



ACTIVITY ANALYSIS AS A SUBSIDY FOR IMPROVING WORK SYSTEMS: CASE STUDY IN THE WAREHOUSE OF A PRINTING INDUSTRY

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SUMMARY: This article aimed to analyze the warehouse activities of a printing industry, identifying the determinants that generate malfunctions, impacting the activity of warehouse workers and production, and proposing improvements. The methodology used was based on Ergonomic Work Analysis. To analyze the activity, interactional methods and techniques (conversational action, listening to spontaneous and provoked verbalizations), observational (global and systematic observations assisted by photographic records) and documentary analyzes were used. The analysis of the activities of the Warehouse Sector identified dysfunctions related to personnel (lack of training and prescriptions for carrying out tasks), work methods (absence of related prescriptions and process audits) and the lay-out of the sector (lack of specific storage location, due to excessive purchase of material, which results in problems related to unnecessary movement of material, storage in separate locations and unidentified materials), rework, among others. The recommendations are mainly aimed at staff training, creation of technical support, development of a problem-solving methodology in the DANFE launch routine and use of the software in material requests. The work brought a reflection on the importance of analyzing the activity of warehouse operators and it was possible to realize that the extra time spent to carry out their tasks caused by malfunctions, leads to workflow problems, generating a work overload in certain areas. periods of the month, which may interfere with the quality and productivity of the printing company's production activities and product delivery times.

KEYWORDS: Ergonomics; Activity Analysis; Graphic industry; Warehouse.

1. INTRODUCTION

The Graphics Industry is a dynamic segment that involves activities related to the reproduction of information in texts or images, including creation, pre-pressing and finishing or post-pressing (RIGHI; RODRIGUES; SCHMIDT, 2009). The Graphic Sector in Brazil is made up of 20,295 companies, being responsible for generating 277 thousand direct jobs. The

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sector is mainly made up of micro and small companies. An important characteristic of this sector is the low barriers to entry into the market, enabling and facilitating the emergence of companies through small entrepreneurs, with the predominant regional market (ABIGRAF, 2009). In the northeast region, 12.5% of production units are concentrated (ABIGRAF, 2009).

The warehouse is a support sector that does not aim for profit, however, this sector is essential for the company to function properly. Inadequate functioning impacts production, which can cause losses in productivity and product quality, delays and lost delivery times, thus impacting the company's results (BORGES; CAMPOS; BORGES, 2010). Souza et. al. (2015) points out that workers in this sector complain of musculoskeletal pain, mainly in the lumbar region, which may be related to frequent load handling and prolonged sitting posture, justifying the analysis of the activities carried out by these workers. operators, to recompose the way they organize themselves and to understand the way they manage processes.

Ergonomics, according to the IEA (2000), is the “scientific discipline that deals with understanding the interactions between human beings and other elements of a system, and the profession that applies theories, principles, data and methods, to projects that aim to optimize human well-being and the overall performance of systems, contributing to the planning, design and evaluation of tasks, jobs, products, environments and systems to make them compatible with people's needs, abilities and limitations”. According to Vidal (2001), the effectiveness of ergonomics consists of the fact that it causes positive transformations in the work environment in its broadest sense, which includes technology and organization as its components.

The field of organizational ergonomics, where this article is inserted, is built from the observation that all work activity occurs within organizations, which comprise three levels: operational, tactical and strategic. To ensure its functioning, it articulates, at all times, its basic processes that constitute its operational levels, with decision-making, which takes place at strategic levels. This articulation is made possible by regulation and control structures that constitute its tactical levels, which establish the interface between production and strategy, a structure that enables the passage of top-down decisions, as well as bottom-up interactions (ROCHA, 2017). Through the modeling of real work, resulting from the analysis of the activity, it is possible to study the chains of informal regulation, formalizing and even standardizing some of these procedures, especially in an effort to codify informal practices, however, in most cases, essential for good progress. of production.

