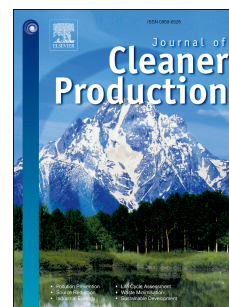


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Towards a circular economy for packaging waste by using new technologies: The case of large multinationals in emerging economies

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Towards a circular economy for packaging waste by using new technologies: The case of large multinationals in emerging economies

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Towards a circular economy for packaging waste by using new technologies: The case of large multinationals in emerging economies

Highlights:

- We identify that MNEs look at their products and its packaging in a distinct way
- We propose that MNEs should change their business model to include its packaging
- We advance a framework with incentives using blockchain and artificial intelligence
- We developed a resources value loop that adds to the product life cycle theory
- We progress the circular economy literature by integrating it with new technologies

Abstract:

Earth's capacity to sustain mankind is reaching a tipping point. Packaging waste is one of the critical problems that is leading to such a situation and a focus of the U.N. Sustainable Development Goals. However, large multinational enterprises look at their products and its packaging in a separate way, which leads them to think that when the product is consumed, their responsibility ends, leaving the government to deal with the issue of managing the packaging waste. Due to the complexity of the issue and the fact that this is particularly problematic in emerging markets, we used an in-depth and longitudinal case study analysis. We found that there were a desire and ability, with the use of the right technology, among urban groups to tackle the problem if with the right incentives to the different involved actors and from a holistic perspective. Our findings allowed us to advance a holistic framework based on incentives by using digitalization and new technologies such as blockchain and artificial intelligence. Doing so, we advance the theory in the circular economy by enhancing it with the use of new technologies and advance a *resources value loop* that adds to the product life cycle theory.

Keywords: Circular economy, Packaging waste; Multinationals; Digitalization; U.N.

Sustainable Development Goals; Emerging economies; Blockchain, Artificial intelligence.

1. Introduction

The United Nations (UN) has stated that we have reached a tipping point as far as the earth's capacity to sustain mankind is concerned (United Nations, 2019). Other organizations (e.g., European Union, 2019; National Geographic, 2019) have voiced similar concerns pointing to the fact that the society needs to move away quickly from certain well entrenched habits. A case in point is the way that the society deals with packaging waste, particularly plastic. Plastic¹ packaging waste (from now on packaging) has an adverse footprint in terms of contributing to climate crisis due to the quantity, volume, and time that it takes to naturally decompose. Not surprisingly, many (e.g., IPCC, 2019; United Nations, 2016) refer to packaging waste as one of the major contributors to the current climate crisis. However, packaging is pervasive in our daily lives as it enables us to save food, reduce product damage, improve shelf-life and appearance, lower costs, and surge convenience.

Thus, we ask: *If packaging waste is a critical and systemic problem in regard to the climate crisis but at the same time so ubiquitous in our daily lives, what are the fundamental and societal changes required to tackle this issue?* Having this research question in mind, the aim of our study is to elucidate on the societal approach required to tackle the issue of packaging waste by bringing all the different intervenient into a holistic framework based on an incentives system.

Currently, corporations have a mentality of distinguishing between the product and its packaging. This, in turn, leads them to think that when the product is consumed, their responsibility ends leaving the government to deal with the issue of managing the packaging waste. We, therefore, see companies exhibiting a dual or bipolar attitude where they acknowledge and market the complete product as inclusive of its packaging before the sale but completely disown their responsibility by dissociating the packaging from the product

¹ Plastic and other slow-decomposing materials.

post-consumption. However, even if this mentality of disowning the packaging waste post-consumption is still very much impregnated in the actions displayed by corporations, consumer expectations regarding the role of corporations in dealing with the challenges of climate change in general, and packaging waste in particular, are changing. Societal awareness to waste in oceans and landfills, for example, is a recent driving force to push for changes (United Nations, 2020). Images of packaging waste eliminating precious marine species, being found inside marine animals, destroying fragile flora and fauna, covering paradisiac beaches, or forming towering waste mountains, are having an impact on consumers. Moreover, NGOs, activists and citizen groups are demanding that corporations and governments act in order to take appropriate action against the issue of mounting packaging waste. Recently, The Guardian (2020) reported that Coca Cola, Nestle, Pepsi, and other large corporations have been sued by a California environmental group for creating plastic packaging waste. At the same time, governments too are stepping up the pressure on corporations to take ownership of the waste generated by their brands by implementing increasingly restrictive laws. A case in point is a recent Solid Waste Management law (SWM, 2016) in India. This law requires corporations to institute a system to collect back the waste generated by their brands.

Nonetheless, and despite these advancements from different stakeholders, corporations have a low incentive to change their current practices, particularly in low institutionalized countries. The apathy of corporations to step forward and take charge of implementing appropriate measures, has resulted in a status-quo of sorts. However, this situation can be improved through the use of recent technology advancements. We believe that an incentive system along the value chain, covering the different stakeholders involved, might change this situation. Technology advancements such as blockchains, artificial intelligence (AI), internet of things (IoT), big data, robotics, amongst others, might help to

close the loop and enable a move away from the current linear to a truly circular economy (CE) on packaging waste.

Since India has the legal framework in place that obliges corporations to be responsible for their own packaging waste and is one of the largest emerging economies (EEs), we investigated the packaging waste problem in this setting and how technology is being used. Indeed, EEs have been an important part of the last two decades' economic development. However, increased production, and thus consumption and the resulting waste, coupled with the institutional voids (Khanna & Palepu, 2005) that exist in terms of enabling institutional capabilities to cope with the quantum and nature of the packaging waste, are the ingredients to a potential world environmental disaster. Thus, EEs are a good starting point to tackle the packaging waste problem.

However, we need to understand that tackling this issue is complicated on such resources and capabilities constrained economies. Because of that, our research proposes a defined strategy that focuses on large MNEs due to four main reasons: 1) The impact that those corporations have on packaging waste on EEs; 2) Their resources and capabilities available worldwide; 3) Their corporate social responsibility and ethics internal strategies; and 4) Their brand value and how much they have to lose when legitimacy from the different stakeholders is jeopardized. Thus, we focused on those corporations and on the understating of how we could align the different stakeholders' incentives towards a packaging CE, so the system makes environmental and social, but also economic sense.

The integrated waste management approach propagated by Wilson et al. (2013) and Seadon (2006) along with the stakeholder theory advanced by Freeman et al. (2004) provide the theoretical basis for our framework. With our framework we provide a practical approach/model by showing the role of the various stakeholders/agents who are part of the waste value chain, and how they can make a positive difference backed by several benefits.

With this article we contribute to the increasing literature in CE by bringing it to a still under-studied specific phenomenon – fast moving consumers good packaging. Moreover, we bridge CE with new technologies, and thus advance our knowledge on how new technologies can enhance and leverage CE framework and practices. We also contribute to the theoretical discussion of product life cycle by expanding it to a *resources value loop* as corporations need to integrate their products with its packaging. The idea of looking at product and packaging separately needs to be abandoned. Finally, we advance the participatory theoretical models backed by a framework that demonstrate the practical approach that can be taken to apply the principles of CE at the grassroots level. Indeed, these models are yet to be conceptualized in the context of EEs, even though its need is paramount from a world sustainability perspective.

2. Literature Review

2.1 Stakeholders Theory

In the modern business context, there has been a transference in objectives of organizations from a focus on profitability of the shareholders and the maximization of profits towards the concern of a more global satisfaction of all stakeholders, allowing concepts such as corporate social responsibility (CSR) and CE to develop. Having that in mind, the Stakeholder Theory (Friedman, 1970) argues that the ultimate test for the company would be to successfully satisfy all the demands of the multiple stakeholders instead of accomplishing conventional economic and financial criteria (Mitchell et al., 1997), where stakeholders are “any group or individual who can affect or is affected by the achievement of the organization’s objectives” (Freeman 2010, p. 24). The Stakeholder Theory attempts to balance the added value and benefits that the different stakeholders exchange with firms (Carroll, 2004). Furthermore, the acknowledged importance of the “well-being” of the natural and social environment in which the companies are inserted leads them to take a strategic approach to CSR in response to

stakeholder demands (Vaaland et al., 2008). Therefore, the Stakeholder Theory defends that the use of a socially responsible strategy to maximize business profits is advantageous (Freeman, 1984).

From a multinational enterprises (MNEs) perspective, Stakeholder Theory needs to be framed from both the firm home and host markets as those firms need to pursue legitimacy also in the host-countries (DiMaggio & Powell, 1983; Hah & Freeman, 2013; Jamali, 2010; Tan & Wang, 2011). Subsidiaries of MNEs, suffer from liability of foreignness as host-country stakeholders often lack information concerning the subsidiaries and can use preconceived notions, which negatively affect subsidiaries (Hansen et al., 2020; Campbell et al., 2012). Therefore, MNEs need to be particularly careful when operating in foreigner markets and analyze carefully the different stakeholders and their power (D'Souza et al., 2020; Mitchell et al., 1997). However, for large MNEs, frequently coming from developed economies, entering into EEs means a relaxation of CSR and activities (Chen et al., 2016).

