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Universidade de Lisboa

MASTERS IN

MANAGEMENT AND INDUSTRIAL STRATEGY

MASTER'S FINAL WORK

DISSERTATION

THE IMPACT OF LEAN METHODOLOGY ON SUPPLY CHAIN – TRANSFOR CASE STUDY

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SUPERVISION:

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Acronym list

JIT – Just-in-Time

MFW – Master's Final Work

VSM – Value Stream Mapping

TPS – Toyota Production System

SCM – Supply Chain Management

Abstract

This study explores the impact of Lean methodology on supply chain operations, with a focus on two key tools: Value Stream Mapping (VSM) and Just-in-Time (JIT). Despite the widespread recognition of Lean principles, such as waste elimination and continuous improvement, many organizations struggle to extend these practices effectively across their supply chains. To address this gap, the research adopts a qualitative exploratory methodology through a single case study carried out at Transfor, a Portuguese industrial firm operating in carpentry, metal work and modular construction. The study is conducted with semi-structured interviews with key company personnel, enabling a practical analysis of Lean tools implementation across the supply chain.

The findings reveal that both Lean tools provide distinct but complementary contributions, where VSM offers strategic mapping and waste identification, while JIT enhances synchronization and reduces inventory costs. Since Transfor Industry is composed by three sub-industries, the effectiveness of each one varies by sub-industry, since, in turn, the suppliers of each are slightly different.

The study concludes also that combining both tools can significantly improve supply chain performance, provided they are tailored to the operational context of each unit.

Keywords: Lean Philosophy; Value Stream Mapping; Just-in-Time; Process Optimization; Supply Chain Management

JEL Codes: D23, L15, L23, M11

Resumo

Este estudo explora o impacto da metodologia Lean nas operações da cadeia de abastecimento, com foco em duas ferramentas principais: o Value Stream Mapping (VSM) e o Just-in-Time (JIT). Apesar do amplo reconhecimento dos princípios Lean, como a eliminação de desperdícios e a melhoria contínua, muitas organizações enfrentam dificuldades em estender essas práticas de forma eficaz ao longo das suas cadeias de abastecimento. Para colmatar essa lacuna, a investigação adota uma metodologia qualitativa e exploratória, através de um estudo de caso único realizado na Transfor, uma empresa industrial portuguesa que atua nas áreas de carpintaria, serralharia e construção modelar. O estudo é conduzido com entrevistas semiestruturadas com elementos-chave da empresa, permitindo uma análise prática da implementação das ferramentas Lean ao longo da cadeia de abastecimento

Os resultados revelam que ambas as ferramentas Lean oferecem contributos distintos, mas complementares: o VSM proporciona um mapeamento estratégico e identificação de desperdícios, enquanto o JIT melhora a sincronização e reduz os custos de inventário. Dado que a Transfor é composta por três subindústrias, a eficácia de cada ferramenta varia consoante a subárea, uma vez que os respetivos fornecedores também diferem ligeiramente.

O estudo conclui ainda que a combinação das duas ferramentas pode melhorar significativamente o desempenho da cadeia de abastecimento, desde que sejam ajustadas ao contexto operacional específico de cada unidade.

Palavras-Chave: Filosofia Lean; Value Stream Mapping; Just-in-Time; Otimização de processos; Gestão da Cadeia de Abastecimento

Acknowledgments

First of all, a special thank you to my household for providing me with all the conditions and unconditional support, not only in this project, but also throughout my academic career, both on a personal and a professional level.

Secondly, I would like to thank all the faculty of the master's, in particular to teacher José Novais Santos, for accepting the position of supervisor and helping me find the way to finish my master's thesis. Its mentorship guided me since the choice of theme and I want to thank him for the solutions, knowledge and the time dismissed with the aim of contributing in the best way for the realisation of a work that will mark the rest of my life.

Thirdly, I would like to express my gratitude to Transfor Group for agreeing to co-operate in this study and for the availability and warm welcome I always received, whether at the company itself or through electronic communications, particularly to:

Mr. Pedro Matias, administrator of CuboDrive, an enterprise of TransforGroup, who put me in contact with Mr. Jorge Balsas in order to clear up my doubts and develop the study.

Mrs. Vânia Maia, purchasing manager of carpentry and modular construction in Transfor Industry, whom I have the pleasure of meeting within the company itself, to better understand the context of the firm and its relationship with the supplier chain, which helped a lot developing this thesis.

