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THE DIFFICULTIES OF SOLID WASTE COLLECTORS CARRYING OUT SELECTIVE COLLECTION IN THE CITY OF MANAUS, BRAZIL

AS DIFICULDADES DOS CATADORES DE RESÍDUOS SÓLIDOS PARA REALIZAREM A COLETA SELETIVA NA CIDADE DE MANAUS, BRASIL

LAS DIFICULTADES DE LOS RECOLECTORES DE RESIDUOS SÓLIDOS PARA REALIZAR LA RECOLECCIÓN SELECTIVA EN LA CIUDAD DE MANAUS, BRASIL

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ABSTRACT
This study described collectors' main difficulties in collecting discarded materials in Manaus (Brazil). The method used involved analyzing the practice of three collectors willing to provide in-depth data and information obtained through semi-structured interviews carried out in the respondents' workplaces, which were then analyzed with the help of the conceptual bibliographic method and interpreted with the help of semantic analysis. The results showed that a) the main difficulties are extreme physical exertion, people's rejection, unhealthy working conditions, lack of personal protective equipment, and lack of participation by people, companies, and governments; b) difficulties occur due to lack of equipment, lack of technical knowledge of the materials handled, people's lack of knowledge about the importance of the collectors' work and lack of participation by society and governments in the selective collection; c) who could help to minimize these difficulties are the residents, companies, and governments and d) what the agents can do is to structure the collection (government), separate the materials (residents), provide more disposal sites (town hall) and donation of equipment and training (companies). The conclusion shows that agents are not prepared to carry out reverse logistics in the city because they are unaware of the importance of waste pickers' work to start the city's circular economy.

KEYWORDS: Waste collectors. Reverse logistics. Circular economy. Reverse logistics process. Collection difficulties.

RESUMO
Este estudo procurou descrever as principais dificuldades que os catadores encontram para realizar a coleta de materiais descartados na cidade de Manaus. O método utilizado consistiu na análise da prática de três catadores que se dispuseram a fornecer dados e informações em profundidade, obtidos através de entrevistas semiestruturadas, realizadas nos próprios locais de trabalho dos respondentes, que depois foram analisados com a ajuda do método bibliográfico conceitual e interpretados com o auxílio da análise semântica. Os resultados mostraram que a) as principais dificuldades são o extremo esforço físico, rejeição das pessoas, condições insalubres de trabalho, falta de equipamentos de proteção individual e falta de participação das pessoas, empresas e governos; b) as dificuldades acontecem por falta de equipamentos, desconhecimento técnico dos materiais manuseados, desconhecimento das pessoas sobre a importância do trabalho dos catadores e falta de participação da sociedade e governos na coleta seletiva; c) quem poderia ajudar a minimizar essas dificuldades são os moradores, empresas e governos e d) o que os agentes podem fazer é estruturar a coleta (governo), separar os materiais (moradores), disponibilizar mais locais de descarte (prefeitura) e doação de equipamentos e treinamentos (empresas). A conclusão

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mostra que os agentes não estão preparados para efetivar a logística reversa na cidade porque desconhecem a importância do trabalho dos catadores para iniciar na cidade a economia circular.

PALAVRAS-CHAVE: Catadores de resíduos. Logística reversa. Economia circular. Processo logístico reverso. Dificuldades de coleta.

RESUMEN
Este estudio buscó describir las principales dificultades que encuentran los recolectores en la recolección de materiales desechados en la ciudad de Manaus, en Brasil. El método utilizado consistió en analizar la práctica de tres recolectores que se mostraron dispuestos a brindar datos e información en profundidad, obtenidos a través de entrevistas semiestructuradas, realizadas en los propios lugares de trabajo de los encuestados, que luego fueron analizadas con la ayuda de la bibliografía conceptual. método e interpretado con la ayuda del análisis semántico. Los resultados mostraron que a) las principales dificultades son el esfuerzo físico extremo, el rechazo de las personas, las condiciones de trabajo insalubres, la falta de equipos de protección personal y la falta de participación de las personas, empresas y gobiernos; b) se presentan dificultades por falta de equipos, desconocimiento técnico de los materiales que se manejan, desconocimiento de la gente sobre la importancia del trabajo de los recolectores y falta de participación de la sociedad y de los gobiernos en la recolección selectiva; c) quienes podrían ayudar a minimizar estas dificultades son los vecinos, empresas y gobiernos y d) lo que pueden hacer los agentes es estructurar la recolección (gobierno), separar los materiales (habitantes), proporcionar más sitios de disposición (ayuntamiento) y donación de equipamiento y formación (empresas). La conclusión muestra que los agentes no están preparados para realizar logística inversa en la ciudad porque desconocen la importancia del trabajo de los recicladores para iniciar la economía circular en la ciudad.

PALABRAS CLAVE: Recolectores de residuos. Logística inversa. Economía circular. Proceso de logística inversa. Dificultades de colección.

