there is an implicit valorisation of the waste pickers category (by some NGOs) who mostly occupy the lower positions in WEEE informality. They are a part of the broader urban labour force and participate in waste picking due to relative ease of entry. It is a typically low-skilled category compared to mechanics, carpenters, plumbers, locksmiths, masons etc. Romanticising waste pickers and valorising their role further perpetuate their position in waste management. Without appreciating their role in service provision, the idea of waste picking is not challenged which restricts their mobility in the economy. Frequently, social class considerations emphasise their diminutive status and make them more vulnerable. Such a view of waste pickers as a pre-existing category is problematic, subjecting them to subordinate power positions.

8.6. **Questioning GVC tenets on Power and Governance**

In this section, the salient concepts of governance popular in the GVC approach is analysed along with its assumptions on power relations centred on 'lead firm governance'. The fourth part of this chapter has outlined the heterogeneous and complex organisation of governance bringing the spatial e-waste recycling network together. Power as exercised and experienced by the diverse formal and informal WEEE actors (to realise specific individual and collective rewards) is dissected to contend that the chain literature inadequately addresses intricate power positions and governance practices.

As evidenced before, the modes of coordination in reprocessing EoL goods are remarkably different from the manufacturing and distribution processes in conventional GPNs. Unlike traditionally envisioned value chains, there is no big corporate firm performing the role of a lead firm and driving the largely disjoint activities (Humphrey and Schmitz 2001; Gereffi et al. 2005). Instead a series of formal and informal actors acting inter-dependently and in a decentralised decision making environment constitute the WEEE recycling network. Hence the international electronics brand manufacturers do not represent the primary source of power or occupy the central position in determining the structure and participation in the network. Despite greater economic resources, technological leadership and market control, they are unable to dictate those involved in informal export and import of e-scrap and other actors engaged in waste practices[35]. Hence, particularly in the case of the informal sector, there is no incidence of 'power over' observed. There is seldom any expression of 'hierarchy' where domination and/or authority are exerted with high power differentials; rather power is distributed and diffused along the WEEE network. This is also demonstrated in the transactions between the inter-connected formal recyclers and the informal actors in India where they compete and collaborate in different situations of collection and recycling. Though variations in power exist, there is no exercise of 'power over' and mutually beneficial outcomes can be achieved from gainful e-waste endeavours. This illuminates the plural manifestations of coordination which is not captured in either market or hierarchy, as proposed by the GVC approach. Thus it can be argued that the GVC framework disregards the dynamic and organic forms of governance and power that are conditioned by and contingent on the geographies of waste circulation and recycling.

Effectively, functions and outcomes of power manifested in the WEEE spectrum inculcate the spirit of 'power to'. The GPN scholars have suggested that such power relations can be frequently observed among the various constellations of actors and their productive activities. The prevalent modes of governance are relational that characterise the associations between the Indian informal traders, dismantlers, recyclers, collectors, seconds' shop-owners and formal recyclers (global and national). This can be also described as associational or network power that can be derived from relations embedded in everyday practices and joint experiences of working together in clusters. This is particularly seen in the procedures followed in bidding for auctions by traders collectively where the actors extract rents out of their knowledge of collusive networks.

[35] However, they can influence the formal recyclers in the Netherlands and Belgium by drawing contracts with selected partners.

Additionally, GVC perspective of market governance does not capture the functioning of the second-hand markets of EEE. There is no standardised product definition or description of used and repaired electronics and relational associations are evoked to mediate and ensure agreeable transactions. According to the GVC categorisations, little and/or low power variations exist in market relations. However, in the seconds' markets, the actors with stronger networks have definite advantage over the others. Seldom market and hierarchy (respectively with low and high power imbalances) are detected in the WEEE landscape which questions the GVC typologies of governance and power relations. The illustration of the WEEE recycling network confounds the GVC understanding of association which is sectorally, contextually, temporally and spatially subjective. This offers a special insight into the ties and linkages that represent and pervade the reverse supply chain of waste.

The state is unable to grasp the functioning of such markets and the overall continuum of formal sector and informal entrepreneurs and labourers. It has a selective understanding of power rankings played out in the relations between capital and labour that constrain the efficacy of its policies. The tenets of GVC typically consider that the formal economy dominates the informal domain but this notion collapses given that informality frequently surpasses formality in the WEEE industry. This depicts how the state machinery cannot appreciate the variations in the technologies and practices of the market in different contexts and for specific goods. The Indian state tries to tip the balance of power in favour of the formal recyclers without realising how the existing power tensions mark the socio-economic interactions between the two sectors. The NGOs working on environment, consumer groups and other actors of the civil society mould the design of regulatory interventions which in turn affect the WEEE market formation. This represents 'a (spatial) shift in the distribution of resources and the balance of power between and among firms, countries, and social groups. These strategies are intertwined with more conventional forms of political power, as market structures are embedded in social relations that, for example, position the state as a promoter of corporate rather than national interests ...' (Levy 2005: 692)

8.7. **Drivers of Informality in E-waste Processing Network**

This section analyses the impetus of informality in the WEEE spectrum. The second section has shown that e-waste management fundamentally embodies production and not merely disposal and recycling. In these secondary processes of production, the formal recycling companies actually pass on environmentally unsafe and labour-intensive stages to the informal sector. This is why e-waste covers trans-national boundaries to end up in the informal realm of cheaper but effective treatment. WEEE informality and formality together contribute to the uninterrupted commodity and waste production which further the capitalist imperative of profit. E-waste does not denote the end of economic life and operations and instead moves in circuits of capital locating informality as an integral part of the capitalist economy. The value in WEEE and informality's role in extracting it constitute one of the primary drivers of informality in the global realm.

The robust governance in e-waste informality increases its resilience and effectiveness. The clustering practices of the informal actors help them to foster networks and place them at a comparative advantage vis-a-vis the formal in the inter-meshed system. The informal players'

incentives and compulsions lead them to compete or collaborate with formality, reproducing unique power combinations. Frequently, the formal recyclers depend on the informal players to access their collection sources and inexpensive recycling techniques. The new Indian law reduces the informal's access to waste (by requiring state license for collection) but the formal recyclers continue to pass the WEEE to the informal with a mark-up and hire informal recyclers. The correlation and interdependence between formality and informality create multi-faceted crossovers and overlaps between them. So these two sectors are characterised by flexible boundaries and close interconnections which sustain and engender pervasive informality in the e-waste network.

Finally, particular institutional environments and socio-cultural milieus correspond to a burgeoning informal sector in the developing context. Consumption habits closely relate to a culture of reuse and repair which is entrenched in many less advanced countries and not just India. Active secondary markets revolve around used products and separated materials generating demand for WEEE. The demand and supply of e-waste work in favour of informal WEEE enterprises. On the one hand, there is massive WEEE production with the ICT boom under globalization and the heightened consumption of electronic products. Short life-spans and continuous technological improvements add to the expansion in e-waste generation. On the other hand, the demand for materials from WEEE culminates in numerous informal players offering cheap services to fulfil this demand and fill a central gap in urban service provision. Wilson (2009 and 2006), Reddy (2013) and Schindler et al. (2012) justifiably contend that the informal sector plays a critical role in the urban waste collection and recycling given the limited role of state and formality in this sector.

The regulatory framework aims to control the environmentally harmful WEEE operations without recognising the value in waste. Hence there exists one world of practical waste flow and treatment and another one with misguided regulatory understanding. In tightly regulated advanced economies, the producers are proactive in operationalising EPR which has limited success due to the existence of the informal sector in emerging economies. But everywhere, law-makers place the informal outside the regulatory sphere and create the distinct category of formal which is considered permissible and legal in the regulatory lexicon. This is further claimed by the structuralist tenets on informality which explains how the state enforces this artificial separation between formality and informality which couple together in the e-waste spectrum. However, in practice, the regulatory impetus to forcefully delink the formal and the informal exhibit the dualist perception of the state. It effectively consolidates their relationship in the WEEE domain and shows how the e-waste network is conditioned and arbitrated by regulatory processes.

