

## Environmental Management System for Small Business

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### Abstract

*The upholstery remanufacturing service provides for the sale of products that contain reused items, extending their lifespan. The objective of this study is to propose a simple and feasible Environmental Management System for small businesses, like upholstery companies. Visits were made to twenty-eight upholstery companies in Teresina, Piauí, Brazil, with the objective of getting to know the sector and accompanying the production process, as well as observing the environmental aspects involved in the activity. The EMS standards do not meet the needs of small businesses like upholstery companies, however, it is possible to outline a minimum set of procedures for improving the enterprise's sustainability, such as the organization of the environment, employees training, reducing material losses, using Personal Protective Equipment, adequate waste destination, reusing materials wasted in the process, among others. The results provide subsidy for application to small companies in Brazil and in other parts of the world.*

**Keywords:** Upholstery; Environmental Impacts; Remanufacturing; Environmental Management System

### 1. Introduction

Remanufacturing can be understood as a recovering process of a worn product through the disassembly and reconditioning or by exchanging some component, obtaining a product with identical characteristics of the originals [1]. Remanufacturing activities, such as those provided by upholstery companies, provide upholstery refurbishment and manufacturing services based on the reuse of components, enabling aesthetic and/or ergonomic improvements at the customer's will. The most competitive price, when compared to the new product, is one of the attractions that contributes to the demand for this type of product/service.

Regarding environmental sustainability, in many cases, remanufacturing can be more advantageous than recycling, which requires high energy consumption and the generation of liquid and gaseous effluents. In addition, remanufacturing can save about 80% of energy and material used to manufacture new equivalent products [2]. However, the same authors state that none of the recovery strategies, including do not implementing any strategy, is always superior to the others, since it depends on several factors, including costs, government incentives, environmental factors, among others.

Companies that perform remanufacturing/reuse have the potential to play a relevant environmental role, since this activity meet environmental objectives, for example, reducing the use of materials and energy [3]. In addition, there is a contribution to the reduction of waste, keeping the residual material circulating in the value chain.

The search for more sustainable production patterns reinforces the need to explore alternatives that make it possible to extend the lifespan of products. This requires efforts and dedication to implement sustainability strategies not only in product development, but also in the provision of services [4].

Although the importance of remanufacturing as an effective means of reducing waste is recognized, there are barriers to be faced so that the production process of these companies is aligned with economic, social, and environmental aspects [1]. According to Karvonen et al. some examples of these barriers are: the need for recognition of the environmental aspects involved in the activity, employees training, use of Personal Protective Equipment (PPE) to protect the staff health, identification of the stakeholder's needs, establishment of an environmental policy aligned with the organization's objectives, among others [5].

To reduce them, there are standards of the International Organization for Standardization (ISO) that assist enterprises that seek systemic improvements, through the implementation of an Environmental Management System - EMS [6]. There are three standards regarding the EMS that guide organizations to achieve a structure for the protection of the environment, together with socioeconomic needs: ISO 14005, ISO 14001 and ISO 14004 [6 to 8].

The ISO 14005 standard focuses on the guidelines for the implementation of an EMS in phases, covering the assessment of environmental performance [7]. The ISO 14001 standard contains requirements with guidance for the use of the EMS directing organizations that aim to achieve environmental results and the ISO 14004 refers to the general guidelines for the implementation of EMS with orientation for the establishment of the continuous and improved environmental management (it can be considered complementary to the previous standard) [6,8].

Despite the assertion, within the scope of the standards, that they can be implemented in any organization, regardless of their characteristics and constitution, it was observed that it is not feasible to apply them in small businesses, such as upholstery companies, due to the absence of the following elements: Context of the organization, Leadership, Planning, Support, Operation, Performance evaluation, and Improvement. These elements are an integral part of the standards for analyzing the feasibility of implementing the EMS.

This absence is mainly due to the simple organizational structure of the upholstery companies, characterized by the centralized and familiar management; familiar workforce, empiricism in process production, absence of a business model, ignorance about the interested parties' expectations and about legislation related to the activity, absence of environmental objectives and lack of training.

In this study, micro and small companies are defined as small businesses, with annual gross revenue equal to or less than R\$ 360,000.00 (about \$ 65,400.00 American Dollar), and the Individual Micro entrepreneur (MEI) with annual gross revenue equal to or less than R\$ 81,000.00 (about \$ 14,700.00 American Dollar) [9]. Also, in this definition, the informal worker who performs the activity in a similar way to those mentioned is considered.

Thus, the aim of this research is to propose a minimum EMS for micro and small companies and for the individual micro entrepreneur, which can be feasible, making applicable aspects such as Planning, Performance and Environmental Improvements in upholstery companies in Teresina, Piauí, Brazil, and in other parts of Brazil and the world. The absence of scientific work that addresses environmental/economic/social sustainability in upholstery companies, both in Brazil and in other parts of the world, makes the research relevant and important for the activity to be developed in compatibility with the three pillars of sustainability.

### *1.1. Overview of Upholstery Service in the World*

A search for scientific articles that addressed sustainability in the activity of upholstery companies was performed. For this purpose, it was used the portal of journals of the Coordination for the Improvement of Higher Education Personnel (CAPES), a database that includes 130 reference bases and a collection of more than 45,000 titles (articles, books, etc.) [10].

The search was carried out using the keywords upholstery AND sustainability; upholstery AND sustainable; upholstery AND "sustainable process", upholstery AND environment; upholstery AND environmental, using the "subject" filters for ten years. Only fourteen papers were recovered with these themes. With the terms in Portuguese, no work was recovered. Thus, it becomes important and relevant to discuss, among academic/scientific peers, sustainability in the activity of upholstery companies.

The upholstery service can be quite divergent in different parts of the world due to the different economic, geographical, climatic contexts, which can influence the type of material used, the degree of standardization and mechanization of services, consumer preference, in addition to the waste and impacts generated in the production process. To understand the behavior of upholstery companies, regarding sustainability, a search for scientific works with this approach was performed.

The results of the search for articles on the CAPES portal show that few scientific papers address sustainability in the upholstery activity. Only fourteen articles were retrieved in the research, two on sustainable projects at the Ikea company and others on different materials (fabrics, chemicals, wood) used in upholstery companies [11 to 14]. One of the articles addresses the environmental impact of transportation in redesigned supply chains, making a case study of a leather upholstery company [15].

