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Daniel Nascimento-e-Silva; Arethusa Paes de Sousa; Tatiane Mayara Miguel da
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Daniel Nascimento-e-Silva

Post-doctorate in Management

Doctorate in Production Engineering

Master in Management

Bachelor in Management

Federal Institute of Education, Science and Technology of Amazonas

Arethusa Paes de Sousa

Logistics Technician

Instituto Federal de Educação, Ciência e Tecnologia do Amazonas

Tatiane Mayara Miguel da Costa

Logistics Technician

Instituto Federal de Educação, Ciência e Tecnologia do Amazonas

Marison Luiz Soares

Post-doctorate in Management

Doctorate in Production Engineering

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Bachelor in Management

Universidade Federal do Espírito Santo

Abstract

The movement of materials has become one of the centers of organizational attention to obtain competitive advantages, which is also perceived in organizations dealing with cargo transportation in the interior of the Brazilian Amazon. This study aims to describe the handling of materials made in the port of modern Manaus. Through a qualitative and quantitative study, the primary data were collected through observation and interviews, having as their subject the intentionally chosen vessel owners and commanders; Quantitative data were analyzed with T test and qualitative data with content analysis in triangular format. The results showed that there is an imbalance between the cargo and passenger transportation capacities in the surveyed vessels and that the material handling is done in an amateur way. The conclusion shows that, unless knowledge about the exploration of this business is deepened, the waterway modal will remain with the traditional characteristics that have persisted in the Amazon for decades.

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Introduction

Rivers are the main means of transportation of the Amazon region. It is through them that the municipalities of the region are supplied and distribute their production. Nevertheless, there are few technical and scientific studies, such as Duarte, Kuwahara e Silva (2011) and Marques, Kuwahara and Andrade (2011), dedicated to the specificities of Amazonian waterway transport, especially in the state of Amazonas. It is assumed, from analogies with the reality of other regions, that the stock of knowledge about the movement of goods through this mode can generate benefits for the development and improvement of the Amazonian waterway transport.

Material movement, as a logical-operational scheme of moving materials from one point to another over short distances, such as within organizations and, in the case of this study, in the port area, contributes to transport efficiency. Thus, the more efficient material handling in the port, the more likely it is that overall transportation (from distributor to port and port to end customer) will gain in efficiency.

In this sense, this study aims to describe the way in which materials are moved in the port of Manaus Moderna. The findings describe the main characteristics of the “transportation” business, which is made up of vessels that carry goods from Manaus to the interior cities and from these cities to the Amazonian capital, how materials are moved from the port to the vessels and how The materials are handled inside the vessels for temporary storage to the destination port.

Material handling: theoretical foundations

The issue of material movement permeates all organizational spaces of every type of organization and basically involves two central concerns: the need for action planning and the use of appropriate equipment for each type of material to be transported. The study by Santos and Guerreiro (2010) shows the example of a municipal health department that, when ensuring the supply of medicine, must plan and control the movement of materials. This purpose cannot be achieved without the use of appropriate means or planning for the distribution of medicines.

On the other hand, Azevedo and Uryu (2005) demonstrate that material handling is actually a reaction to the demands of a new business environment. The reason is that increasingly demanding customers and the increasing intensity of competitive intensification are driving companies to schedule changes in their warehousing and distribution structures. Thus, material movement becomes part of the business strategy of the organization, so that this effort can be converted, in some way, into a competitive advantage, either in terms of cost reduction or increasing customer satisfaction.

The level of concern about the accuracy of material handling has been the subject of organizational analysis because it influences the customer perception, negatively, if done inappropriately. When the movement is normal, it is not perceived by the client and even the organizational members. However, when this normality is broken, it is often easily perceived by members of the organization and also by customers, causing at least a reduction in satisfaction - and when satisfaction is compromised, this abnormality can be converted into dissatisfaction.

This is one of the reasons that explain why material movement should be identified and accompanied by documents that make it easier to understand why a certain movement is necessary and what is the

destination of the pieces (Drohomeretski & Souza, 2012). Thus, the percentage of error tends to be reduced, as the movement processes are documented, which facilitates the movement of materials movement within the organization and, at the same time, if the error occurs, facilitates the identification of its causes and the consequent correction. In order to avoid mistakes, as a result, sophisticated techniques and resources are being introduced into the reality of many different types of organizations to achieve agility and speed.