This happens because consumers and other social groups are frequently not seen as a strong stakeholder as it happens in developed economies (Figueira et al., 2020). Furthermore, the formal institutions in EEs are weak (Torres de Oliveira et al., 2020; Oriaifo et al., 2020), which allows the MNEs to operate with less CSR consciousness (Miska et al., 2016). Packaging of their products is an example of an activity that MNEs, particularly large ones, tend to rely on the institutional voids of the host countries instead of following more stringent policies as frequently happen at home or other developed economies (Chen et al., 2016). This also happens because there is the overall perception, even among large MNEs that present billions of dollars on financial profits very year, that packaging of their product is out of their responsibility as soon as the product is sold and therefore packaging is someone else responsibility. In this research, however, we bring the MNEs to the center of the problem but also to the center of the solution and armed with the Stakeholders Theory, we

felt the necessity to also bring together the others MNEs stakeholders to help tackle this critical problem, particularly to EEs.

2.2 Packaging waste and circular economy

Boulding's concept of a closed circular earth system with finite assimilative capacity and the resulting requirement for an equilibrium between the environment and the economy (Boulding, 1966) was a first attempt to describe what we today call CE. Stahel and Reday (1977) developed the concept of the loop economy and supporting efficiency and dematerialization industrial strategies. However, it is Pearce et al. (1989) that are often credited with introducing the CE concept as they described the influence of natural resources on the contemporary linear economic system. In this research, we follow the Kirchherr et al. (2017, p. 224) comprehensive definition of CE and the different concepts that summarizes all important aspects of it.

Environmental threats, economic challenges, and unmet social expectations have resulted in the concept gaining momentum amongst practitioners, scholars, and policymakers (Geissdoerfer et al., 2017). The CE is now argued to be one of the most notable sustainable development concepts (MacArthur, 2013) as products can be repaired, reused, upgraded or become a part of a fully recycled system, leading to furthering environmental, economic, and social goals (Geissdoerfer et al., 2017).

However, many practices are fundamentally entrenched in firms' operations and business models and once established are often difficult to adjust (Bocken et al., 2016). Also, political obstacles remain difficult to remove due to the strong influence of lobby groups also hindering the introduction of externalities policies. Complex international supply chains and large up-front investments are holding companies back from transitioning from a linear to a CE. Even if we know that CE initiatives had been incorporated into the corporate sustainability agenda of large MNEs (Aguilar-Hernandez et al., 2020), we also know that

initiatives addressing consumers are critical for making a transition towards CE and those are still largely missing (Stewart & Niero, 2018). Indeed, the CE initiatives seem to emphasize on the design of processes and the cycling of materials but frequently remain silent on the social dimension inherent to its applicability and sustainable development (Qu et al., 2019).

Indeed, the responsibility not only lies with private businesses, but also with regulators and policy makers (Sun et al., 2020), and with the consumers and social organizations. Credible global, national and regional consumption targets, smart regulation and incentive structures should consider, guide and align all stakeholders' behavior, encourage innovation and investment, as well as international governmental and professional cooperation, as well as encouraging transformative systematic change rather than incremental efficiency gains (Korhonen et al., 2018). Furthermore, in the advancement of the CE it is crucial to support EEs to avoid further 'business model lock-ins'. This is why a holistic view with the different stakeholders involved is required. Indeed, CE implementation is an example of an organization's decisions being influenced by stakeholders' demands (Cantrell et al., 2015), and therefore linked to the Stakeholders Theory.

CE emphasizes the importance of recycling as one of the means to reduce the environmental impact of waste, where packaging plays an important role. Because plastics, for example, generated from packaging has increased exponentially, there have been several calls to tackle the issue, namely from European Union and United Nations (Eygen, Laner, & Fellner, 2018). However, only some packaging materials can be recycled or reused (Geueke, Groh, & Muncke, 2018). For example, the applicability of plastic waste for a product needs to be assessed on a case to case basis due to product-specific quality requirements because the chemical composition of some plastic wastes might hold hazardous substances and therefore are undesirable for being circulated (Dahlbo, Polaikova, Myllari, Sahimaa, & Anderson, 2018).

Most of the research and efforts in the sustainable packaging domain has been conducted in developed economies due to the existence of enabling policies (Meherishi, Narayana, & Ranjani, 2019). However, EEs are today important consumer markets and packing waste generators and where frequently no treatment happens. Therefore, tackling the packaging waste in EEs is critical from a local and world environmental perspective (de la Caba et al., 2019).

Furthermore, to design effective packaging waste policy initiatives, data pertaining to the flows of the packaging is needed. However, one of the major issues pertaining to recycling and recovery is that most of the recovery efforts focus on the downstream portion or the last mile. Therefore, closing the loop connected to packaging waste depends upon a variety of factors and the waste collection system deployed by a municipality should be just one of the factors affecting the overall recycling rates instead of the critical role that today's plays. Other factors that have a bearing are sorting and recycling methods, competition between recycled and virgin materials, price volatility of recycled materials, waste management policies, level of education and participation, and associated financial incentives (Tallentire & Steubing, 2020).

Therefore, to try to build a circular packaging waste framework some need to look at it from a systemic waste management perspective and acknowledge the necessity of a better packaging design and technology advancements at the sorting and recycling stages (Rahimi & Garcia, 2017). Furthermore, it is noted that more detailed mapping of resource movements along company and sector value chains is required, as well as analysis on value creations and economic impact of products and companies, which is becoming increasingly possible due to recent technology developments (Preston, 2012; Song et al., 2017). Indeed, today we have a group of technological tools available (Wang et al., 2019) that can also enhance the circularity of packaging waste.

2.3 Digitalization enhancing the circular economy

Often defined as the increase in the use of digital technology, digitalization is a process that generates business change using digital capabilities (Torres de Oliveira et al., 2019). This transformation is characterized by four main aspects: The “vertical networking of smart production systems”, “horizontal integration”, “through engineering” and “acceleration through exponential technologies” (Deloitte, 2015, p. 1).

Fast and strategic utilization of technologies such as the IoT (fast automated data transaction and collection through a system of interconnected digital devices), AI (data processing augmentation beyond human reasoning), virtual reality (new communication and experience method), robotics (industrial production enhancing work automation), 3D printing (new production method), sensors (production process monitoring method), big data (data processing and interpretation) and blockchain (records linked by cryptography for increased transparency) amongst others, promises increased competitiveness and reduced operational risk (Peruffo et al., 2017).

It is widely accepted that digitalization will promote the CE by enabling more efficient use of fewer resources through the provision of accurate information and visibility of resources and products, ultimately resulting in the closure of resource loops. Enabling the utilization of intelligence on not only material availability, but also its location and condition, digitalization helps achieve efficiency gains by minimizing transaction costs and waste through the promotion of more durable products (Antikainen et al., 2018).

For example, a move to servitization is considered a crucial CE accelerator, as it involves the combination of durable physical products with intangible services designed to fulfil customer needs replacing the generation of profit through the sale of artefacts with that of cost and material efficient reuse. The utilization of digital technologies, such as cyber physical systems, big data, data mining and analysis, IoT, as well as AI, blockchain

technology, and smart products have the potential to allow for improved product design, new value creation, and the capture of opportunities that reduce resource use, improve material transparency, traceability, reliability, and trust within the global value chain, as well as product performance optimization. Further benefits can be enhancing product innovation, better attraction of the target customer segment, improved technical support provision, customer satisfaction, ease of collaboration with stakeholders, and higher profit through the sale of data. Lastly, maintenance and product upgrades could be better planned and targeted, if product use, and end-of-life activities were optimized (Bressanelli et al., 2018). In short, CE requires the careful coordination and optimization of the entire value chain (Fischer & Pascucci, 2017) and digital technologies have the potential to enable decision makers to comprehend vast amounts of data to make effective, accurate, and sustainable decisions, as well as to control information and material flows.

However, past literature (Pagoropoulos et al., 2017; Tseng et al., 2018) explained the limited research on the opportunities created by, as well as the challenges hindering, digital technology-aided circular business model implementation. However, research does suggest that the main challenges in relation to CE and digitalization are financial (benefit measurement), structural (lack of information exchange, unclear responsibility), operational (infrastructure & supply chain management), attitudinal (perception of concept and risk, willingness to collaborate), technological (product design & operational technology integration), and educational (competency requirements) (Antikainen et al., 2018). Thus, further research is required to determine how barriers can be overcome theoretically and practically.

3. U.N. Sustainable Development Goals, Emerging Economies, and Large Multinationals Responsibility

The 2030 agenda for sustainable development published by the United Nations provides a guide for achieving the goals of peace and prosperity for our planet (United Nations, 2020).

