

The circular economy in the perspective of sustainable joinery: a case study in the Amazon

A economia circular na perspectiva da carpintaria sustentável: um estudo de caso na Amazônia

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ABSTRACT

This article explores the concept of the circular economy based on the use, as base material, of wood residues from the production process of a company that operates in the hygiene and cleaning products sector based at the Manaus Industrial Pole. These residues

feed the manufacturing process of a Sustainable Joinery, which, in turn, manufactures custom products, as well as those from its catalog. It is intended to explore the manufacturing process, in the context of the pillars of the circular economy. The methodology of this work consisted of exploring the stages of its manufacturing process, the process flows, the chain involved, and the waste management of this process. In this study, the life cycle stages of raw material supply and end-of-life pathways of wooden pallets were assessed environmentally from different perspectives with lifecycle assessment (LCA). In addition, it reveals the potential to be explored in the region due to the economic opportunities and social and environmental impacts, since, considering only the year 2019, 21 tons of wood were reprocessed, representing an average monthly revenue in the order of \$ 5,000.

Keywords: joinery, sustainable joinery, circular economy.

RESUMO

Este artigo explora o conceito de economia circular baseado na utilização, como material base, de resíduos de madeira do processo de produção de uma empresa que opera no sector dos produtos de higiene e limpeza sediada no Pólo Industrial de Manaus. Estes resíduos alimentam o processo de fabrico de uma Marcenaria Sustentável, que, por sua vez, fabrica produtos personalizados, bem como os do seu catálogo. Destina-se a explorar o processo de fabrico, no contexto dos pilares da economia circular. A metodologia deste trabalho consistiu em explorar as fases do seu processo de fabrico, os fluxos do processo, a cadeia envolvida, e a gestão dos resíduos deste processo. Neste estudo, as fases do ciclo de vida do fornecimento de matéria-prima e os percursos de fim de vida das paletes de madeira foram avaliados ambientalmente de diferentes perspectivas com a avaliação do ciclo de vida (ACV). Além disso, revela o potencial a explorar na região devido às oportunidades económicas e impactos sociais e ambientais, uma vez que, considerando apenas o ano de 2019, foram reprocessadas 21 toneladas de madeira, representando uma receita média mensal da ordem dos 5.000 dólares.

Palavras-chave: marcenaria, marcenaria sustentável, economia circular.

1 INTRODUCTION

With the advent of new technologies and increasing demand for products, our linear economic model becomes unsustainable and puts the survival of future generations at risk, given that we live on a planet with finite resources. In this way, a counterpoint is created to question the progressive model of development that, for many years, was disseminated in the form of a right for all, without, however, assessing the excessive exploitation of natural resources, with the consequence of the commitment to the environment.

In addition, we are a population that does not receive adequate education and training to minimize damage to the environment due to our current lifestyle. In view of

this, it is necessary to use the natural resources responsibly, mitigating their extraction and promoting the use of waste generated as raw material for new products.

The increase in the world population and its concentration in large cities, has resulted in the growing demand for products on a large scale, together with the lack of a holistic view on the part of the government, leading to a time of economic losses, causing negative natural impacts (Ellen MacArthur Foundation, 2020). Indeed, the population needs to be educated based on new paradigms, mainly about their responsibility to the environment, the consequences of consumption, and the need to minimize the generation of waste.

According to the report on Waste Management in Latin America and the Caribbean, the generation of solid waste in this region tends to increase considerably, from 541,000 tons per day, resulting in an average of 1 kg per day per person in 2014. It is estimated to reach 670,000 tons a day by the year 2050, that is, an increase of 25% in our waste generation (Unenvironment.org, 2020). This prediction puts society in a serious situation, as we are leaving liability for environmental degradation for future generations, greatly compromising the necessary natural resources that maintain an ecosystem on the planet Earth and guaranteeing a full and healthy life.

The transversal concepts between Sustainability and Circular Economy (Prieto-Sandoval *et al.*, 2018) particularly those that relate the premises of the circular economy - reuse, remanufacturing, and recycling, with the sustainable development objectives of United Nations Organizations (Sustainable Development Goals, 2020) - industry, innovation and infrastructure, sustainable cities and communities, responsible consumption and production, has been the greatest challenge for the modern world. In addition, a great paradigm, as part of the premise of finding a balance between the economy of a country and the lifestyle of people.

Moreover, actions for the other areas foreseen by government agencies are interconnected, insofar as they have a cascading effect, one in relation to the others, such as the search for cleaner solutions in the manufacturing industries in general and services, interconnected with industry 4.0 initiatives and reverse logistics (Batista *et al.*, 2018; Rajput & Singh, 2019). Actions in search of sustainable cities that will impact the better use of water, and soil, the search for energy efficiency, clean energy, and reduction of the emission of polluting agents in the environment (Beard *et al.*, 2019; Johnson *et al.*, 2020; Shen *et al.*, 2020). In innovation, when looking for new uses, new materials, increased product reliability, and development of new products with a sustainable footprint (Mestre

& Cooper, 2017; Vanegas *et al.*, 2018; Cordova-Pizarro *et al.*, 2019; Li *et al.*, 2020). In education, when looking for a new way of thinking and acting responsibly regarding our consumption and behavioral patterns and their effects on the social chain (Andrews, 2015; Merli *et al.*, 2018; Kirchherr & Piscicelli, 2019).

