

Scope of Digital Waste Exchange Platforms in India

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ABSTRACT

Digital waste exchange platforms are an emerging concept which has gained immense popularity in recent times worldwide. The main reason for such increasing popularity is its push towards a complete circular economy and which in turn helps in conservation of resources as well as energy. The study focuses on the scope and the aspects of a digital waste exchange platform in India. A few frameworks on digital materials exchange have been developed by certain international organizations and institutions abroad. With increase in the amount of waste generation as well as population, the need for such a platform in near future will become essential. With the current waste management system in India, it won't be able to curb the challenges posed with increasing amounts of waste in near future. The study has tried to formulate a framework based on various International literatures keeping in mind the Indian scenario. Moreover, a study on the external environment of a digital waste exchange platform in India is carried out using the PESTLE analysis. The results have indicated the various opportunities as well threats pertaining to the various identified factors of the six aspects of PESTLE analysis.

Keywords: Digital platform; Waste management; PESTLE analysis; Digital framework

INTRODUCTION

India, since the late 90s, has seen rapid industrialization, economic boom along with population increasing at a high rate. With the booming economy and rapid urbanization, quantities of municipal, industrial as well as e-waste generated have greatly accelerated. The annual waste generation has increased proportionately with increase in population and high standard of living. This increases the issues related to disposal, its collection and treatment of wastes.

According to the "Swachhata Sandesh Newsletter" by Ministry of Housing and Urban Affairs, Govt of India, as of January 2020, 147,613 metric tonnes (MT) of solid waste is generated per day, from 84,475 wards across the country [1]. Without a comprehensive waste management plan and its implementation on-ground, it has been observed that countries worldwide, including India follow mostly a linear model of waste management. This means extraction, processing, utilization (a very small percentage) and lastly disposal takes place through incineration or landfill ("take, make, waste"; [2]). Such materials no longer become available for use within economic process. This has resulted in massive resource loss as well need for new materials becomes a necessity.

In the 21st century with such improvement in the digital sector, a digital transformation may offer solution to solve as well will make us better equipped to mitigate such problems. From the perspective of digital waste exchange portals, these platforms demands a

proper management of database and the active participation from its customers as well the local administration involved in the following area. We should start aiming at reducing the waste generated with closed material loops [3]. Digital based waste exchange portals as marketplaces could play pivotal role where the discarded products or recyclable fractions can be exchanged between companies in a value creation network to enable Reuse, Remanufacturing, Recycling or proper waste treatment [4]. These platforms can act as business-to-business marketplaces where customers including general public as well as companies interact to exchange these materials for application such as reuse, recycling, obtainment of goods for remanufacturing or purchase of recycle to use in production [5].

The major concentration here is on platforms whose major functioning is enabling exchange of materials with the help of digital linkages between suppliers and customers, thus removing physical barriers and lowering search costs. Here analytical capabilities of data science through "Fast data" or "Big Data" utilized could be considered which will help the authorities to monitor, evaluate and understand the emerging resources and value stream [3]. Data collected and provided by the users should include information on the status/quality of the material, the composition of the materials such as presence of hazardous ingredients, the amount of supply or demand and also clarify the time of supply as well as demand.

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Through such platforms both the suppliers as well consumers can benefit. The suppliers can realize the current price in conformity of the quality of the products listed, stopping the suffering from consumer externalities. In the same way, the consumers achieve clarity and certainty regarding materials and the goods they obtain for reuse or recycle.

The digital waste exchange platforms in India will provide a safe and sound environment for proper management of wastes. Introduction of circular economy can solve a major part of the waste problem in India along with conservation of natural resources. The use of digital platforms for such a purpose can help India to transform from a linear to circular economy (Table 1).

Maintaining a digital waste exchange platform can help us overcome these shortcomings. *Market failure* could be mitigated using the various algorithms and by recombining innovative solutions. *Information failure* can be solved using the Cyber Physical Systems where there is digital tracking and provision of information collected over the value chain, thereby storing both product and process information. Transparency can be maintained on the composition of the materials listed for sell which will make it easier to direct it to its most effective utilization process. Customer information failure can be addressed by the information collected thus giving insights to the collected waste materials qualities and thereby diminishing the risk of creating a market with no specific information regarding its price, quality etc. The data collected becomes reliable, trustworthy and traceable, eventually eliminating the use of secondary/wastes materials. As already mentioned about technological externalities, it could be avoided if the product information also contains data regarding its disassembly. This information will help the end-of-life products to be automatically traded on such platforms and finds its best price or processing unit. Improved retail chances for recyclates would then also motivate for recycling friendly design.