In view of this, this article aims to analyze the activity carried out by the warehouse operators of a printing company, characterizing the technical, organizational and human determinants that generate malfunctions that impact the activity of the warehouse workers and, consequently, the company's production and, propose solutions for overall system improvement.

2. METHODOLOGY

The methodology used in this research was based on the Ergonomic Work Analysis-AET method (WISNER, 1987, 1994; GUÉRIN et al, 2001; VIDAL, 2003). AET comprises a set of global, systematic and intercomplementary analyzes that allow the operational modeling of the work situation, that is, the modeling of real activity in its context, considering technical, human, environmental and social factors (VIDAL, 2003), comprising the following steps: instruction/construction of demands, modeling of the activity and design and construction of solutions adapted to the company in focus.

The demand for this work is characterized as provoked (SALDANHA et al, 2012) and was sustained by the process of social construction (VIDAL, 2003; SALDANHA, 2004). In the analysis of the activity, interactional methods and techniques were used (conversational action, listening to spontaneous and provoked verbalizations), through the application of dynamic

scripts and a socio-economic questionnaire, observational methods and techniques (global and systematic observations assisted by photographic records) and, document analysis.

3. RESULTS

The company studied is a medium-sized family printing company located in the central region of a capital in the Northeast region of Brazil. It has been in the market for 30 (thirty) years and has 190 (one hundred and ninety) employees, working in the promotional, editorial and, occasionally, industrial segments. Its main customers are located in the states of Paraíba, Ceará, Rio Grande do Norte, Pernambuco, Alagoas, Sergipe and Bahia, all in the Nordeste region.

The company is divided into the following sectors: pre-press, printing, finishing, warehouse, logistics and administration. The first three are part of the production sector, while the subsequent three refer to the staff or support area. Table 1 presents a summary of the main activities of each sector and Figure 1, the company layout.

Table 1: Graphic sectors

Area	Sector	Employees	Main attributions
Production	Pre-Print	27	Receiving and processing the digital service; Engraving of printing plates.
	Print	24	Printing of production orders; Varnish application and lamination; Laboratory analysis.
	Finishing	101	Application of cutting, creasing and folding on the printed sheet; Application of square spine or staple in notebooks; Manual activities; Final cutting and packaging.
Staff	Warehouse	04	Receiving materials; Storage; Internal distribution of materials; Stock management.
	Logistics	13	Issuance of DANFE (Electronic Invoice Auxiliary Document) packaging, transportation and service delivery.
	Administration	21	CTP (Screening and Planning Center), Commercial and Purchasing, Health and safety, Building and Canteen Maintenance; Human Resources, Marketing, Finance, Tax, Treasury and Management.

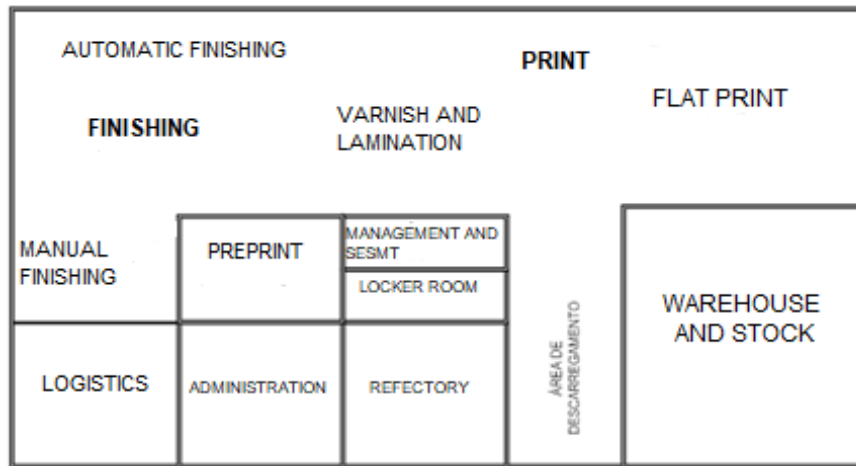


Figure 1: Graphic Lay-out

The Warehouse Sector, the object of this study, is made up of four employees, 3 of whom are warehouse workers aged between 22 and 25 years old, and a supervisor aged 42 years old. The length of experience in the activity carried out varies from 6 months to 8 years, with two of the storekeepers (A1 and A2) having previous experience in other companies. The general profile of employees in the Warehouse sector is described in Table 2.