At the heart of the blue print are the 17 Sustainable Development goals which are the clarion call for all the nations, irrespective of their developmental stage, to collaborate in developing a partnership in order to pursue economic growth while balancing the issues pertaining to health, state of our cities, justice, pollution, equality and state of the oceans and earth.

Packaging waste is relevant to at least six of these goals: Goal No 6: Clean Water & Sanitation; No 11: Sustainable Cities & Communities; No 12: Responsible Consumption and Production; No 13: Climate Action; No 14: Life Below Water; and No 15: Life on Land.

If developed economies already have mechanisms in place that will allow them to tackle some of the UN goals (World Health Organization, 2016), the reality in EEs is very different (George et al., 2016). Indeed, most of the waste increase is expected to come from emerging economies (World Bank, 2018b) – please refer to Table 1. Within the context of emerging economies, tackling the waste problem is a bigger challenge in the urban areas since they are the ‘engines of growth’ (Duranton, 2009) but also the ‘agents of change’ (Vliet, 2002).

Insert Table 1 around here

Because of their economic development, countries in Asia have attracted large corporations, many of which are large MNEs – please refer to Table 2. For example, Hindustan Unilever, the Indian subsidiary of the consumer goods major Unilever, is expected to become the largest subsidiary for the global giant Unilever, by surpassing the US unit by 2027 (Malviya & Sriram, 2017). Having an annual estimated growth rate of 9%, it is the fastest among all of the Unilever’s markets. The Indian subsidiary is already the largest market for Unilever in terms of volume and nearly 45 billion units are produced annually at the company's factories across India and nearly 98 per cent of households in India use one or

more Unilever brands. Similarly, Proctor and Gamble (P&G) India controls over half the diaper, sanitary napkin and shaving razor market in India (Malviya, 2019). Not surprisingly, large MNEs are responsible for more than 95% of packaging waste in countries like India – please refer to Table 3.

Insert Table 2 and 3 around here

Having in mind the importance of urban spaces on EEs and how much large MNEs contribute to the packaging waste problem globally, we focus this research on how these large MNEs can be agents of change, or at least participants of change, on urban emerging economies' settings. However, due to its complexity, waste requires an integrated approach where governments will also be an important stakeholder.

3.1 Institutional initiatives

Several governments are making a stance on waste. For example, in 2019 the European Parliament approved a ban on a wide-ranging list of single use items². In addition, financial measures such as offering deposit refund programs have been encouraged to ensure collection of 90% of single-use bottles by 2025. In India, Prime Minister Narendra Modi is keen to stop the use of single use plastic in India by 2022 and has asked businesses to do their part in order to accomplish this goal.

However, it was the Indian SWM (2016) law that created a regulation that puts the onus on the brand owners for collecting their products' packing waste or packet for sanitary waste. Its article 17 (2) reads: "*All manufacturers or brand owners who sell or market their products in such packaging material which are non- biodegradable shall put in place a system to collect back the packaging waste generated due to their production*"; and article 17 (3) reads: "*Manufacturers or brand owners or marketing companies of sanitary napkins and diapers shall explore the possibility of using all recyclable materials in their products or they*

² Single-use plastic items, including straws, cotton swabs and disposable plastic plates and cutlery, to be banned by 2021.

shall provide a pouch or wrapper for disposal of each napkin or diapers along with the packet of their sanitary products.”

This document also articulates the need for business firms, communities, and NGOs to work together with the local municipal authorities, in order to deal with the large quantum and composition of the municipal solid waste. As a part of this integrated³ approach to managing municipal solid waste, producers have to put in place a proper mechanism to take back the waste caused by their brands if they want to keep operating under the Indian legal framework.

However, due to the institutional voids present in India, as in many other emerging economies, large MNEs are able to dodge this because of the lack of coordination between various local and regional governments, an archaic legal system, minimal use of technology, absence of data, and a lack of a legal enforceability system. In one of our interviews a municipal commissioner in the government of Maharashtra, India, stated:

“It is more than three years since the Solid Waste Management Rules 2016 have been notified. The regulations require companies to take back their waste but they don’t do it. We have sent them legal notices but they don’t bother to respond to them. They are not providing pouches for the disposal of sanitary pads and they just don’t care about the consequences. The rules don’t specify the deterrents for non-compliance with the Solid Waste Management Rules. We have limited powers and believe me there are so many challenges that we have face here...we need to be empowered and the companies need to get the message that they cannot just come sell and leave us to clean up the mixed waste....”

Thus, proper implementation of the policy continues to remain a challenge (Agarwal et al., 2015). Large MNEs, on the other hand, follow a ‘*not in my backyard*’ attitude, which exacerbates the problem.

4. Methodology

³ An integrated solid waste management approach adopts a strategic view by considering the generation, segregation, transfer, sorting, treatment, recovery, and disposal of waste in an integrated manner, with an emphasis on maximizing efficiency of resource use. The role of the Central, State, and Local Governments in Municipal Solid Waste Management has been elaborated in the document published by the Ministry of Housing and Urban Affairs of the Government of India.

Buckley et al. (2017) expressed the importance of phenomena-driven perspective as a way to address and tackle the big questions and grand challenges. Others stressed how qualitative methods are important for understanding real-world phenomena and for future development, but also found that outstanding qualitative research in top journals was conducted under single case studies (Cuervo-Cazurra et al., 2016, p. 884), namely the Tomioka Paper Company (Brannen & Peterson, 2009) and the Ikea case (Jonsson & Foss, 2011).

Welch et al. (2011) explained that case studies can follow different paths. Due to the problem in hand, a phenomenon that is seemingly different from past theories and the available frameworks, in this research we decided to follow a contextualized explanation (Bhaskar, 1998). This method was particularly relevant for this research as we knew that we would be analyzing a dynamic and complex set of mechanisms that we wanted to deal with from a holistic perspective. Thus, we followed a deductive approach by grounding our observations and theorizations on past theoretical frameworks.

5. Data Collection and Analysis

The topic of this paper is of an exploratory nature, concerns a contemporary and novel phenomenon, and has the potential for theoretical development. Therefore, we followed the literature recommendation to employ an in-depth longitudinal case study approach to gain rich qualitative insights (Eisenhardt, 1989; Eisenhardt & Graebner, 2007; Yin, 2013).

Such a qualitative research approach, and particularly longitudinal case-studies design, have been advocated for addressing contemporary or novel phenomena which can challenge previous theories or models (Eisenhardt, 1989; Eisenhardt & Graebner, 2007; Ghauri, 2004; Yin, 2013), particularly because of its very nature of being illustrative and explorative. With this approach we gained an invaluable opportunity to obtain and interpret rich data and information in order to shed light on underexplored research areas, as tracing the experiences of the stakeholders who are part of the packaging waste chain, such as

users/waste generators, collectors, urban governance bodies, waste dealers, start-ups working in waste, management committees of large residential societies, researchers, waste landfill site staff, and corporate managers. From a secondary data perspective, we also studied the existing policy guidelines, large urban residential societies reports and other documents, and company reports to understand the mechanisms associated with the incentives to the different stakeholders to tackle the packaging waste problem.

4.2 Gathering data

We started gathering data through semi-structured interviews (Easterby-Smith et al., 2012). We selected the number of interviews based on considerations of theoretical saturation, as suggested by Glaser and Strauss (2017). More specifically, we continued our interviews until the explanations and knowledge obtained from additional interviewees were very similar to the explanations and knowledge already obtained (Bryman, 2004; Eisenhardt, 1989).

This process resulted in 45 interviews, totalizing almost 65 hours, more than 20 video clips, and over 150 photographs. The interviews were conducted from March 2018 to June 2019. Our approach involved interspersing the field work, which covered various stakeholders involved in the waste value chain, with the views of functional, business, and policy experts from this field – please refer to Tables 4 and 5.

Insert Table 4 and 5 around here

Interviews were conducted both in Hindi, Marathi, and English. We decided not to edit the interview transcripts (e.g. by correcting any grammatical or language-related errors) and to use direct quotes when the interviewees responded in English to avoid the risk of altering the meaning of their explanations. We further ensured verbatim translations from Hindi and Marathi into English in order to keep the meaning of the conveyed explanations.

In addition to the interviews, there were several observations conducted by two of the authors on different settings such as the process of doorstep waste collection in urban

residential societies, segregation/aggregation of packaging waste, transport by the municipal authorities to the landfill for further processing, among others. The authors also spent a large amount of time in scrap sheds understanding and observing the waste segregation and sale process and speaking to municipal officials to understand the challenges with regards to waste management implantation.

Apart from this in-depth longitudinal work, we collected secondary data and information through company reports, websites, urban residential societies reports, news media, and reports and publications from the United Nations on the SDGs⁴, Indian regulations, among others.