The enactment of the Indian law can be seen as the government's policy to appease the green non-governmental organizations and lobbyists while paying lip-service to formalisation. The state explicitly favours the formal recyclers by easing their access to e-waste vis-a-vis the informal sector. It shifts the control of WEEE sources from the private informal players to the bigger capitalist recyclers like the formal companies. This marginalises the informal sector and belittles their innovative disassembly and recycling of e-waste. The formal companies want to tap the profitable e-waste market while the state invites their investment in waste processing. This manifests a possible coalition of public and private

interests where the state and the recycling corporations co-benefit from their political and economic liaisons. However, the Indian state's attitude towards informality suggests that it does not aim to upset informal waste entrepreneurship that processes the WEEE generated without which the state has to invest in and develop effective infrastructure for management. Therefore the state is latently complicit in informal waste operations while appearing to control and circumscribe it. An analogy is found in the household waste sector where the informal waste pickers collect perishable organic waste and transport it to the municipality dumpsites, but are not compensated by the state. Hence, they 'subsidise the formal system by recycling "for free"' (Schindler, Demaria, & Pandit, 2012). The government avoids participating in door-to-door solid waste management (SWM) and itself externalises the social cost of waste management to the informal. In SWM in Delhi, it has contracted big companies for collection, segregation and transport of waste to incinerators for conversion to energy (ibid). Consequently, the informal loses ownership and control over the waste. 'This preference for private firms is inexplicable given the fact that with legal recognition and minimal investment, the productivity of the informal sector could be boosted dramatically' (Schindler et al. 2012: 20). The government's acquiescence to this manifests its ambiguous and questionable development policy in relation to issues of poverty and urban livelihoods since it side-lines informal actors without actually banning their activities and on the other pushes big corporate interests in sectors traditionally dominated by informality.

8.8. Conclusion

This chapter has located the drivers of informality in e-waste at the international and national scales. It has examined how the landscape of e-waste is institutionally embedded where embeddedness 'signifies the social relationships between both economic and non-economic actors (individuals as well as aggregate groups of individuals, i.e., organizations) (Hess 2004: 176), both in the public and private domain. Formality and informality are entangled together in the WEEE spectrum and the state's venture to dissociate them and outlaw the informal works backwards. The new Indian legislation necessarily converts the 'informal' into 'illegal' with the state preferring formal recycling companies. Hence the law encourages the growth and coverage of formal recyclers and grants them recycling rights provided they meet certain environmental standards. Since the formal companies also regard waste recycling as a profitable business, they liaise with the informal actors to derive additional value from WEEE than is possible in the regulated environment. The experience of HRA in Delhi bears evidence to this claim where they are unable to form a profitable deal with any formal recycler within the legal ambit.

The state, instead, should play a proactive role in incorporating the informal sector in an efficient and equitable model of waste management. E-waste informality has commendable expertise in metal reclamation, widespread channels of collection and is proficient in manual sorting, disassembling, and repairing, corroborated by,

'Developing countries, however, harbour in their economies an entrenched sector, perhaps honed to a high degree of efficiency, whose profitability depends on the retrieval of material from e-waste using methods harmful to the environment.'

(Sthiannopkao & Wong 2013: 1152)

The entire WEEE economy stands to benefit by integrating informality into the system which can be mediated by the state. Civil society actors like NGOs can assist waste collectors and workers to form collectives to allow the latter to gain political visibility and bargaining power. In the current scenario, the informal lacks any form of state patronage that at best ignores its presence and potential. However, by only monitoring the formal sector, environmentally safe e-waste treatment would remain an illusion since disregarding the informal proves counter-productive. A sustainable waste management programme must be envisioned with the informal such that their important role is recognised and rewarded.

To portray the drivers of informality and how regulations systemically bolster the formal-informal e-waste nexus, the argument in this chapter has integrated and utilised the concepts discussed in the third chapter. First, the GPN and GVC approaches have been applied to trace the global recycling networks and its actors as well as definite national waste constellations. The study has illustrated that 'the precise nature and articulation of GPNs are deeply influenced by the concrete socio-political, institutional and cultural 'places' within which they are embedded, produced and reproduced' (Coe et al. 2008: 279). It also uses the modes of governance defined by GVC to emphasise the strong organisation in the dense system of networks among waste actors who are entrenched in social power relations and forms of vertical and horizontal inequality. It applies the industrial clusters literature to reveal the informal trust building exercises within and beyond clusters that strengthen the efficacy of informality. The formality-informality scholarship is employed along with the explanation of e-waste as capital through the circuits of capital framework. It is shown that informality is 'no longer as temporary housing, space for the poor, but as a permanent fixture of capitalism (Gidwani & Wainwright 2014: 42). In conjunction with the GPN, it is clarified that informality is a 'political creation, in the sense that its conditions of existence as a pervasive, routine and institutionalized presence are significantly shaped by the state' (Weiss 1987: 218). Thus it emphasises the primacy of the state in providing more than the regulatory environment and 'the state and its organizations (are) integral, active part of GPNs rather than just an institutional frame' (Hess 2008: 454).

CHAPTER 9: CONCLUSION

9.1. **Introduction**

This final chapter weaves together the overall narrative of global e-waste flows and its local management, highlights the major findings and contributions and considers the implications for policy and further research. The study has demonstrated the intricacy and articulation of the dynamic WEEE production and processing network. It has analysed the role and position of formal and informal actors within it, and the impact of the institutional environment on material flow and treatment. The concluding chapter is organised as follows. The subsequent section revisits the fundamental gaps in e-waste scholarship and shows how the key finding from the thesis addresses these gaps. The third section proceeds to reflect on the main contributions of the thesis that can advance the understanding of the e-waste phenomenon. The fourth section acknowledges the limitations while simultaneously deliberating on the policy implications of this study. It also scopes out the directions for future research.

9.2. **The Research Gaps and Key Findings**

This research started with an examination of the understanding of e-waste informality in the WEEE scholarship. It established that a critical knowledge lacuna in the existing research is its underdeveloped comprehension of the formal and informal relationships in e-waste operations and the implications of regulatory institutions on the same. Thereby the literature is incapable of locating the complex drivers of informality in the global waste landscape. Hence this research responds to the research questions below,

Main Research Question: What drives informality in e-waste movement and management?

This is divided into the following research sub-questions that are investigated theoretically and empirically.

i. How does e-waste flow along the reverse supply chain from the point of its generation?

ii. What is the nature of transactions defining the formal – informal linkages in the process of e-waste disposal and recycling?

iii. How does the regulatory environment influence the informality of e-waste processing?

This section presents the answers to the above queries through an exposition of formality and informality in the spatial e-waste network and their embeddedness in specific institutions. It manifests the global pattern and contextual articulation of WEEE informality by using the major conceptual and empirical findings from the European and Indian cases. The most significant message from this dissertation is that formality and informality are entwined and interdependent in the physical and relational architecture of the global and national e-waste networks (among and in Europe and India). They are integrated in the conjoined circuits of electronics and e-waste and work together in the generation of value therein. The multitude of ties and linkages between and amidst these sectors manifest that are seamlessly connected through the uninterrupted flow of waste material, knowledge,

technology, finance as well as actors between them. They propel informality in e-waste and guide the informal characteristics of the otherwise 'formal' waste sector. They additionally fashion a well-organized WEEE network where the informal traders/dealers and seconds' shop-owners (in India) bestride the flexible boundaries between the formal and informal economies. Though the informal dealers are the central actors orchestrating the Indian waste cycle, every category of informal actor has an essential function in the network. The power asymmetries between the formal and informal players shift with the changing regulatory environment in India. The decomposition of the WEEE informal sector demonstrates that it is differentiated in terms of the actors' power, position and value production. Formal-informal intersections in e-waste economies also exist in more formalised environments like in Europe but to a lesser degree.