It is precisely in this sense that Silva (2010) says that the movement of materials became faster with the emergence of mobile robots in industries. Reasoning from the point of view of production lines, the author shows that automation arises there to alleviate the difficulties of little flexibility in handling trajectories or in the ability to adapt to the increase in cargo volume. To this end, vehicles have been developed with the ability to be programmable and progressively endowed with some autonomy, which brings faster and safer operation.

Unfortunately, for most organizations, as Pereira (2011) demonstrates, material handling is not properly planned. His study shows that there are numerous problems centered on the positioning and sizing of equipment carefully to rationalize the internal transport of materials. It is necessary to plan the movements in order to be more efficient and, thus, the productivity can be increased and, thus, eliminating the activities that do not add value, especially the unnecessary transportation of materials.

The study by Rodrigues et al. (2010) reports several problems related to the complexity of material handling and focuses on several inadequacies that can lead to movement errors and production process failures due to the large number of activities performed. To minimize such errors, companies have found in information technology a great ally in improving process quality and gaining information efficiency and speed.

Competitiveness has also been seen and addressed in the effectiveness of material handling. Studies such as Culchesk et al. (2010) show that moving materials is vital to a company's survival and competitiveness. Competitiveness begins in the supply chain and ends in the distribution chain, but essentially in the design and implementation of the production system. And this is where the efficiency and effectiveness of the material handling system become essential tools in ensuring competitiveness because it ensures flexibility and agility to the production process. But in order to be efficient, it is necessary to have adequate equipment for each type of operation. And the integration of equipment with the stages of the production process is done through their contemplation in the design of the organization's production strategy.

It is in this sense that the study by Junqueira (2011) reports that material handling systems deserve special attention: because they are responsible for maintaining the material flow between machines, manufacturing cells, cost centers or between companies. Even when the movement does not add value to the product, special attention to it is necessary, because in every organization the need for efficient movement is essential so that all action can flow quickly and safely. When material handling does not add value, lack of integration with the production system detracts from value.

Costa (2010) considers that the movement of materials is intended to provide efficient transportation of finished products from the end of the production line to the consumer. In this case, movement planning would not be restricted to the internal dimension of the organization, but would now be part of the organizational transportation system. In this way, material handling would integrate the production planning and control sector with the process stocking, packaging and delivery of the product to the end

customer. Thus, the movement of materials would not only be restricted to the company's internal supply, but would be an integral part of materials management and the distribution chain.

Material handling is an interconnected activity system that is part of a large system of an installation or built-in functions (Paletta, 2010), such as care due to the fragility, size or weight of the object to be transported (packaging is designed for this purpose). so that there is no damage to objects when transported). This definition is really part of the reality not only of what happens within the organization, but also of the practical needs of moving materials throughout the logistics chain, from the most upstream supplier to the end customer. Thus, material handling would be an integral activity of the entire material logistics chain.

For this study, the internal movement of materials is the act of moving materials from one space to another within an organization, either to supply the production line or its middle activities, or in restricted areas, such as the Manaus Moderna port. This means that movement will only be studied from an internal point of view, even though its principles and equipment can effectively be used and integrated with movement within the supply and distribution chain. It will also be limited only to the simple displacement of materials, using the human body or mechanical or electronic equipment, geared both to feed the company's production lines and to supply non-operational production activities with materials.

Methodology

The structured methodological arrangement to describe the handling of materials in the port of Manaus Moderna, general objective of the investigation, sought to answer two ancillary research questions: a) What are the main characteristics of the "Transport" business made by river vessels operating in the port? (b) How materials are moved from the port to vessels? The method designed was characterized by being descriptive, in the classification made by Nascimento-e-Silva (2012a), and qualitative, with unit of analysis individual, level of interorganizational analysis (each vessel was considered an organization) and cross-sectional perspective.

The subjects of this study were intentionally chosen from commanders and / or boat owners who were not preparing for transportation on the day of data collection. This intentionality criterion was essential for the subjects to have sufficient time to provide all the information and data that would clarify the questions posed to them, which would not be possible on days of travel because the entire crew, including the commander and / or owner, have to deal with numerous problems typical of these organizations on travel days. These subjects were also chosen due to their high degree of knowledge about the transportation activities, the transported materials, the specificities of the vessels and the Amazonian river network. Four subjects were selected, all vessel commanders, since none of the owners were present. These commanders were chosen because they had the necessary time (two hours or more) for the interview and were fully willing to answer all questions regarding the research protocol items.