Table 2: Profile of Warehouse employees

Characteristics	Warehouse 1	Warehouse 2	Warehouse 3	Supervisor
Age	22	25	23	42
Education Degree	Full medium	Full medium	Superior (tempo)	Superior (tempo)
Profession time	1 year and 8 months	2 years and 4 months	6 months	8 years
Company Time	1 year and 8 months	2 years and 8 months	3 months	3 months
Previous roles at the Company	None	Finishing assistant	None	None
Previous experience	None	Production assistant	Teacher	stockist, Warehouse Stock Supervisor

The opening hours of the production sector and warehouse are from 6am to 10pm. The working hours of warehouse employees are distributed as follows: warehouse 1, from 6am to 2pm; storekeeper 2 from 2pm to 10pm; Storekeeper 3 and the Supervisor work during business hours, which run from 8am to 6pm, as shown in Table 3.

Table 3: Distribution of working hours of Warehouse employees

Employee	Working hours (hours)																	
	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	
Warehouse 1	█	█	█	█	█	█	█	█	█									
Warehouse 2										█	█	█	█	█	█	█	█	
Warehouse 3			█	█	█	█	█	█	█									
Supervisor			█	█	█	█	█	█	█									

It is observed that for most of the day (8:00 to 18:00 hours), which corresponds to business hours, the sector operates with three employees, two storerooms. The exception corresponds to the beginning and end times of the working day, when only one warehouseman is available, however, at these times the workflow is smaller.

All warehouse workers take turns developing the four groups of tasks that make up the sector's prescription: receipt, storage and distribution of materials and inventory management, as shown in Figure 2 on the Warehouse Sector Task Flow. The Supervisor, in turn, is responsible for managing the sector, ensuring that activities are carried out as expected.