The second important lesson acquired here is that the composition and configuration of the e-waste network are deeply influenced by the legislative and socio-cultural environment they are engrained in. The state is unable to read the value in the commodity-waste couple of EEE and recognise the formal-informal relationships. This culminates in growing e-waste informality and effectively strengthens the nexus between formality and informality. Thus the state's endeavour to transform informality into formality fails as these two sectors are functionally assimilated in value creation and capture in the spatial reverse supply chain of e-waste. By misinterpreting the dynamics of WEEE transfer and treatment, the regulatory framework at multiple scales shapes and consolidates waste informality.

In India, informal e-waste management is an active commercial enterprise with a high degree of network coordination between the actors in their specialised sites. The Indian state is tacitly tolerant of the informal sector in the contemporary WEEE spectrum. It does not purposely curtail informal activities despite their environmental consequences. Through the recent e-waste legislation, it aspires to bring informality under control and promotes formal waste companies. Thus bigger corporate interests are being encouraged in the domain of waste management. In the case of Europe, the state expressly invests in e-waste management infrastructure and consumer awareness. The EU users are able to afford new EEE and there are limited secondary markets of WEEE products. The manufacturers' active engagement in EPR (legally enforced) better directs eco-friendly formal waste processing. However, even in the highly regulated European context, there are substantial WEEE leakages to the global informal economy through inadequately unregulated ports. The new e-waste legislation in India emulates the European legislations but disregards the variances in their political economy like lower valuation of labour, importance of informal recycling and repair of WEEE and the presence of robust secondary market for used EEE. The formal-informal e-waste narrative is arbitrated and stimulated by state interventions and the civil society representing its institutional embeddedness.

Finally, the elucidation of the continuous circuits of e-waste clarifies that WEEE treatment constitutes capitalist production by combining capital and labour. The formal recycling sector outsources hazardous waste recycling to the informal sector which cheaply and efficiently salvages valuable commodities. This secures the position of informality as an inherent segment of formal capitalism and

exposes the nature and purpose of the capitalist economy of waste. This counters the dualist understanding of formality and informality to show that they co-exist and co-evolve within capitalist relations of value production and profit accumulation. However, the legislative apparatus perceives waste as a cost and environmental concern while informality is driven by the realisation of value from the same source. It ends up favouring formality and according it superior power status vis-a-visa informality as observed in India. In a bid to formalise e-waste treatment, the Indian state effectively intensifies the bonds between formality and informality and creates space for the development and sustenance of informality.

Therefore, the singular important learning from this dissertation is that not only are formality and informality in e-waste practices interconnected, they are also structurally and functionally interwoven. This is the principal driver of informality in the realm of e-waste production and processing at various levels. Pervasive informality can also be attributed to how waste is valued differently by different actors like the formal/informal actors on one hand and the regulatory authorities on the other. Despite the regulatory initiatives in Europe and India, the systemic and spatial linkages between the formal and informal remain. In fact, these legislative frameworks at multiple scales stimulate informality by mediating its relationship with formality.

9.3. **Contributions of the Research**

This section discusses how the lessons from the research enrich the current debates on and comprehension of the e-waste network. To start with, this is the first rich empirical study which examines the entire length and breadth of the e-waste network. It encapsulates all the direct and indirect participants in the e-waste industry in the context of India and conducts an extensive primary fieldwork which has no earlier precedence. Academic research has looked at specific impacts of the new Indian legislation (Agarwal, 2013) and that of the international NGOs on the formal-informal dynamic in e-waste (Reddy, 2013). Some reports have surveyed fragmented portions of the Indian e-waste network by focussing on a few EEE like computers, mobile phones and televisions (MAIT-GTZ, 2007) or just computers (EMPA, 2004). But no research has charted the e-waste stream in and beyond India and the gamut of formal and informal actors that perform its EoL management from the point of generation. This thesis elucidates the nature of the Indian e-waste landscape and connects it to that of Netherlands and Belgium, despite their institutional diversity to exhibit how Indian informal communities are incorporated in and occupy a significant position in the spatial WEEE network.

Moreover, no previous academic exercise has undertaken an exhaustive mapping of the international and national e-waste networks and the formal and informal players within its trajectory. This endeavour transcends the popular focus beyond conventional processes of manufacturing which culminates in consumption. This research can be located in the recent work of waste recycling networks undertaken by GPN scholars (Brooks, 2012, 2013; Crang et al., 2012; Lepawsky & Billah, 2011; Lepawsky, 2014). It advances this scholarship by demonstrating that formality and informality in e-waste are fundamentally enmeshed and teases out the patterns of these relationships. This is by far the most important contribution of the research.

This leads to the third novel attempt that deconstructs the monolithic notion of informality in the articulation of WEEE networks. The idea of dualist and segmented formal-informal labour markets is challenged and the structural nexus between WEEE formality and informality is substantiated. Although the formality-informality debate has refuted the dichotomy between the sectors, regulatory bodies are often trapped in archaic interpretations of informality. Consequently, 'the institutional, social and cultural regulation of labour markets that emerges from this form of segmentation associated with informality (thus) tends systematically to devalue labour in the secondary segments of the economy' (Phillips 2011: 393). Hence this essay not only facilitates a realistic understanding of the functioning of the informal labour processes and secondary e-waste markets, but also enriches the analytical rigour of the GPN lexicon by incorporating the concept of informality in it. GPN (and GVC) frameworks have not engaged with the heterogeneous nature of and multiplicity in informality (as pointed out by Phillips 2011) in the contemporary production networks and value chains. This shortcoming is overcome here.

Fourth, the typical firm-centric analysis of governance and driven-ness of lead firms in GVC and GPN are extended here to analyse informal governance practises and trust networks with kinship, family and community relations. The thesis stresses the reproduction of formal-informal power relations by showing that 'the power of the actors is located in their position in the network, along with links and individual expertise' (Thorelli, 1986). Fifth, the study investigates the effect of regulatory authorities on the e-waste network, both globally and nationally. Such an analysis can be applied to locate the legislative impact on other waste practices and paradigms. The very regulations that aim to control WEEE informality end up promoting it and deepening its intersections with formality. This unintended consequence of the regulations stems from its misinterpretation of informality as a site of hazardous waste treatment rather than for capitalist accumulation. This encumbers the successful governance of illicit e-waste transfer and its unsafe treatment. The formal recyclers in the EU invest in waste recycling since they realise the value and potential of profit in processing waste and not just because the state obliges and subsides them. The concept of waste is contested and does not merely represent an environmental agenda but manifests the politics of resource consumption and waste treatment in a society. This work problematizes the state's reading of and response to the informal actors and their value-generating activities, beyond the domain of e-waste. This can facilitate the evaluation of the efficacy of laws and policies on waste management through a meticulous examination of the WEEE network.

Finally, it enriches the e-waste and GPN-GVC scholarship by illustrating the theoretical primacy of value (production and distribution) embodied in the spectrum of waste movement and management. This has broader implications for understanding other global recycling networks where the value in waste informs the functioning of such networks. E-waste informality (re)makes commodities through secondary processes of production using labour to unleash the latent use–value in discarded electronics. This establishes the centrality of value in all socio-economic processes and underlines the importance of (informal) labour in producing that value. This begs the important question as to who should be considered a producer and a capitalist (in that right) given that informal waste managers engage in capitalist production from e-waste as a raw material or capital. In the process,

labour-power is (re)produced 'in the form of a commodity with particular attributes in specific locations' (Taylor, 2007: 535). The use of the Marxian circuits of capital in conceptualising e-waste as capital is an original essay. It reaffirms the centrality of production as a socio-economic relationship which maintains and reproduces the capitalist system even in the ambit of waste generation and treatment. This furthers the Marxist rationale beyond the realm of production to consumption, waste generation and its treatment which was originally outside the purview of Marxist lexicon. Therefore, it reinstates the application of Marxist rationale of surplus value generation in capitalism that defines the contemporary globalisation of waste.