The data collected were all of primary type. We opted for the primary data due to the scarce documentation and studies on river transport in the Amazon and also the lack of concern of these vessels to document their activities. For the collection, a research protocol was used to be used in accordance with the observation and interview techniques: for the observation, it was centered in the understanding of the type and the way

the materials are moved from the port to the vessel and from the vessel to the internal location where these materials would be stored; For the interview, the focus was on collecting quantitative data describing the main aspects of the transportation business and qualitative data that allowed identifying the material handling techniques inside the vessel, as shown in table 1.

The use of protocols is very common in organizational investigations, such as the study by Cunha, Passador and Passador (2012), and other areas of science (Arruda et al, 2012; Costa Júnior, 2012). In logistics, recently this tool has been used more intensely to deal with extremely complex qualitative phenomena, such as the investigation by Manga (2012) and Pantaleão (2012), and in search of in-depth explanations about certain aspects of logistics reality, as can be seen in Vieira (2012), Ferreira Neto (2012) and Mota (2012). Experience has shown the effectiveness of this tool both for adequate data and information collection and for the validation process of results.

Table 1. Summary of the research protocol

The business Shipping features	Material handling in the port Drive description	Material handling on the vessel Drive description
Route cities Travelled distance Carrying capacity Crew quantitative Average revenue Schooling of the crew Vessel dimension	Way of movement Handling equipment Type of material transported Material characteristics Operators risks	Receipt of material Material packing Stock area Handling equipment Safety equipment Most common damage and malfunctions

Observations were recorded and interview responses recorded in a field notebook; Afterwards, the quantitative data were organized in spreadsheets and the qualitative data in synthesized charts. These procedures were necessary so that they could undergo the analysis process capable of generating the answers sought for the research ancillary questions, as recommended by Nascimento-e-Silva (2012b).

The data collected were all of primary type. Quantitative data were analyzed with descriptive statistics: simple frequency to summarize data and correlation tests to look for associations between variables. Summarizing the data by frequencies or percentages allows us to see the quantitative dimension of the categories under analysis and, by extension, the phenomenon under analysis; In this case, the phenomenon is the movement of materials in the port of Manaus Moderna. Again, the method used is “field research” rather than “case study” since the latter requires at least three sources of evidence (this study used only two: interviews and observations).

As descriptive tools, linear correlation tests were used to discover associations between variables. Correlation results were analyzed as follows: from 0.0 to 0.2, there is no correlation; from 0.21 to 0.5, poor correlation; from 0.51 to 0.7, mean correlation; from 0.71 to 0.9, strong correlation; and above 0.9, very strong correlation. This means that the higher the test result, the higher the correlation and, consequently, the stronger the association between the two correlated variables.

Data from interviews and qualitative observations were organized in synthesizing tables and analyzed through content analysis. The results were generated from the finding of similarities of answers to the questions in the protocol. For example, for the question concerning the types of equipment used by workers in material handling, whose data were collected by observation, first all the equipment used by each worker was listed individually; This listing was then worked out to allow identification of the most frequent equipment to finally generate the response. In some cases, as in the example of the main difficulty in moving materials from each vessel, the data collected by the interviews were crossed with the data collected via observation; In this example, it was noticed that the equipment used is obsolete, old, which was verified by the answers provided by the commanders through the interview.

Results

In accordance with the specific objectives of this investigation, the results achieved describe the main characteristics of the “Transport” business made by river vessels operating in the port of Manaus Moderna, how materials are moved from the port to the vessels and how the material is handled. packed inside the vessels.

Business Characteristics

As shown in the results shown in Table 2, the main operating characteristics of the vessel transport business are as follows: a) they have a point of departure, destination and route in the same locations, both from Manaus to the last city of the itinerary and on the return from this last city to Manaus, b) with little variation, the one-way mileage is the same as the return, c) however, the length of the trip up the river is almost twice the descent, d) the average number of cities on the course is approximately 4 ee) the average boat size is 21.25 meters measured from bow to stern.