Mr. Jorge Balsas, managing director of Transfor Industry, for all the availability shown every day, and specially for sharing his professional experience with real situations and accumulated data totally crucial for the development of this project.

Lastly, but not least, to my university colleagues and other friends who contributed, directly or indirectly, for this project to become a reality.

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Introduction

Nowadays, regular customer is someone who is much more informed and rigorous. To this extent, companies need to be constantly seeking development, growth, and innovation. In this vein, companies keep on seeking to meet customer expectations, while at the same time, improving their service and optimizing their costs and processes.

Thus emerges the lean philosophy, a methodology whose objective is "to generate a system that is efficient and well organized and devoted to continuous improvement and elimination of all forms of waste" (Simpson and Power, 2025, p.63). Lean Methodology, rooted in the Toyota production System (TPS), has evolved from a manufacturing-focused philosophy to a holistic approach integrating supply chain management (SCM) as a critical factor. While Lean's core principles- waste elimination, continuous improvement, and customer-centricity are well-established in production systems, their application to supply chains remains complex and context-dependent.

Lean implementation can be complex to adapt to a company, and one of the reasons may be the supply chain, challenged by "dealing with many actors in many tiers, from multiple industries potentially everywhere on the globe" (Rosseti et al, 2023, p.1383). This philosophy disposes of some tools that help facilitate the implementation of the methodology, such as just-in-time and value stream mapping.

The literature review underscores the symbiotic relationship between Lean management and Supply Chain management, focusing especially on tools like Just-in-Time and Value Stream Mapping. However, some gaps persist in understanding how Lean impacts supply chain performance, how companies tailor Lean practices to supply chain practices, and especially, how Lean tools play their key role in supply chain management.

Therefore, the aim of the study is to understand how Lean tools affect the supply chain. This raises the following question: how VSM and JIT affect the supply chain of different industries within the same company?

This study addresses the research question by developing a case study focusing on Transfor, a Portuguese enterprise connected to construction. Interviews were carried out with the purchasing manager of carpentry and modular, and with the managing director, both from Transfor Industry.

Tools like JIT and VSM are designed to eliminate waste and synchronize workflows extending their impact beyond production floors to reconfigure supplier relationships.

While JIT proves itself as a tool constantly pending on supplier's flexibility and in scheduled product demand, being more impactful in predictable environments, VSM is revealed as universal analysis, since it can adapt to any type of situation. And so, it will be important to realize, given the limits of each approach and its respective conditions of implementation, the importance of each one in the same company, however in the face of three different industries requiring different solutions for disparate problems.

Next chapter presents a literature review. Chapter three comprises the methodology, demonstrating the study's elaboration, describing all the methods and procedures focused on answering the research question.

In chapter four, the case study follows. Chapter five encompasses the discussion followed by chapter six, holding the conclusions, together with managerial implications, limitations, and future research.

Literature review

LEAN

The lean philosophy emerged after the end of the First World War, by the founder of Ford Motor Company, Henry Ford, who aimed to turn its industrial production into a mass production, allowing his company to produce automobiles in less time and with less costs. Following the second world war, known mainly by the wreckage of Hiroshima and Nagasaki, the Japanese needed to reinvent themselves quickly. In the automobile sector, Toyota Motor Company has chosen to base itself on the American work while adapting it to the Japanese necessities, marking the start of the Toyota Production System (Ohno, 1988). Based on TPS, it would emerge a new concept known as "Lean" firstly referred by Krafcik, as an acceptable way of describing Toyota Production System without offending the other sponsors of the International Motor Vehicle Program (Gil-Vilda et al, 2021).

In 1956 Ohno already working on TPS visited automobile facilities in the U.S. where he would come to know of the methodology "Kanban supermarket", which he used to control material replenishment and support the two pillars of TPS, claimed by him, as autonomation and JIT, in which lean production is based into and Kiichiro truly believed "in a comprehensive industry such as automobile manufacturing, the best way to work

would be to have all the parts for assembly at the side of the line just in time for their use" (Matthias Holweg, 2007, p.422).

Lean production turns out to be a "multi-dimensional approach that encompasses a wide variety of management practices", which includes just-in-time, quality systems, among others. The application of lean in a certain production line allows the customer to receive their demand at the pace they ordered it, minimizing as much unnecessary waste as possible and enhancing the customer experience (Shah & Ward, 2003, p.129).