The most important aspect in these digital platforms is the user security and the legal issues for participant protection. There occurs the danger of abuse in different ways after data collection. Thus both legal and otherwise precaution should be taken. Major barriers in such platforms include data piracy, violation or loss of property rights and threats like viruses etc. The platform should develop a standard for the exchange of products in terms of specific quantities [6]. It also needs to be designed in such a manner that it becomes trustworthy to the general public for transaction or find its ways to make trust less important. Another important feature the portal needs to possess is the guarantee of user protection. This should be done so that every participants rights along with the exchanges are legally protected. Accounts of the participants need to be safeguarded so that it can't be overtaken by any third party ("take, make, waste"; [2]).

The paper focusses on two aspects of digital waste management for understanding and assessing the current scenario in India: 1) Critically assess digital waste exchange portals and develop a framework on the basis of Indian scenario, 2) Identify the challenges and opportunities in already existing digital waste exchange portals. In the concluding section, the paper discusses the findings and support for the realization of digital waste exchange portals for a better waste management system in Indian market.

METHODOLOGY

For conducting the study, a mixed method of literature review and primary data collection is involved. The first step includes the secondary literature to assess and evaluate the various aspects of digital marketplace. The framework on the digital waste exchange portal is developed based on theoretical investigation of literature related to digital platforms for waste exchange. This framework gives an idea about the various components involved in the digital platform including its supporting environment. The components including the actors as well the stakeholders are identified according to Indian scenario based on literature.

For identifying the opportunities as well as challenges in the digital platforms, we need to understand the external environment of such a platform. For this, PESTLE analysis has been conducted to find the various aspects and their influence on such platforms. PESTLE stands for Political, Economic, Social, Technology, Legal and Environmental analysis. PESTLE analysis is generally used by a company or an organization to study the external environment which influences them before launching a service or product [7]. For developing a digital waste exchange platform in India (a form of service), understanding the marketplace as well the externalities associated with it is a primary need. This will help to understand the Indian waste exchange market as well the digital market potential.

A questionnaire is prepared by considering the various aspects of PESTLE analysis; Political, Economic, Social, Technology, Legal and environmental. A number of factors have been identified for the 6 aspects of the analysis. An ordinal scale is used for ranking the factors on a scale of 1 to 5; 1 being the lowest and 5 being the highest. 3 major actors for the proper functioning of the digital waste platform have been identified based on literature; the policy makers, the solution vendors (IT industry) and the awareness and campaign systems. The primary data is collected from these actors. For Solution vendors the Software technological parks of India (STPI) is considered, for policy makers MSME is taken into account and for the awareness and campaign systems, TERI, is selected. A total of 24 samples have been collected from the above mentioned organisations (Figure 1) [8].

Table 1: Shortcomings of the current waste management system in India.

Components	Characteristics
Market Failure	<ul style="list-style-type: none"> • Higher transaction cost for the waste materials • Absence of information resulting in problems of price discovery
Information Failure	<ul style="list-style-type: none"> • Missing information on qualities of wastes materials as well as material flow • Unavailability of information regarding the quality of the waste materials e.g. Its composition • The waste materials produced may not be directed to the highest potential value added services thus catering for value loss.
Customer information failure	<ul style="list-style-type: none"> • Misconception on the quality and sustainability of wastes materials which leads to the preference of new materials • Unawareness of sustainability
Technological externalities	<ul style="list-style-type: none"> • As there is no such immediate return for producers, recyclability provide no such advantage • Missing markets for externalities