INTRODUCTION

Reverse logistics can be defined as a process (FU; LIAO, 2023; RIVALDY; PATAMA, 2023; YANG, 2022; WILSON; PASCHEN; PITT, 2022; NGADIMAN et al., 2022). Every process comprises logically ordered steps that produce some result in the end. In the case of reverse logistics, which focuses on the return of materials that have already been used, the intended result is that the waste is in complete or satisfactory condition so that it can be reused or adequately packaged in an appropriate location. It takes the ability to organize and control the activities of the reverse logistics process to optimize the intended results through the various treatment modalities, such as reduction, reuse, recycling, dismantling, and reuse, among others. Given its complexity, reverse logistics challenges are almost always in line with the implementation of public policies (FU; LIAO, 2023; ZORZI; VANIN; AZZOLINI, 2023; NUNES et al., 2023).

Environmentally adequate management enables the adoption of a correct policy involving manufacturers, importers, distributors, traders, consumers, public service holders of urban companies, solid waste management organizations, and the government, materializing what has been called the circular economy (GUO; HUANG, 2023; GUARNIERI et al., 2023; Nunes et al., 2023). The reverse logistics process is essential because it works as an economic instrument that enables the collection and recovery of solid waste and makes it available to the business sector. Thus, through reverse

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logistics, materials can be reinserted into the production cycle or sent to an appropriate place for disposal or treatment.

In this sense, this study aims to describe the main difficulties encountered by solid waste collectors working in Manaus. These professionals start the reverse cycle. If this step presents few challenges to be carried out properly, the steps likely have their execution facilitated. It tends to contribute so that the results by the organizations that are part of this production chain are more likely to be achieved. In addition, there is an urban and citizenship gain because the city becomes cleaner, and the population tends to increase their satisfaction with the urban environment they inhabit (JAYARATHNA; AGDAS; DAWES, 2023; NOORLIZA, 2023; ALI; SHIRAZI, 2023).

REVERSE LOGISTICS: CONCEPT AND STAGES

The literature review showed that process is the predominant term equivalent to reverse logistics, as can be seen in the studies by Delponte et al., (2020), Milani (2019), Almeida (2019), Bayramov (2021), Matušinec et al., (2022), and Garzón-Agudelo, Palacios-Alvarado and Medina-Delgado (2019). As a process, reverse logistics consists of stages and their respective procedures. The procedures focus on returning materials already used for the production process and aim to reuse and properly dispose of materials, which are environmental preservation and the continuity of the economical use of this waste. The reverse logistics process procedures cover essential final areas, such as recycling, manufacturing, reuse, reform, and proper final disposal. For this study, reverse logistics will also be taken as a process.

In one sense and the other, the attributes are the most perceived when executing the reverse logistics process. On the other hand, the features that stand out most in the literature as fundamental characteristics of reverse logistics are disposal (MILANI, 2019), consumption (DELPONTE et al., 2020), reuse, recycling, and cost reductions (BAYRAMOV, 2021). In addition to these, other vital attributes appear in the survey, such as customer satisfaction (Bayramov, 2021), the raw material (MATUŠINEC et al., 2022), and valuation (DELPONTE et al., 2020). These attributes represent a set of actions, procedures, and means designed to facilitate the collection and reintegration of solid waste into the business sector for reuse in its cycle or other production cycles. They also account for the search for another final destination that is environmentally appropriate.

It is important to note that the reverse logistics system brings several benefits to an organization's business. Not just because this is legal in some cases but because it generates benefits for society and for the recognition of the organization as environmentally friendly, a fact that often has a strong marketing appeal. However, several products explicitly mentioned in the law are obliged to structure reverse logistics systems due to the danger they pose to people and the environment, such as batteries, tires, and others. From an ideal point of view, for all industrialized products to implement the dynamic reverse logistics system, there must be technical investment and savings for its implementation, in addition, naturally, to government incentives. In this sense, for this study, reverse logistics is defined as the process of recycling, remanufacturing, reusing, reforming,

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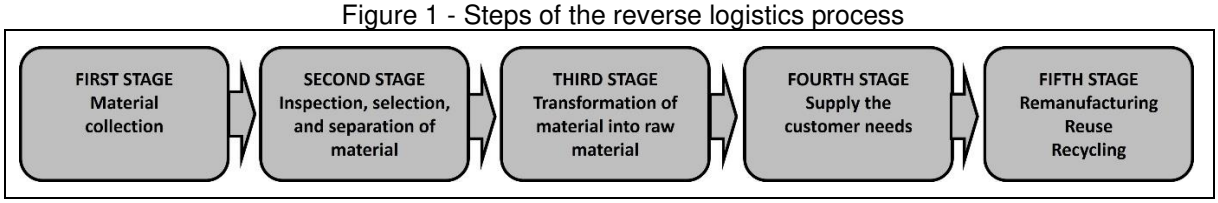
and proper final disposal of solid and liquid waste. For this purpose, a survey was also carried out to know the different processes of reverse logistics and the various ways it is practiced.