1990 marks the year when the term "lean" became popularized as an operations management concept. Womack established the term "lean production" to describe TPS and compared it with mass and craft production to highlight the importance that this new concept could have in transforming the global manufacturing.

In the following years and to this day many other important terms linked to "lean" would emerge such as "Lean Thinking" characterized by a process-oriented approach to organizational efficiency. This affiliation emphasizes continuous improvement, waste reduction and strategic adaptation to external environmental conditions (Azadegan et al, 2013), "Lean Management" described as a method of managing companies that involves adapting current market conditions through organizational and functional changes, focusing on professional training, shaping staff attitudes and maintain positive public relations (Dekier, 2012) , and even "Lean Enterprise" portrayed as an organization that applies Lean and Agile principles across all departments to respond swiftly to changing market conditions, customer needs and emerging technologies (Humble & Molesky & O'Reilly, 2014), all definitions that have contributed to the meaning the word "lean" has today.

In the production process there can be 7 different types of wastage coming from certain activities within organizations that end up not adding any value to the customer nor the company, and should be eliminated, such as: inventory waste; overproduction waste; transportation waste; waste due to defects; motion waste; processing waste and waste of waiting time (Hopp & Spearman, 2020). With the aim of fighting waste, lean organizations usually embrace the concept of continuous improvement. Many companies have also realized that by striving to eliminate all forms of waste, they are also indirectly contributing to transforming the organization into an even more environmentally sustainable firm, as well as reinforcing customer priorities, even if that is not their primary objective. This is how the green paradigm emerges, guiding organizations in decision-

making to generate environmental impact. As global awareness of corporate environmental responsibility grows, neglecting these impacts can lead to higher risks, including strict regulations, increased costs and potential customer backlash. The joint focus of "lean" and "green" is obvious in its actions, giving rise to Lean-Green strategy, adopted by the majority of companies whose focus was on waste reduction, efficient use of resources and satisfying customer needs (Duarte & Cruz-Machado, 2013). According to (Simpson and Power, 2005, p.63), "the objective of lean is to generate a system that is efficient and well organized and devoted to continuous improvement and elimination of all forms of waste" concluding that the practices supporting lean manufacturing are very similar to the ones supporting the environmental performance.

Although lean manufacturing and environmental performance are crucial when addressing customer demands, Rossini et al (2024) reinforce the idea that supplier collaboration is another factor to take into account, since companies perceived customer demands are met when organizations acknowledge the necessity of cooperative efforts among all parts involved in a business. "A supply chain is a network of facilities that performs functions of product development, procurement of materials between facilities, the manufacturing of products, and distribution of goods to customers" (Ugochukwu et al, 2013, p.88).

The combination of supply chain concept with lean methodology gives rise to a new concept called "Lean Supply Chain", whose objective is the creation of high-quality production systems aligned with customer demands. Lean supply chains are crucial for modern business since they not only improve system flows by eliminating non-value-activities but also play a key role in fluctuating demands and short product life cycles while responding to delivery requests in terms of speed, quantity, and quality (Ionel, 2024).

The term "Lean Supply Chain" results from the evolution of Lean management and its combination with Supply chain management and goes back to 1996, when Lamming recognized a new opportunity of improvement through this concept.

Bortolotti et al (2016) concluded that implementing the combination mentioned above is not that simple, however with the benefits coming from the implementation of lean methodology in the production sectors within a company, its extension is completely justifiable to other parts of the chain like supply chain.

Lean supply chain management has its own implications, focusing its managing approach mainly on strategies for effective relationship between supply chain partners, efficient delivery as regard to time, customer satisfaction, and quantity and quality (Ugochukwu, 2013).

Lean Tools

The aim of this study is to understand the impact lean methodology has in supply chain operations. It is already known that the main foundation of this methodology is to do more with less. Lean Tools are going to be used in this context.

Based on Lean tools, it should be able to perceive, analyze and propose improvements to all kinds of wastage. Among all the existing practices of this methodology, Just-In-Time and Value Stream Mapping are going to be the ones highlighted since are the ones providing the most complete and accurate examination about the various stages during the production process. Since VSM is the most widely used tool when talking about small and medium companies and JIT when talking about big companies, and both are constantly combined with others for further analysis, such as Kaizen, Kanban, 5S, among others (Ladeira, 2017), these two will be held the most relevant in the work context.