Elf et al. examined Ikea's Live Lagom project, a behavior change initiative that aimed to explore how to go beyond conventional approaches, demonstrating how companies can support sustainable development by encouraging their customers to take more sustainable lifestyles [12]. The results show that the wide range of interventions led to changes in pro-environmental behaviors, with potentially positive impacts on the client-company relationship. Therefore, more companies must be involved in similar behavior change projects that allow citizens to develop more sustainable lifestyles and behaviors, in all contexts.

Despite the lack of papers with an environmental bias, to understand the sector in other parts of the world, articles that address design, quality, practicality, lifespan, among other factors, in the upholstery activity were analyzed. In Egypt, many people prefer to use classic furniture (French, English) or modern style, abandoning the use of Islamic furniture in their homes. The Islamic design of furniture and upholstery fabrics has traditional and inherited shapes over time and was not developed to suit the modern era, which makes it unattractive to the user. In many cases, there is no correlation

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between the furniture design lines and their upholstery fabrics [16]. This is relevant for remanufacturing companies, which need to adapt their services to customer preferences.

A study carried out in Poland on furniture design aiming at user comfort showed that the thickness of foams has a significant impact on this issue. As the thickness of the foams increases, the size of the contact area is larger, increasing comfort [17]. Thus, to offer a quality service, it is important to assess the impact of the thickness of the upholstery materials on the comfort of the furniture, especially when it is about remanufactured products.

In Turkey, consumers choose upholstered furniture for comfort, aesthetics, functionality, and ergonomic design, in addition to observing whether the products are made with high-quality materials, with a long lifespan, and brand value. These consumers use their furniture for a long period and only replace it when necessary. For this reason, they tend to prefer useful products, made of high-quality materials and with a more timeless aesthetic design [18]. This fact is important when considering remanufacturing of upholstery furniture since customers demand quality for a durable product.

Upholstery production in the USA is divided into cover materials like fabric, leather, others (synthetic leather, microfiber, vinyl), and the upholstery market is analyzed considering the main determinants of demand (labor market, consumer confidence, income from households, spending on furniture and the evolution of new home sales prices). Upholstery consumption in the USA is divided by lining materials (leather, fabric, others), type of product (fixed and mobile upholstery furniture), and price ranges (low, medium, medium-high, and high) [19]. Although the assessment of the American upholstery market considers new furniture, the concept is valid for remanufacturing companies, which must analyze the factors of consumer's preference, demand, price, etc. when offering their services.

Thus, it is important to develop research that addresses sustainability (economic, environmental, and social) in the upholstery business because of the deficiency of scientific material that represents the sector, with this perspective. Some websites of companies that offer these services bring some initiatives regarding sustainability. However, the subject needs to be studied by the scientific community to generate subsidies for the improvement of production processes, waste management, mitigation of environmental impacts, among other factors.

## 2. Methodology

The study was carried out through field research (visits) in formal and informal upholstery companies located in Teresina, Piauí, Brazil. The selection process of formalized upholstery companies, that is, the ones who have the National Register of Legal Entities (NRLE), took place through a search on the Federal Revenue website, which makes public NRLE data available and where,

also, it can be found information on the cadastral situation and the National Classification of Economic Activities (NCEA).

The NCEA makes available the code 9529-1/05, referring to the description of the service/activities performed by upholstery companies, which are: upholstery of furniture items; upholstery services; repair; upholstery renovation; upholstery repair services. Thus, 31 companies registered in this NCEA code were retrieved, however, only 21 participated in this research. The others did not accept to participate or were not found.

There are many professionals who offer this service in Teresina, however, it is not possible to specify this amount, because most of them work informally. Thus, seven informal companies were selected. They perform upholstery services similar to the formal companies and they are distributed in the four zones of the city.

The zones of the Teresina are defined according to the Master Plan for Territorial Planning, which divides it into four Urban Macro zones: Development Macro zone; Moderate Occupation Macro zone; Environmental Interest Macro zone; Conditional Occupation macro zone. For the purposes of this research, the subdivisions of the Development macro zone were used: development zones center south, north, east, southeast [20]. Informal companies were randomly selected, obeying the saturation criterion, that is, when the responses became repetitive, visits were conclude.

The confidentiality term was prepared and handed over to the managers, which guarantees the confidentiality and non-disclosure of their name and the company name, as well as the commitment to use the data only in the scientific community. Also, the term of consent and free clarification (which explains the purpose of the study) was signed by the managers, in addition to the participant declaring, by means of his/her signature, the agreement to collaborate with the research.

During the visits, the upholstery production process was monitored to get to know the activity, observing the business model adopted by these enterprises and the entire context of the organization, from the stakeholders involved in the process to the destination of the waste. To guide the collection of information from the managers of the upholstery companies, a questionnaire was used, enabling a better analysis, and understanding of the processes.

The next stage of the research was to identify the environmental aspects arising from the activity and the negative environmental impacts, allowing the suggestion of a feasible standard.

Among the three existing standards on the EMS, the most consulted in this research was ISO 14001, as it brings the initial aspects to be considered when organizations propose to implement an EMS [6]. The other standards refer to the following steps to be carried out for the implementation and performance evaluation, including environmental issues.

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### 3. Results and Discussion

#### 3.1. Overview of Upholstery Services in the Visited Companies

According to the information provided by formal companies' managers, that is, those ones that have NRLE, the reasons that led them to register the company are the need for contracting services by offices, due to the requirement to issue an invoice, and to access bank credit and contribution to social security included in the single tax.

One characteristic of small businesses concerns the position in the occupation of the self-employed worker, who is the "person who works exploring his own enterprise, alone or with a partner, without having an employee and whether or not with the help of an auxiliary family worker" [21].

Regarding the infrastructure, in general, the upholstery company has a space that serves for the receipt, disassembly, assembly and delivery the product. However, it was observed that the available space does not always fully meet the needs of companies, which use the sidewalk to dismantle products or even part of the public road, making it difficult for pedestrians to pass, leaving waste, and hindering vehicle flow.

In the Municipal Posture Code of the City of Teresina, Complementary Law No. 3610 of January 11, 2007, it is stated that depositing and throwing, directly or indirectly, on sidewalks waste of any nature constitutes a harmful act [22]. In addition, it is prohibited to prevent, by any means, the free transit of pedestrians in appropriate places and vehicles on the streets, avenues, roads, and public paths, except for exceptions defined by the Teresina City Hall. The non-compliance with the law may result in the cancellation of the business license.