9.4. **Limitations, Policy Implications and Future Research Agenda**

However, this thesis is also constrained in the following ways. Some empirical limitations arose from the multiple instances of partial or complete 'silences' encountered during primary data collection from both Europe and India that sometimes rendered communication problematic. Silence could not be circumvented as persistently pursuing a point can culminate in the withdrawal of the interviewee. It is valuable to fathom the knowledge implicit and/or expressed in the silence which can potentially be powerful and eloquent. Silence must be investigated and interpreted sensibly and sensitively since silence on a specific subject does not indicate that the topic is unimportant or irrelevant (Oinas, 1999).

The elite respondents in The Netherlands and Belgium steadfastly declined knowledge of the informal actors and the details of the exporters and importers. While the custom officials monitoring illegal e-scrap shipments did offer some insight on operationalising the WSR (Waste Shipment Regulation), they were essentially tight-lipped about the illicit players who violate legislations. This precipitated into the inability to locate or consult any international waste broker in the reverse supply chain of WEEE. Hence the international linkages between Europe and India could not be practically investigated. In the case of Indian informality, the incidence of 'silence' pertained to questions regarding the receipt of prohibited e-waste from overseas sources or linkages with exporters. This reticence can largely be attributed to the illegal nature of international WEEE trade that remains shrouded in secrecy. It is important to understand what motivates or compels specific respondents to withhold information given their social, political and institutional embeddedness (Oinas, 1999). Primarily, the informal agents were aware that with the impending legislation, they would be perceived as illegal by the Indian state. Hence they were particularly taciturn and deliberately excluded any information that could possibly implicate them. Additionally, they preserved confidentiality in their trade and frequently refused to divulge details of their contacts and connections to safeguard their personal and collective social networks. Sometimes, they might have been circumscribed by the lack of knowledge rather than their reluctance to reveal it. Though many national respondents alluded to the widespread presence and the expansive scale of illicit activities, none of the players involved could be accessed. At the formal end, the Indian formal recycling companies denied any association with the international waste traffic, informal markets and actors since that would reveal their non-compliance with the legislative requirements. Finally the state was persistently silent on informality that was reflected in its reluctance to address the issue in the upcoming legislation.

None of the countries researched maintained an official inventory of e-waste actors, or amount of WEEE generated and recycled on a national scale. Moreover, no data on waste quantities exported or imported was publicly available which compromised the understanding of the magnitude of global WEEE flow. These factors limited the scope of primary research coupled with a deficiency in secondary quantitative data. This serious constraint pre-empted quantitative research. Further, the difficulty in accessing and extracting information from informal respondents rendered a large-scale survey and random sampling impossible. However, the purpose of this study is a detailed exploration of the e-waste actors (especially informal) and their activities for which an in-depth qualitative research is better suited. Such a methodology captures the motivation of the different actors and suitably infers 'how' and 'why' questions without imposing causality between socially constructed and complex human experiences and socio-economic processes. However, it also suffers from the problems of a qualitative case-study. Thus it has not completely avoided the problem of the researcher's subjectivity, individual discretion and selection bias. It is essentially driven by the type of respondents chosen and their personal bias. It is also restricted by the nature of the queries and specific situation and sites of the interviews. Additionally, qualitative analysis delimits the scope of findings and any extrapolation to other cases must take into consideration context-specific conditions.

Despite these limitations, the study has important policy implications for appropriate regulatory engagement with WEEE practises and labour market reforms. It indicates that the state must take affirmative action to incorporate informality for a green and inclusive e-waste management programme rather than actively legislating laws against it. This can solve the challenge of huge capital investment required for an extensive collection infrastructure and sophisticated recycling techniques. There are severe drawbacks in the regional and national regulatory frameworks due to their discordant waste policies. Overall, credible and ecological WEEE treatment requires further commitment of the state and the producers in the system and an increased level of consumer awareness. The informal sector must be taken on board and consulted while formulating regulations. Further, it is recommended that the state must improve informal livelihoods and labour conditions in conjunction with the protection offered to formal labour and employment. This broadly applies to all policies that target or affect informality and informal labour rights in the developmental agenda and not just waste processing paradigms.

This study throws up interesting opportunities for further research. First, the conceptualisation of waste as capital within a theoretical framework of Marxist analysis can be extended to tease out the capital-labour relations and processes in waste management systems. Second, it can be applied to other contexts to observe how institutional diversity plays out in configuring specific local waste operations. It can also be used to discern the effect of changing regulatory scenarios on the e-waste landscape in different countries. Third, the emerging patterns in international WEEE trade and their implications for Asian, African and Latin American countries can be studied following the multiple uses of waste and the benefits associated with that. It can be investigated whether these new trends effectuate a global shift or broader transformation in the waste network and the participation of the countries within it. Fourth, by unpacking the heterogeneous informal sector, its variable role and dynamics can be enquired in more formalised environments to reflect on the similarities and

divergences in WEEE informality in advanced and developing nations. Ultimately, with a longer time period and more resources, an expanded macro-level study can be conducted to analyse and upgrade a country's e-waste processing.

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APPENDICES

APPENDIX I: Information Accompanying Shipments of Waste i.e. Green listed or non-hazardous waste to OECD countries in the European WSR

Consignment information (1)

<table>
<tr><td colspan="2">1. Person who arranges the shipment
Name:
Address:
Contact person:
Tel.: Fax:
E-mail</td><td colspan="2">2. Importer/consignee
Name:
Address:
Contact person:
Tel.: Fax:
E-mail</td></tr>
<tr><td colspan="2">3. Actual quantity: Tonnes (Mg):
m^3:</td><td colspan="2">4. Actual date of shipment:</td></tr>
<tr><td>5.(a) 1st carrier (2)
Name:
Address:
Contact Person:
Tel.:
Fax:
E-mail:
Means of transport:
Date of transfer:
Signature:</td><td>5.(b) 2nd carrier
Name:
Address:
Contact Person:
Tel.:
Fax:
E-mail:
Means of transport:
Date of transfer:
Signature:</td><td>5.(c) 3rd carrier
Name:
Address:
Contact Person:
Tel.:
Fax:
E-mail:
Means of transport:
Date of transfer:
Signature:</td><td></td></tr>
<tr><td colspan="2">6. Waste generator (3)
Original producer(s), new producer(s) or collector:
Name:
Address:
Contact person:
Tel.: Fax:
E-mail:</td><td colspan="2">8. Recovery operation (or if appropriate disposal operation in the case of waste referred to in Article 3(4)):
R-code/D-code:

9. Usual description of the waste:</td></tr>
<tr><td colspan="2">7. Recovery facility ☐ Laboratory ☐
Name:
Address:
Contact person:
Tel.: Fax:
E-mail:</td><td colspan="2">10. Waste identification (fill in relevant codes):
(i) Basel Annex IX:
(ii) OECD (if different from (i)):
(iii) EC list of wastes:
(iv) National code:</td></tr>
</table>

11. Countries/states concerned:				
Export/dispatch	Transit			Import/destination

12. Declaration of the person who arranges the shipment: I certify that the above information is complete and correct to my best knowledge. I also certify that effective written contractual obligations have been entered into with the consignee *(not required in the case of waste referred to in Article 3(4)*):

Name: Date: Signature:

13. Signature upon receipt of the waste by the consignee:

Name: Date: Signature:

To be completed by the Recovery facility or by the Laboratory:

14. Shipment received at recovery facility □ **or laboratory** □ Quantity received: Tonnes (Mg): m^3:

Name: Date: Signature:

(1) Information accompanying shipments of green listed waste and destined for recovery or waste destined for laboratory analysis pursuant to Regulation (EC) No 1013/2006. For completing this document, see also the corresponding specific instructions as contained in Annex IC of Regulation (EC) No 1013/2006 on shipments of waste

(2) If more than 3 carriers, attach information as required in blocks 5 (a, b, c).

(3) When the person who arranges the shipment is not the producer or collector, information about the producer or collector shall be provided.