4.3 Data Analysis

The main technique of data analysis used was template analysis, even to have a methodical structure of the gathered data and information (King, 2012). We selected the computerized analysis software NVivo, which aided us in analyzing the complex and large quantity of collected data and information. Due to the large abundance of information from our cases, we needed the triangulations of primary and secondary data sources, as suggested by Ghauri (2004), to avoiding common-source biases and anecdotal accounts. Given the exploratory nature of the topic, we designed our semi-structured interviews in a way to allow ample time for open-ended questions that aided us in exploring new knowledge and information and incorporating these in subsequent interviews.

5. The cases

Municipal Solid Waste in India

For the purpose of this paper, we have chosen to explain the answers to our research questions against the backdrop of the waste generated in the urban Indian household context by particularly looking at large confined residential compounds, also called residential

⁴ For example: <https://sustainabledevelopment.un.org/?menu=1300>

cooperatives housing societies (RCHS). India is among the top 10 countries in the world generating the highest amount of municipal solid waste. In 2019, India alone generated around 62 million tons of solid waste and this number is expected to increase to 165 million tons by 2030 (Ministry of Environment, 2016). About 70-75% of this waste remains untreated (Sharholly et al., 2005) and is mostly dumped into landfills.

Our fieldwork was carried out in the Pimple Saudagar area of Pune, India. The city is the second biggest city of the state of Maharashtra. There are two municipal corporations which are operational in Pune, namely the Pune Municipal Corporation (Pune Corp) and the Pimpri Chinchwad Municipal Corporation (Pimpri Corp). Our fieldwork was conducted in the latter area because there are many large housing society clusters and due to its fast growth that relates to the availability of information technology (IT) jobs. This, in turn, has attracted a large number of educated individuals and led to the creation of cosmopolitan communities that are relatively more open to experimenting with IT prototypes and are savvy with using various mobile applications and tools.

Past literature in the domain of waste management (Marello & Helwege, 2018; Zhang et al., 2010) has highlighted the challenges and the limitations faced by the administrative machinery, and the case of the municipality under study is no different. The Pimpri Corp generates about 750 tons of garbage waste and in 2015 spent nearly USD 1.3 million for distributing garbage bins (green and white) to around 480 thousand families for segregating the wet and dry garbage (More, 2019). The Pimpri Corp has spent close to USD 32.5 million in waste management for the period 2008-2017. This expenditure is expected to go up to USD 92 million for the period 2018-2026.

Following the SWM (2016) law, Pimpri Corp made it mandatory for their residents to segregate garbage into dry, wet, hazardous, and electronic waste. This waste segregation initiative was launched on June 5, 2017, which was designated as the World Environment

Day by the Commissioner of the Pimpri Corp area. The move was prompted by the fact that Pimpri Corp slipped to 72nd position, in its Swachh Bharat ranking in 2017.

From a municipality perspective, they started tackling this problem by looking at RCHS due to their large number of residents. Following the government movement, and given the magnitude of the problem, we decided to investigate RCHS within the Pimpri Corp catchment.

5.1 Case Study 1:

Roseland Residency Cooperative Housing Society

One of the places that Pimpri Corp picked to launch their waste segregation initiative in 2017 was the Roseland Residency Cooperative Housing Society (Roseland RCHS). Roseland RCHS is among the oldest and biggest residential societies in the area. There are 37 buildings in the society and it has approximately 1,200 apartments, which house about 4,000 residents.

Following the initiative from the local movement, the Roseland RCHS took several actions. First, it started garbage segregation and electronic waste management. Garbage is segregated by the residents into three categories: organic, recyclable (packaging), and reject sanitary waste - achieving nearly 70-80% segregation at source – see Figure 1. The segregation and composting efforts have not only helped the society to earn awards like the Prime Minister National *Swachh Bharat Award*, but have also enabled the society to sell the compost and generate revenue. The compost is primarily used for gardening. Second, it started a water conservation program by rationing water supply during the peak summer months, collecting rainwater for harvesting, and a conscious ban on using tanker water. The main and only source of water supply until 2016 was the borewells situated on the campus. A third initiative was related to bird feeders. There are bird feeders and water dispensers installed throughout the society. This has helped to revive the declining sparrow/bird population. Fourth, the society enhanced a power savings scheme by switching to LED lights,

which helped towards achieving power and carbon reduction targets. As a result of the management of the RCHS, the temperature inside the society is nearly two degrees cooler than outside. Fifth, the society installed a sewage treatment plant. The water that is used by the residents is treated and reused for gardening. Sixth, the society installed solar power panels to generate renewable power within the complex. This will also help them save money in diesel costs for powering the electric generator.

Other initiatives conducted by the Roseland RCHS were related to reducing waste. For example, over the course of the past three years it created a partnering for social causes initiative where the society organized clothes collection for unfavorable communities such as GOONJ⁵. The society also created a material recovery facility area where residents are encouraged to drop-off the hard to recycle items such as glass, broken bulbs and tube lights, clothes, plastic bottles, among others. Various recycling companies collect these items for onward processing. Finally, the society tries to bring the young generations into the waste management problem by creating a children's army of 'Plastic Warriors' to collect the plastic waste from households and send it onward for recycling – see Figure 2.

As one of the householders said: *“There are a lot of initiatives that our society has undertaken towards environment and social sustainability and it's really a nice place to live. Even after nearly 12 years, our residential complex is among the cleanest and safest places to live. We have revived the sparrow and have got many awards over the years. In fact, it is easy to sell an apartment in this society because so many people want to buy an apartment here.”*

Insert Figure 1 and 2 around here

5.2 Case Study 2:

Kunal Icon Cooperative Housing Society (Kunal)

⁵ https://goonj.org/page_id=22873/index.html

Kunal Icon Cooperative Housing Society (Kunal RCHS) is spread over 76,891 square meters space and has a total of 873 apartments and houses. There are approximately 4,000 residents in the complex. They are located in close proximity to the Roseland RCHS. The push for undertaking segregation of waste was spurred due to the Pimpri Corp directive to manage waste and from the election of a new management committee that was keen to support Prime Minister Modi's initiative called 'Swachh Bharat Abhiyan'⁶. The Kunal RCHS has undertaken similar approaches to sustainable living approach when compared with Roseland RCHS. Kunal RCHS also used rainwater for harvesting, which helped the society to remain water sufficient from July to November every year as compared to other residential complexes in the municipality area, which have to depend upon water trucks ferrying water. The society also has solar power generation to reduce the dependence upon the power grid. This activity also qualifies for earning credits required in order to get a property tax waiver. The Kunal RCHS has also been involved in tree plantation activity in order to keep the campus verdant, even to qualify towards earning points that are reverted in property tax credits. A material recovery center was also set-up for the purpose of collecting plastic, cardboard, papers, and electronic waste. Interestingly, the Kunal RCHS included a disposable sanitary pads incinerator to prevent soiled sanitary waste from leaving the campus. This also prevented waste workers from coming in contact with such items, and to reduce the possibility of further contamination.

In this society, compost preparation from the food waste and scraps was done in-house. The food waste (wet waste) was collected from each building and thereafter weighed using a digital scale. A shredding machine was used to shred the food scraps into smaller particles and thereafter natural composting techniques were used, wherein microbial culture along with an assortment of Indian herbal plant treatments was applied to the mixture placed

⁶ Swachh Bharat Abhiyan : Clean India Mission (Urban and Rural) see <http://swachhbharaturban.gov.in/> for the details of the clean India mission urban.

in composting pits (aerobic process). The task of doorstep collection of food and recyclable waste, incineration of soiled sanitary napkins and compost preparation was handled by three different vendors.

6. Findings

Based upon our fieldwork on these two residential societies, which are similar to many others all over India, and after talking to different stakeholders we found some commonalities.

First, we found that there is a desire and ability among communities to find solutions to the mammoth problem of managing waste. As the Chairperson of the Roseland RCHS put it:

“We want this to be a great place for people to live and raise families. Therefore, we know that it is up to us to keep this place clean and livable. We just have to step out the precincts of our gates to see the contrast between the cleanliness and hygiene standards that we have maintained in our residential complex versus what is available outside. We also involve our kids in understanding the need to segregate household waste properly, so that this habit is imbibed in them right from a very young age. This is our country and it’s our moral and civic duty.”

However, these intentions were linked with institutional support. For example, it was interesting to realize that instead of reprimand measurements, the municipality decided to incentivize RCHS and compounds in waste segregation and other sustainability initiatives, namely by introducing tax waivers⁷. Moreover, and in order to encourage community participation in eco-friendly activities, particularly waste segregation, the municipality also introduced an innovative program to offer a waiver on the property tax for its residents based upon on several criteria – please refer to Table 6.