In many countries, the counterpoint to all these initiatives is still found in the barriers related to legislation (McDowall *et al.*, 2017; Fedotkina *et al.*, 2019; Talens Peiró *et al.*, 2020). The economic interests or the preservation of their market, and with the growing discussion of how to reconcile sustainable development with new forms of production and habit's consumption with a focus on the preservation of resources and the environment, become facts that are in the process of improvement (Oliveira *et al.*, 2017; França & Rangel, 2018; Ghisellini & Ulgiati, 2020).

This research addresses the specific problem of the management of wood waste faced by a large multinational industry, which operates in the industrial pole of Manaus-Amazonas, in the sector of cleaning products. It intends to present the actions related to the performance of a small company, called Sustainable Joinery, which uses the disposal of wooden supports as food for its manufacturing process.

The joinery focuses on the manufacture of various wooden products, either on demand or from its portfolio, formed based on the order history, exploring the premises of the Circular Economy, giving sustainable disposal to the waste of its partner as well as to its own waste. In addition, it intends to conceptualize its role in the generation of jobs and income, based on the vision of sustainable production as a model for the viability of new extracts of economic performance with less impact on the environment.

The study of the logistics chain, from the moment of wood discarding in the industry, going through the entire production process, processing and finishing of wood to transform into products, concluding with the delivery of a quality product/service to customers, using the recycling process is an object to be explored in this work.

Section 2 explores the literature review that supports this work. Section 3 refers to the methodological path used. Section 4 refers to the discussion about the results followed by conclusions at section 5.

2 LITERATURE REVIEW

2.1 CIRCULAR ECONOMY

Since the phenomenon of industrialization appeared, our production processes have been conceived in a linear way, where the raw material of nature is extracted, and a

good is produced from it and, after use-consumption, it is generally discarded into the environment. In addition to this cycle of use, there is the disposal of waste arising from the production process of this consumer good, as well as after its use, disposal.

The use of this systematic part of the unreal premise that nature is an inexhaustible source of natural resources and, as consumption increases, there is also a systematic increase in the extraction of natural resources and consequently, generated waste. In this sense, as pointed out by (Weetman, 2017), the linear economy, which is derived from previous industrial revolutions, based on the extraction of production and disposal, is gradually being replaced by the circular economy. Furthermore, (Michelini *et al.*, 2017) maintain that there is already a consensus that we are going through a period of severe depletion of our natural resources and that the current linear socioeconomic system, characterized by the disposal of the product at the end of the product's useful life, is one of the main causes of this natural depletion.

The main concept of the circular economy is to eliminate the term waste. What was previously considered waste must now be seen as a raw material for another process, and this must be maintained continuously, in a closed cycle. In effect, from the new perspective, from waste to resources, we have a new open economic field, with the potential to be used for a new process or product.

Therefore, the circular economy is based on optimizing the flow of goods, maximizing natural resources and minimizing waste production, with the creation of value, movement from one production chain to another and the creation of a new economic flow, with impacts across the social spectrum (Geissdoerfer *et al.*, 2017; Govindan & Hasanagic, 2018; Agyemang *et al.*, 2019). In addition, actions related to the circular economy are not limited only to industrial processes, but also to service processes and other different business models, as pointed out by some researchers (Ramos *et al.*, 2019; Romero & Rossi, 2017; Pieroni *et al.*, 2019).

2.2 SUSTAINABILITY: ASPECTS RELATED TO THE WOOD SECTOR

According to the UN, the term sustainable development is used to designate an economic model that seeks to reconcile economic development with the preservation and maintenance of available natural resources, that is, it is defined as “that which meets the present needs, without compromising the capacity of future generations of meet your own needs” (Sabau, 2020; Sustainable Development Goals, 2020). In this sense, the principle

of sustainability proposes that economic growth should not lead to environmental degradation or the depletion of natural resources.

Regarding the processes that use wood as raw material, the scarcity of natural resources and the generation of waste without proper destination are a worldwide concern related to the linear production model (Araújo *et al.*, 2019). Although it is considered a renewable resource, the speed at which forests have been explored, not following the natural cycle of some species, places this resource at a high degree of risk.

In their studies on the impact of wood waste on Australian furniture industries, (Daian *et al.*, 2009) show that, around 7 to 50% of material is not used in the production process. This total is becoming waste, and point to greater awareness of the use of this resource, in addition to emphasizing the costs resulting from such waste and alternatives for recycling and better destination of the generated waste.

In the context of the reuse, remanufacturing and recycle approach, (Weetman, 2017) points out that remanufacturing, for example, enables the offer of sustainability and economy, without compromising the quality and durability of a product. The potential presented by the possibility of reducing wastes in manufacturing processes, in which the resource is wood, reveals a range of possibilities for using the generated waste (Mair & Stern, 2017; Tamanna *et al.*, 2020). Applications from the power generation (Faraca *et al.*, 2019; Cesprini *et al.*, 2020), composite material (Sommerhuber *et al.*, 2017; Heräjärvi *et al.*, 2019), and managing construction (Ratajczak *et al.*, 2015; Trochu *et al.*, 2018) are some of the ways to apply the 3R's principles to wood waste.