As for lighting, in general, it is inefficient since most of the companies use only natural light. However, there are few windows to allow sunlight to enter and, when there is artificial lighting, it is not directed to the place where the tools are handled. This fact makes the environment dark and unsafe, since sharp materials are used, which increases the risk of accidents.

Studies show that buildings with high levels of natural light produce better environments for human health, productivity, learning and psychological well-being, which demonstrates the importance of adequate lighting, preferably, natural light [23]. The use of natural light also contributes to the reduction of the cost and environmental impacts of the electric energy (artificial lighting).

Moreover, the poor luminosity also promotes the proliferation of fungi that, in addition to the deficient air circulation, produces a characteristic moldy odor. Humidity and temperature have a direct influence on the formation of mold, caused by fungi, a condition that can be mitigated by increasing the entry of sun into the environment [24]. Also, the materials are not properly conditioned, being left in direct contact with the floor and dirt, such as dust and other residues.

Most upholstery companies have problems in the layout, without division by areas and without a minimum organization system defined for the storage of inputs and waste. Proper organization can facilitate the production process, reducing waste, and decreasing the risk of accidents at work. For Battisti et al., the work environment should provide comfort and safety to the worker, ensuring proper health conditions [25].

About employees, upholstery companies have a variable number of workers, with a minimum of two and a maximum of six person. They learned the trade in the places where they worked and some of them later set up their own business. Regarding training, employees do not have access to any type of improvement/training on best manufacturing practices, modeling, assembly, care when handling certain types of products, importance on the use of Personal Protective Equipment (PPE), correct way to accommodate the raw material, and waste management.

#### 3.2. Customers

The clients, in general, are individuals and entities, who hire Upholstery Company considering requirements such as price and service quality, according to information from the participants. Of the upholstery companies visited, four provide services to entities with NRLE and one of them, also, provides authorized service to a furniture store in Teresina.

The managers say that, normally, within a period of five years, customers seek services from them at least twice to renovate the same upholstery furniture. In general, the renovation involves only the replacement of the covering material. When they decide to replace it with a new one, they look for companies to donate or sell the old product.

#### 3.3. Raw Materials and Suppliers

In general, the upholstery furniture consists of wood, plywood - Medium Density Fiberboard (MDF) or wood agglomerates - Medium Density Particleboard (MDP), metal or plastic, which serve as a structural basis for the products. Foam is used in the backrests and seats. Woven textile materials and resin-impregnated textile materials are used to cover the upholstery.

Woven textile materials are those with a flat, flexible structure, formed by interweaving the warp threads, a set of threads in the longitudinal direction and weft threads, transversal arrangement, forming a 90° angle [26].

These materials can be impregnated with chemically activated or thermally activated resin. The materials with chemically activated resin have a woven or non-woven base, which will later receive one or more combined resins, activated by solvent. The second type of textile material differs from the first, only, in the form of activation (thermal activation), and there is also the possibility of applying or not adhesive film [26].

In addition to these materials, non-woven textile materials, formed by a veil or blanket made of fibers or filaments oriented in a defined direction or at random, can be used as a lining for the back and seat, with a flat, flexible, and porous structure, stabilized through a mechanical and/or chemical and/or thermal process, or by a combination of them [26]. There are also materials that are used to join or provide support to the parts of the product, such as strap, nails, staples, synthetic adhesives, and feet that can be from metal, wood, or plastic.

About the adhesive, all upholstery companies use synthetic adhesives based on aromatic hydrocarbon solvent, except for one, which uses water-based adhesive. The use of synthetic adhesives is mainly because they are easily found, with an average price of R\$ 30.00 (about \$ 5.40 American Dollar) per 1 kg of the product. While the other type, sold only in online stores, has an average price above R\$ 80.00 (about \$ 14.50 American Dollar) per 1 kg of the product.

Synthetic adhesives have environmental effects such as the release of vapors and toxic smoke in contact with fire. Solid waste from this material is classified as hazardous (class I) and pollutes water resources. In humans they cause immunosuppressive effects, acute and chronic toxicity, carcinogenic and mutagenic effects, and local

body effects [27].

Bekhta and Kusniak state that, despite their positive characteristics in relation to adhesion, such adhesives are toxic [28]. The release of formaldehyde can cause damage to the respiratory, nervous and eye systems, and even cancer and leukemia. Therefore, the reduction of the toxicity of wood materials is of great importance for the environment and, mainly, for human health.

The raw materials, from all upholstery companies, are purchased from local suppliers (in the city of Teresina), with price and quality requirements for the acquisition. Purchasing products from local suppliers helps to mitigate the impacts with emissions from dislocation (transportation of inputs) and contributes to regional economic growth.

### 3.4. Price and Composition of the Raw Material

The pricing of the service in the upholstery companies depends on the size of the furniture and the raw material, varying depending on the composition and characteristics. The price of the raw material is established in a linear meter, as there is a variation in width depending on the material. Table 1 specifies the composition of the fabrics most used in upholstery.

Fabric	Composition	Price/m (\$) (Dollar)
Chamois/Suede	100% Polyester	2.34
Linhão (thread)	100% Polyester	3.81
Impermeable	70% Cotton / 30% Polyester	4.22

**Table 1: Composition of the most common fabrics used in upholstery companies and the average price per meter**

Source: Authors

Suede and linhão (thread) are the most sought after by customers, as they are among those that are a fashion trend (during the period of research), making the price of the final product attractive. The

impermeable fabric is the one with the highest price, which makes it the least chosen by customers.

Table 2 shows the composition of the synthetic laminates most frequently searched for in the surveyed upholstery companies

Synthetic Laminate	Surface Composition	Base Composition	Price/m (\$) (Dollar)
Napa	100% Polyvinyl chloride (PVC)	100% Polyamide (PA)	4,52
Corano	100% Polyvinyl chloride (PVC)	100% Polyester (PET)	2,81
Corino	100% Polyvinyl chloride (PVC)	100% Polyester (PET)	1,99

**Table 2: Composition of the Most Common Synthetic Laminates Searched For in Upholstery Companies and Average Price per Meter**

Source: Authors

Napa, according to the managers, is the best synthetic laminate, both in terms of durability and in the finishing quality of to the final product. However, the price of this raw material is higher, reducing demand due to the high cost. Corano and corino are the most sought after and, between them, the corano quality is superior. The corino has a thickness of the PVC sheet between 0.22/0.26

mm with a total weight of 381g/m<sup>2</sup>. The corino thickness of the PVC sheet is approximately 0.27 mm with a total weight of 436 g/m<sup>2</sup>. In this way, it is possible to perceive that the thickness and weight of these materials are directly related to the final quality of the refurbished product.