APPENDIX II: Categories in Annex V (of the WSR) relating to WEEE

Part 1A (banned for export)

A1160 Waste lead-acid batteries, whole or crushed.

A1170 Unsorted waste batteries excluding mixtures of only List 1B batteries. Waste batteries not specified on List B containing Annex 1 constituents to an extent that render them hazardous.

A1180 Waste electrical and electronic assemblies or scrap (not including scrap assemblies from electric power generation) containing components such as accumulators & other batteries included on List 1A, mercury switches, glass from cathode ray tubes & other activated glass & polychlorinated biphenyl (PCB) capacitors, or contaminated with Annex 1 constituents (e.g. cadmium, mercury, lead, PCBs (>50 mg/kg)) to an extent that they possess any of the characteristics contained in Annex III.

A2010 Glass from cathode ray tubes and other activated glass

Part 1B (permitted for export)

B1040 Scrap assemblies from electronic power generation not contaminated with lubricating oil, PCBs or polychlorinated terphenyls (PCT to an extent to render them hazardous.

B1070 Waste of copper and copper alloys in dispersible form, unless they contain Annex 1 constituents to an extent that they exhibit Annex III characteristics.

B1090 Waste batteries conforming to a specification, excluding those made with lead, cadmium or mercury.

B1110 Electrical and electronic assemblies:

– Electronic assemblies consisting only of metals or alloys.

–Waste electrical and electronic assemblies or scrap (not including scrap from electric power generation) (including printed circuit boards) not containing components such as accumulators and other batteries included on List 1A, mercury switches, glass from cathode ray tubes and activated glass and PCB capacitors, or not contaminated with Annex 1 constituents (e.g. cadmium, mercury, lead, PCBs) or from which these have been removed, to an extent that they do not possess any of the characteristics contained in Annex III.

– Electrical and electronic assemblies (including printed circuit boards, electronic components and wires) destined for direct reuse (including repair, refurbishment or upgrading, but not major re-assembly) destined for direct reuse (some countries may consider such materials a non-waste) and not for recycling or disposal.

Parts 2 and 3 (not permitted for export)

If waste does not appear in Part 1 but does appear on the lists in Part 2 or 3 to Annex V, then its export to non-OECD countries is prohibited.

APPENDIX III: Categories of Electrical and Electronic Equipment covered under the E-waste Rules, 2012 in India

1. **Information Technology and Telecommunication Equipment**

Centralised Data Processing: Mainframes, Minicomputers
Personal Computing:
Personal Computers (Central Processing Units with input and output devices)
Laptop Computers (Central Processing Units with input and output devices)
Notebook Computers
Notepad Computers
Printer including cartridges
Copying equipment
Electrical and Electronic Typewriters
User terminals and systems
Facsimile
Telex
Telephones

Pay Telephones

Cordless Telephones

Cellular Telephones

Answering Systems

2. **Consumer Electricals and Electronics**

Television sets (including sets based on LCD or Liquid Crystal Display and LED or Light Emitting Diode Technology)

Refrigerators

Washing Machines

Air-conditioners excluding centralised air conditioning plants

APPENDIX IV: Categories of WEEE in the Directive

i. Large household appliances
ii. Small household appliances
iii. IT and telecommunications equipment
iv. Consumer equipment
v. Lighting equipment
vi. Electrical and electronic tools
vii. Toys, leisure and sports equipment
viii. Medical devices
ix. Monitoring and control instruments
x. Automatic dispensers

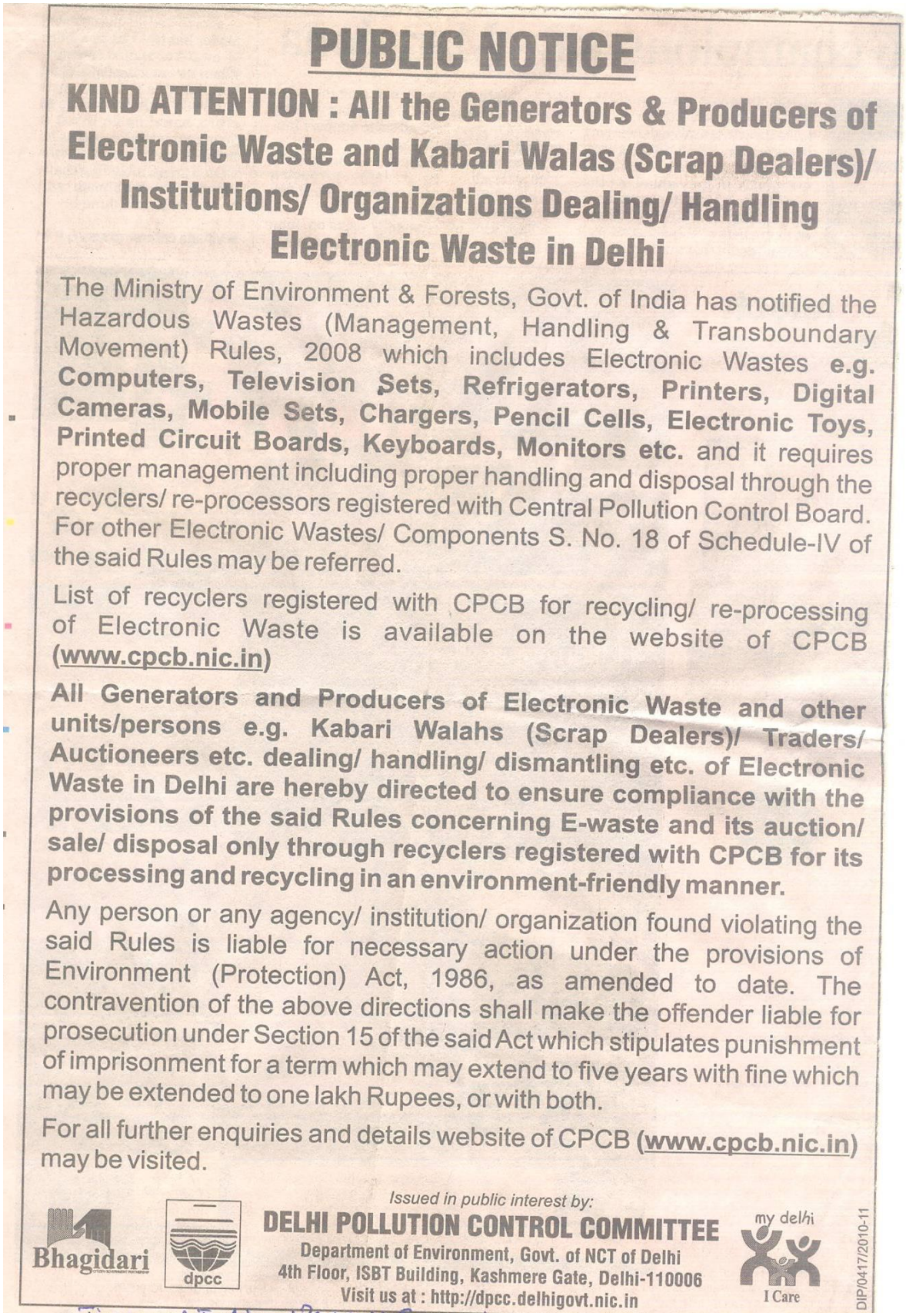
APPENDIX V: Product groups in the Eco-Design Directive of the European Union

i. Air conditioning and ventilation systems
ii. Electric and fossil-fuelled heating equipment
iii. Food-preparing equipment
iv. Industrial and laboratory furnaces and ovens
v. Machine tools
vi. Network, data processing and data storing equipment
vii. Refrigerating and freezing equipment
viii. Sound and imaging equipment
ix. Transformers
x. Water-using equipment

APPENDIX VI: Table 2: WEEE Recovery Rate by Average weight

Categories of WEEE (from Table 1)	Recovery Rate (at least)	Component, Material & Substance Recycling (at least)
1. Large Household Appliances 10. Automatic Dispensers	80%	75%
3. IT & Telecommunication 4. Consumer Equipment	75%	60%
2. Small Household Appliances 5 Lighting Equipment 6. Electrical & Electronic Tools 7. Toys, Leisure & Sports Equipment 9. Monitoring & Control Instruments	70%	50%
10. Gas Discharge Lamps		50%

APPENDIX VII: Public Notice by Delhi Pollution Control Board (2010) for Impending E-waste Rules



PUBLIC NOTICE

KIND ATTENTION : All the Generators & Producers of Electronic Waste and Kabari Walas (Scrap Dealers)/ Institutions/ Organizations Dealing/ Handling Electronic Waste in Delhi

The Ministry of Environment & Forests, Govt. of India has notified the Hazardous Wastes (Management, Handling & Transboundary Movement) Rules, 2008 which includes Electronic Wastes **e.g. Computers, Television Sets, Refrigerators, Printers, Digital Cameras, Mobile Sets, Chargers, Pencil Cells, Electronic Toys, Printed Circuit Boards, Keyboards, Monitors etc.** and it requires proper management including proper handling and disposal through the recyclers/ re-processors registered with Central Pollution Control Board. For other Electronic Wastes/ Components S. No. 18 of Schedule-IV of the said Rules may be referred.