3 METHODOLOGY

Based on lifecycle assessment analysis - LCA, the methodological path developed in this work consisted of an exploratory approach to the flows related to the Sustainable Joinery production process, from the acquisition of the raw material, the logistics involved, the manufacturing process, and the distribution of finished products and the disposal of its own waste. In this study, the life cycle stages of raw material supply and end-of-life pathways of wooden pallets were assessed environmentally from different perspectives with lifecycle assessment (LCA).

Therefore, it is a case study on the management of solid waste that is generated from the productive activity of the company Sustainable Joinery. For a better understanding of the process, it was necessary to create a chain flow showing all the actors involved and their participation, with the aim of explaining how the circular economy

flows as well as the generation of waste in the sustainable joinery production chain. An action plan for the correct disposal of company waste can be carried out. The period covered comprises the years 2016 to 2019.

The products manufactured in the joinery are consumable items, decoration and furniture that have pine wood (*Pinus Elliottii*, Pine-American Wood and Pine Wood) as the main raw material, residue from the manufacturing process of an installed American multinational chemical industry at the Manaus Industrial Pole, which has sustainability as one of its strongest pillars.

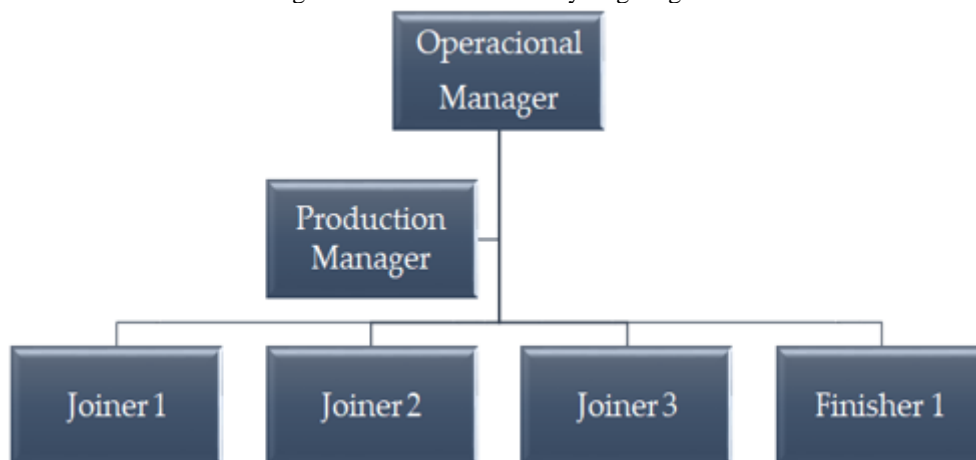
3.1 CHARACTERIZATION OF THE COMPANY SUSTAINABLE JOINERY

The Sustainable Woodshop works in the furniture sector in the city of Manaus, state of Amazonas, and in its manufacturing process it employs 06 direct employees, being 03 joiners, 01 finisher, 01 production manager and 01 operational manager.

In addition, it generates 04 indirect employees for service providers, 01 of whom is in command of carrying out the freight for the removal of waste, 01 locksmith, 01 planer operator and 01 responsible for carrying out domestic freight for the delivery of products to final customers.

The organizational structure of the company is detailed in the flowchart shown in Figure 1, where all the steps involved in the process are described, from the moment of removal of this waste at the factory until the moment when the item is delivered to the final customer.

Figure 1. Sustainable Joinery Organogram.



The process is carried out in two different joiners: the auxiliary joinery, where the material is taken for dismantling and cutting the cuttings so that it can proceed to the planing process, where the wood will be leveled, on the face and corner. After carrying out this operation, all the wood goes to the main joinery, where the rest of the process is carried out. The details of the company's operations are as follows.

- **Strategic Level:** this stage involves the capture and building of customer relationships, with the aim of becoming lifelong customers. In addition, there is a concern to explain the company's objective, its environmental practices and the circular cycle. The stages of this phase are divided into:

- **Budget:** the client contacts the Sustainable Joinery by different ways: scheduling a meeting at the physical store; Instagram social network; WhatsApp or going to the physical store;

- **Products Shop 24h:** budget requests for products from the brand's portfolio are answered within 24 hours;

- **Products Store 72 h:** requests for project quotes are answered within 72 h;

- **Order (PO) not confirmed by the client:** process completed and closed in the system;

- **Order (PO) confirmed by the customer:** order is inserted in the Trello system so that it is included in the Production Plan.

- **Operational Management:** operations and production management.