### 3.5. Machinery, Tools and Use of Personal Protective Equipment

The straight industrial sewing machine is used for sewing parts of



the cover material. In one of the companies, the Overlock sewing machine is also used for the internal finishing of the cushions. Regarding the tools, the establishments use the stapler and hammer, as auxiliary instruments in production.

In general, employees do not use any type of PPE, such as gloves, apron, appropriate shoes, and mask. The use of PPE is necessary when performing any work/activity that exposes the employee to occupational risks and/or illnesses that may threaten the safety and health of the worker [29].

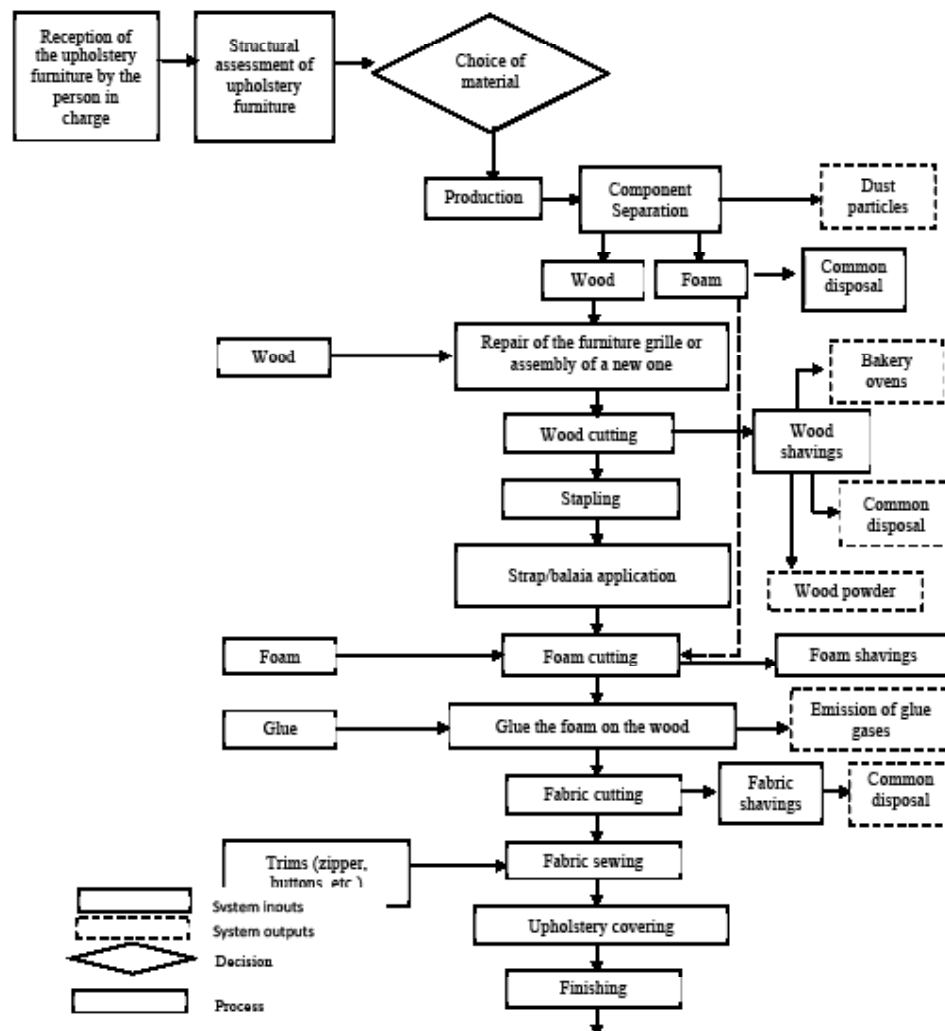
Regulatory Norm NR 6 states that the company is obliged to provide employees with PPE appropriate to the risk, free of charge, in perfect condition and functioning [30]. In return, employees are required to use them correctly.

The use of PPE is necessary because employees have contact with different factors such as dust, fungi, and mites resulting from the disassembly of the product, in addition to the gases exhaled from

the synthetic adhesive. They must handle with sharp objects such as nails, staples, and wood splinters, which are used in some of the production stages. Only one of the upholstery company uses the mask, apron, closed shoes, and appropriate clothing.

The production process is similar in all the visited companies, starting with the reception of furniture that can be taken to the location by the customer, or picked up at home by the company's employee. Figure 1 describes the complete and detailed flowchart of the production process of an upholstery furniture, explaining the environmental aspects involved in each stage of the process.

The initial assessment of the product's physical structure is carried out when it arrives at the company, to identify the feasibility of the renovation. In the disassembly stage, three aspects are considered: structure, flexibility, and appearance. In the structural assessment, it is verified if it is necessary to replace wood, foam, springs (if any) and straps, related to the flexibility of the upholstery furniture.



**Figure 1:** Flowchart of the Upholstery Production Process and Identified Environmental Aspects

The appearance is decided by the customer, when choosing the covering material and the design characteristics that will be modified in the product. After these steps, the upholstery is covered and delivered to the customer. The time between the start of the service and delivery varies according to the upholstery furniture's conservation status, which may require a major/minor renovation, as well as the type of material used, among other factors.

Employees state that there is no concern for the environment in any of the production stages, as well as in the choice of inputs, nor the identification of environmental aspects in order to mitigate the negative environmental impacts of the activity. It is possible to observe the raw materials used, the losses involved in the manufacturing process, and in which stages they take place to identify those that characterize environmental aspects that may cause negative impacts on the environment and on human health (Figure 1).

When the components are separated, the foam that is not used in the upholstery company is destined for disposal along with household waste, as well as the shavings resulting from the wood, foam and fabric cutting step. Only one part of the wood shaving is sent for reuse in bakery ovens.

Besides the discarded waste, there are also emissions of gases and particulate matter that cause impacts on human health and on the environment. Thus, there is potential for implementing an EMS aiming at mitigating the various negative impacts arising from poor waste management, emissions, among others, generated in upholstery companies.

