



How Can Reverse Vending Machines for Plastic Bottle Packaging Contribute to Sociopreneurship?

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Abstract. The way of managing plastic bottle waste so far is dominated by the landfill method. This open dump technique endangers the environment and the surrounding community. This study discusses how the Reverse Vending Machine (RVM) simultaneously contributes to sociopreneurs solving environmental, economic, and social problems. This study was carried out qualitatively by following the Design Thinking procedure. Based on the analysis of data obtained during the Empathize, Define, Ideate, and Prototype phases, this paper concludes that RVM's contribution to the character of sociopreneurs does not begin with changes in consumer behavior toward plastic bottles (although the change also arises due to the introduction of RVM to the public). RVM-mediated sociopreneurship develops in two ways, namely: a). ownership of Reverse Vending Machine machines, and b) purchase of RVM-output plastic pellets by Startups, MSMEs, artisans, and other business units that empower communities to obtain financial profits.

Keywords: Bottle Plastic Packaging, Reverse Vending Machine, Sociopreneurship.

1 Introduction

In 2016, 335 million tons of plastic were produced globally. This figure is in line with the high demand of people who consider plastic a lightweight, cheap, and durable material for various purposes, such as medical equipment, vehicles, food/beverage packaging, and others [19]. Of that amount, most (40%) are used for beverage/food packaging because they have other superior properties, such as being safe from contaminants and temperature resistance. The materials are PET and HDPE fabricated into bottles [29]. Post-consumption PET and HDPE bottles are not managed properly and correctly. In Indonesia, in only the 1st quarter of 2021, there were 11,600 tons of plastic bottle waste, according to PT. INOV (2021).

So far, PET bottle waste management in Indonesia is the same as other solid waste management. A small part of it uses sanitary/controlled landfills such as the Bantar Gebang landfill and Benowo landfill, and most of them use landfills or open dumps that

now have exceeded capacity [12]. The rest of PET and HDPE plastic waste is unmanaged and spread in nature. Only some parties apply the 3R principle [13].

PET and HDPE plastic waste managed by landfill methods and spread across nature causes three major problems. First, mountains of garbage have the potential for flowslides, as happened in Cirende, which killed 157 people [21]. Second, the duration of decomposition for hundreds or even thousands of years will reduce soil and water fertility [9]. Even according to Fachrul & Rinanti (2018), after hundreds of years of physical, chemical, and biological decomposition, plastic bottle waste will still become microplastics. If this is the case, environmental problems will become more serious [6]. This is because microplastics contain carcinogenic compounds that will penetrate the food chain at various trophic levels, ultimately impacting not only environmental health but also human health. Third, PET and HDPE bottles in the ocean are damaging ecosystems. Currently, there are 150 million tons of plastic in the ocean, and it will increase by at least 8 million tons per year [9]. This problem is similar to the experience in Europe and America, whose recycling rates could be higher, which is 6% of the total plastic demand [17]. In Indonesia, this condition is exacerbated by people's consumption patterns attached to disposable cultures. Only 10-15% of PET and HDPE bottles are managed following the 3R principle. The rest are accommodated in landfills and are still scattered in nature [4].

Various literature and studies have recorded environment-friendly waste management activities, facilitation, and evaluations. There are waste management activities and facilitation in Kuta [30] and Banyuwangi [25]. Meanwhile, the evaluation of waste management is in Gianyar [31] and Jayapura [30]. Such activities, facilitations, and evaluations have only solved a few environmental problems. In fact, according to activities in Tangerang, the management is only looking for new landfill land [20]. These experiences indicate that the management of existing plastic bottle waste needs to be completed to solve environmental problems and also cannot solve other derivative problems from the mismanagement of plastic bottle waste, namely social and economic problems.

Socially, people are ignorant of the low recycling rate and the deteriorating quality of the environment (soil quality is reduced due to plastic pollution). Meanwhile, economically, the economic value of post-consumption plastic bottles is low, which is 2,500/ kg. For traditional scavengers and collectors who make plastic bottles a significant commodity in business, the low economic value of plastic bottle waste is an urgent issue. This happens because abundant resources cannot be utilized optimally to benefit the community they cover [10].