List of recyclers registered with CPCB for recycling/ re-processing of Electronic Waste is available on the website of CPCB (**www.cpcb.nic.in**)

All Generators and Producers of Electronic Waste and other units/persons e.g. Kabari Walahs (Scrap Dealers)/ Traders/ Auctioneers etc. dealing/ handling/ dismantling etc. of Electronic Waste in Delhi are hereby directed to ensure compliance with the provisions of the said Rules concerning E-waste and its auction/ sale/ disposal only through recyclers registered with CPCB for its processing and recycling in an environment-friendly manner.

Any person or any agency/ institution/ organization found violating the said Rules is liable for necessary action under the provisions of Environment (Protection) Act, 1986, as amended to date. The contravention of the above directions shall make the offender liable for prosecution under Section 15 of the said Act which stipulates punishment of imprisonment for a term which may extend to five years with fine which may be extended to one lakh Rupees, or with both.

For all further enquiries and details website of CPCB (**www.cpcb.nic.in**) may be visited.

Issued in public interest by:

DELHI POLLUTION CONTROL COMMITTEE
Department of Environment, Govt. of NCT of Delhi
4th Floor, ISBT Building, Kashmere Gate, Delhi-110006
Visit us at : http://dpcc.delhigovt.nic.in

Bhagidari

dpcc

my delhi I Care

DIP/0417/2010-11

APPENDIX VIII: Gold Extraction Processes: The two methods of gold extraction from e-waste are explained below.

Cyanide Leaching: This process is complex but inexpensive (traditionally used in the mining industry) where leaching, separation and purification are consecutively carried out. To start with, the PCBs are burnt and immersed in water and potassium or sodium cyanide is added to facilitate gold leaching (common technique of removing metals from ores in which a solvent is passed through a mixture to extract a desired substance from it) in presence of air acting as an oxidising agent. The chemical reaction is

$4Au + 8CN^- + O_2 + 2H_2O \rightarrow 4Au(CN)^-_2 + 4OH^-$

Thereafter the gold cyanide is sieved and washed to totally remove the metal from the waste. The second step of gold separation is accomplished by mixing silver salt with nitric acid and aluminium foil. Aluminium precipitates the gold and the silver from the solution and the silver prevent the gold from dissolving again. The following reactions describe the steps.

$Ag + 2HNO_3 \rightarrow AgNO_3 + NO_2 + H_2O$

$AgNO_3 + NaCl \rightarrow AgCl + NaNO_3$

$3[Au(CN)_2]^- + 2Al \rightarrow 2Al^{3+} + 6CN^- + 3Au$

$4Ag + 8CN^- + O_2 + 2H_2O \rightarrow 4Ag(CN)^-_2 + 4OH^-$

Then the gold is retrieved after draining the liquid and filtering the slag (vitreous matter obtained by smelting metal ores). For purification, the slags are finely grounded and melt after mixing calcium carbonate and flux (material added to metals in a furnace to promote fusing or prevent formation of oxides). Gold is recovered by boiling the excess water off and subsequently separating silver from gold by addition of nitric acid.

Mercury Amalgamation: This is a relatively simple process involving the formation of an amalgam of mercury (readily available and cheap) with gold. For leaching, water and nitric acid are added to burned PCBs which releases gold deposits and dissolves the copper in the solution (copper is recovered by adding iron). The gold residue is filtered and mixed with mercury and few drops of nitric acid to produce the amalgam. Sodium bicarbonate is added to the mixture and the mixture is decanted. The slag is squeezed through the cloth to get rid of excess mercury which is used again. The residue in the cloth is the amalgam with a high concentration of gold. The amalgam is softened by adding mercury and water. Nitric acid is them added which dissolves part of the mercury. The mixture is decanted and boiled at high temperature to vaporise the nitric acid and the mercury after which pure gold is recovered.

Source: (Rajeswari, 2007)

APPENDIX IX: NOC by MoEF to Customs for Import of DELL Servers (by M/s. Amplio Technologies, Pvt. Ltd., New Delhi)

भारत सरकार
पर्यावरण एवं वन मंत्रालय
GOVERNMENT OF INDIA
MINISTRY OF ENVIRONMENT AND FORESTS

By Speed Post

No. 23-76/2012-HSMD

30th March, 2012

OFFICE MEMORNAUDM

This has reference to the application by M/s. Amplio Technologies Pvt. Ltd., New Delhi, seeking permission to import of refurbished Dell Poweredge Servers to be used for Software Development and data hosting services.

2. The matter has been examined. The Ministry has **no objection** for import of **4 nos. of refurbished Dell PowerEdge Servers by M/s. Amplio Technologies Pvt. Ltd., New Delhi,** through **Air Cargo Delhi** subject to the following conditions:-

(i) all the servers would be re-exported to the place from where these are being imported, within a period of 18 months from the date of import or on completion of project, whichever is earlier.
(ii) the Ministry and the Delhi Pollution Control Committee would be kept informed about the import and re-export of the servers.

3. The Customs Authorities at the Air Cargos have the responsibility to verify the documents. They are also requested to take action as per the Hazardous Wastes (Management, Handling and Transboundary Movement) Rules, 2008 and the Customs Act, 1962 against the importers found to be violating the norms.

4. This issues with the approval of the competent authority.

(Dr. Saroj)
Director
Telefax: 24364067

To:

1) Shri R. P. Singh, Director (Customs), Ministry of Finance, Department of Revenue, Central Board of Excise and Customs, North Block, New Delhi- 110 001
2) The Chief Commissioner of Customs, New Custom House, Near IGI Airport & Air Cargo Complex, New Delhi- 110 037
3) Shri Sandeep Kumar Mishra, Member Secretary, Delhi Pollution Control Committee, 4th Floor, ISBT,Building, Kashmere Gate, Delhi-110006
4) M/s. Amplio Technologies Pvt. Ltd., L-79, Lower Ground Floor, Malviya Nagar, New Delhi.