### 3.6. Waste Disposal

Employees claim that the materials resulting from disassembly, due to the size and damage suffered and the shavings of fabrics and synthetic laminates, which do not have enough footage for use, are disposed to the collection of common waste carried out by the Teresina Environmental Consortium (TEC).

Two companies claim to deposit the waste at Waste Receiving Points (WRP), made available by the Municipal Secretariat for Urban Development and Housing (SEMDUH), for the collection of non-household waste from small generators. The location of the final destination of these residues is defined by SEMDUH and transportation is carried out in vehicles suitable for this purpose [31].

TEC is responsible for the collection of solid household waste, in addition to the waste resulting from the provision of services, commerce and other activities performed in the city. However, the Collection, Transport and Final Disposal Fee for Extra-household Solid Waste is charged for residues characterized as extra-household, that is, those that due to their volume, weight, degree of dangerousness or degradability, or other specificities, require special procedures for its management and disposal, in view of the negative impacts and risks to health and the environment [32].

Among the residues considered as extra-household are domestic furniture goods and other bulky residues, as well as waste generated in commercial establishments and services that exceed the volume of two hundred and forty liters or sixty kilograms, for a period of twenty-four hours [32].

One of the companies said that it puts foam residues at the company's door every week to be taken by anyone who perceives any use. The justification for this attitude is that, usually, collectors take these products to recycling cooperatives, according to the company manager.

Regarding wood waste, the employees of one of the companies claim that they try to make the most use of it, using boxes for separating materials, shelves, organizing niches and in the cutting tables. However, the material that is not used is destined for common collection. The other companies dispose all of their waste in the common collection.

In informal companies, employees from two companies claim that new fabric shavings, when requested by artisans, are donated to the manufacture of carpets, pillows, and bags. However, there is no periodicity in the collection. Thus, when accumulated, they are destined for common collection.

The foam and fabric shavings from one of the informal upholstery company are used to make pillows. Another four companies use the larger size shavings for making cushions and pouffes. However, everyone stated that the smaller size shavings are destined for common collection. None of the informal upholstery companies quantify the discarded material. Regarding wood waste, two upholstery companies claim that, when sought by bakeries, they sell the material to be used in ovens, but there is no frequency, so they send it to WRP.

According to data from the National Sanitation Information System (SNIS), it is estimated that in Brazil, in 2019, 65.11 million tons of solid urban waste were collected. Of this amount, approximately 48.1 million tons were disposed of in landfills and 15.9 million tons had an inadequate final disposal, in controlled landfills and dumps, making a total of 24.9% of the total disposed of in soil [33].

The data show that the majority of dumps are in the Northeast region, with a total of 622 units, that is, 55.8% of the total registered dumps. The number of controlled landfills becomes low, only 13.8% of the total amount registered [33]. This data is relevant because it demonstrates the reality of the region where these companies are installed and the necessity of manage their waste.

### 3.7. Waste Management

According to the employees' response, there is no planning for the solid waste management from any of the upholstery companies, both formal and informal. This can be explained by the managers'

lack of interest in working compatible with the mitigation of environmental impacts and, also, by the lack of partnerships with companies that can perform the selective collection of these materials, especially those that are potentially reusable.

Law No. 12,305/2010 instituted the National Solid Waste Policy (NSWP), which establishes principles, objectives and instruments related to waste management, the generators and public power responsibilities, and applicable economic instruments [34].

For companies to comply with the law it is necessary that there are actions aimed at the consolidation and application of its provisions and mutual interest among all spheres of society in order to achieve the proposed objectives. Thus, strategies that seek cleaner production, a more circular production chain, planning the product's life cycle, understanding of social responsibility, must be increasingly aligned with any manufacturing process.

In Chapter II, Art. 3, item IV of the NSWP, the product life cycle is defined as a series of steps that involve product development, from obtaining inputs, through the production process, consumption and, finally, the final disposition [34]. Thus, in the planning phase of a product, all steps from pre-consumption to post-consumption must be known, also identifying the environmental aspects involved, to mitigate those with a potential negative impact on the environment.

The objectives of the law range from the protection of public health and environmental quality to the encouragement of environmental labeling and sustainable consumption. Also, the law suggests waste management starting with the non-generation, reduction, reuse, recycling, treatment, and environmentally appropriate final disposal [34]. Therefore, the law suggests rethinking the form of production, by recommending, as a first initiative, not to generate waste, always seeking to minimize, as much as possible any waste, until the material is not amenable to use, and it needs an adequate disposal.

In upholstery services, although some materials are reused during the process, there are still no practices aiming at reducing waste. There are sporadic actions, in some enterprises, to make some waste available for collection, by artisans, however, there is no periodicity and monitoring of the occurrence of this practice.

The use of residual upholstery material for the manufacture of other consumer goods, such as those manufactured by artisans, refers to the concept of upcycling which, according to Bridgens et al. [35], is the use of discarded objects or materials, to create a new product that has characteristics such as quality and value superior to the original. The authors add that activities involving the reuse of materials can be influenced in view of the social, economic, and political context in which they are inserted and pay attention to the care that must be taken regarding discriminatory positions that the reuse of waste by artisans generates products of low quality. Also, they argue that reuse can be carried out with skill and aesthetic quality.

Another issue is related to the reuse of wood waste. Some upholstery companies provide these materials for use in bakery ovens. However, Top explains that, despite being a way of reusing waste, there is the environmental pollution caused by the burning of fossil fuels [36]. This pollution is aggravated if the burning is carried out in wood stoves, ovens, and wood boilers because it is necessary the complete combustion of wood residues and this is only achieved when the firing takes place in appropriate furnaces, so that pollutants such as carbon monoxide, manganese and organic compounds do not continue to be released. The ideal scenery is the waste returning to the supplier company, so it can give an environmentally appropriate destination. This is possible through integration between the supplier of the raw material and the company that uses the input.

According to Bridgens et al., another way for a more assertive destination, would be with products designed intentionally to meet the needs of a second life cycle, with functional aspects totally different from the original, differentiating them in post-consumption [35]. When the product is planned to have a second life, it has the design that provides reuse, and different from those that do not have this intrinsic value. In this case, an ad-hoc recycling is carried out, that is, the recycling is performed in a product that, initially, was not designed for this purpose, resulting in less reuse of components.