- **Production plan:** the production plan is organized based on the PO entry dates, following the FIFO so that the orders fulfilled are delivered within the dates established with the customers. The weekly production plan is prepared from the project information, which includes a schedule, production regime, project reference, among another information necessary for the team of carpenters to start manufacturing activities. At that time, the customer also receives a notice from the carpentry informing that the order has gone into production;

- **Production:** the process starts with the distribution of the production plan, which are delivered at the beginning of the week. Before the start of production, some measures are deliberated, namely: carrying out the 5S in the environment, analyzing the inventory, purchasing specific items, checking and updating production information with the team.

- Outsourced joinery: this is the phase where the entire joinery manufacturing process begins, in the circular context.
 - Supplier Logistics for Outsourced Carpentry: after the supplier requests the collection of wood waste, the company sends the freight truck to collect this material. After the entire process of removing this material, such as weighing and issuing an Invoice as a donation, the truck goes to the outsourced joinery, where the material is unloaded and organized so that the beneficiation process begins;
 - Disassemble: the wooden frames are disassembled and separated into two compartments, according to their size (80 cm and 1,00 m);
 - Chip cutting: after the separation, the chip cutting that the slats contain and are stacked according to the size of the lath (80 cm and 1,00 m) is started;
 - Planer: according to the kanban that exists in Sustainable Joinery, the beneficiation priorities are defined at the beginning of the planer process, where the planks will have the face and the corner aligned on the equipment that gives the name to the process;
 - Logistics for Sustainable Joinery: the slats are transported to the Sustainable Joinery, where the car will be unloaded and the wood organized in the determined area so that it proceeds to the next process.
 - Sustainable Joinery: the company's headquarters where the items are manufactured, according to the approved production plan.
 - Face cut: step in which the slats will go through the face alignment process contrary to what was aligned in the planer process;
 - Cut in width: step in which the slats will be aligned in the corner contrary to what was planned, according to the need of the project to be produced;
 - Gluing and tying the cloths: step that takes place according to the characteristic of the product to be manufactured, where the slats are glued together and are pressed to later be fixed and go through a white glue curing process for 24 h to that can proceed to the next step of the process;
 - Coarse Sandpaper: the slats pass through the beginning of the finishing process, where they will pass through the manual sanding bench so that the material is completely uniform;
 - Fine Sandpaper: the hand sander is changed, and all items go through the manual sanding process again so that now the marks of the coarse sandpaper are removed with the finer grain sandpaper;

- Tracer: the slats are cut to the width of the project being produced and sent to the sealing process;
- Finishing: the parts are sent to the finishing sector for sealing and sanding;
- Assembly: the parts produced, already individually sealed, are assembled.
- Shipping: after being assembled, the items are sent to the shipping sector, where they will be cleaned and will receive the company's brand label. The operational management sends the communication to the customers informing that the order is completed so that arrangements are made for the delivery of the product, which may occur as follows:
 - Pick-up at the store or factory: usually items of small consumption, leaving the option of picking up the material in the store at the customer's discretion;
 - Delivery with Installation: delivery and installation are made to the customer as agreed between the parties;
 - Delivery without installation: freight is provided for delivery to the customer.
- Customer Satisfaction Form: the satisfaction form is sent to customers to be filled out, covering the following evaluation metrics: Budget, Price, Communication channels, Product quality, Finishing, differentiated products, Doubts answered, Sustainability proposal, Team, Installation and After Sales.

Figures 2 and 3 are related to the phases of the processes described above. The flowchart for this process is shown in Figure 4.

Figure 2. Stages of Production Process. (a) Face cut. (b) Cut in width. (c) Gluing and tying the clothes. (d) Coarse sandpaper.

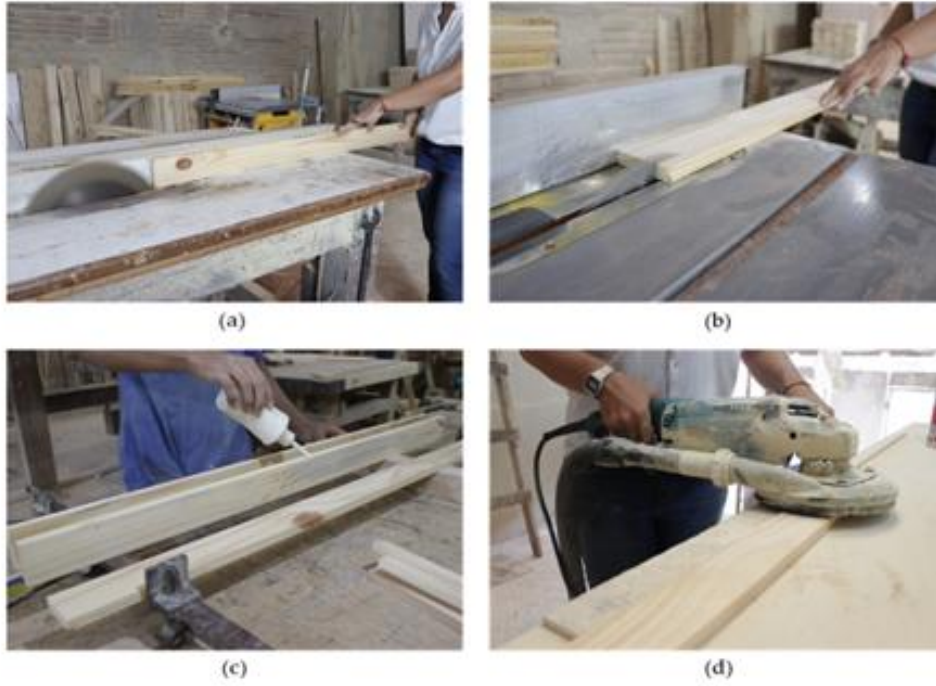


Figure 3. Stages of Production Process. (e) Fine sandpaper. (f) Tracer. (g) Finishing. (h) Assembly