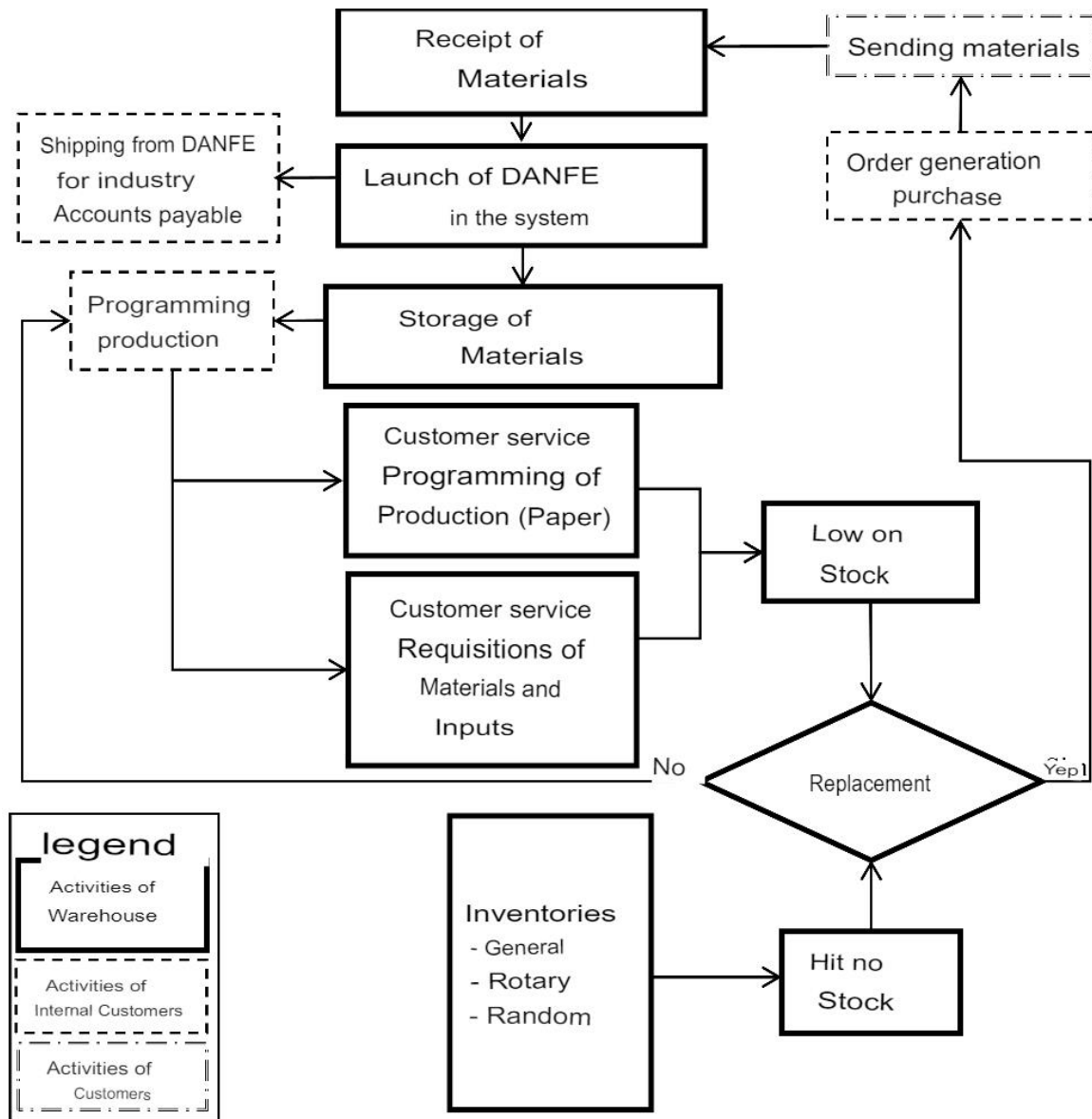


Figure 2: Prescribed Material Flow

“Receiving materials” consists of receiving the materials and checking whether the items and quantities received match the purchase order made by the purchasing department. Upon receipt, DANFE is entered into the company's information system so that the stock is updated. DANFE is the acronym for Electronic Invoice Auxiliary Document, which is a graphic representation of the NF-e (Electronic Invoice). After the release of DANFEs, they are

forwarded to the accounts payable sector. Finally, the material is identified and stored in the specified locations.

The materials are stored in the materials warehouse, where the shelves are arranged so that all items from the same product family are grouped together, in order to monitor the consumption of purchasing batches. The areas were established based on lot sizes determined by the Purchasing and Warehouse Department. Furthermore, in the paper stock, there is a subdivision of space to store paper by type, format and weight.

The distribution of materials starts from the Production Schedule. Each production sector (pre-press, printing and finishing) sends requests for materials and inputs necessary for production and the warehouse workers separate and deliver the requested items and update the stock in the system.

Inventory management is carried out based on the release and write-off of materials. After updating the stock through the write-off of materials, it is checked whether there is a need for replacement. If the need for replacement occurs, the Warehouse communicates to the Purchasing Sector, which in turn, generates a purchase order, which authorizes the purchase of materials, which in turn, enters the receipt schedule. Furthermore, when the commercialization of a graphic service is being negotiated, the Company's Sales department checks with the Warehouse if the quantity available in the stock of materials is sufficient to fulfill the order. If the stock of materials does not meet the customer's service needs, a purchase order is generated.

Another task performed by Storekeepers, related to inventory management, is inventories, which can occur randomly, rotating or generally. Random inventory occurs when the warehouseman or a user identifies the possibility of stock divergence. The rotating inventory is developed weekly in the various product families that are registered in the Information System. Finally, the general inventory takes place annually, when all stock and its accuracy are checked.

Table 4 presents a summary of the tasks prescribed for the warehouse sector, their procedures, their purpose, those responsible for their execution, the moment in which the task must be performed and the place of execution. Through this table it is possible to understand how each task influences the flow of tasks in the analyzed sector.