The literature review presented short processes with only three steps, such as those proposed by Carmo, Mascarenhas and Marçal (2007), Gonçalves and Leme (2018), Milano and Pugliese (2014), and Alamassi (2014). Still, the processes were also long, with seven stages, as Araújo et al., (2012) and Kumar et al., (2015) proposed. However, most studies presented approaches with four steps. Another finding is that the content of the processes is also different. Some studies focus on the purely logistical aspect, as is the case of Araújo et al., (2013), with the stages of transportation, storage, packaging, handling, production, and supplies, while others apply pure recycling terminology, as is the case from the study by Cesar, Sacomano Neto and Farah (2007), with final disposal, recycling/selection, dismantling and reuse.

We found that the first most cited stage is the collection, constant in the studies of Carmo et al., (2017), Campos et al., (2019), Gabriel et al., (2018), Cardoso, Santos and Gomes (2021), Milano and Pugliese (2014), Nikolaou, Evangelinos and Allan (2013), Kalogerakis et al., (2015), Kumar et al., (2015) and Alamassi (2014), which he calls collection. It is important to note that the study by Seppälä (2010) places collection as a second step. The second stage identified consists of the inspection, separation, and selection of materials, as can be seen in the studies by Carmo et al., (2017), Cesar et al., (2007), Cardoso et al., (2021), Nikolaou et al., (2013), Kalogerakis et al., (2015), and Alamassi (2014). First, the collection is carried out, followed by the inspection, separation, and selection of the materials that will pass to the third phase of the process.

The third phase is the transformation of the selected material into raw material. It appears in the form of dismantling (CESAR et al., 2007), processing and crushing (Gabriel et al., 2018), transformation (CARDOSO et al., 2021), shipping (MILANO; PUGLIESI, 2014), disposal (SEPPÄLÄ, 2010), recovery (KALOGERAKIS et al., 2015) and repair (KUMAR et al., 2015). The challenge here is to get the material ready for reuse, which characterizes the fourth stage, made differently.

Figure 1 - Steps of the reverse logistics process



Source: Prepared by the authors.

These pieces of evidence allow for building a dynamic and general logic, which makes sense of the apparent chaos and supposed lack of organization that the literature review data presents. This logic, it seems, begins with a diagnosis made from the collection of solid waste from the external and internal environment and ends with the execution of a plan and the execution to achieve a good destination for the trash. The program is made in the steps of collection, inspection, reprocessing, reuse, handling, production, and supplies) and how each step will be developed and applied to reach

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a suitable destination. The plans come from the set of these two phases, as shown in figure 1, which results from the steps elaborated based on the literature detailed below.

First Stage: Material collection

This stage was called the collection, following the studies by Carmo et al., (2017), Cardoso et al., (2021), Milan and Pugliesi (2014), Nikolaou et al., (2013), Kalogerakis et al., (2015), and Kumar (2015). It is at this stage that the labor of collectors is applied. They are the ones who extract from the streets the waste dumped improperly by consumers. In this process, they sort the material, separate it, and put it on uniforms. The result of this collection is superb. The volumes and measurements reach millions or more of waste, be it plastic, paper, glass, and many others, that could be directly directed to an appropriate destination. Although there are campaigns and incentives for waste separation, this does not happen 100%, and the rate of materials thrown on the streets anywhere is significant. Mainly in outlying areas, where people themselves contaminate that environment, and thus, sometimes they even walk through their garbage. People must start to look at waste as something that can benefit them and not with disgust and dumping because what causes this is the lack of interest in looking at a clean, pleasant world without the mass destruction that occurs with streets, rivers, lakes, and streams where waste is dumped.

Second Stage: Inspection, separation, and selection

The second stage was called inspection, based on the studies by Kalogerakis et al., (2015), Kumar (2015), Alamassi (2014), and Carmo et al., (2017). It is focused on verifying how the procedures are carried out because they may be vulnerable to health problems depending on where the collectors are. The inspection must be done correctly. It will help the collectors, buyers, and partners responsible for sending it to the industries, places responsible for reprocessing, reusing, or implementing reverse logistics. Before suggesting changes, it is essential to know that the different types of waste do not go to the same places, if disposed of correctly, they are not mixed; that is, it is essential to separate the products.

Third Stage: Transformation of waste into raw material

In this stage, raw material production from the collected material stands out (ARAUJO et al., 2012). It is necessary to know how long each material takes to disappear to be reabsorbed by nature. This temporal dimension is the core of the awareness of the whole society. For example, tires and plastic have different useful lives, and each one also differs in the time to be entirely reabsorbed by nature. Knowledge about the lifespan of each material makes it possible to also think about the valuable life and life cycle of new products based on that raw material when purchasing.