Insert Table 6 around here

We also found that monetary incentives such as property tax breaks introduced by the municipalities and presence of other incentives such as public recognition among peers helped to secure a “buy-in” and hasten the transition from a ‘*not my problem*’ to a ‘*our community problem*’ as the community started participating in segregation to a point where it

⁷ <https://timesofindia.indiatimes.com/city/pune/property-tax-waiver-for-eco-friendly-societies/articleshow/60771357.cms>

is segregating nearly 85% of their solid waste. Furthermore, we found that the initial stages of building awareness, overcoming resistance and convincing residents is very tough.

However, the RCHS created the ‘waste champions’ as they knew that attitudinal change is a long process that can result in a lot of friction. Some of the society’s managing committee members explained that it is only after receiving accolades and success that things become a bit easier. As a committee member said: *“It would helpful to have a forum wherein such work is recognized so as to motivate more waste champions to come and take the work forward in their respective communities.”* The same managers explained that there are generally one or two persons who are spearheading the task of awareness building, overcoming any resistance, and ensuring that the segregation continues on a daily basis.

Another finding from our field work relates to the various innovations that occur at the grassroots level, especially while managing the entire activity on a limited budget and in the midst of a skeptical audience. This can be in the form of design of the structures, equipment, and processes. In both of the above societies, the group driving the waste segregation initiative had produced design innovation pertaining to the compost pits, marking of sanitary waste, rainwater harvesting methods used, and the push carts prepared for collecting the waste at the door-step level. Interesting, however, is the extent of the usage of social media for publicizing the initiatives taken⁸ as it was different between the two residential societies.

Nonetheless, with these palpable achievements, not everything went smoothly on this transition to a more sustainable residential society. The indifference regarding the inability of the existing municipal machinery to cope with the volume of waste, namely packaging one, and the lack of awareness regarding the harmful effects of items such as used sanitary

⁸ See Roseland Residency Cooperative Housing Society’s website here : <https://www.facebook.com/roselandresidency4> and Kunal Icon’s Waste Warriors here : <https://www.facebook.com/groups/Kunaliconwastewarriors/>

products were challenges. Moreover, marketing the compost made from the food waste was a challenge faced by both residential societies. In the absence of suitable sales avenues, this resulted in the stockpile of the compost inventory causing space problems. The managing committee member who is in charge of the waste management project in Kunal RCHS said:

We are meticulous in segregating the food (organic) waste and preparing compost by following the aerobic method. We spend about USD 785 per month for offering door step waste collection facility to our residents and our capex cost for constructing the compost pits, procuring materials, labor, etc. for constructing 5 compost pits was about USD 1 200. In fact, our compost is of a very good quality but it is difficult to market the same. As a result, it piles up and occupies a lot of space...marketing linkages for the compost should be developed.

Our interviews also pointed to the fact that both RCHSs were interested in partnering with the municipality and commerce companies in conceptualizing/implementing solutions that involved minimizing waste or enabling efficient collection of the waste generated by brands. In the case of Roseland RCHS, for example, they had volunteered to be part of an exercise to test market a new product design for sanitary napkins and diapers by the leading brand leader in this space. The Chairperson of the Roseland RCHS said:

“Since we are a community of approximately 4,000 people, we get a lot of packages ordered via the ecommerce websites. Another contributing factor is that since most of our residents are people working in the IT space, they are comfortable in using the internet for their purchases. During promotional events conducted by the ecommerce companies, such as mega sales and festival promotional offers, we get a lot of packages that are discarded as waste. Quite a lot of these packages can be reused, but since there is no incentive to hold on these packages, people just throw them. We are willing to work with ecommerce players in order to contain this waste. We can set aside some additional space in our premises for the recovery of the resource such as good sturdy cardboard boxes, plastic covers etc. which can be reused. In one location itself the ecommerce company can get back what would otherwise be treated as waste – and convert it into an item that can be used to service the next order and so forth.”

6.1 Use of Technology:

Both the residential societies used a semi-automated approach for their administration purposes. In the case of Roseland RCHS, usage of technology has evolved with the passage

of time and increase in the number of residents. In the time period 2009-2011, the main medium of communication was the email. A Gmail group was created for information exchange purposes. Further, a Facebook page was also created⁹. Subsequently, a WhatsApp group was created, and the e mail account was discontinued. Roseland RCHS uses the ADDA software for managing its administrative activities. External reports to be submitted to government authorities are prepared using a combination of MS office tools along with the ADDA software. Roseland RCHS also has its own website.

Kunal RCHS, on the other hand, uses the Tally software for its accounting purposes. Vendor bills are received either via email or through a physical copy and paid by updating the relevant expense head in Tally. Unlike Roseland RCHS, which does not track its organic waste to compost data, Kunal RCHS maintains daily records of the organic (food waste) collected from each building as well as the amount of compost harvested every month. This data is maintained in excel and detailed records are kept of the quantity harvested, sold, and price sold. They also use WhatsApp for communication and have created a group on Facebook called the 'Kunal Icon Waste Warriors'¹⁰ to discuss the concerns and challenges related to waste management in the society. Kunal RCHS also has a website¹¹. Both the residential societies also use You Tube for posting videos that highlight their sustainability initiatives, and celebrations¹². The managing committee members and the residents of both these RCHS are cognizant of the power of the visual medium in spreading the word regarding their work by providing a visual documentation to government officials, prospective buyers and corporate sponsors, and the media. It also seems that the residents are open to try new things as one of the residents stated: "*...there are still many things that we can do to reduce*

⁹ see <https://www.facebook.com/roselandresidency4>

¹⁰ <https://www.facebook.com/groups/Kunaliconwastewarriors/>

¹¹ <http://www.kunalicon.com/home>

¹² https://www.youtube.com/results?search_query=roseland+residency and https://www.youtube.com/results?search_query=kunal+icon

the waste generation. We are about 4,000 people so even small steps can make a huge difference. Our society is always ready to try out new initiatives.”

During the course of the data collection in Kunal RCHS, one of the authors piloted the idea of developing an app for capturing the household related waste segregation pattern and behavior. A functional document was prepared after studying the daily waste segregation behavior. The application has been conceptualized with the purpose of gathering user level ‘first mile’ data of which there is a great paucity in the present context. Availability of the first mile data (i.e., individual user level waste segregation pattern data) can help to reward good behavior through appropriate recognition and reward in a data driven manner.

7. Discussion

Packaging waste management is a complex issue in any setting. However, packaging waste management in low institutionalized countries, such as emerging economies, is even more complex due to the institutional voids that are present. Notwithstanding this, some countries, such as India, have in place laws and regulation that require and push the agenda for a CE on packaging. A case in point is the SWM (2016) law in India as previously mentioned.

With this research we start to uncover the black box that brands created around the divorce between products and packaging. Brands, and particularly large MNEs of fast-moving consumer goods, need to rethink the way they look at their product as consumers will more and more follow an integrative approach where packaging is part of the product. This approach is also in the government’s and individual’s interest.

However, and due to the resource constraints and other limitations, the enforceability of such regulations is not effective, leaving brands to operate on a linear economy (Ferreira et al., 2014; Huysman et al., 2017). However, and having in mind the stakeholders theory and a CE approach, combined with some of the features offered by some emerging technologies, we believe that the right systems with the right incentives can help in alleviating the situation

by enabling better tracking, higher participation by the stakeholders, better governance of waste, and enabling opportunities that can help to harness the efficiency of recycling packaging waste. In our framework some of the emerging technologies like mobile applications, geographical information systems (GIS), AI, and blockchain act as catalysts to enable the implantation of an incentives stakeholder approach towards a CE.

7.1 The incentives

Past literature (e.g., Brehmer et al., 2018) explains that apart from conducive policies and governance and product design, the other critical elements of the CE is the ability to have business models that focus on value creation, rather than booking short term gains, to the different shareholders and that incorporate the extended producer responsibility guidelines. Thus, a truly integrated approach towards moving to a CE requires participation from all the major stakeholders. It is only then that it is possible to move towards an economy that is restorative and regenerative by design (MacArthur, 2013). To do so, more than a system based on penalties, which tend to not work on low institutionalized countries (Torres de Oliveira & Rottig, 2018), we suggest a business model that incentivize the different main stakeholders involved.

Thus, an aligned incentives schemes needs to be in place for the primary stakeholders involved: Large MNEs, local authorities, residential societies (RCHS in our case), and individuals. Therefore, we start by explaining the incentives for each of the primary stakeholders.

As our cases demonstrated, individuals and RCHS can be easily incentivized by tax relief. Thus, the residents living in large RCHS have the incentives to qualify for any incentive programs being administered by the government agencies. Apart from that, residents will want to have cost savings due to being able to purchase refills of various items that are package free, benefit from higher visibility and potentially quicker sales of their

properties, and possible tie-ups with companies who are interested in partnering for undertaking CSR policies, which can potentially lead to financial benefits.