Table 4: Distribution of Warehouse Tasks

Task	Procedure	Goal	Responsible	Time	Local
1. Receiving Materials	Check the material received with the Purchase Order.	Avoid discrepancies in receipt.	Warehouse	On demand	Warehouse
2. Launch of DANFE on the System	Enter the DANFE information into the system and check the entries.	Feed the system with stored items and quantities	Warehouse	Upon receipt of Materials	Management software
3.Storage of Materials	Identify and store items in specified locations.	Facilitate the identification of materials when fulfilling requests.	Warehouse	After the launch of DANFE	Stock
4. Production Scheduling Service (Paper)	Analyze in the Production Schedule the materials to be made available for production.	Compliance with production deadlines.	Warehouse	According to schedule demand	Paper Stock
5. Fulfillment of Material Requests	Separate the requested materials and deliver them to the requesting sectors.	Meet production needs	Warehouse	According to requisition demands	Warehouse Stock

6. Low Stock	Enter the requested and delivered materials into the system.	Keep the system updated.	Warehouse	After separation	Management software
7. Inventory (General, Rotational and Sampling)	Count the materials in stock and compare them with the system quantities.	Check and correct system stocks based on actual inventory	Warehouse	and delivery of materials	Stock
8. Stock Correction	Enter the discrepancies found into the system	Correct stock discrepancies.	Supervisor	Programming, rotary or sampling	Management software

From the analysis of the activities carried out in the warehouse, dysfunctions were identified that interfere with carrying out the procedures as prescribed in tasks 1, 2, 3, 4 and 6 of Table 4. These dysfunctions generate difficulties in execution and rework, with consequences for the operation of the company, impacting the quality and productivity of services and the health of warehouse employees. These activities, their dysfunctions and their consequences are listed in table 5.

Table 5: Malfunctions in Activities carried out in the Warehouse

Procedures	Malfunctions	Consequences
1-Check the Purchase Order with the material received.	<ul style="list-style-type: none"> - Lack of identification at DANFE, through the Ordinance, and communication of the purchase order number to the warehouse; - Difficulties in accessing the purchase order for DANFE checking; - Failure to train the process of checking the material to be received. 	<ul style="list-style-type: none"> - Receipt of material with differing specifications and quantities; - Increase in the time for checking the Purchase Order and the material received; - Difficulty identifying the specification material presented at DANFE.
2-Enter the DANFE information into the system and check the entries.	<ul style="list-style-type: none"> - Lack of DANFE checking with the purchase order, generating divergence and making it impossible to launch it in the system; - Problems in the release of taxes generated by DANFE; - Lack of internal support from the management system to identify and solve the problem. 	<ul style="list-style-type: none"> - Rework of the Purchasing Sector to change purchase orders; - Contact with the Tax Sector to identify discrepancies; - Compromise in the stock update flow, due to lack of DANFE's release in the system;
3-Identify and store materials in specified locations.	<ul style="list-style-type: none"> - High diversity of materials and storage locations; - Lack of standard identification label. - Lack of planning in the material acquisition process, resulting in receipt of materials exceeding storage capacity; - Inadequacy of equipment or people to move materials. 	<ul style="list-style-type: none"> - Unnecessary relocation of materials in stock. - Difficulties in identifying and separating materials when fulfilling requests. - Adoption of inappropriate postures and handling of excessive loads due to lack of planning when separating materials.
4-Check the Production Schedule, scheduled Production orders for each machine.	<ul style="list-style-type: none"> - Lack of information for the warehouse regarding changes to the Production Schedule; - Disorganization of the warehouse work routine to meet production changes, not previously communicated. 	<ul style="list-style-type: none"> - Delay in meeting material requests, generating conflicts between Sectors. - Errors in entering and/or interpreting data in the system; - Risks of accidents when responding to urgent changes in production.
5-Launch and write off requested and delivered materials in the system.	<ul style="list-style-type: none"> - Digitization of all requested items, as requests are manual; - Delays in launching and downloading items from the system due to the high demand for requests; 	<ul style="list-style-type: none"> - Accumulation of items to be released into the system, causing it to become outdated; - Complaints regarding the outdated system by the Purchasing and Production Planning and Control Sectors.