The parameters for the production of the raw material come from the collectors' customers. The more the raw material produced by these parameters, the more added value the production will tend to have. These quality parameters, however, suffer decisive interference from the population

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regarding the preparation of waste to be discarded so that the collectors can handle them appropriately to guarantee the quality required by their customers. Production planning and execution, therefore, consider market demand factors, the production capacity of the collectors and their customers, the technologies to be used, and, above all, the technical knowledge available.

Fourth Stage: Customer supply

In this stage, the supply of the collectors' customers with the raw material produced in the previous stage stands out. The studies by Kumar (2015) and Araújo et al., (2012) consider supply as a set of strategies to integrate the flow of goods and services, finance, and information. Through this, it is possible to bring people together to carry out activities from consumption to material disposal. For this, the size of the business does not matter. The rule is that the structure must be consistent with planning, material acquisition, contact with suppliers, transport, and storage. This rule is so essential that any industrial organization's excellent functioning and profit depend on its determining factors, such as infrastructure, services, product quality, and motivated employees. Here too, reverse logistics continues with the concern with the return of certain products to the business cycle or to the productive process of the chain, which is carried out through reverse channels, where value is added or recaptured to the product.

Post-consumer logistics is based on the final life of the product. In this case, the product returns to the chain where it will receive final disposal or become raw material for developing other products. It is the case, for example, with the reuse of pet bottles as raw material for new packaging. The discarded pets are crushed and transformed into pellets, which will then be remanufactured to produce new bottles. Without remanufacturing, new mineral extractions from nature would be made for the continuity of the production chain. It shows how closely reverse logistics is linked to sharing responsibilities between the supply chain links. This responsibility is only well consolidated with a policy for sharing information and definitions for each connection. And waste pickers are a vital link in reverse logistics.

Fifth Stage: Beginning of a new production cycle

This final step is mainly done through remanufacturing, reuse, recycling, and final packaging (for materials that cannot be reused). Numerous materials, such as aluminum, can be reprocessed, but some stand out. It is due to the technical ease and greater appreciation of this material, which is infinitely recyclable and requires simple technology to use in recycling. It is different from what happens with steel. The literature treats the beginning of a new production cycle as reprocessing (NIKOLAOU et al., 2013). Here, complexity and logistical cost are essential aspects, often considered obstacles. The change in consumption patterns needs to be rethought because reuse, recycling, and remanufacturing processes increasingly require cutting-edge technologies. Changing mentality is impossible if you don't have the help of society. The community needs to be involved in this effort, including waste pickers.

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Reprocessing refers to the inspection processes of returned products, separated into different segments; some products will be recovered, and others will be discarded. Reverse logistics is essential because it contributes to the development and proper planning to pitch or take advantage of every material already used and dispensed. Understanding the processes and putting them into practice is a differential. Because of population growth, the more people there are, the more waste will be accumulated. And this accumulation can have disastrous results.

The heavy rains in summer highlight some of the severe problems in Brazilian cities: all it takes is for the water to fall and the streets to be flooded. The lack of maintenance of the underground galleries added to the excessive mismanagement of the garbage, resulting in the scenes seen every year repeating themselves: the flooding of houses and buildings by rainwater. Most of the materials that cause these floods could be reused, starting a new production cycle. The work of environmental education can be considered one of the best reasons for encouraging the reuse of materials and raising awareness among children and, through them, adult citizens. Turning garbage into art, for example, can help many people's lives. Developing reuse programs helps people who make the collections to reduce the perverse impacts of the absence of reverse logistics.

Poor management of waste generated by the most diverse activities can also harm the environment and health. Laboratories and health services also generate a large amount of toxic waste. They must organize themselves to implement their management to protect the health of living organisms and environmental preservation. These actions can be exercised directly or indirectly in the stages of collection, transport, treatment, and environmentally appropriate destination, as well as in the final disposal of waste. It makes the monitoring and control of these activities in the collection of solid waste indispensable (ARAUJO et al., 2012).

Handling corresponds to the treatment of materials from the first stages of use to the disposal destination. This procedure is based on the fact that all material (paper, cardboard, glass, plastic, tires, wood, and even organic waste) must be appropriately disposed of in a proper location. It naturally includes its permanent final destination so that it is reabsorbed by nature. Good handling requires knowledge of the characteristics of each material, what each of them can cause to humans and the environment, and it's chemical composition, whether it is toxic or flammable, among others. It assists in analyzing potential risks that will determine the appropriate disposal strategy. The collection of materials may require decontamination, inactivation or even the impossibility of reuse. These factors all help to reconfigure the importance of activities carried out by waste collectors.