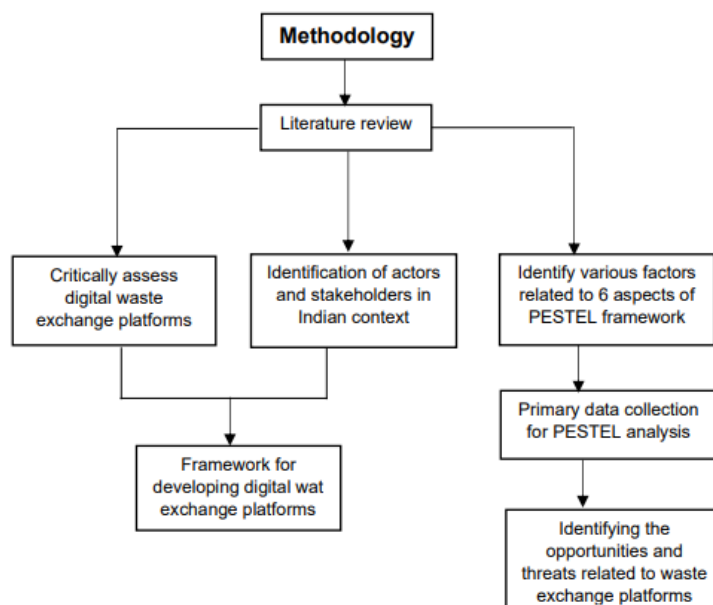


Figure 1: Schematic diagram of the methodology applied.

Table 2: Features of the actors and stakeholders identified.

Actors	Features	Stakeholders	Features
Policy makers	They define policies to control and support the digital waste platform implementation	Enterprises	To innovate various business models for better functioning and offer the digital services to the customers
Campaign and awareness systems	Transfer knowledge to support the use of such platform and services along with the professional skills to implement them	Administrative sector	Provide public services with higher efficiency and better transparency
Solution vendors	Provides technical solutions in order to operate and support the platform	Civil society	They are the final recipients of the digital services and gain the benefits deriving from the higher quality of these services

RESULTS AND DISCUSSIONS

Framework for developing a digital waste exchange platform

A digital waste exchange portal to work as a marketplace needs better understanding of the dynamics while creating it. The platform needs to identify different subjects which can help them to perform smoothly. Two major subjects who can play a pivotal role are the actors and the stakeholders. Actors have the role of enabling the platform while the stakeholders use this platform services produced by it (Table 2).

For the framework to work the digital platform should have a proper support environment. This support system has different aspects related to it such as offer and demand along with governance with the help of e-rules along with the evaluation.

Four aspects of the support system are:

- Offer: It is the most crucial aspect with which the platform will start working. It needs incentives both from market as well as from government policies.
- Demand: It is another important aspect as it helps the platform running. Demand is made by drivers that stimulate the request of such services by the customers i.e., the general public.
- The evaluation includes both the ex-ante and ex-post evaluation to identify the priorities, expected benefits and the real fulfillment of the desired outcomes.

- Governance by e-rules allows for the proper functioning of the digital platform.

In the present scenario, most of the developed countries in Europe and U.S along with a few developing countries have come up with such portals. From the current market based research and studying the international literature, a total of 20 such portals has been identified which are acting as a digital platform to offer such services. Most of these portals deal with municipal as well industrial waste along with a few which deals with e-waste separately. Moreover, majority of such portals operate locally as there is no such centralized platform for the digital exchange of wastes. By assessing the services these 20 portals provide, 5 major services have been selected which helps in the proper management of wastes in those areas (Table 3).

Identifying opportunities and threats using the PESTLE analysis

To understand the external environment as well the opportunities and threats, a PESTLE analysis is performed. The six aspects of PESTLE analysis is being taken into consideration for a proper understanding. It helped to determine to what extent the external environmental conditions are appropriate to achieve the goals and targets of the digital platform.

Primary data is collected on the basis of the various factors identified. Based on the data results, a number of opportunities as well threats to the platform is deduced. Following is a table of those opportunities and threats (Table 4).

Table 3: Level of services and their features.

Level	Feature	Characteristic
L1	Awareness	It is the first level of any platform which provides awareness to the general public for the need of such platforms
L2	Database creation	The second level refer to the identification of various products to be exchanged and then create a database regarding the detailed information of such identified materials
L3	Leveraging existing knowledge and technology	The third level is the use of the present business models used by the various enterprises and how it can be implemented in this regard. Moreover it helps in creation of jobs both directly and indirectly. It also allows funding for any research work in this field.
L4	Collaboration and networking	This level refers to the use of innovative ideas regarding waste management by collaboration with various research organizations. Moreover, it aims at forming a network business by connecting with any existing organization already working in this field.
L5	Expansion and centralization	This level refers to the funding of the entrepreneurs who wants to work in this field and work as a centralized organization to the budding companies they have funded for their working.

Table 4: Opportunities and Threats identified using PESTLE analysis.