	- Interruption in the separation of materials requested for receipt of materials	Divergence between the actual quantities and those reported by the system.
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Most of the malfunctions are related to the launch of DANFES and their respective conferences and the launch of material requisitions (Table 5). In this way, we sought to delve deeper into the investigation of dysfunctions related to this activity.

According to information from the company's G-Print inventory management software, the number of DANFEs received in the warehouse sector between the months of January and March was 324, varying between 93 and 125 as shown in Table 6.

According to the Warehouse Supervisor, the largest number of DANFE movements occurs on Mondays and Tuesdays, mainly between the 25th of the current month and the 10th of the following month.

The average time to launch a DANFE is approximately 5 minutes, however, due to malfunctions identified during launch, the launch time can reach 40 minutes. According to the Warehouse Supervisor, around 50% of DANFEs present problems when launching, requiring the intervention of the Purchasing Sector and the Financial Sector to solve problems related to taxation and registration codes. Table 6 presents a demonstration of the impact of malfunctions in different situations, that is, launch of DANFEs with and without malfunctions (normal).

Table 6: Monthly time for launching DANFEs

Month	DANFES / Month		Fill Time	Allocated monthly time		
				Min.	Hours:min	
January	93	Normal	47	5	235	3:55
		w/ Dysfunction	47	40	1.880	31:20
Fevereiro	125	Normal	63	5	315	5: 15
		w/ Dysfunction	63	40	2.520	42
March	106	Normal	53	5	265	4:25
		w/ Dysfunction	53	40	2.120	31:20

The main dysfunctions related to the launch of DANFES are:

- The lack of identification of the purchase order number by the concierge;
- Difficulty accessing the purchase order for DANFE verification;
- Lack of training for warehouse workers to check material and launch DANFE;
- Problems in the release of DANFE taxes;
- Lack of internal support for management systems;
- Communication problem between the PCP (Production Planning and Control sector) and the warehouse sector;
- Interruption of routine activities to resolve various problems in other sectors.

The process of requisitioning materials also presents malfunctions that impact the activity of warehouse workers. The request for materials is carried out manually, however, employees from all sectors of the company who request materials have access to the company's Information System (IS), the G-Print software, and can check the materials and their respective balances available in the stock. Thus, all Sectors and Departments manually generate their requests and send them to the Warehouse so that the materials can be separated, delivered and the balances updated in the company's Information System.

To analyze the material request routine, data referring to the months of January, February and March was taken as a basis. Table 7 shows the number of requests generated,

referring to the aforementioned months and distributed by sectors and departments. Thus, on average, around 14,800 requests were generated in the months analyzed.

Table 7: Material requests generated from January to March

Area	Sector/Department		Number of Requests Generated			
			January	February	March	Media
Production	Pre-Print		54	43	20	39
	Print		101	72	92	88
	Finishing		569	406	282	419
Staff	Warehouse		5	6	13	8
	Logistics		10	20	6	12
	Administration	Administration	713	565	542	606
		CTP	13.857	12.244	18.442	14.847
Total Requests Generated per Month			15.309	13.356	19.397	16.019
Total Requests fulfilled by the warehouse			1.452	1.112	955	1.155
Average daily requests fulfilled by the warehouse			56	43	37	44

The CTP, Finishing and Administrative Sectors account for the largest number of requests generated by Sectors and Departments. Disregarding the CTP requests, which are processed by the aforementioned Sector at the time the programming is made, we reached an average of 1,155 requests generated during the months analyzed, varying between 955 in March and 1452 in January, that is, a variation of 52%. Considering an average of 26 days worked, we have an average of 44 requests generated per day. It is worth mentioning that production demand during this period was low, so, at peak times, demand can be increased by around 35% to 40%. Regarding the fulfillment of requests and entries in the system, interviewees stated that the average routine time is 7 minutes. Thus, considering the average number of 44 requests per day, an estimate of 308 minutes was reached, which represents more than 5 hours of work, without interference. As interference is part of the work routine of these professionals, consequently, responding to requests consumes practically all of a storekeeper's working time.