During our fieldwork we found that our studied RCHS, apart from the tax incentives, emerged as pioneers in adopting sustainability practices and got noticed either through social media and other media channels. This entailed benefits such as: a) quick turnover of the residential units put on sale as there was a keen interest in buyers to acquire a property in such ‘visionary clusters’, hence residents found communities like Roseland or Kunal RCHS to have similarity to western initiatives among citizens to adopt sustainability practices; b) the spirit of the residents to work together in order to solve basic needs issues such as availability of drinking water and maintenance of public spaces, which meant that most of the residents knew each other and instances of crimes like theft and robbery were virtually absent; c) these RCHS were seen as ‘leaders’, which brought good will. These best practices, interestingly, spurred on many other surrounding RCHS that, in turn, have resulted in an atmosphere of healthy competition and quicker speed of adoption, which is also beneficial to the municipality, environment, and the population in general.

If the local government will be losing revenues due to the tax incentives, it will be recovering it through lower waste management required and also because informal economy will be reduced, namely from waste pickers and waste collectors. Urban local bodies spent between USD7- USD14 per ton on solid waste management (Kumar et al., 2017) whereas the collection & transportation of waste constitutes approximately 80-95% of the total budget allocated for municipal solid waste management (Sharholly et al., 2005). So, the potential financial benefits are indeed high. The local governments have, thus, several incentives that range from less waste to management, decrease of the informal economy, not being accountable for not enforcing the SWM (2016) legislation, among others.

However, to close the loop it is necessary to include large MNEs, owners of the most important brands used on emerging economies. At the moment, their incentive to take care of their packaging is very reduced and almost only ethical, as these corporations take advantage on the lack of the legal enforceability in emerging economies, where India is a case in point (Luo & Tung, 2007). As these large MNEs are originally from developed economies they should understand that their base home country consumers have high expectation in terms of CSR behavior, which include packaging waste. Moreover, host country consumers, namely from emerging economies, are also becoming more aware of the impact of these large MNEs and how they are impacting their lands (Purohit, 2009). Thus, large MNEs need to rethink and be the agents of change towards close the cycle of waste and even to ensure a sustainable approach in their local business practices and thus to ensure the firms' existence in the long run. The perception that consumers have of the firm's operations and ethical behavior is paramount (Moore & Manring, 2009) and this is in itself the firm's main motivation to do what is right and within the legal framework, even if such framework is not enforced.

Institutions can use, for example, their roles as promoters or detractors of large corporations based on their legal and moral behavior. From a moral perspective, researchers stress the need for an increased role of corporations in solving the challenges that affect the society, environment and economy (e.g. climate change, pollution, income disparity). A negative message issued from a local or regional government in an emerging economy towards a global MNE can easily and quickly spread around the globe with huge impacts on their image, reputations, and client base.

The local governments can also incentivize the large MNEs instead of following a punitive system. For example, quicker turnaround times and discounts on the renewal fees for state licenses, publishing the success stories via the internet and even promoting, for free, best practices from large MNEs. Furthermore, large MNEs could start saving financial

resources by applying a package-free refills approach. Initiatives to opt for package-free refills can be rewarded based upon the cost of the packaging saved, when compared to the actual purchase plus the environment benefit that can be translated in wellbeing. A case in point is soap and shampoos: customers can bring their own refill containers and avail of a monetary discount. If this practice might not be feasible for developed economies, the business model literature pointed to how effective small financial benefits and costs are in emerging economies (London & Hart, 2004; Seelos & Mair, 2007).

In summary, the main incentives for the large MNEs to adopt a CE approach for their packaging are: 1) Remain within the legal framework that will become more stringent around the different settings; 2) Fulfil their sustainability commitments, namely in terms of carbon emissions and waste footprint; 3) Follow their CSR framework by doing what is ethical and responsible for the society and the environment; 4) Follow what their different stakeholders are demanding in terms of packaging; and 5) Make sure that they do not deceive customers' expectations, as it seems that is already happening:

"...so many things are possible but the companies [MNEs] don't want to think outside the box. They will spend millions of Indian Rupees in advertising expenditure but don't want to do anything at the grassroots...all this CSR is just a farce because there is nothing that they are doing in cases where there is so much scope to make a difference..." - Roseland resident.

8. Rethinking packaging waste: Towards a circular economy framework using emerging technologies

From an institutional perspective, current policies are still focused on waste management while in the CE the very idea of 'waste' is considered redundant. Waste from one process becomes the input for other products and the products are designed to prevent waste. Waste management policies and product development policies become linked to each other, resulting in the creation of policies and activities that enable circular flows. We suggest

closing this policy-implementation gap by means of a CE framework that incorporates a community led, data driven approach to facilitate governance and establish accountability. Having that in mind, we developed a CE framework that makes use of emerging technologies, namely blockchain, mobile applications, GIS, and AI. Doing so, this framework has the intention to promote sustainable communities and close policy gap implementations, which is particularly important for EEs (Weber, 2003).

Our framework shows (please refer to Figure 3) a model wherein some of the emerging technologies have been applied to achieve accuracy, efficiency, transparency, and accountability among the various stakeholders with respect to managing packaging waste. An important part of our framework is the tax incentives in place towards RCHS and residents and at the same time the focus on large MNEs on taking care of their waste. Thus, our framework was created with a sustainability fund in mind, which is funded by a group of large MNEs.

Insert Figure 3 around here

In order to control the quality of segregation as well as get details of the composition of the recyclable waste, a mobile app with AI technology can be used to determine data about a) brand; b) brand owner/manufacturer; c) type of packaging material; d) number of pieces of the same package present in the dustbin of the respective household; e) size of the package; f) weight; g) whether there is any dry waste (recyclable waste) mixed in the wet waste (food waste bin); h) whether the waste was segregated into 3 categories or fractions as required; i) whether the waste was handed over for further processing to the waste picker in a timely manner; and j) and other miscellaneous information, depending upon the level of detail required. In case there is a default by the householder on any of the activities listed above, an SMS can be sent to him/her for information and corrective action. A system of decreasing incentives can be instituted to prevent repeat lapses.

On the other hand, local authorities need to have control systems in place to proceed with the incentives. This control can be done in several ways, but blockchains can be an extremely handy solution. The rationale for recommending blockchain is that according to past literature it is recommended when: i) the transactions currently involve multiple parties and require not only the assurance of an intermediary, but also a precise and immutable record of transactions (Wüst & Gervais, 2018); ii) have potentially competing incentives (Yermack, 2017); iii) retroactive manipulation of data is a risk (Irving & Holden, 2016), iv) multiple uses of the same asset are very likely (Wang & Kogan, 2018), and v) no central trusted authority is available/wanted (Torres de Oliveira, 2017). In such scenarios, blockchain offers a disintermediation solution when all the intervenient will be able to be used in a traceable and transparent way. The data for each household will be updated in a database that can be mounted on a blockchain in order to prevent data tampering.

In our framework, the physical waste can be sold to waste dealers and the details can be updated on the same database. The physical reconciliation (i.e., the actual pieces sold versus digital reconciliation, which represents the quantities updated via the mobile app) can be used for verification. It is possible to do an audit of the physical and digital categories. Conducting a physical waste audit can also be another method of cross checking the data and its veracity. Using the features of the blockchain technology, it is possible to track the onward journey of the packaging waste, to ensure that it is disposed of in a suitable manner and not discarded in an unscientific manner. This ability to track the entire journey of the waste right from the first mile (point of creation) to the point of disposal (last mile) is possible due to the power of an integrated approach involving all stakeholders.

The access to the audit trail of the transactions can enable various stakeholders to verify the authenticity. Based upon the quantum of recyclable waste processed and managed in-house by large RCHS, a daily update of the funds due to them by the manufacturers/brand

owners can be available. Physical funds can then be transferred on a pre-specified frequency. For waste that cannot be categorized or attributed to a manufacturer (small chance given that AI has the capability to work with large datasets) such items can be charged to a 'Suspense Account'.

Every brand owner/manufacturer should be required to contribute to the sustainability fund in proportion to their market share and a smaller fee into a Suspense Account. The existence of a separate Suspense Account will also help to isolate and track such cases in detail.

This data based approach can also encourage corporations to think of integrating principles of CE approach in their business strategies as they may find it more profitable to manufacture products that last longer, offer repair and refurbishing services to extend the life of some of their products, or consider package free options like refills of certain items. The thick arrows in the diagram indicate the flow of funds while the thin arrows indicate the process flows. The non-linear thick arrows indicate that the data generated can be used to create a sustainability map, which can help to disseminate the performance of the various housing communities.