Regarding the previous problems of these three facets (environmental, social, and economic), this study aims to examine the contribution of a Reverse Vending Machine (RVM) in solving these three problems at once through the development of sociopreneurship. This study is important because the RVM in this study is claimed to be the latest form of RVM made by Plasticpay, which is more environmentally friendly, complete, and sophisticated and has a contribution to the future economy. This urgency needs to be considered, mainly because the current management methods, such as waste banks [11] and the application of 3R [22], have yet to significant impact.

The achievement of the above goals can be a guide for environmental and social activists in empowering the community, MSMEs, Startups, and other business units to be able to help themselves through social entrepreneurial activities. As for the government and general society, achieving the above objectives can support the pace

of the green economy in a participatory manner, ground the digital economy trends, and change the linear economic pattern in society into a circular economy pattern.

2 Methods

This study was carried out qualitatively by following the Design Thinking procedure in Jakarta. The procedure was chosen because it is a way of solving problems that is practical and subject or user-centered. Implementing such methods can produce creative business ideas that are right on target (Müller-Rotenberg, 2018). However, it should be emphasized that this study only applies four of the five steps of the Design Thinking procedure, namely Empathize, Define, Ideate, and Prototype.

The Empathize phase is conducted to understand empirical problems according to the subject's perspective [26]. Therefore, this phase is passed by conducting participatory observations and in-depth interviews. Both words and interviews are carried out by referring to observation guidelines and interview guidelines instruments that have been validated following content validity procedures (expert judgment). The subject of observation is the general public, whose activities produce plastic bottle waste in Jakarta. At the same time, the interview subjects were 18 traditional waste managers (waste collectors and scavengers) in Jakarta. The results of the Empathize process are then visualized into four quadrants of the Empathy Map that answer the questions: a). what they say; b). what they do; c). what they think, and d). what they feel, the answers in this Empathy Map are clues to go through the Define phase.

The Define phase is intended to determine the core problems of a series of plastic bottle waste management problems in Jakarta regarding the economy, environment, and society. Therefore, the Define phase is carried out with literature studies and surveys to confirm the data obtained from the Empathize phase [8]. The Ideate phase is then carried out by initiating solutions to problems identified, formulated, and confirmed in the Define phase. The idea of a problem-solving solution is then realized through the Prototype phase. This last phase is carried out with the fabrication method and theoretical experimentation (testing prototype performance).

3 Results and Discussion

The initial stage of analysis in this study succeeded in uncovering a series of environmental, social, and economic problems along with the core problems that are the cause of the series of issues. During the Empathize phase, there are at least three conclusions that can be presented as empirical problems faced by communities and traditional waste managers (collectors and scavengers). First, people are very attached to disposable cultures. They must familiarize themselves with reuse, reduce, and recycle (3R) activities. This behavior causes a large amount of plastic bottle waste to scatter in the natural environment. This behavior also causes an unhealthy environment. Second, the pattern of plastic bottle waste management has so far been dominated by a "gather-transport-dispose" mechanism. Unlike the general public, who tend to throw waste out of place so that waste is spread in nature, the management of plastic bottle waste by the cleaning department with a "gather-transport-dispose" mechanism ends up in the landfill. If it has arrived there, then there are only two possibilities for the plastic bottle waste to be ignored or picked up again by scavengers to be sold to garbage

collectors at low prices (2,500 / kg). There are three main reasons why the price of plastic bottles is priced very cheaply, namely: a). the dirty condition; b). mixed between PET and HDPE bottles, and c). not in the form of ready-to-recycle shreds. Third, based on the analysis of data mapping through Empathy maps, communities and traditional waste managers need a way to increase the economic value of post-consumption plastic bottles. These three main issues will be the basis of determining the core problem.

Regarding the above considerations, through the Define phase, this study decided that the core of the above issues is the absence of facilities that help society move from a linear economic pattern to a circular economy. The transformation of economic activity from linear to circular is needed not only to improve environmental quality through changes in people's behavior but also to develop an entrepreneurial character among the community to develop themselves financially [27].

Through the Ideate phase (Fig. 1), this study initiated a machine that facilitates the community and traditional waste managers to switch from a linear economy to a circular economy and develops an entrepreneurial character in the form of solopreneurship. How the prototype form is, and RVM's projected contribution to sociopreneurship are discussed in the three sub-discussions below.