Table 8: Service Time Variation Daily requests in normal and high production demands

Situation Daily demand Requests	Number of Requests	Response time for requests	
		Unit (min.)	Total (hours)
Demanda Normal de Produção	44	7	5 hrs: 8 min
Demanda Alta de Produção	62	7	7 hrs : 15 min

4. SUMMARY OF THE ANALYSIS AND RECOMMENDATIONS FOR IMPROVEMENT

To analyze the effects related to the launch of DANFEs and material requisitions, the Ishikawa Diagram was used, with the aim of analyzing the cause and effect of the problems identified in the processes. Figure 3 shows that the causes are related to Personnel, Materials and Methods. The sub-causes that contribute to the aforementioned problems are presented as elements that indicate the reasons why the problems persist.

Regarding causes related to personnel, the lack of training of both doormen and warehouse clerks are the main reasons for triggering the identified malfunctions.

Furthermore, Figure 3 also presents the implications related to lack of training. These are presented as the difficulty in identifying the Purchase Order, divergent entry and receipt of material, difficulty in posting taxes in the information system, lack of technical support and interruption of routines.

Regarding materials, the lack of a specific storage location stands out, due to the excessive purchase of material, which implies unnecessary movement of material, storage in separate locations and unidentified materials.

Finally, regarding the methods linked to the problems analyzed, the absence of auditing the processes triggers a cycle of dysfunctions in the processes developed in the sector and in the organization. Of these, we can mention the lack of internal audits, generation of manual requests and adoption of decisions different from the procedures adopted by the company.