RESEARCH METHODOLOGY

Reverse logistics has at one of its cyclic ends, the collection of waste, solid or liquid, which will be transformed into raw materials for the same or new products. In big cities like Manaus, which do not have consolidated selective collection and is part of the population's mentality, individual collectors remove a large amount of what is discarded from the environment. In this sense, the general objective

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of this study was to understand the leading difficulties these individuals encounter in adequately executing this mister. Here, how this objective was achieved will be detailed.

Guiding questions

The intended general objective was divided into five well-defined goals, transformed into guiding questions: 1) what are the main difficulties encountered by collectors? 2) How do these difficulties happen? 3) What examples can one have to understand the operationalization of these difficulties? 4) Which agents could minimize the difficulties of material selection for collectors? 5) What could these agents do for this purpose? The entire study design was designed to answer these questions.

Study design

The guiding questions were answered in 11 stages. The first was the definition of the study's specific objectives, carried out by unfolding the general objective from the guidelines emanating from the theoretical framework. The transformation of each goal was done by replacing the verb in the infinitive with an interrogative pronoun and noun, as in "Knowing how difficulties happen" transformed into "What ways do difficulties happen?". The third stage consisted of choosing the respondents, which resulted in elaborating a list of available waste pickers that could be contacted. The fourth stage showed how difficult and challenging it is to find someone willing to provide information for studies of this nature, so much so that nearly all individuals contacted declined to participate.

Only three collectors were willing to participate in the study through a previously scheduled interview in the fifth stage. In the sixth stage, data were collected on the agreed days and times following a protocol explained in advance to all respondents. After all the interviews were done, each one was transcribed using a word processor, always taking care to transcribe what was asked and answered, configuring the seventh step.

The eighth step aimed to organize the data. The principle adopted was to copy and paste the answers to the same question side by side in a table, replacing the respondent's name with the letters A, B, and C, to maintain guaranteed anonymity during the contact phase. A summary table of all the answers obtained for each question was received.

The new stage consisted of data analysis. The difficulty question was analyzed using the similarity technique, in which we tried to identify similar answers to the question and marked differences. The tenth step was the consequence of the previous one because it aimed to find out how much the responses were similar and how much they were different. When all were similar, that item was considered consensual. Finally, the eleventh stage dealt with interpreting the results and comparing each development with the theoretical framework on which the investigation was based.

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Research subjects

Even carrying out daily collections with the little she earns, she could not afford the necessary protective materials for display, such as suitable quality gloves. We contacted the first respondent at his home, where he kept the collected objects and sold them to companies. It was a man who appeared to be approximately 40 years old, medium height, and slightly overweight.

The second we found on the streets, she was a woman. She appeared to be close to old age. She wore substandard gloves, which looked like they had been used for a long time. It looked worn from its long service on the streets picking up cans. Despite all the difficulties, it seemed to be in condition for the long walks needed for collection.

The third was a man, who appeared to be approximately 50 years old, wore gloves of poor quality, and did not seem to have good hygiene, most likely due to his lack of resources. He appeared to be physically fit and well-fed, which indicates that despite his difficulties, he could obtain his necessary food.

Data collection instrument

Data were collected through semi-structured interviews, carried out with the help of a script of questions (NASCIMENTO-E-SILVA, 2020a; 2020b; 2021a; 2021b; 2021c; SILVA et al., 2020). Each question in writing came from the theoretical frame of reference, which dealt with the first phase of reverse logistics: the collection of materials. When there is no selective collection, the materials are collected by individual collectors. These individuals often need help in adequately carrying out their work.

Thus, the researchers developed an instrument that allowed both the identification of difficulties and the signaling of possible solutions. For this reason, the interview script was as follows: 1) listing the main difficulties for collecting materials, 2) knowing how the difficulties happen, 3) collecting at least one example for each type of difficulty, 4) identifying the agents who could help alleviate or eliminate each difficulty and 5) make a map of what each agent could do with that intention. After elaborating on the script, it was validated based on the comparison with the theoretical framework and evaluation of other specialist researchers in reverse logistics.

Data collection strategy

We looked for each one of the interviewees, we arrived at their residences where one of them collected their waste and kept it in his own house using it as a mini deposit, where he gathered and then delivered and sold the collected materials, the others contain and usually make sales to companies right away, so we approached them and approached them and asked if we could ask them some questions about their work, as we were doing field research on a scientific work that we were putting together, so we talked to everyone them, and they spoke about every difficulty that each one went through, everyone spent the day on the streets looking for recyclable waste, to sell and thus support their families or themselves, thus generating an income, they reported to us through the

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questions that many times they find rubbish thrown and wrong shapes in the wrong places like on street corners or in vacant lots, in addition to which glass or cans (metal) are thrown in any way, thus causing injuries to their hands, if they are not careful as reported, sometimes they do not have adequate work material, many times due to lack of resources, another worrying situation is the way in which the population dispenses their garbage, especially in times of a pandemic, they report "we never know if this garbage is leaving the homes of infected people, thus being able to infect ourselves and those around us". One of the things that caught our attention was seeing the scars on their arms or hands, we asked what happened, and they said that it was doing the collection and that many times they get hurt with glass, cans, and irons for not having protective equipment individual.