Aspects	Factors	Opportunities	Threats
Political	a) Present policies to curb the problem of waste	a) Government's approach towards involvement of NGOs and other private organization with the laissez-faire policy will encourage them to be involved in a more direct manner.	a) The policies prepared by the government is not taking into account the various factors like living standard, places of waste generation (e.g. urban or rural), which is making it impossible to curb the problem of waste management.
	b) Government's approach towards collection, storage and the disposal trends of wastes	b) With the introduction of Digital India mission by the central government, government's support will help with the implementation of the platform.	b) The traditional methods involved in collection and storage by the government is not able to meet the standards due to increase in wastes generation with increasing population.
	c) Government's attitude towards the involvement of NGOs and other private organization in waste sector; Interventionist or laissez-faire policy.		
	d) In the present age where the central government supports digitalization, a digital waste exchange portal will be well accepted.		
Economic	a) Current economic status of India	a) India's economy is in growth phase	a) Currently, a major source of economic loss due to unsuitable disposal methods.
	b) With 70% wastes in India not recycled or reused, is it considered as a major economic loss.	b) Help in the creation of a circular economy.	b) Lack of information in economic terms about the unsuitable disposed wastes.
	c) Lack of information in economic terms about the wastes that is disposes off.	c) Creation of green jobs with the help of digital waste exchange platform.	
	d) Use of digital exchange platform in economic terms in creating jobs along with the creation of a circular economy.		
Social	a) Impact of literacy rate on waste disposal methods both in rural and urban areas	a) With the increase in literacy rate per year, people will have adequate knowledge about the wastes and the ways to prevent its inappropriate disposal methods.	a) Unequal distribution of wealth in accordance with high living standard and different day-to-day material lead to inappropriate disposal methods.
	b) Impact of unequal wealth distribution on wastes produced.	b) A different approach need to be made for both the rural as well as urban waste management.	b) The idea of digital waste exchange portal may not be highly welcomed by the informal sector in India.
	c) Need of a different approach in both rural as well urban areas based on living standards as well as day-to-day material use.	c) With the increase in literacy rate in coming years, the various awareness campaigns started by NGOs and government can be successful even at the grass root levels.	

	d) Impact of various awareness programs initiated by the government and NGOs on waste disposal methods at the grass root levels.	
	e) Informal sector and the idea of digital wastes exchange platforms	
a) India is considered as the second largest online market with over 470 million people having internet access and is considered to increase up to over 680 million by 2021; can this factor help with the success of this portal.	a) With such high percentage of population having access to internet and smart phones, the digital waste exchange portal can gain success here if properly implemented.	a) User friendly interface in both as well computers.
	b) Availability of the portal on both computer as well as mobile phones has an impact on the usage rate in pan India.	
	c) Research and developmental efforts focused in the waste management sector.	
Legal	a) Rules and regulations laid down by the constitution	a) Rules and regulation are not appropriately followed by the civilians as well the industries and organizations producing wastes.
	b) Impact of the regional law enforcement department e.g. police working towards the inappropriate waste disposal methods by the people.	b) The regional law enforcement department e.g. police is not helping in proper implementation of such laws.
	c) Fines imposed in the current system.	c) Fines levied are not properly assessed before
Environmental	a) Impact of the present waste management procedure towards resource management of the wastes disposed.	a) A digital waste exchange platform can help in introducing a circular economy which in turn will help the proper management of resources along with energy management.
	b) With such high volume of fossil fuels already used in the industrial sector; impact of the digital waste exchange portal with a view of circular economy provides better management.energy	a) The present waste management system in India which includes inappropriate landfilling as well as incineration is posing threat to the environment.
	c) Impact of the present waste disposal methods on the climate change with the use of open landfill disposal as well as incineration.	b) Due to the lack of circular economy, virgin materials are being used continuously which in turn have many negative impacts on environment due to their manufacturing processes

CONCLUSION

With ever increasing population in India, the wastes generated will only increase in the coming years. A proper long term management system is of utmost importance in India. The study has shown that digital waste exchange platform is a promising field for introducing the concept of circular economy in India. This will help to reduce the use and manufacturing of virgin raw materials which in turn will reduce the rate of resource usage. Such a marketplace can become a useful source to create value creation networks between

the waste sector, the recycling industry and the digital sector.

As mentioned earlier, this platform can be a strong push factor for the resource as well energy conserving circular economy. However, many challenges are needed to be overcome in order to have a beneficial impact on participants and sustainability as well. From the threats identified, the platform will need support as well guidance in accordance with the implementation as well as legal frameworks which will make the platform both safe as well accessible for everyone. The support includes funding from the

government as well many international heavyweights. Using digital platform in order to have a better circular economy will ultimately depend on these factors and the negating the threats identified.

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