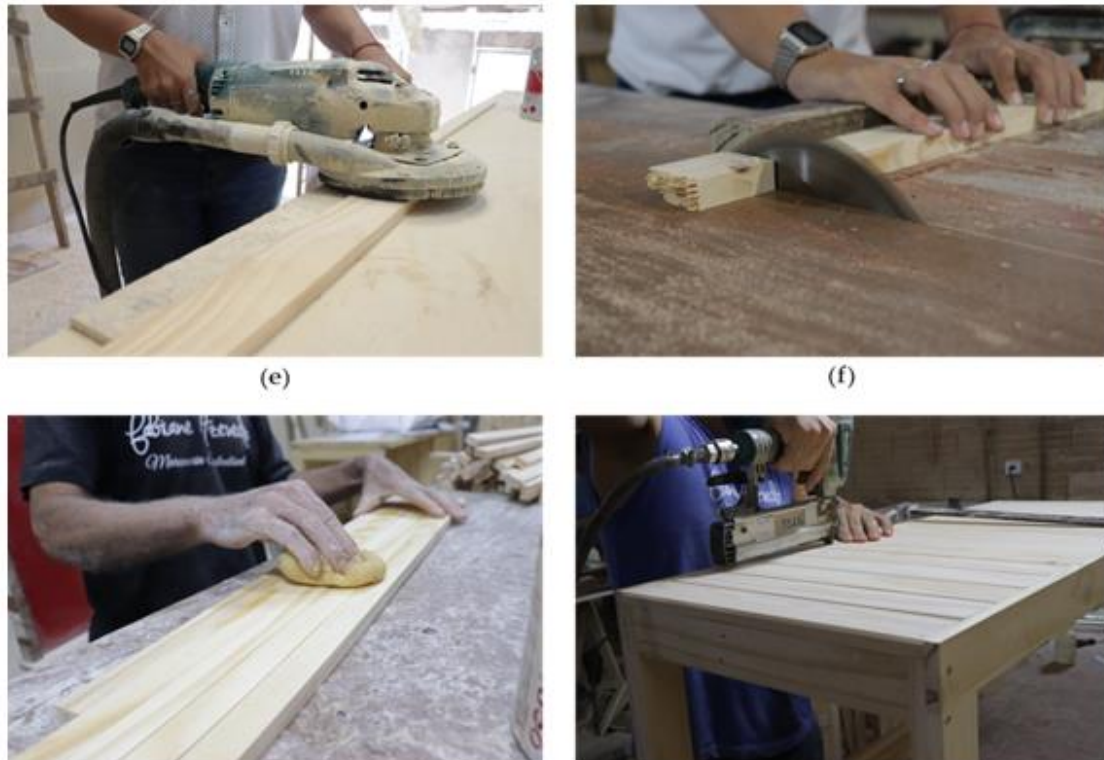
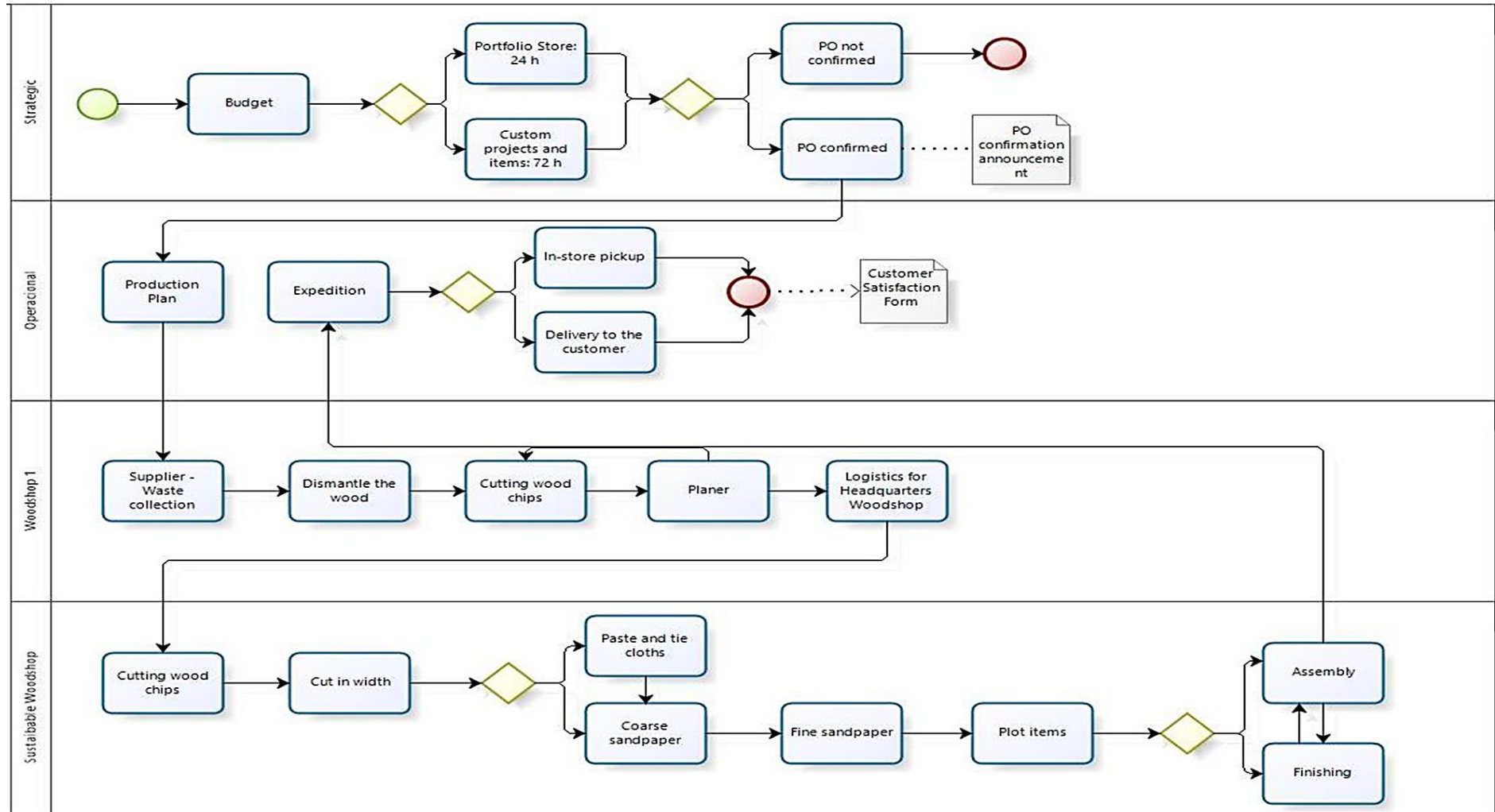