Data organization and analysis techniques

The data were transcribed and typed in a word processor in the way the questions were asked, and the answers provided. The purpose of this procedure was to maintain complete fidelity of the data so that the analysis process did not suffer any contamination. After being transcribed, each answer gave rise to a table. On the left side of the table, the respondents' names were replaced by the letter A, B, or C, and the answers provided were written down on the right side. This step's challenge represented all the answers to each question in a single figure.

Data analysis was carried out in line with the guiding question. For the question that sought to know the difficulties, the investigation focused on seeing a) the variety of difficulties, b) which were the most different, and c) the most consensual. The question about how these difficulties occur and their respective examples were analyzed to identify the core, the source of the difficulty, as in the case of "the lack of garbage separation makes us fix ourselves with glass," in that the danger of bodily harm was the source of the difficulty. For questions about agents and what they can do to alleviate difficulties, the analysis focused on identifying people and institutions and the roles they could play.

Techniques for generating and interpreting results

The results were generated from the answer to the guiding questions. For the question relating to difficulties, the result was a list of problems waste pickers often encounter daily. The result of the question about how these problems happen was a synthesized description that allowed a clear understanding of each difficulty. This understanding was facilitated by the result of the examples requested from respondents. The result of the question about the agents was to know that the community/residents, city hall, governments (state and federal), and companies that buy the collected materials have roles to play to alleviate and eliminate the difficulties. These roles constituted a list presented as the fifth and final result.

The results represent the answer to the epistemological question "what is happening in reality?" the first instance of a scientific study. The interpretation of the results consists of the search for answers to two questions, also of an epistemological nature: how it happens and why it happens. The show is empirical, which begins with the data collected from the respondents, while the why is

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theoretical, exemplified, and demonstrated with data from reality. For this reason, the interpretation of the results followed two parallel paths that, from time to time, connected: the actual data and the theoretical frame of reference. In summary, the interpretation resulted from comparing reality with what the theoretical framework predicted.

Study limitations

Like any scientific study, this investigation also has two limitations that do not invalidate its results. The first concerns the sample size, consisting of only three respondents. The first consequence of micro samples is the impossibility of generalizing their findings. However, one of the intentions of the study was precisely to know in depth the difficulties that the collectors face, which almost always make it impossible for them to improve their lives. Studies with large samples could hardly show, for example, the cut hands of the respondents, their tears when telling their life stories, and so on.

The second limitation concerns the data collection strategy, which was restricted to only one source of evidence. Ideally, there would be at least participant observation and other records sources. But the fact is that the reality of the individuals interviewed is so unusual that it prevented the systematization of different sources. When approached, the collectors imagined that the researchers were government or police agents and that they represented some threat to them. The difficulty of understanding the research questions and expressing their answers comprehensibly also contributed to this.

RESULTS AND DISCUSSION

The purpose is to describe the difficulties encountered by waste collectors and their impacts on the practice of reverse logistics in the city of Manaus. Here, the answers obtained for each of the guiding questions of the research will be presented. The systematic presentation begins with a description of the empirical data obtained, proceeds with the interpretation of the results, and ends with comparing these findings with the theoretical framework of reference.

Main difficulties encountered in collecting materials

One of the difficulties encountered when collecting waste is the hard physical effort. It occurs because of the full and heavy bags placed on carts. It happens because the collectors do not have equipment that meets their needs. They submit as a matter of necessity and almost always without having work options. This extreme exertion causes health problems such as chronic pain and back and hand issues. It compromises the health of the collector.

Because they are in a low-income situation and enter unhealthy places, they have unwanted physical appearances and are rejected. Despite this being uncomfortable, they have to continue collecting their materials. Naturally, it would be more "comfortable" to be in an environment where they could gather materials without contact with people who reject and discriminate against them. Some

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are in these conditions because they were not given opportunities to choose. In contrast, others are in this condition because they do not want to take advantage of the study opportunities. In any case, everyone needs to support themselves and their families by scavenging.

Another very recurrent situation is the mixing of materials, which in most of the collection is found toilet paper, diapers, cans, plastic, glass, and food leftovers in the same bag. All this makes the work very difficult, at these times they are subject to cutting, for example with the glass, as shown in table 1. It would be so nice if people/scavengers started to be more aware and look more closely at waste but not always look with disgust as if nothing was reused and everything was harmful.

Table 1. Main difficulties in collecting materials

Respondents	Main difficulties
A	Physical effort people's rejection mixed waste
B	Work accident Unhealthy Individual protection Lack of waste separation
C	Lack of selective collection Lack of waste separation Work accident

Source: Data collected by the authors.