These results indicate the predominance of traditional exploitation of this means of transport. By traditional is meant the continuity of the same system of market exploitation (trajectory, type of vessel, ported cities, among other characteristics) for several decades, with few changes, including technological updating, such as the use of radio for communications. What can be seen, therefore, is that in many decades few changes have been made to the waterway transport system in the region, changes focused, for example, on the type of engine and safety equipment of the vessel (as in the case of the radio, which is used for communication between vessels along the way). These changes, it seems, have not yet covered the logistics part of the business.

Table 2. Modal Operation Characteristics

Vessels	Cities	One way trip (Km)	One way trip (Days)	Route back trip (Km)	Route back trip (Dias)	Vessel size (in meter)
A	2	1,536	12	1,536	3	25
B	5	700	3	700	1	30
C	3	300	6	800	3	20
D	5	500	2	600	1	10

On the other hand, the financial and production characteristics, as shown in table 3, of the waterway modal business practiced by the surveyed vessels operating in the port of Manaus Moderna are as follows: a) the average transport capacity of the vessels is 412,7, b) passenger capacity is 328 people, c) average revenue from cargo and passenger transportation from Manaus to the interior cities is R\$ 6,250.00 and from the interior to Manaus is R\$ 7,500.00 and the crew's schooling is the same as that of the vessel's commander. As can be seen, there are significant differences between the carrying capacities between vessel C and D; there are differences between vessel A and others in terms of passenger carrying capacity, especially in relation to vessel B; there are differences between them in outbound travel billing; but there is similarity in your back billings. The differences noted in revenues are quite marked between vessel B, much larger in size and transport capacity, and vessel C, of medium size among the surveyed. These data and conclusions therefore require the search for more accurate and consistent explanations, which is why association tests will be used.

Table 3. Modal Business Characteristics

Vessel	Capacity of load (Ton)	Capacity of passengers	Revenues* (One way)	Revenues* (Return)	Schooling (Crew)	Schooling (Commander)
A	130	70	5,500.00	8,000.00	High school	High school
B	490	900	9,500.00	8,000.00	Hight school	Hight school
C	110	163	4,000.00	6,000.00	Elementary school	Elementary school
D	921	180	6,000.00	8,000.00	Elementary school	Elementary school

*Revenues in real (R\$): 1 dollar is equivalent to 4.1 reais).

Correlation tests showed the following: a) there is no correlation between the cargo carrying capacity of these vessels and the passenger carrying capacity, ie a vessel carrying a lot of cargo does not necessarily carry many passengers since the correlation between These variables were 0.2; (b) the correlation between loading capacity and outward turnover is 0.1 and back turn is 0.5, which indicates that revenue is higher on return than on departure; c) the correlation between passenger transport capacity and outgoing turnover is 0.99 and return 0.3, which shows that revenue is higher with passengers on return; c) the correlation between outgoing turnover and vessel size is 0.7 and the turnover ratio is 0.1.

These results indicate the need to balance cargo and passenger transport capacity as follows: a) increase use of return cargo transport capacity and b) increase use of outbound cargo and passenger transport capacity. This balance can be made from the strategy of price-size marketing mix, which is the sensitive part of the business, according to the commanders interviewed, as follows: as boats necessarily have to make the round trip, transport prices freight and passenger charges can be reduced so that there are no costs (fuel, personnel, maintenance etc.) without revenue. This same strategy can be used in return, in relation to cargo transportation.

4.2 Processo de movimentação de materiais no porto

According to the observations made, the river has a major influence on the regional economy, which is the most usual way to sell goods. There are many vessels leaving Manaus for the interior municipalities and vice versa, bringing and bringing fruits, appliances, stevedoring, and people. All observed movement is done using only the body as the means of transport. And this generates several problems, such as loss of goods, bags sticking, fruit damage, beer cans crumpled by falling on the way to the boat, the goods suffer many damages on the way to storage inside the vessel.

Four activities related to the handling of the port, namely receiving, transferring, selecting and sending were found. First, the truck arrives on a street that gives access to where materials are unloaded, after passing under a bridge that gives access to a large area for unloading the goods; The note is then taken to the person in charge of the boat for clearance; if everything is normal, the goods begin to be removed from the truck, which is done through the loaders (one is inside the truck passing the goods to another); The goods are placed at the head of the shipper, who thus crosses a sand trail until he reaches a ramp that gives access to a ferry where the boats are moored; then the porter climbs a small wooden ramp that gives access to the boat, walks to the hold, where another porter is waiting to pick up the goods; Then another ship loader picks up the merchandise, distributes it and stores it inside the boat.