3.1 Overview of RVM

System Integration for Machine as Nature Protectant (in this study, the system is referred to as RVM) is a prototype of the synthesis result or advanced development of RVM, initially developed by Plasticpay (plasticpay.net). RVM, made by Plasticpay, is the recipient's RVM and converts plastic bottles into the first reward points in Indonesia. It collects empty bottles, records them in the database, and rewards users (bottle depositors) in the form of e-money that can be spent on Tokopedia (one of the leading e-commerce platforms in Indonesia). However, the RVM made by Plasticpay has several disadvantages in the form of a). the reward system is not connected to banking services; b). e-wallet options are minimal; c). RVM compatibility is very low. d). not equipped with a bottle shredding machine and e). not equipped with IoT technology and sensors to sort out bottle types. The limitations on items d and e confirm that Plasticpay's RVM cannot significantly increase the economic value of plastic bottles. The RVM (Fig. 2) was then designed and produced collaboratively between the authors and Plasticpay to overcome the limitations of the previous generation RVM.



Fig. 1. The outer view of the RVM.

Instead of developing RVM on a competition basis (creating new products as competitors), the authors developed collaboration-based RVM. The most concerning considerations are brand and corporate identity. Plasticpay has been widely known as

the initiator of RVM, which holds and rewards plastic bottles received. The Jabodetabek region even has 287 mini collection point locations (plasticpay.net). This indicates that although RVM is a product, it has a dual role as the corporate identity of Plasticpay. Corporate identity is inherent in people's visual, imaginative perceptions and memories [16]. Therefore, according to research by Akbar et al. (2021) on rebranding, manufacturing new products that are present as competitors is unnecessary because it requires branding and rebranding with an extended amount of time and complicated strategies [1]. In addition, the socio-economic impact on the community has also yet to be achieved because its position in the company's priorities has become not dominant [28].

Through this machine from the author's collaboration with Plasticpay, anyone can put PET and HDPE bottles independently into the machine to be directly classified and chopped into plastic granules (Recycled Polyester Staple Fiber, RePSF). Machine outputs are PET and HDPE plastic shreds that can be distributed to the yarn industry, carpet fibers, fabrics, etc. Instead, users will get rewards through e-money connected to various e-wallets, e-commerce, and e-banking services.

As a system, RVM provides attractive application designs for managing user databases, rewarding systems, and workshop agendas on plastic bottle waste management to develop entrepreneurial character in the community (Fig. 3). An example of the user interface of the RVM application can be accessed via the link: pameran.in/ven.

The features in the above application contain a brief explanation of why RVM was created, how to use Reverse Vending Machines, what contribution users can make to the environment and economy through Reverse Vending Machine, and an entrepreneurial workshop agenda to develop a sociopreneur character that all Reverse Vending Machine users can participate in. In addition, the RVM application also provides information about the reward amount for each type of plastic bottle.

3.2 Business Model Canvas for Startups and SMEs

Regarding the economy, RVM increases the selling value of post-consumption plastic bottles. If initially a plastic bottle was only worth 2,500/kg, then after being classified and shredded by Reverse Vending Machine, the value was worth 9,000/kg. However, more than that, the extensive and complex systems networks in RVM also develop sociopreneurs society through Startups and MSMEs. How RVM contributes to sociopreneurs can be seen in the visualization of the BusinessModel Canvas mapping in Fig. 4.

3. KEY PARTNERS	4. KEY ACTIVITIES	5. VALUE PROPOSITION CANVAS	2. CUSTOMER RELATIONSHIP	1. CUSTOMER SEGMENT
1. Waste Banks 2. Plastic pellets buyers 3. Manufacturers that take	1. Data collection: plastic bottle waste collection center.	Design and Technology: 1. The machine	1. The formation of a plastic waste treatment community	The Potential Customers of Reverse Vending