There are many difficulties, but the daily work accidents in the collections leave them sad and unwilling to continue. They say it is unfortunate to have to take steps that cause injuries and contamination. It means they are often out of work and unable to make a simple purchase. It would be essential if they could get support for the grooming, with at least gloves and boots. It would already help you and get rid of many problems you face. They point out that protective equipment would greatly help to groom, motivating them to work with less concern for their health. Factors harmful to health are related to unhealthy conditions because the places where they work are dirty, with strong odors, which cause them health problems. These factors attack their health and gradually make them disabled.

Consumer awareness would help contribute to many of these problems because it would make collections more accessible and free them from workplace accidents, such as contamination and injuries. Separating waste benefits health and the environment by avoiding contamination, pollution, and unpleasant odors for collectors. The collectors say things will change when the population takes waste as essential.

These difficulties are in line with what the literature shows. For example, the studies by Corrêa (2022), Shinohara et al., (2022), and Alves et al., (2020) showed the extreme physical efforts of the collectors due precisely to the lack of public and private support regarding the collection and transport infrastructure. Rejection and discrimination were also observed in the studies by Cabral (2022), Vasco (2022), and Meirinho (2020), among others, as a consequence of the ignorance of the majority of the population about the vital activity carried out by collectors of recovering the value of the material they

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society itself, also out of ignorance, throws it away. Finally, many studies confirm that the community does not collaborate with the practice of reverse logistics because it does not separate garbage (MARCIANO, 2022; VAGNER et al., 2019; FIGUEIREDO; NASCIMENTO, 2021).

How difficulties happen

Not having the equipment makes the collectors feel abandoned and unimportant to the population. But many say that if it weren't for their work, many places wouldn't be clean and would contaminate the environment. Thus, not having the equipment to transport the materials makes them suffer with the large volumes, and this causes health problems. Another very unpleasant situation is the rejection felt by people because they are in difficult situations without being able to have an appropriate place to be and take care of themselves. Work to make people aware of the importance of separating materials, as this will help us change how we collect them and eliminate accidents, as shown in table 2.

Table 2. How difficulties happen

Respondents	Difficulties	How they happen
A	Physical effort	Does not have the equipment to carry weight
	People's rejection	feeling of indifference
	Mixed waste	The materials are mixed
B	Work accident	Suffer cuts, contaminations
	Unhealthy	Material storage sites are filthy
	Individual protection	Lack of personal protective equipment
	Lack of waste separation	The materials are all mixed
C	Lack of selective collection	Residents do not separate garbage
	Work accident	They cut themselves with glass and sharp materials.
	Lack of waste separation	All types of garbage are placed in the same bag

Source: Data collected by the authors.

In addition, accidents at work cause waste pickers to suffer cuts and contamination precisely because of the minimal importance consumers give to waste materials used. If you no longer have the equipment to carry out the work, there should be a collaboration for properly separating materials. All these procedures would help the collectors to remove and store the materials until they reach the companies where they buy the waste.

These results again confirm the national literature findings that society, which includes people, companies, and governments, does not participate in the selective collection (CARDOSO et al., 2019; CARDOZO et al., 2020; ALBUQUERQUE et al., 2021; GONÇALVES, PINHEIRO P; PINHEIRO N, 2019). As this triad is the one that effectively initiates the reverse logistics process, it compromises the implementation and institutionalization of the circular economy in the municipality of Manaus.

Examples of how difficulties happen

Residents do not separate the garbage, which hinders workers' collection, as it can cause accidents and health problems. It is common to cut with glass or sharp materials because they do not

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have identification and do not use protective equipment, so they cannot protect themselves against these threats. And the day-to-day of these collectors is marked by obstacles and unpleasant situations.

Table 3. Examples of how difficulties happen

Respondents	Difficulties	Examples of how they happen
A	Physical effort	The carts are cumbersome because they have to carry heavy bags with the materials.
	People's rejection	People are often disgusted with waste pickers and want them to stay away.
	Mixed waste	Lack of knowledge about the materials.
B	Work accident	When people dispose of garbage, they do not identify the materials.
	Unhealthy	The places are dirty, out in the open, with every kind of dirt imaginable.
	Individual protection	Lack of financial resources.
	Lack of waste separation	We found a waste of toilet paper, mixed foods, plastic bottles, canned food, broken glass, and mirrors.
C	Lack of selective collection	People need to try to learn how to dispose of correctly
	Work accident	As the garbage is all mixed up, glass is often in the bags that, cause serious injuries.
	Lack of waste separation	They mix glass with cans, toilet paper, and organic.

Source: Data collected by the authors.

Making an effort to dispose of waste, at least removing the common sharp and cutting ones, will help immensely, as shown in table 3. The fact that all materials are placed in the same bag increases the difficulty of picking, as this causes accidents and a very high degree of contamination. There are no identifications of the materials, which affects the collectors' work. When they have problems with accidents, they have to stay away or even go to work at greater risk.