Figure 4. Circular Productive Flow - Sustainable Joinery.



4 DATA COLLECTION AND ANALYSIS

During the period from 2016 to 2019, approximately 74 tons of wood waste were collected, which was sent by the partner company to the company Sustainable Joinery, with collections being carried out monthly, as shown in Table 1.

Table 1. Wood waste output.

Month	Waste Output: Accumulated				
	2016	2017	2018	2019	Acc.
January	0,260	2,850	2,870	2,180	8,160
February	1,440	0,000	2,330	0,000	3,770
March	1,410	3,260	2,050	2,480	9,200
April	2,370	0,000	0,000	2,480	4,850
May	0,000	0,000	3,800	2,230	6,030
June	2,120	2,640	1,140	1,560	7,460
July	0,000	0,000	3,730	1,610	5,340
August	0,000	2,690	1,970	1,540	6,200
September	0,000	0,000	1,390	1,280	2,670
October	2,020	2,030	2,260	2,400	8,710
November	0,000	0,000	1,050	2,580	3,630
December	2,730	2,310	2,020	0,780	7,840
Total (ton)	12,350	15,780	24,610	21,120	73,860

All production processes, direct and indirect, were considered in this survey with respect to the generation and destination of solid waste from the company Sustainable Joinery, not considering the reverse post-consumption channels. In order to guide this work, some questions related to the activities of sustainable carpentry were considered, whose main objective is to operate as directing questions for the analysis and discussions of the collected data:

- What are the residues generated in each link in the Sustainable Joinery chain?
- Are they dangerous? If so, what are the dangers they pose?
- Are there possibilities for treatment, appropriate disposal or reinsertion into the production cycle?

Regarding the destination of the waste generated in the process, these occur at different levels, ranging from the sending of solid material for recycling at the Association for Recycling and Environmental Preservation (ARPA), to the collection company Residue Celeste, which produces fertilizers, as well as sent for composting to the vivarium of the Federal University of Amazonas (UFAM). Inorganic materials and wood scraps are in the process of developing actions for their proper disposal and, for now, they are destined for the city's landfill.

Below we detail the types of waste generated in the production process:

- **Sawdust:** waste is generated in the planning process, commonly called sawdust, which for the Sustainable Joinery has no significant economic value, as it is a waste from its production process that needs to be discarded and for this to be done, it generates a cost of cleaning the joinery. This organic residue with no commercial value for the joinery is destined for the vivarium of the Federal University of Amazonas, which has the activities of creating experimentation of mice for application in scientific research of students who are starting scientific research in undergraduate courses as well as master students. Doctoral students. Following the company's principles of staying in the loop of the circular economy, since the beginning of supply, which dates from Feb / 19 to the present day, 30 sawdust bags with an average of 2.5 kg were supplied, totaling the amount of 75 kg of sawdust correctly.