<p>advantage of recycled plastic pellets</p> <ol style="list-style-type: none"> 4. Plastic bottle packaging manufacturers 5. Business Incubator Centers 6. Ministry of MoEF 7. Banking 8. Machine fabrication partners 	<ol style="list-style-type: none"> 2. RV Mutilization process: bottle cleaning, sorting, bottle loading, and shredding. 3. Collection of shredded results from several points of the RVM machine. 4. Weighing and repackaging . 5. Sales to plastics factories. 6. Payment to the depositor. 7. Training in the manufacture of derivative products 8. Marketing and introduction of RVM 9. Socialization and promotion 	<p>is easy to operate</p> <ol style="list-style-type: none"> 2. Ergonomic design 3. The shred's quality meets the industry's needs <p>Economy:</p> <ol style="list-style-type: none"> 1. Low maintenance cost. 2. Business opportunities for processing plastic pellets. 3. Creating job opportunities. <p>Environment:</p> <ol style="list-style-type: none"> 1. Reduced non-biodegradable plastic waste. 2. The risk of cancer is reduced, and the quality of health improves 3. The risk of landfill burning is reduced 	<ol style="list-style-type: none"> 2. Improvement of Waste Bank management. 3. Support for collaboration between the government and the plastic treatment industry 4. Formation of a new business startup 	<p>Machine RVM are:</p> <ol style="list-style-type: none"> 1. 30% of the 3.7 million scavengers in DKI Jakarta 2. 5% of the 40 million visitors to the top tourist areas 3. 20% of the 1.36 million students of Elementary-High Schools in DKI Jakarta <p>End users and industry sectors:</p> <ol style="list-style-type: none"> 1. 5% of 800 derivative companies of plastic pellet treatment 2. 2% of 50 exporters of
	<p>6. KEY RESOURCES</p>		<p>7. CHANNELS</p>	
	<p>Key resources:</p> <ol style="list-style-type: none"> 1. Plastic waste 		<ol style="list-style-type: none"> 1. Coordination with Waste Banks 2. Socialization RVM machine 	

	2. New technology (machine) 3. Funding support Human Resources: 1. Plastic waste expert 2. Environmental Engineering expert 3. Industrial Engineering expert 4. Visual Communication Design expert 5. Information Systems Expert 6. Entrepreneurship Expert	4. Flood risk is reduced	using print communication media and social media. 3. FGD and seminar 4. DKI Provincial Government Policy 5. Ministry of Environment and Forestry Policy	plastic pellets
8. COST STRUCTURE			9. REVENUE STREAMS	
Startup Cost	Fixed Cost	Variable Cost	1. Sales of plastic shreds 2. Machine sales 3. Sale of processed plastic recycled products 4. Training on making plastic products 5. Revenue from advertisements on the RVM media box	
1. Procurement of RVM Machine 2. Procurement of Application 3. Branding	1. Employees Salary 2. Electricity 3. Transportation 4. Machine Location Rent	1. Bottle shreds packaging 2. Reward services for customers 3. Transportation to the buyers 4. Training mentor services		
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Fig. 2. RVM Business Model Canvas.

In Jakarta only, RVM can be used by more than 3.7 million scavengers, more than 40 million visitors to leading tourist areas, more than 1.36 elementary to high school students, and some from modern shopping centers. The large number of chopped plastic bottles

produced by RVM is then absorbed by critical partners, such as waste banks, startups, and MSMEs that utilize recycled plastic pellets. Thus, RVM becomes a provider of raw materials for the sustainability of Startups and MSMEs engaged in recycling plastic pellets and produces standardized products to be marketed with high economic value (Fig.5). Not only Startup and MSME actors, the general public and communities or environmental activists can also empower themselves to become entrepreneurs (establishing new Startups and MSMEs) through RVM ownership or by buying plastic bottles processed by Reverse Vending Machine.

3.3 Multiple Impacts on Sociopreneurship

From the very beginning of its inception and creation, the orientation of the RVM has been to resolve social, environmental, and economic problems. From a social point of view, RVM promotes behavioristic environmental care behavior. The introduction of RVM made the public's relationship with plastic bottles no longer limited to using and disposing of, but instead using, sorting, and depositing into Reverse Vending Machine. This means that RVM changes people's habits from a gather-transport-dispose behavior to a gather-exchange-money. This kind of behavior change, according to Rizos et al. (2017), is an indirect impact of the popularization of a circular economy concept [24].