Who could help minimize difficulties

The physical effort can be changed or reduced with the help of the city hall, providing types of equipment that help the collectors to collect the materials. Regarding the rejection felt by the collectors, residents need to try to understand that they are part of and contribute to making environments more beautiful and pleasant for society. The companies that buy the materials can help the waste pickers with encouragement and help identify the materials and the responsibility of sorting.

Accidents at work with waste pickers can be reduced or disappear with the help and contribution of residents who dispose of materials. Governments could implement specific disposal sites and encourage people to leave materials separated and identified in these appropriate locations. It would reduce the risk of accidents and contamination. Also, the companies that buy the materials could help them with safety equipment. This equipment is an expense for the company. Still, there should be a collaboration with the collectors who deliver the raw materials to them (recycling companies) and provide a good destination for the materials they discard, as shown in table 4.

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Table 4. Agents that could minimize difficulties

Respondents	Difficulties	Agents that could minimize them
A	physical effort	City hall
	people's rejection	Residents
	mixed waste	Government
B	Work accident	Companies that buy the materials
	unhealthy	Residents
	individual protection	Government
	Lack of waste separation	Companies that buy the materials
C	Lack of selective collection	Residents
	Work accident	Government
	Lack of waste separation	Residents

Source: Data collected by the authors.

The government could invest more in the selective collection in appropriate places and start demanding a more effective contribution from the population. If the residents contribute to identifying and separating materials, the collectors will have more security and protection. However, if residents do not contribute to keeping the environment clean and free of dirt, such a government effort will not help. It is the price to be paid to preserve the city's natural resources, clean neighborhoods, and guarantee your health. Respondents cited the oldest streams in Manaus, which today are polluted, making it impossible to take a bath or even walk peacefully through those places. Several studies have confirmed this way of thinking of the interviewed waste pickers, showing a possible inverse relationship between the effectiveness of reverse logistics and environmental degradation (CARVALHO, 2023; PONTES et al., 2022; LIMA et al., 2022; VIOTTI et al., 2022).

Agent actions to minimize difficulties

Respondents suggested that the government could provide financial assistance to make it possible to purchase individual and collective protection equipment. It would cause accidents to decrease or be eliminated. In addition to the government's help, the collectors need the attention of the residents so that they can separate the waste and identify hazardous, sharp, self-cutting materials and others.

More selective collection points are needed in more visible places, such as schools, bus stops, UBS, etc. With the presence of the city hall in providing more collection sites, residents and consumers need to be aware and identify the risks each material can cause to collectors. The city hall could also apply fines to people who do not follow the rules for proper waste disposal without differentiating social classes, as shown in table 5.

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Table 5. Agents should do to help reduce difficulties

Agents	Agent actions
Government	The government could help them with some aid aimed at your maintenance to help, especially for purchasing protective equipment.
Residents	Consumers/residents must help with the separation of materials. It will avoid accidents with them, avoid diseases, which are contamination.
City hall	The city government implements more disposal sites, but not only that, it encourages people/consumers to know the materials and adequately carry out the separation of materials.
Companies	The companies that buy do not work with the provision of protective equipment for the collectors, nor do they provide lectures or moments of iteration to alert the collectors about accidents.

Source: Data collected by the authors.

Companies that buy materials from collectors do not hold lectures or provide protective equipment for waste collection. However, they believe the material collected by the collectors is mainly cardboard. These companies invest in training their employees directly linked to waste collection and not the collectors. They suggest that they be included in this training so that their products increase in quality and, consequently, can collaborate towards achieving the objectives of these companies, which are their customers. The studies by Cabral and Nascimento-e-Silva (2022) and Bastos and Nascimento-e-Silva (2022) showed similar results about what the primary agents of reverse logistics in Manaus could do to reuse the waste that the city produces effectively.

CONCLUSION

This study pointed out that the main difficulties faced by solid waste collectors in carrying out the selective collection in the city of Manaus are physical effort, people's rejection, unhealthy working conditions, lack of personal protective equipment, and the lack of participation of people, companies, and governments. These combined factors mean that very little of what is produced is reused. As a result, the other stages of the reverse logistics process are wholly compromised, making it impossible to implement a circular economy in the city.

The collectors, the first agents, do not have technical knowledge about logistics or the materials they handle. They also lack the necessary equipment to deal with the waste without compromising their health and simultaneously deliver quality raw materials to your customers. Residents and second agents do not participate in reverse logistical efforts by not preparing the material to return to collectors. They discriminate against these professionals precisely because of the service they perform. The companies, and third-party agents, that buy the collected waste do not collaborate with the collectors, even with the training they offer to their employees. Finally, governments, fourth agents, are also absent from the reverse logistical effort because they do not provide the necessary amount of properly structured collection points, nor do they apply a public policy in this sense that is known to the population.

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