All movement is done manually, which implies that the whole operation of transport and support of goods is done by the human body, which is the working instrument of the shippers. Due to these adverse ergonomic conditions, workers are exposed to some risk of illness, that is, they are exposed to injuries and hernias that are characterized as normal factors due to the type of work and how it is performed by the loader. In addition, throughout this journey, it has been observed that shippers often carry excessively heavy loads, with the aim of unloading the truck as soon as possible and loading all merchandise into the boat. Some use only a cloth tied to the multi-ply head to cushion the load carried. This type of procedure can cause serious spinal injuries over time. Regarding the products transported, it was noticed that from Manaus to the interior municipalities are transported appliances, thermal box, beers, soft drinks, chocolates, corn chips, milk in packs, toys, notebooks, furniture, clothes, jewelry. , satellite dishes, mortar, paints, cement and other building materials. All these goods are taken from Manaus to meet the needs of people living in the countryside. However, from the municipalities to Manaus are transported banana, watermelon, pumpkin, passion fruit, cocoa, orange, cucumber, pepper, bell pepper, maxixe, cheese, among others. It was found, therefore, that Manaus supplies the interior cities with industrialized products and the interior supplies it with food.

Goods are usually transported the way they are packed in the manufacturing process. In the observation made, no form of packaging was found in accordance with the unitization and palletizing techniques so that the goods could be transported more safely, so that they would not suffer damage during the journey made to the vessel. What the carriers use are ropes to tie several overlapping bags in a primitive unitization process and prevent them from falling during transport. Another finding is that the goods are distributed in the hold as follows: first the heaviest are placed so that the weight is well distributed in the hold and then the lightest depending on the order in which the goods will leave the boat: When the vessel goes to more than one municipality, the goods are placed in order of places that the vessel stops. Thus, the goods from the last location of the itinerary are stored first, and finally from the first.

In violation of material handling and storage techniques, various types of goods are stored together, with no consistent distribution. According to what was collected from the interviews to justify this procedure, what happens is that there is always a “last minute” merchandise to ship, so this is where there is room where it can fit, no matter how dangerous or fragile it is; and when the hold is full, the goods are stored on deck with the passengers.

Table 4. Difficulties in moving materials in your surveyed vessels

Vessel A	Vessel B	Vessel C	Vessel D
Little space in the cargo hold	Machine and electrical problems	Old equipment	Little space in the cargo hold
Low crew schooling	Low crew schooling	Low crew schooling	Low crew schooling
Best working conditions for crew members	Best working conditions for crew members	Lack of cold room	Machine and electrical problems
No place to store materials with high hazard	No place to store materials with high hazard	Few safety equipment	Lack of skilled labor
Poor sanitary conditions (for all passengers, there are only 2 bathrooms)	Poor sanitary conditions (for all passengers, there are only 2 bathrooms)	Best working conditions for crew members	Lack of cold room
Lack of adequate accommodation for crew members	Lack of adequate accommodation for crew members	No place to pack high hazardous materials	Few safety equipment (vests, small boats)
Lack of equipment in cargo transportation	Disorder in receipt of goods	Disorder in receipt of goods	Best working conditions for crew members

Table 4 shows the various difficulties encountered in vessels for the proper handling of materials. In all of them, amateurism and improvisation are present in practically the entire cargo and passenger transport business operated by these vessels. It seems that this reality has lasted for decades with almost no substantial changes to the business foundation and value chain of which this mode is part. Thus, the deepening of knowledge about this reality by Production Engineering is fundamental, regarding the creation of artifacts that facilitate the handling of materials, as well as Administration, regarding the design of efficiency acquisition formats and effectiveness in investments that add value to users of this traditional Amazonian system of distributing local wealth.

Conclusion

This study showed that the handling of materials made in the port of Manaus Moderna is traditional, unbalanced and amateur. Traditionalism derives from maintaining the same form of business exploitation done several decades ago; the imbalance is of a financial nature as well as the proper use of cargo and passenger capacity; and amateurism is due to the lack of use of engineering and management techniques, tools and systems made in accordance with the technical and scientific requirements of enterprises. This

means that, unless knowledge about this reality is deepened, these three characteristics tend to be perpetuated in the exploration of the Amazonian waterway transport mode.

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