#### **4. Environmental Aspects Involved in Upholstery Services**

ISO 14004 defines environmental aspects as the interaction of elements of an organization's activities, products, or services with the environment [8]. The standard also explains that the term environment specified in its scope refers to the surrounding area in which the organization operates, including air, water, soil, natural resources, flora, fauna, human beings, and their interrelations.

To determine the environmental aspects involved in the activity performed by an organization, some points must be observed, such as: emissions to air; land launches; use of raw materials and natural resources; generation of tailings and/or by-products.

##### **4.1. Environmental Aspects: Emissions to Air**

Emissions to air are neglected by the surveyed companies. Only in one of them do employees use a mask. In the others, there is no protection to prevent the inhalation of dust particles or gases exhaled by the synthetic adhesive. Employees were asked if they felt any physical reaction during exposure to gases and dust. They replied that sometimes they feel nausea, headaches, dizziness, nasal congestion, and rhinitis, but that the symptoms do not always appear together and that, over time, the frequency of occurrences decreases.

The manifestation of rhinitis is due not only to exposure to dust, but also to the fact that the adhesive is a respiratory sensitizer, defined by ABNT NBR 14725-1 as a substance that, when inhaled, induces hypersensitivity of the upper airways [37]. The classification criteria for substances that are respiratory sensitizers



are the evidence manifested in humans or in positive results in animal tests, characterized as hypersensitivity reactions that include asthma, rhinitis, and conjunctivitis.

The composition of the adhesive has a toxic effect on human health and is classified as a dangerous product. A synthetic adhesive manufacturer makes this information available to consumers in FISPQ No. 26, in which contact glue is classified in accordance with Ordinance 204 of May 1997 - Classification and definition of the class of dangerous products [38].

The contact glue FISPQ indicates that the components that contribute to the product's danger are organic solvents, noting that it contains toluene and a mixture of hydrocarbons. The record classifies the product as dangerous because it is flammable and toxic, also presenting damage to human health, environmental effects, physical and chemical hazards, and toxic effects [27].

The acute toxic effects to human health, due to excessive exposure to the adhesive are irritation of the respiratory tract, skin, and eyes; corneal irritation or burns, headache; nausea; dizziness; somnolence; dermatitis on the skin [38]. Among these effects, the symptoms reported by employees were rhinitis, headaches, nausea, and dizziness.

Bortey-Sam et al. observed in their study that human beings exposed to compounds that contain hydrocarbons, such as those of synthetic adhesive, present rhinitis, nasal congestion, persistent cough, and headaches [39]. Rengarajan et al. further explain that the exposure to this chemical component occur in different ways, one of them is inhalation and dermal contact in work environments, being considered a potential occupational carcinogen [40].

#### ***4.2. Environmental Aspects: Launches on Land, Use of Raw Materials and Natural Resources, and Generation of Tailings and/or By-Products***

Other environmental aspects identified in the upholstery companies are launches on land and generation of tailings and/or by-products that will be discussed together in this section, as they are related. Among the solid waste there are fabrics, non-woven fabrics, synthetic laminates, and wood. When they are discarded, added to the material, there is the energy spent for the processing of this raw material, as well as the increase in negative environmental aspects, initiated with the use of chemicals present in some stages of the production process of textiles and synthetic laminates and that will end up launched into the environment.

According to data from the Brazilian Association of the Textile and Clothing Industry - ABIT this is an important economic sector representing 16.7% of jobs and 5.7% of the Manufacturing Industry turnover, with a turnover of R \$ 185.7 billion in 2019 [41]. Thus, for Oliveira Neto et al. strategies such as Cleaner Production that seek a c Top ge in the waste generation scenario, aiming at approximating sustainability in the textile chain, must be implemented [42].

Rovira and Domingo affirm that in the finishing stages of textiles such as bleaching, printing, dyeing, impregnation, coating, plasticization, among others, different chemical substances are used resulting in the generation of dyes, metals, pentachlorophenol, whiteners such as chlorine, biocides, halogen transporters, free formaldehyde, and softeners, which are harmful to the environment and human health [43].

The environmental impacts caused by textiles are part of the entire production chain. The environmental burden is also related to factors such as thread and fabric thickness and the types and mix of fibers used in the manufacture of textiles, which influence the decomposition or recycling process. In addition, natural fibers (like cotton), for example, represent a global volume of approximately 40% of the total production of textiles and demand considerable use of water resources, besides the application of pesticides and fertilizers, while synthetic fibers are produced from non-renewable resources and toxic products, which also points to their polluting potential [44, 45].

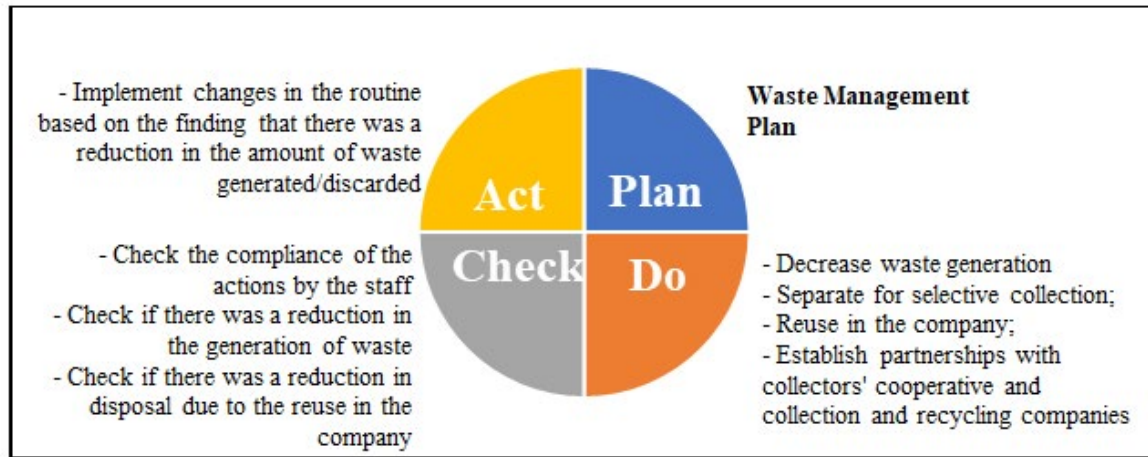
The management of textile waste, especially in the post-consumption moment, should be a priority and reuse, recycling, and incineration with energy recovery, are strategies that can mitigate the impacts caused by this waste, in contrast to destinate it to landfills [46, 47].