In terms of environment, RVM presents the independence of non-decomposable waste processing technology. Thus, RVM reduces the risk of reducing soil and water quality. The most apparent indication (observable) is a significant reduction in plastic bottle waste in nature. Meanwhile, from an economic point of view, RVM supports the realization of the digital economy in society, increases the pace of the green economy in a participatory manner, and changes the pattern of the linear economy into a circular economy. Nevertheless, the prospects for developing the impact of RVM from an economic point of view are broader.

Revisiting the business model canvas in Fig. 4, the use of RVM in public spaces and private spaces can create new business opportunities for waste bank communities, scavengers, collectors, MSMEs, Startups, and artisans processing PET and HDPE plastic pellets. Some of the popular processed plastic pellet products are carpet raw materials, interiors, home properties, and others (Fig. 5). According to the experience of Tri Alam Lestari waste bank, the re-production of plastic into new products increases not only economic value but also creates social value to solid plastic waste [5]. It is no longer seen as a commodity that gives profit but is also treated as an instrument to bond social ties between plastic pellet processor entrepreneurs, develop competencies as workers and entrepreneurs, and train financial independence.

The potentials, as mentioned earlier, can be achieved more quickly when RVM, as an essential variable in sociopreneurship in Jakarta, is supported by community involvement, both communities that promote environmental health and communities that coordinate new business units in plastic recycling. Communities that promote environmental care movements can be the driving force for the grassroots level, where this lower level is often not reached by the policies of the central and local governments [7]. Some of the communities that are already engaged in Jabodetabek, for example, are the Jakarta Eco Project Community, the Plastics for Good Community, Gempita (Universe Lovers Movement), K3SI (Indonesian Waste Sharing Community), and the Bogor Ecobrick Community.

Based on experience, these communities have succeeded in raising environmental care activities through education and participatory invitations in the Clean River Movement, the Clean Beach Movement, the Green Jakarta Movement, the Urban Plastic Free Movement, and other environmental care movements. However, to build a sociopreneur character in society, the community can become a driving force by reorienting the vision to not only reduce the distribution of plastic bottle waste but also to increase the economic value of bottle waste and increase the entrepreneurial capacity of the community [14]. Thus, the community, together with the RVM Reverse Vending Machine, can jointly create new business units (both in the form of Startups and MSMEs).

The development of the new business unit should be directed to something other than collecting and selling plastic waste to Startups or existing companies, such as Waste4Change, Rekosistem, and Rebricks. That way will not solve the problem because the concept still uses linear economic patterns. The newly formed business units should be directed to develop by managing their own company, since the collection of raw materials using Reverse Vending Machine RVM, processing, and marketing of products. One of the best ways is to join associations, communities, or organizations that accommodate business actors in the field of plastic recycling, such as the Indonesian Plastic Recycling Association or ADUPI (<https://www.adupi.org/>) and Indonesian Plastic Recyclers (<https://www.plasticsrecyclers.id/>).

A series of collaborative processes between RVM Reverse Vending Machine, the environmental care community, and the plastic recycling business unit community can form the most prominent plastic recycling chain ecosystem in Indonesia from upstream to downstream, ranging from waste collector groups and waste banks to the recycling industry. Therefore, the presence of Reverse Vending Machine RVM as an efficient technology has the latest contribution in supporting ecology for sustainable development [23]. It not only changes the ecological behavior of society (maintaining the ecological balance between the environment and humans and its development) but also becomes part of the circular economy and sociopreneurship.

4 Conclusion

This study reinforces the statement of Patharkar and Kishnani (2022) that entrepreneurship activities were initially oriented toward obtaining maximum profit. However, when the scheme was changed to sociopreneurship (one of Reverse Vending Machine's visions), the orientation also encompassed the eradication of unemployment, maximizing resources, and balanced profit share within the social organizations involved. This study concluded that RVM's contribution to the character of sociopreneurs did not begin with changes in plastic bottle consumer behavior (although the change also emerged due to the introduction of RVM to the public). RVM-mediated sociopreneurship develops in two ways, namely: (a) ownership of Reverse Vending Machines and (b) purchase of RVM-produced plastic pellets by Startups, MSMEs, artisans, and other business units that empower communities to obtain financial benefits.

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