The contribution into the fund can be made by using the market share data/sales data reported in the statutory filings of these companies. Housing communities that are undertaking the task that is actually the responsibility of these large MNEs should be compensated based on the amount that is recycled. The work done at the housing society level can be certified by an independent audit committee. This committee can comprise people from diverse skill sets such as social scientists, environment experts, policy experts, NGO's, students, government representatives, and waste workers. Smart contracts can be used to execute the payments from the sustainability fund into the accounts of the cooperative housing society (residential cluster). The back end of the data can be mounted on blockchain

to keep traceability. For the purpose of explaining the mechanics of the operation of a sustainability fund, we have used the data from a recent waste audit report published by GAIA¹³. This waste audit exercise was undertaken in 2018, across 15 cities of India. Volunteers collected 46,100 different packaging waste items to gather evidence about the situation at the grassroots level. This is presented in tables 7.

Insert Table 7 around here

Having an arrangement wherein waste pickers are able to collect and segregate the waste within the precincts/in close vicinity of a large residential cluster, such as RCHS, can help them earn a livelihood that is based on a fair wage and work in relatively good working conditions. This approach can also help the waste workers get a fair compensation for their efforts and earn their livelihoods in a suitable setting instead of operating from the roadside makeshift segregation points, located in unsafe areas/spaces from where they operate to escape harassment and abuse.

Furthermore, local authorities can create digital open source solutions to promote the sharing of the principles of CE via a web map. The idea is to use this web map as a means of communication to help in transmitting the best practices and aid in monitoring the sustainability practices being followed by different clusters by publishing a ‘Sustainability Index’. Different clusters based upon their efforts over a period of time, can have different indices that can be shown in different colors, which incentivize a healthy competition. The key is to use technology as a medium for motivating pro-active behavior in a transparent manner. Another option is to use community GIS platforms using spatial data infrastructure.

9. Conclusions and implications

Apart from the implications to practice and policies, our research advances theory in three main ways. First, we brought the CE framework to a still under-studied specific phenomenon

¹³ <https://www.no-burn.org/india-brand-audit-2018/>

– fast moving consumer goods packaging. This is particularly important due to the paramount problem that plastic wasting has in the world (United Nations, 2019). Second, we advance the CE by integrating it with new technologies, and thus advance our knowledge on how new technologies can enhance and leverage CE framework and practices. If past research started to uncover how new technologies might be used on a CE framework (e.g., Bressanelli et al., 2018; Heyes et al., 2018), our manuscript gives specific application on how this can be used in practice. Finally, we contribute to the theoretical discussion of product life cycle (Klepper, 1996) by expanding it to a *resources value loop*. Up to now, the literature on product life cycle focused on the tangible asset that is consumed (Terzi et al., 2010). However, we challenge this premise as the packaging and its waste, can have, at least, a similar impact on consumers when compared to the products. Such impact has the potential to impact a firm's financial sustainability in the long term, which requires the firm to change its business model to accommodate the packaging and its treatment. By advancing a participatory theoretical model backed by a framework that demonstrate the practical approach that can be taken to apply the principles of CE at the grassroots level, we conceptualize how a resources value loop can exist.

10. Limitations and future research

As with any other, this research has several limitations. A main limitation of our work is its settings. Our approach is particularly relevant to EEs where large MNEs have a large impact on packaging waste and where large residential societies/compounds exist. All of these conditions are not always present and thus our framework has associated boundary conditions. However, it seems that large EEs follow similar situations to the ones that we studied, which allows us to think that our framework has the potential to impact a large percentage of packaging waste.

On the other hand, this research opens several avenues for future research. A topic related with products packaging relates to the packaging of online purchases. Future studies can try to unpack how web-commerce can follow a CE. As one of the Roseland residents said: *“There is so much unnecessary packaging waste that is a part of any online order from the popular ecommerce stores like say Amazon, Flipkart, Myntra or other such similar sites. I mean even if I order a garment it is wrapped again in bubble wrap, there is a cardboard box, plastic air pillows for one such item which is not even going to break! Why do we need all this extra packaging? I mean think about it – for clothes, bed sheets, sports shoes, belts, bags, combs, books, etc. There are so many more items that we can think of where we don’t need all this extra packaging. The government needs to fine these folks. So much unnecessary packaging cost, transport cost, why? What is Jeff Bezos thinking?”*

Another topic that our research uncovered relates to the use of new technologies. Even if we used some of the recent advances in terms of new technologies, there are many other technologies that have the potential to be used and thus open new avenues of research. A case in point is augmented reality or the IoT, which might have the potential to overcome some of the current limitations.

Appendix:**Table 1: Waste generation projections for 2025 by region (Source: World Bank (2018a))**

Projections for 2025				
Region¹⁴	Projected Population		Projected Urban Waste	
	Total Population (Millions)	Urban Population (Millions)	Per Capita (kg/capita/day)	Total (tons/day)
AFR	1.152	518	0.85	441,840
EAP	2,124	1229	1.5	1,865,379
ECA	339	239	1.5	354,810
LCR	681	466	1.6	728,392
MENA	379	257	1.43	369,320
OECD	1031	842	2.1	1,742,417
SAR	1938	734	0.77	567,545
Total	7,644	4,285	1.4	6,069,703

Table 2: Leading global brands across categories in India (Source: Adapted from Nielson (2018))

Category	Leading Brands in India
Deodorants	Hindustan Unilever (HUL)
Diapers	Proctor & Gamble (P&G), Unicharm, Kimberly Clark
Shampoos	HUL, P&G, L'Oreal
Toilet Soaps	HUL, Reckitt Benckiser
Toothpastes	Colgate Palmolive, HUL
Washing Powder	HUL, P&G
Chocolates	Mondelez, Nestle, Mars
Breakfast Cereal	Kellogg's, Frito-Lay
Salty Snacks	Frito-Lay
Juices	PepsiCo; Coca-Cola

Table 3: Top packaging polluters in India (Source: Adapted from GAIA (2019))

Manufacturer	% share of plastic waste
PepsiCo	27.70
Perfetti van Malle	14.45
Unilever	11.66
Coca Cola	10.51
Mondalez	9.13
Nestle	5.95

¹⁴ AFR: Africa, EAP: East Asia & Pacific, ECA: Europe & Central Asia, LCR: Latin America & Caribbean, MENA: Middle East & North Africa, OECD: Organization for Economic Cooperation & Development, SAR: South Asia region.

CG Foods Pvt Ltd	5.82
McDonald's	1.96
P&G	1.70
Ferrero SpA	1.55
Lotte	1.17
Reckitt Benckiser	1.06
Colgate Palmolive	1.01
Pran Foods Ltd	0.68
Johnson & Johnson	0.62
Total	95%

Table 4: Time of the research activities – Primary data collection (Source: Authors)

Nature of the Activity	Time Period/Year	Role	Brief Description
Workshop and interviews	Sep-18	Organizer	We hosted 'The Commons Dialogue'- wherein we organized a 3 day program consisting of student interactions, faculty meetings and a talk given by Michel Bauwens who is a well-known figure and a pioneer of the ' <i>cosmo local</i> ' approach . This was to gain an insight into the practices followed in other developed and developing countries since Mr Bauwens is well versed with the European and SE Asian countries and their practices in the sustainability domain.
Workshop and interviews	Sep-18	Guest/Facilitator	Conducted a field visit for officials from various municipal corporations organized by the Ministry of Urban Affairs to show the implementation of the Solid Waste Management 2016 in the Roseland RCHS.
Campaign	Oct-18	Organizer	The Red Dot Campaign: 0.4 million lakh red dot stickers were distributed to mark menstrual waste and help in easy identification. Additional 1.5 million stickers were printed and distributed by the municipal corporator in various municipal wards located in the Pimpri Corp area.
Film	Oct-18	Writer/Director/ Voice Over/	Conceptualized, scripted and a short Film covering the Red Dot Campaign undertaken at the Roseland RCHS.
Workshop and interviews	Nov-18	Organizer	Waste Management Seminar organized with Tata Centre located in IIT Bombay. We invited representatives from the Central, State government departments, NGO's, start-ups as well as exemplar communities that had demonstrated a very successful method of managing their municipal solid waste.
Symposium	Jan-19	Organizer	A Waste Management Round Table to discuss the challenges faced by various stakeholders associated in the waste value chain. We invited representatives from the Central, State government departments, NGO's, start-ups, and CSR managers to understand the various perspectives.
Film	Jan-19	Writer/Direct/ Voice/Edit Support	Film that covered the waste management activities undertaken by the Tata Centre located in IIT Bombay.
Survey	Jan-19	Research	A study of the processes involved in waste collection & disposal.
Interviews	Feb-19	Research	Door to door waste collection exercise from 63 households of a housing society that is proactive with regards to undertaking sustainability initiatives.

Workshop and interviews	Apr-19	Organizer	Menstrual Waste Disposal & Management: Scalable best practices & policy gaps.
Demo Map: GIS for MSW	Apr-19	Academic/ Research	Collaborated with GIS lab to develop a demo map to develop a prototype of a web based tool to highlight sustainability initiatives undertaken by large cooperative housing societies (>300 apartments and generating >100 Kgs of daily municipal solid waste also.
Workshop and interviews	May-19	Co-organizer	Management & Disposal of Municipal Solid Waste.
Field Work	May-19	Research	Invited by Ahmedabad Municipal Corporation (AMC) to survey their waste collection/disposal process.