Sanitary landfills are still the most widely used disposal route, considered economically viable, even knowing the emissions of gases and leachate in addition to the use of large areas for their allocation [48]. Thus, rethinking the life cycle of products, ensuring that the destination of pre- and post-consumption waste is carried out in an appropriate manner, contributes to the reduction of environmental damage.

#### ***5. Analysis of Environmental Management System Standards and Applicability in Upholstery Companies***

The EMS standards were designed to serve the most different organizations, regardless of the type of activity, the nature of the enterprise and the size, and can be used in small, medium, and large companies. The approach considered by the ISO 14001 standard is based on the concept of the Plan-Do-Check-Act (PDCA) cycle, always seeking to observe the objectives, the implementation of the planned processes, the monitoring of these processes and actions for continuous improvement [6].

However, to start the evaluation process of the organization that chooses to implement the EMS, it is necessary to analyze seven elements of the PDCA Cycle: Plan (1- Context of the organization; 2- Leadership; 3- Planning; 4- Support); Do (5- Operation); Check (6- Performance evaluation) and Act (7- Improvements). Each element has specifications that must be considered at the time of the analysis [6, 49]. A simplified example of PDCA cycle application for environmental improvement regarding the management of upholstery waste is described in Figure 2.



**Figure 2:** Simplified Example of Using the PdcA Cycle Tool in Upholstery Companies for Waste Management

Planning for better waste management can trigger practical and sometimes simple actions, such as proper separation for selective collection, resulting in environmental benefits and favoring better economic performance with the reuse of a material that would be discarded. Thus, the application of the PDCA cycle in upholstery companies can help, both in sales and profit goals, as well as in environmental and social issues.

Some characteristics pointed out in the standard are different between small, medium, and large companies, mainly due to the

organizational structure of larger enterprises that allows for better management, with division of labor, application of strategies and resources by sector, internal systems and conduct regarding environmental issues. So, the application and analysis of some tools become more complex [49].

Therefore, a gap was identified between what the standard points out as requirements for analysis in upholstery companies. For a better understanding, Table 3 presents the description of the seven elements mentioned.

Requirement with guidance for use	Description of the elements
1 Context of the organization	<ul style="list-style-type: none"> <li>- Understanding the organization and its context</li> <li>- Understanding the needs and expectations of interested parties</li> <li>- Determining the scope of the environmental management system</li> <li>- Environmental management system</li> </ul>
2 Leadership	<ul style="list-style-type: none"> <li>- Leadership and commitment</li> <li>- Environmental policy</li> <li>- Organizational roles, responsibilities and authorities</li> </ul>
3 Planning	<ul style="list-style-type: none"> <li>- Actions to address risks and opportunities</li> <li>- Environmental aspects</li> <li>- Compliance obligation</li> <li>- Action planning</li> <li>- Environmental objectives and planning to achieve them</li> <li>- Planning actions to achieve environmental objectives</li> </ul>
4 Support	<ul style="list-style-type: none"> <li>- Resources</li> <li>- Competence</li> <li>- Awareness</li> <li>- Communication</li> <li>- Documented Information</li> </ul>
5 Operation	<ul style="list-style-type: none"> <li>- Operational planning and control</li> <li>- Emergency preparedness and response</li> </ul>
6 Performance evaluation	<ul style="list-style-type: none"> <li>- Monitoring, measurement, analysis and evaluation</li> <li>- Internal audit</li> <li>- Management review</li> </ul>
7 Improvement	<ul style="list-style-type: none"> <li>- Nonconformity and corrective action</li> <li>- Continual improvement</li> </ul>

**Table 3:** Description of the Elements of the ISO 14001:2015 Standard for the EMS Implementation

The elements presented in Table 3 are not known by the upholstery managers. This is mainly due to the constitution of the activity, without any organizational structure that promotes improvements, not only economic, but also social and environmental in the short, medium, or long term. Thus, there is potential for the development of a standard that is feasible and applicable to the reality of small companies such as upholstery companies.

## 6. Proposed Environmental Management System for Upholstery Companies

Through the scenario presented on the upholstery business, the information on the identified problems and environmental issues were gathered in Tables 4 and 5. In Table 4 there is an overview of the problems identified in the upholstery companies and the practices that can be adopted aiming at improvements.

Analyzed criteria	Identified barrier	Verified problems	New practices
1-Infrastructure: Organization	Lack of organization in the work environment.	Improper packaging of raw materials, preventing their future use. Increased expenditure on the purchase of new inputs as there is no defined place to store them.	- Use of the 5S Methodology. - Material cost reduction.
2-Infrastructure: Lighting	Little artificial lighting. Predominant use of insufficient natural light.	Less efficient execution in stages that require greater care to avoid accidents. Dark and humid environment contributes to the fungi proliferation.	- Artificial lights with focus directed to the object ensuring a safer and higher quality work. - Compliance with the Standard
3-Infrastructure: Ventilation	Poor air circulation.	Many upholstery furniture piled up and close to the ceiling, hindering air circulation and strong musty odor.	- Improvement of workers' health. - Reduce storage time.
4-Infrastructure: products packaging	Inappropriate accommodation of materials.	The materials are in direct contact with the floor and dirt such as dust and residues.	- Material cost reduction. - Loss reduction. - Provide storage infrastructure.
5- Training	Absence of information on production practices.	Waste of some inputs in the production process.	- Improvement in the production process, reducing the risk of losses. - Employee training.
6- Raw material	Material loss.	Absence of knowledge about modeling, causing losses in the cut.	- Use of modeling. - Improvement of the production process, reducing the risk of losses;
7-Personal Protective Equipment	Absence of PPE.	Respiratory problems resulting from contact with dust, gases, glue. Sharp objects.	- Improvement of workers' health. - Safety in the work environment.

**Table 4: Overview of the Problems Identified in the Upholstery Companies**

In the upholstery companies there is no layout that facilitates operations and, for the most part, there is no organization with materials in a defined location. The suggestion is the adoption of organizational principles that facilitate daily work, as proposed in the 5S methodology, of Japanese origin, in which each "S" corresponds to the development of an aspect: 1 - SEIRI (Sense of Use); 2 - SEITON (Sense of Organization); 3 - SEISO (Sense of Cleanliness); 4 - SEIKETSU (Sense of Standardization and Health); 5- SHITSUKE (Sense of Discipline and Self-discipline). This type of methodology contributes to all areas of the business, as it involves processes and behaviors [9].