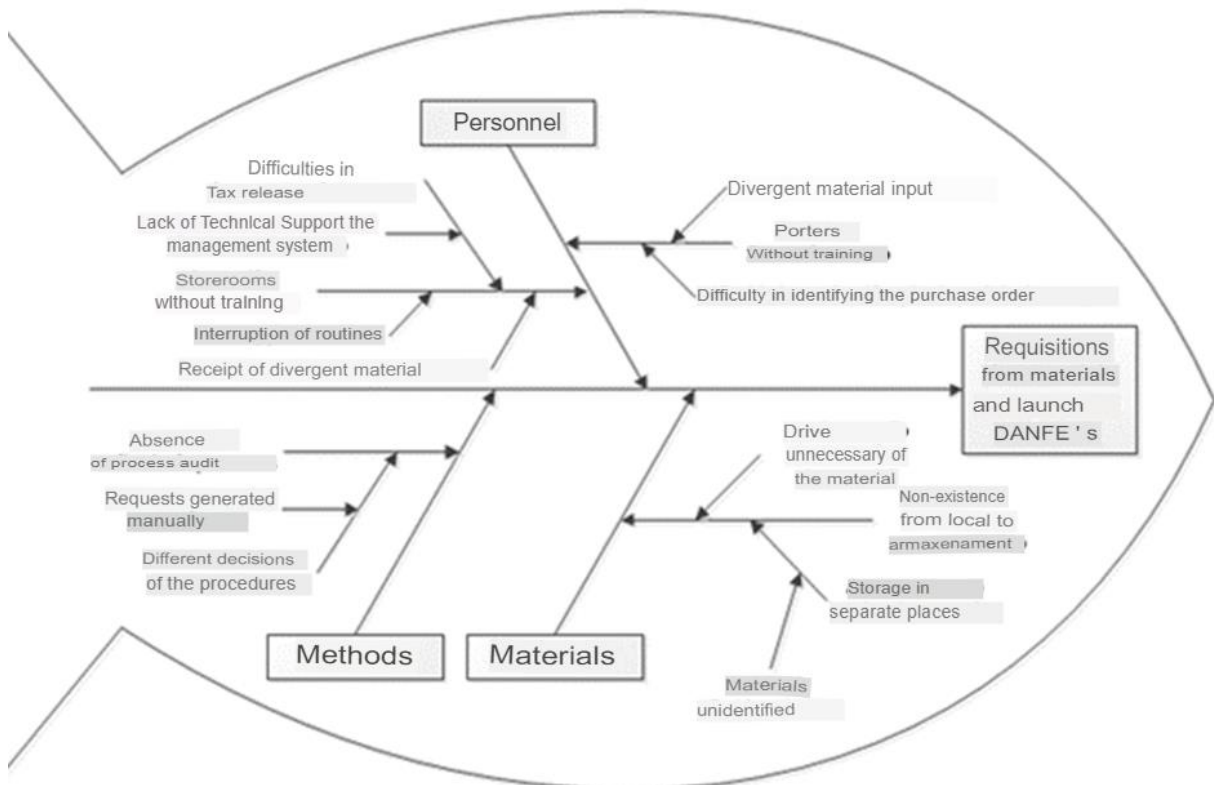


Figure 3: Cause and effect relationship between the launch of DANFEs and material requests

In view of this, a list of recommendations was drawn up in an attempt to propose improvements for better functioning of the sector and the company as a whole:

- Training for the concierge sector to identify the purchase order before forwarding the material to be delivered to the warehouse.
- Training of storerooms for the launch of DANFEs and checking of material;
- Training for the release of DANFE taxes;
- Creation of internal Technical Support for the Management Software to assist users in clarifying doubts and resolving problems;
- Greater integration between Technical Support and users, in order to adapt the systems to the needs, capabilities and limitations of the company and the sector;
- Development of a problem-solving methodology in the routine launch of Management Software DANFEs;
- Generation of material requests via Management Software to reduce Warehouse workers' time using the management software and inform the quantity of materials available in real time;
- Organization of warehouse stock areas, defining zoning and specific areas for each family of materials, facilitating the identification and selection of materials requested by the different sectors of the company and carrying out material inventories;
- Standardization of the way materials are identified;
- Carrying out periodic inventories of materials in the warehouse;
- Creation of routines for the company's related sectors, establishing deadlines for the sectors to request materials, enabling warehouse clerks to select materials in advance;
- Establishment of work routines for storerooms, in order to avoid stopping activities to solve problems;
- Establishment of audits for continuous process improvement.

5. CONCLUSION

The objective of this work was to carry out an analysis of the activities of the warehouse of a printing industry, identify the technical, organizational and human determinants that generate dysfunctions in the sector that impact the activity of the warehouses and, consequently, the company's production and, propose an improvement in the flow of work in this sector of work.

The analyzes showed that the extra time spent carrying out activities caused by malfunctions and lack of training lead to workflow problems, generating work overload for storerooms at certain periods of the month, internal conflicts between the company's sectors with consequences in production.

It was found that the need for adequate training supported by materials planning, in addition to inspections through audits can provide positive results for the organization. Furthermore, the implementation of the proposed improvements can positively influence the organization of work and, consequently, factors linked to productivity and meeting deadlines, in addition to aspects linked to the health and safety of warehouse workers.

Malfunctions identified through analysis of the activity generate difficulties in execution and rework with consequences for the functioning of the company's sector and with impacts on the quality and productivity of the service and the health of warehouse employees.

It is worth highlighting the list of ergonomic recommendations whose principles serve as a basis for the implementation of improvements by the management sphere, aiming, in this way, to increase the quality of life at work for employees as well as increasing the quality of products offered and deadlines. delivery by the company.

This work's practical contributions were to improve the functioning of the warehouse, with impacts on improving the company's overall effectiveness and the working conditions of

warehouse employees. Furthermore, it presents an ergonomic analysis in unusual sectors, showing the potential of activity analysis and organizational ergonomics for solving problems in administrative sectors, generating improvements in production, productivity, working conditions, that is, effectiveness from the company.

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