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वहाँ है खुशहाली॥

पर्यावरण भवन, सी.जी.ओ. कॉम्पलैक्स, लोदी रोड, नई दिल्ली - 110 003
PARYAVARAN BHAWAN, C.G.O. COMPLEX, LODHI ROAD, NEW DELHI - 110 003
Website : moef.nic.in

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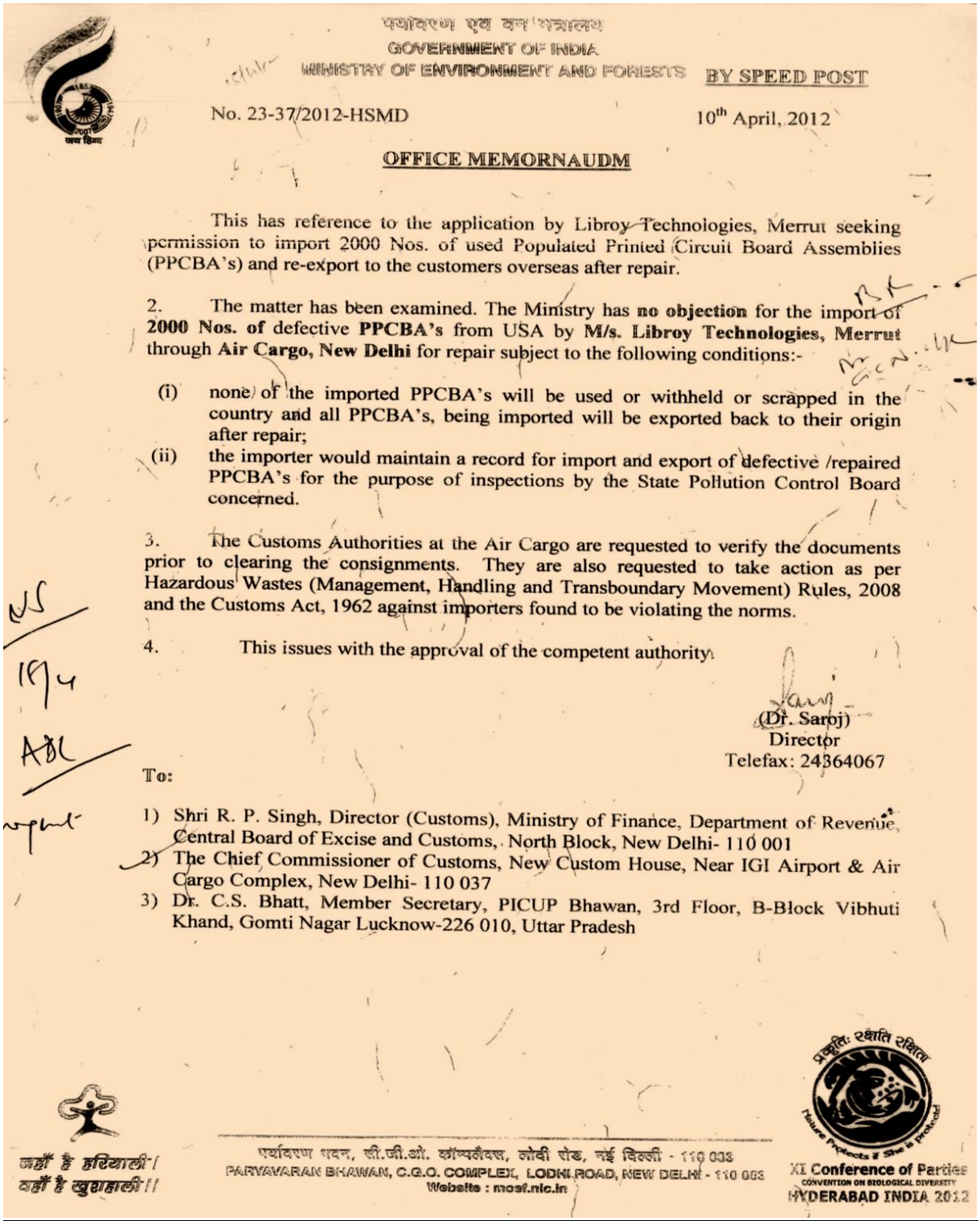
XI Conference of Parties
CONVENTION ON BIOLOGICAL DIVERSITY
HYDERABAD INDIA 2012

APPENDIX XI: NOC by MoEF to Customs for Import of PCBs (by Libroy Technologies, Meerut)



पर्यावरण एवं वन मंत्रालय
GOVERNMENT OF INDIA
MINISTRY OF ENVIRONMENT AND FORESTS BY SPEED POST

No. 23-37/2012-HSMD 10th April, 2012

OFFICE MEMORNAUDM

This has reference to the application by Libroy Technologies, Merrut seeking permission to import 2000 Nos. of used Populated Printed Circuit Board Assemblies (PPCBA's) and re-export to the customers overseas after repair.

2. The matter has been examined. The Ministry has **no objection** for the import of **2000 Nos. of** defective **PPCBA's** from USA by **M/s. Libroy Technologies, Merrut** through **Air Cargo, New Delhi** for repair subject to the following conditions:-

(i) none of the imported PPCBA's will be used or withheld or scrapped in the country and all PPCBA's, being imported will be exported back to their origin after repair;

(ii) the importer would maintain a record for import and export of defective /repaired PPCBA's for the purpose of inspections by the State Pollution Control Board concerned.

3. The Customs Authorities at the Air Cargo are requested to verify the documents prior to clearing the consignments. They are also requested to take action as per Hazardous Wastes (Management, Handling and Transboundary Movement) Rules, 2008 and the Customs Act, 1962 against importers found to be violating the norms.

4. This issues with the approval of the competent authority.

(Dr. Saroj)
Director
Telefax: 24364067

To:

1) Shri R. P. Singh, Director (Customs), Ministry of Finance, Department of Revenue, Central Board of Excise and Customs, North Block, New Delhi- 110 001
2) The Chief Commissioner of Customs, New Custom House, Near IGI Airport & Air Cargo Complex, New Delhi- 110 037
3) Dr. C.S. Bhatt, Member Secretary, PICUP Bhawan, 3rd Floor, B-Block Vibhuti Khand, Gomti Nagar Lucknow-226 010, Uttar Pradesh

जहाँ है हरियाली / वहाँ है खुशहाली !!

पर्यावरण भवन, सी.जी.ओ. कॉम्प्लेक्स, लोदी रोड, नई दिल्ली - 110 003
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APPENDIX XII: NOC by MoEF to Customs for Import of Digital Camera Equipment (by M/s. HCL Technologies Ltd., Noida)

भारत सरकार
पर्यावरण एवं वन मंत्रालय
GOVERNMENT OF INDIA
MINISTRY OF ENVIRONMENT AND FORESTS **BY SPEED POST**

13/4/2012

No. 23-77/2011-HSMD Dated: 10th April, 2012

OFFICE MEMORNAUDM

This has reference to application by M/s. HCL Technologies Ltd. Nodia seeking permission for import of used digital cameras, development boards for the cameras, networking devices, power supply adapters, etc. for the purpose of software development/development of prototype of digital video cameras.

2. The matter has been examined in the Ministry. The Ministry has **no objection** for the import of **50 Nos. of used electrical and electronic assemblies, as per the details annexed,** by **M/s. HCL Technologies Ltd., Noida** through **Air Cargo, Delhi** subject to the following conditions:-

(i) the imported electrical and electronic assemblies will be used for the purpose of software development;
(ii) all the assemblies, imported as per this permission, would be exported back within 18 months from where these have been imported or on completion of the project, whichever is earlier;
(iii) the importer would inform the Ministry about completion of the project and re-export of these assemblies; and
(iv) the assemblies will not be used for any other purpose.

3. The Customs Authorities at the Air Cargo have the responsibility to verify the documents prior to clearing of the consignment. They are also requested to take action as Hazardous Wastes (Management, Handling and Transboundary Movement) Rules, 2008 and the Customs Act, 1962 against importers found to be violating the norms.