- **Dust of wood:** it is a residue generated in the sanding cutting processes. For every 10 kg of sawn wood, the amount of 50 g of sawdust is generated, totaling the amount of 230 kg of saw dust generated.

- **Wood chips:** waste generated during the production process in two moments, the first, in the beneficiation process called "Cut to Width" and at the time of assembly "Tracer," where the wood is cut to the correct sizes for the process of assembling the items.

- **Wood chips with staple:** waste generated at the beginning of the process, when the wooden structures are disassembled and the staple shavings are taken from the slats so that they follow the process, this being the first process of wood processing to be transformed into material for use. It is a product that also follows the line of organic waste and cannot be reduced, since it is part of the wood that needs to be removed for processing. Despite being wooden stumps, they are contaminated with metal staples, which make them inorganic.

- **Plastic Packaging:** the main generation of plastic waste is glue packaging, both white and yellow, used in the item assembly process. Conduct, as bags and packaging of consumable materials are to ARPA - Association of Recycling and Environmental Preservation for a new production cycle.

- **Cardboard Packaging:** generated from the purchase of screws that come in boxes, and when the goods are delivered to the joinery, larger boxes come packing small items in a box to characterize a volume. The volume of this material is very small, and

this item is also destined for the collector available in the joinery, and later it is sent to ARPA - Association of Recycling and Environmental Preservation for a new production cycle.

- **Metal Packaging:** generated from the consumption of chemical items for finishing the joinery products that are Thinner and Sealer, the same when finished are also destined to ARPA - Association of Recycling and Environmental Preservation for a new production cycle.

The flow of the entire process related to the company Sustainable Joinery takes place according to Figure 5, where the material is collected at the headquarters of the company that supplies wood waste, processing and production, treatment and generation of waste. Table 2 classifies the type of waste according to each phase of the Production process, where we have since the generation of organic and inorganic residues from the process or from the use of the inputs required for production.

Table 2. Destination of Process Residues.

Process	Residue	Type of Residue	Destination
Cutting wood chips	Stumps of wood	Inorganic	Landfill
Planer	Sawdust	Organic	Bioterium (Federal University)
Cut in thickness	Wood dust	Organic	Composting (Celeste Residue)
Cut in width	Stumps of wood	Organic	Landfill
Sander	Sawdust	Organic	Composting (Celeste Residue)
Sealing	Can of sealer	Chemical	Metal recycler (ARPA)
	Thinner can	Chemical	Metal recycler (ARPA)
	Tow	Inorganic	Landfill
	Sandpaper	Inorganic	Landfill
Assembly	Screw box	Inorganic	Metal recycler (ARPA)
	Plastic packaging	Inorganic	Metal recycler (ARPA)
	Metal packaging	Inorganic	Metal recycler (ARPA)
	Cardboard packing	Inorganic	Metal recycler (ARPA)
	Glue can	Chemical	Metal recycler (ARPA)

Regarding the positioning of the company Sustainable Joinery in view of the concepts recommended by the circular economy, Table 3 was developed, based on the Circular Economy Framework proposed by Weetman (2017). Considering the portfolio of products manufactured by the company Sustainable Joinery is based on a production plan based on customer demand (customization) and, for high output products, based on sales history, figures 6 and 7 are typical examples of the work performed, with the premises of Sustainability and Circular Economy.

Figure 5. Wood Waste Processes Flow.