Table 5: List of interviews – Primary data collection (Source: Authors)

Sr No	Organization / Entity	Designation	Number of Interviews	Approximate Duration (in Hours ¹⁵)	Language	Purpose in brief
1	Roseland RCHS	Waste contractors	5	10.50	Marathi	To understand the logistics involved in the door step collection, segregation, and transport of the waste to the waste dealers
2	PCMC	Health Officer	2	2.50	Marathi	Obtain the views of an officer with more than 25 years of experience in working/overseeing waste management activities including the landfill located at Moshi (Pune)
3	BVG	Site Supervisor	1	0.45	Marathi	To understand the operation of the state-of-the-art waste processing plant located in Moshi and to inspect the operations
4	Swach	CEO	2	1.45	English	To understand the role of this NGO working with waste workers and the challenges faced in this endeavor
5	NEERI	Scientist	1	0.50	English	Importance of proper incineration of menstrual waste
6	Govt of Maharashtra	Deputy Municipal	1	0.45	Marathi / English	Waste Management efforts undertaken

¹⁵ Rounded off to the nearest

		Commissioner				to keep the city clean
7	Roseland Residency	Residents	5	5	Various : Hindi / Marathi / English	Views on the waste segregation practices followed at the household-level. Understand the challenges on those practices and the meaning of the participation of their society in eco-friendly activities and winning the National Award in 2017 under the Residents Welfare Association (RWA) category
8	Kunal Icon	Waste Management Champion	5	6.5	English	To understand the household (door step) waste collection process and logistics
9	IIT Bombay	Waste Pickers (affiliated to Stree Mukti Sangathana-Mumbai)	3	5	Marathi	To trace the logistics involved in collecting household waste, segregating it and transporting it to a waste segregation shed
10	SWACH	Office bearer	1	3	English	To understand the methodology of conducting a waste audit
11	Ahmedabad Municipal Corporation	Environmental Engineer	5	12	Hindi / English	To understand the waste collection practices being followed in the city – right from the door step waste collection up to the landfill
12	NA	Scientist	1	1	English	The cost of getting compost tests and economical options
13	Self Employed	Waste Dealer	1	1.5	Marathi	Payment and working conditions of waste workers, process of selling the segregated waste onward to larger dealers
14	Daily wage earners	Manual scavengers	2	2	Hindi	Challenges faced in unclogging the drainage system present on roads due to garbage back-up

15	IIT Bombay	Scientist	4	5	English	Technology enabled community participation
16	IIT Bombay	Professor	1	1	English	Using emerging technology such as blockchain for waste management
17	SWACH	Manager – Scrap Depot	2	4.5	Hindi / Marathi	Understand how the waste workers are compensated, weighments of the deposited waste, segregation, etc.
18	BAIF	Thematic Program Executive	1	0.5	English	Parameters to be verified while testing compost
19	Director – Solid Waste Management	Ahmedabad Municipal Corporation	1	1.0	English	Innovative approach adopted by the city of Ahmedabad for managing waste using technology
20	BVG	Manager	1	1.0	Marathi	Segregation of packaging waste
			45	64.85 hours		

Table 6 – Initiatives and percentage points for property taxes waivers (Source: Pimpri Chinchwad Municipal Corporation)

Criteria/Initiatives	Percentage of Points
100% Waste Segregation	30
Water Conservation	20
Solar Power/LED usage	15
Tree Plantation Initiatives	20
Other Innovative Programs	15
Total Points	100

Table 7: Waste Audit Results based upon category of packaging (Source: GAIA (2019)¹⁶)

¹⁶ 46,100 pieces of waste collected from 15 cities in India were analysed.

Type of Products	Packaging	% Share
Food Products	Single layer (SL)	14.07
	Multilayer / Composites/ Laminates (ML)	53.39
	Polystyrene (PS)	0.30
	Hard Plastics (HP)	8.65
	Polyethylene (PET)	13.44
	Others	0.48
	Total	90.32
Household Care Products	SL	1.10
	ML	2.86
	PS	0.02
	HP	0.63
	PET	0.49
	Others	0.18
	Total	5.28
Personal Care Products	SL	0.57
	ML	1.97
	PS	0.02
	HP	1.42
	PET	0.05
	Others	0.36
	Total	4.40
	Percentage total	100

Figure 1 – Material Recovery Facility in Roseland RCHS



Figure 2: Children involved in plastic segregation – Plastic Warriors.



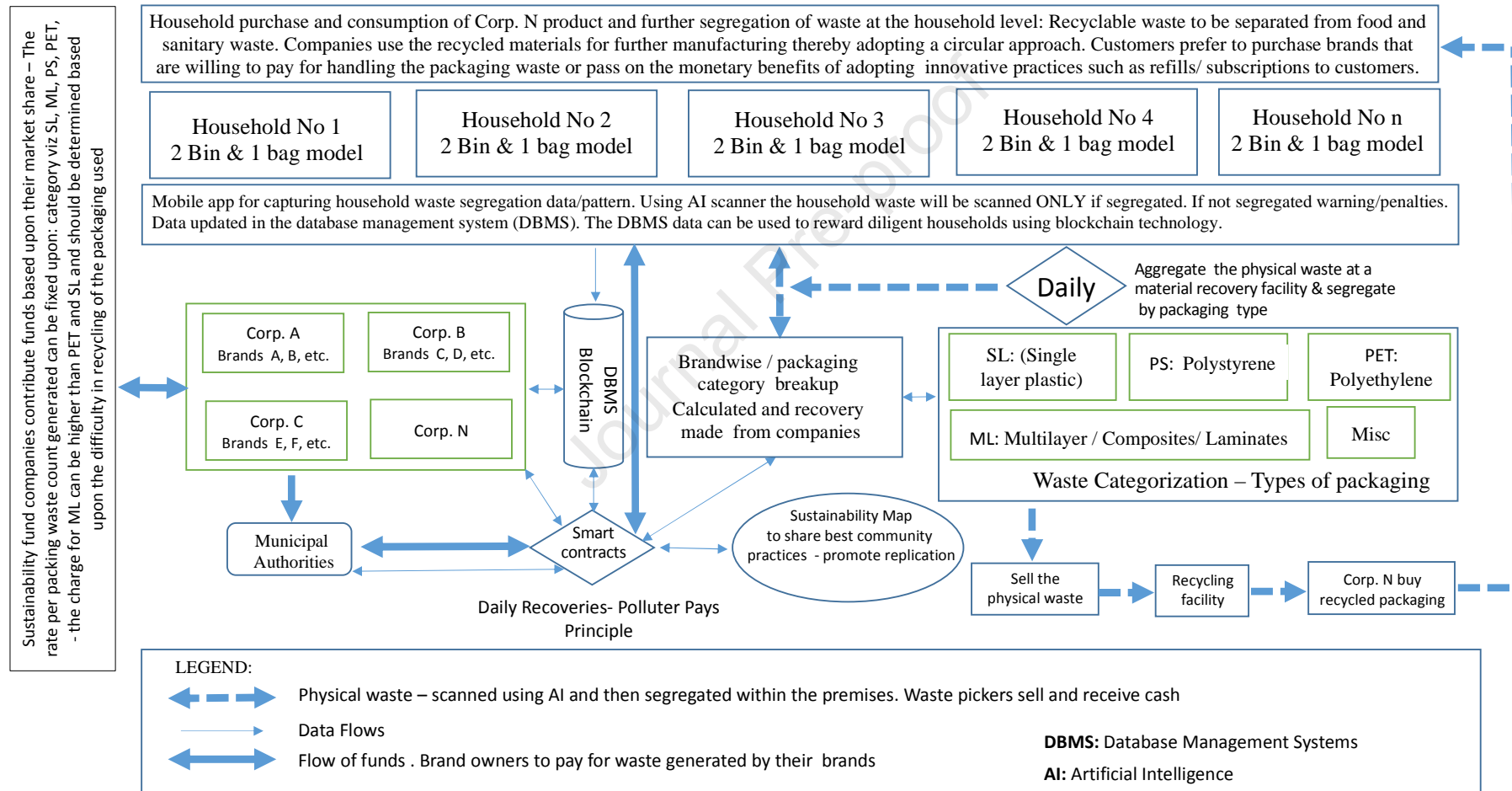
Figure 3: Manual Segregation- Aggregation – Identification – Compensation (Source: Authors)

Photo 1: Red Dot Campaign conducted in October 2018



Photo 2: Glimpse of the workshop on managing municipal solid waste – May 2019



Photo 3: Workshop on human waste disposal and management – April 2019



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Towards a circular economy for packaging waste by using new technologies: The case of large multinationals in emerging economies

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