There are rules that establish parameters for the necessary adaptations, aiming at to ensure, in the first place, the health and safety of the worker in the work environment. ISO 8995-1

Workplace lighting Part: 1, specifies the lighting requirements for indoor workplaces and the requirements for people to perform visual tasks efficiently, comfortably, and safely during the entire work period [50].

The luminance distribution must preserve the efficiency of the eye functions, maintaining comfort, performance, and visual safety. In this way, the balance between diffused and directional light must occur considering the verification of the lighting quality in indoor environments. Adequate values for maintained illuminance should be 300 lux (illuminance unit) [50].

The upholstery furniture is piled up, causing the obstruction of natural air passages, preventing good air circulation, increasing the possibility of fungi proliferation, and stopping gases and dust in

the environment, causing problems related to the health and well-being of employees.

Complementary Law No. 4,729, of June 10, 2015, Teresina's Construction and Building Code, determines that places of prolonged stay, such as workshops, industries and equivalent, that do not have openings that besides lighting and insulation serve for ventilation, they must adopt mechanical ventilation [51]. The suggestion for the companies would be to unblock air passages and the use of fans when the employees are handling with synthetic adhesives.

The accommodation of materials does not follow any procedure that keeps them out of contact with dirt. In this way, the adoption of storage structures such as drawer boxes and shelves can be the solution for accommodating materials of different sizes.

According to Regulatory Norm - NR 6, the use of PPE by workers

aims to protect them from the risks in the work environment [30]. The company is obliged to provide PPE free of charge to employees who, in return, are responsible for using them correctly. The use of PPE in upholstery companies can avoid the problems described in Table 4, the analyzed criteria 7.

Another issue to be observed among employees is training. The training of employees has the function of keeping them informed and qualified to perform their activities in a better way. The loss of raw material could be reduced, for example, with training in modeling, which would allow greater precision in the material cutting process, reducing inputs waste. The partnership with SEBRAE can be a way to train employees, since the entity offers several courses, in different locations, in person and online.

In the upholstery companies, also, the environmental aspects involved in the activity were verified, as shown in Table 5.

Analyzed criteria	Identified barrier	Verified problems	New practices
Emissions to air	Absence of minimum care to avoid inhalation of gases exhaled by the glue and dust from the upholstery	Collaborators with clinical issues like nausea, headaches, dizziness, nasal congestion, and rhinitis.	- Use of PPE to improve the protection against accident risks and improvement in workers' health.
Land launches	Absence of solid waste management.	Destination of materials with potential for reuse at the controlled landfill.	- Separation of materials with potential use to revenue generation through sale or use in other products. - Environmental improvements.
Generation of waste and/or by-products	Absence of planning and modeling contributing to material losses.	Waste of fabric, synthetic laminates, and wood shavings.	- Partnership with Production Centers and artisans to reuse the material in other products. - Contribution to the local economy. - Environmental improvements.
Use of space	Use of the sidewalk and public road for the disassembly and assembly of upholstery furniture.	Difficulty for pedestrians to walk on the sidewalk and cars on public roads, and waste not collected.	- Social and environmental responsibility, through better use of the internal space of the company, avoiding external occupation. - Correct disposal of waste.

**Table 5: Observed Environmental Aspects and Identified Problems in Upholstery Companies**

Regarding environmental aspects, some initiatives can be adopted to reduce the harmful effects caused by them. The main problem caused by emissions to air is the employee who, when working without PPE, inhales dust and toxic gases exhaled by synthetic adhesives. The toxicity generated by aromatic hydrocarbons, which are the basis of these adhesives, interferes with cell membranes. In addition, they have, in the long term, carcinogenic and mutagenic effects. Also, they are potent immunosuppressant's, compromising the immune system, humoral immunity, and host resistance [52]. Thus, the use of PPE by these professionals is essential.

About launches on land and generation of waste and/or by-products, it can be said that they are interconnected, considering that these two items deal with potential waste of material. A strategy to avoid this type of waste would be to establish partnership with production

centers, artisans, and universities through junior centers, for the use of these inputs in other production processes.

Regarding the use of space, such as sidewalks, enterprises must comply with Law No. 4,522 of 7 March 2014, which establishes new sidewalk standards and criteria for their construction, reconstruction, conservation and use of sidewalks in the Municipality of Teresina [53]. Chapter VII, which deals with the conservation and cleaning of sidewalks, states that depositing, throwing waste of any kind, directly or indirectly, is harmful to the conservation and cleaning of sidewalks. Another law to be considered is Complementary Law No. 3610 of January 11, 2007, which also deals with acts harmful to the conservation and cleaning of sidewalks [22].

It is important to mention that the participation of the municipal government is fundamental in reaching the proposed goals. The city hall may assist with partnerships for the collection of waste and sending for recycling, as well as increasing the inspection regarding the use of sidewalks for the disposal of materials and waste.

The government can also intermediate the partnership with a cooperative of waste collectors in order to provide the appropriate destination for potentially reusable waste. Thus, with the collaboration of the public authorities, companies can envision the potential for implementing a feasible EMS for the upholstery companies' sector.

## 7. Conclusion

The results found through visits to the upholstery companies in Teresina, Piauí, Brazil, show a scenario of great potential for improvement and adaptation to an EMS. The monitoring of the production process and the understanding of the services provided to the population made it possible to outline initiatives that take these companies to another level of competitiveness in the market, in a more orderly and planned manner, aiming not only at the economic benefits, but also at an understanding about the socio-environmental responsibility that the activity should promote.

The suggested practices, also, aim at a greater notoriety of the public power in relation to the activity, since, in general, this sector is on the margins of society. There are no actions to improve management, especially of waste and use of public space (sidewalks). The participation of the municipal government can help the goals of EMS, considering that the sector is representative for the population attending, mainly, those that look for the refurbishment of the upholstery furniture due to the lower cost.

The proposed EMS meets the minimum required to transform the sector and provide better conditions for upholstery companies, aiming at improvements to achieve the three pillars of sustainability (social, economic, and environmental), which can be developed by the small entrepreneur with the partnership of the government and support institutions. The system can be applied in other parts of Brazil and the world. The benefits would directly and positively impact the individual micro entrepreneur, the informal worker, their neighbors, employees, customers, and all society.

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