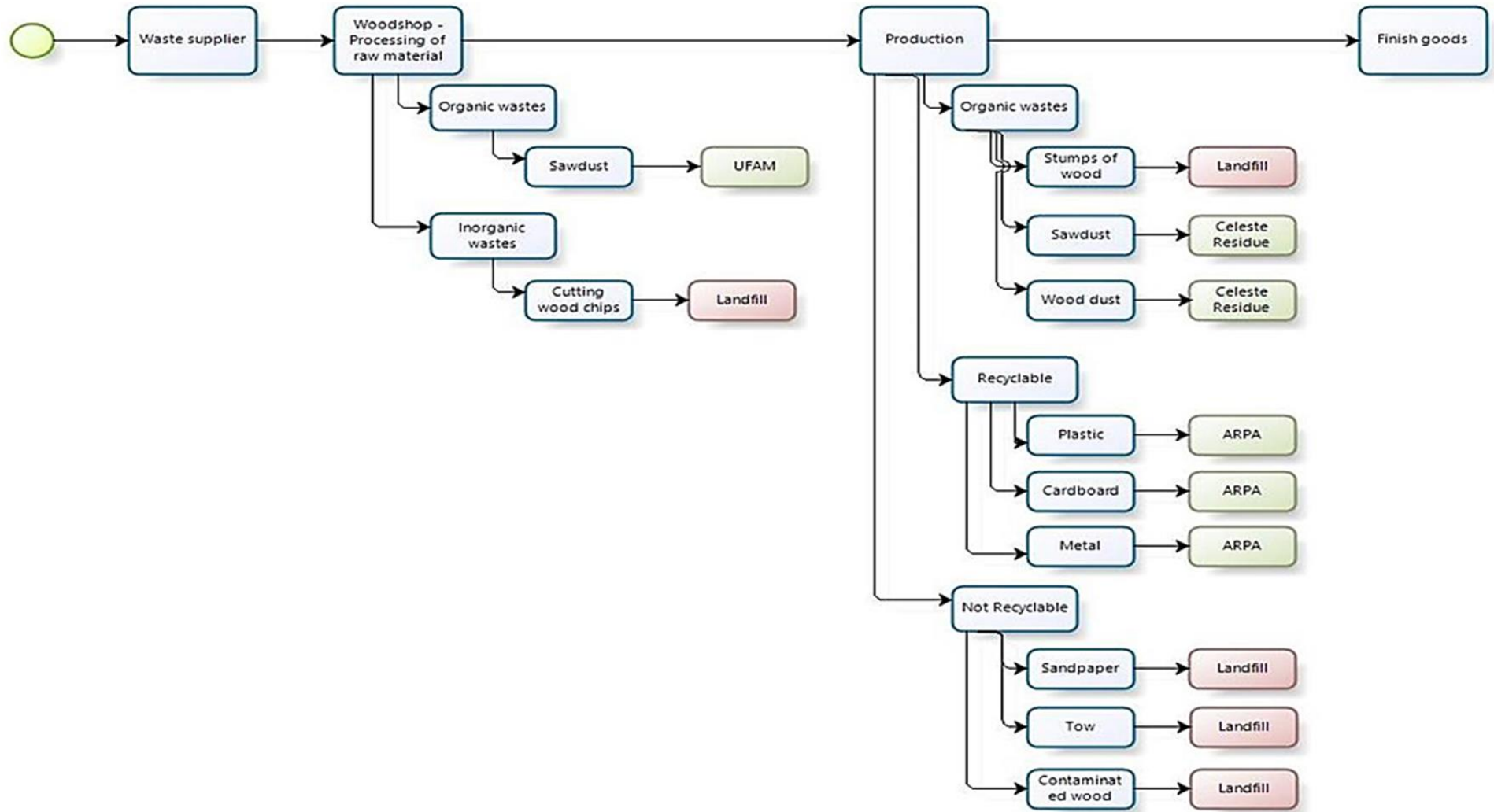


Table 3. Framework of Circular Economy - Sustainable Joinery.

Sustainable Joinery	Sector: Manufacture of wooden utensils		Channels: B2B e B2C		Region: Manaus-AM-Brazil		Open /Closed Loop: Open loop, same sector	
Business model	Property	Sharing	Exchange	Rent / Leasing	Services	Recovery	Recycle	Reuse / Resell
Circular inputs	Recycled	Recovered	Renewable	Safe and secure				
Product design	Use less	Use it more	Use it again					
Process design	Use less	Waste = food	Renewables					
Circular flows	Reuse	Keep	Renew	Remanufacture	Recycle			
Enablers	Biomimicry	Green Chemistry	Systems thinking	I3D	Asset tracking	Internet of Things	Platform and applications	Biotech.
Accelerators	Collaboration	Open code	Certification	Product Stewardship	Life cycle assessment	Taxes / incentives		

Source: Adapted from Weetman (2017).

Figure 6. Sustainable Joinery - Product Portfolio 1.



Figure 7. Sustainable Joinery - Product Portfolio 2.



5 CONCLUSIONS

Maintaining the production system based on the linear economy, as a standard, results in two major problems. First, our natural resources are finite and, consequently, their irresponsible use will put future generations at risk; second, we have a high generation of waste, both in the production of goods and in post-consumption, which are disposed of inappropriately in the environment.

In Manaus is installed a large industrial pole, with over 500 companies and that manufacture from electronics, motorcycles and cleaning material, housing national companies and multinational companies attracted to the pole due tax benefits granted. However, due to the lack of specific legislation, companies do not invest to be environmentally sustainable and responsible limiting their control actions only in their processes, with decisions taken internally, with no concern for their product after it leaves the factory. Another way of understanding this demand is to develop policies that encourage producers to take responsibility for the entire life cycle of the product, from the stage of production, use and end of use, which is translated into the concept of product stewardship.

Considering the volume of waste treated by the company Sustainable Joinery, clearly the impact on the economic chain is quite relevant, as it has the capacity to generate six (6) direct jobs and foster employability with its partners. In addition, the waste sent to companies that belong to this loop also contributes to the generation of jobs and income in the community. The average monthly revenue calculated in 2019 was U \$ 5,000, which reflects the importance and the economic and social impact of these initiatives. In this sense, the reflection takes place with respect to the high volume of waste generated in all industrial centers and the potential economic reflexes, should this circular system become reality and a natural part of the region's economic cycle. In addition, a new economic matrix is projected, based on sustainability and efficiency, promoting actions that reduce or eliminate waste, the impact on the environment and promote new consumption habits. It is in this context that Sustainable Joinery is found, seeking to be an agent for transforming the social fabric and promoting good production practices.

A possible way out of this situation is the revision or expansion of the tax incentives currently granted in order to encourage concrete actions by companies in relation to the entire process, from the supplier to the consumer, with responsibilities in

all phases. It will allow the creation of a systematic of a closed loop, as recommended by the basic concepts of circular economy.

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