4. This issues with the approval of the competent authority.

(Dr. Saroj)
Director
Telefax: 24364067

To:

1) Shri R. P. Singh, Director (Customs), Ministry of Finance, Department of Revenue, Central Board of Excise and Customs, North Block, New Delhi- 110 001
2) The Chief Commissioner of Customs, New Custom House, Near IGI Airport & Air Cargo Complex, New Delhi- 110 037
3) M/s. HCL Technologies Limited, SEZ, INFRA Block Unit 2,3, Plot No. 3A, Sector-126, Noida 201301 (UP)

जहाँ है हरियाली।
वहाँ है खुशहाली॥

पर्यावरण भवन, सी.जी.ओ. कॉम्पलैक्स, लोदी रोड, नई दिल्ली - 110 003
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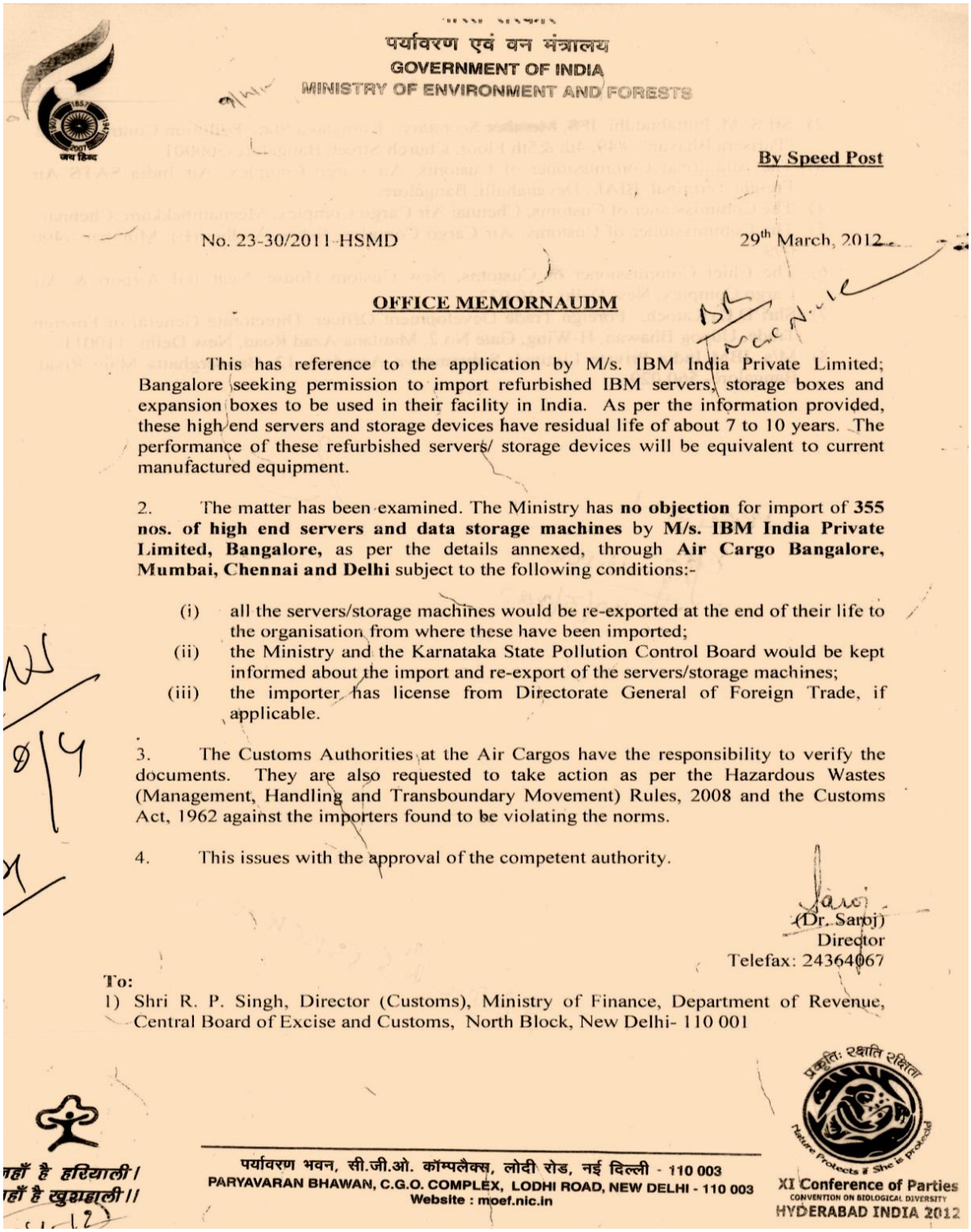
Website : moef.nic.in

XI Conference of Parties
CONVENTION ON BIOLOGICAL DIVERSITY
HYDERABAD INDIA 2012

APPENDIX XIII: NOC by MoEF to Customs for Import of used IBM servers and storage devices (by IBM India Private Limited, Bangalore)



पर्यावरण एवं वन मंत्रालय
GOVERNMENT OF INDIA
MINISTRY OF ENVIRONMENT AND FORESTS

By Speed Post

No. 23-30/2011-HSMD

29th March, 2012

OFFICE MEMORNAUDM

This has reference to the application by M/s. IBM India Private Limited; Bangalore seeking permission to import refurbished IBM servers, storage boxes and expansion boxes to be used in their facility in India. As per the information provided, these high end servers and storage devices have residual life of about 7 to 10 years. The performance of these refurbished servers/ storage devices will be equivalent to current manufactured equipment.

2. The matter has been examined. The Ministry has **no objection** for import of **355 nos. of high end servers and data storage machines** by **M/s. IBM India Private Limited, Bangalore,** as per the details annexed, through **Air Cargo Bangalore, Mumbai, Chennai and Delhi** subject to the following conditions:-

(i) all the servers/storage machines would be re-exported at the end of their life to the organisation from where these have been imported;
(ii) the Ministry and the Karnataka State Pollution Control Board would be kept informed about the import and re-export of the servers/storage machines;
(iii) the importer has license from Directorate General of Foreign Trade, if applicable.

3. The Customs Authorities at the Air Cargos have the responsibility to verify the documents. They are also requested to take action as per the Hazardous Wastes (Management, Handling and Transboundary Movement) Rules, 2008 and the Customs Act, 1962 against the importers found to be violating the norms.

4. This issues with the approval of the competent authority.

(Dr. Sarbj)
Director
Telefax: 24364067

To:
1) Shri R. P. Singh, Director (Customs), Ministry of Finance, Department of Revenue, Central Board of Excise and Customs, North Block, New Delhi- 110 001

जहाँ है हरियाली / वहाँ है खुशहाली //

पर्यावरण भवन, सी.जी.ओ. कॉम्पलैक्स, लोदी रोड, नई दिल्ली - 110 003
PARYAVARAN BHAWAN, C.G.O. COMPLEX, LODHI ROAD, NEW DELHI - 110 003
Website : moef.nic.in

प्रकृतिः रक्षति रक्षिता
Nature Protects if She is Protected
XI Conference of Parties
CONVENTION ON BIOLOGICAL DIVERSITY
HYDERABAD INDIA 2012

APPENDIX X: Consent to Operate for HRA in 2012 by DPCC

Delhi Pollution Control Committee

4th & 5th Floor, ISBT Building, Kashmere Gate, Delhi - 110006.
Website : http://dpcc.delhigovt.nic.in

Despatch No. 755
Date. 07/12/2012

CONSENT ORDER

Certificate No. : O-019191

Name of the Unit : HRA E WASTE PVT. LTD.

Address : A-59, SECOND FLOOR, JHILMIL INDUSTRIAL AREA,DELHI-110095

Consent Order No : DPCC/BMW/2012/30997

Date of Issue : 03-12-2012 Date of Expiry : 07-10-2017

Product/Activity : WEEE Collection, Sagregation and Storage (without Dismantling and Recycling)

This Consent to **Operate** is hereby granted under section 21 of the Air (Prevention & Control of Pollution) Act, 1981 and under section 25/26 of the Water (Prevention & Control of Pollution) Act, 1974 under **Orange** Category. This consent is subject to terms and conditions specified overleaf.

M/s N/A has done the analysis vide report dated N/A as follows:

N/A

Prescribed standards

N/A

Verified by : ENVIRONMENTAL ENGINEER
SUNIL KUMAR
Env. Engineer (CDC)
Delhi Pollution Control Committee
4th & 5th Floor, ISBT Building
Kashmere Gate, New Delhi-110006

Issuing Authority : SENIOR ENVIRONMENTAL ENGINEER
SUNIL KUMAR
Sr. Env. Engineer (CDC)
Delhi Pollution Control Committee
4th & 5th Floor, ISBT Building
Kashmere Gate, New Delhi-110006