Just-in-Time (JIT) – efficient flow of materials

Just-in-Time is a production methodology aimed at minimizing inventory and enhancing efficiency by ensuring products and materials are received only as needed in the manufacturing process. This production tool dates to Detroit during the early 20th century, when the methodology was known as Hand-to-Mouth System, with the simple aim of reducing inventory levels. Afterwards, and as previously mentioned, in the 1970s, Toyota introduced the term Just-in-Time, even though these two processes nearly equal (Schwartz & Fish, 1998).

JIT is a philosophy of continuous problem solving supporting lean production driven by the “pull” of the customer’s order. This tool focuses mainly on the elimination of waste and continuous improvement of its system, working towards production of high volumes of output with fewer resources (Christensen et al, 2004). When talking about fewer resources logically the inventories will also be less. As companies need to maintain

production constantly as possible, the key solution for the problem is the reduction of the time of set-up (Villa & Taurino, 2013).

For successful JIT production, there are some essential elements that must be implemented with the aim of realizing the correct implementation of the methodology: Uniform production; quick set up times; small lot sizes; short lead times; preventive maintenance; multifaceted work force; supplier development; kanban production control. (Benton Jr et al., 2011). Without any of these steps in the implementation, the whole success of the production flow could be jeopardized, knowing that every action is linked to each other.

Value Stream Mapping (VSM) – waste identification

"Value Stream Mapping (VSM) is one of the pioneer lean manufacturing tools that intends to provide a clear picture of information and material flow at every stream from the supplier to the factory and finally to the customer" (Tiwari & Sharma, 2022, p.1117). VSM is a term initially coined by Jim Womack and Dan Jones that was afterwards developed by Rother & Shook.

This methodology is characterized by mapping all the production flow of a certain product within the organization, since raw material until the "arms of the customer". The objective is to understand the bigger picture, the details and information passing through the flow of material, occurring during the production process, perceiving whether all the steps add value or not and developing, if it is the case, improvements where necessary (Rother & Shook, 1998).

Afterwards, VSM continued its evolution, not only in the manufacturing context but also adapting itself across various industries such as healthcare, public administration, education (Riezebos & Huisman, 2020), among many others.

More recently, and with the same logic as lean management, the role of VSM has been explored in the sustainable aspect, as well as its integration with other lean tools with the aim of enhancing productivity. The appearance of ErgoVSM and ExtendedVSM (Ugochukwu et al, 2012) demonstrate how this tool is evolving beyond company borders.

Lean: Success factors and barriers to implementation

There is no methodology that does not have barriers to implementation, as well as success factors, moreover when the possibility to overcome those barriers exists.

Lean is one more philosophy known by its diverse success factors among different companies and industries, although it can also present some difficulties that will have to be overcome.

Despite all the benefits arising from the application of Lean Management, there is a considerable percentage of organizations that are unsuccessful in implementing this philosophy and the reason could be due to different kinds of barriers: Managerial and technical barriers; economic barriers; social barriers (Elkhairi et al, 2019). This classification emerged allowing the barriers to be classified and overcome more specifically.

As managerial and technical barriers can be highlighted lack of planning, lack of communication between management and workers, lack of commitment from top/senior management or lack of expertise and perseverance; while economic barriers include limited resources, incompatibility of lean with company bonus or incentives, insufficient investment in equipment or lack of financial capability; finally in the topic of social barriers stands out the resistance to change, cultural differences, lack of cooperation from suppliers and lack of mutually beneficial strategic partnership (Jadhav et al, 2014).

On the other side, for Lean to be implemented is crucial to understand the critical success factors that will ensure the methodology will be successfully executed, and they are: management engagement and commitment, company financial capability, cultural change, relationship with suppliers and clients, commitment from top management, education and training, leadership (Jeyaraman & Teo, 2010; Elkhairi et al, 2019).

Faced with this, it is crucial to mention that not every lean methodology is successfully implemented in the same way, nor is every tool the solution for every organization objective. Beyond internal factors in which companies are used to base themselves to develop lean management, there are constantly external opportunities emerging when combining knowledge and competencies (Netland & Powell, 2016).

By talking about external factors, as previously, it can be mentioned supply chain, which, as already stated, play a key role in the final customer satisfaction. Ugochukwu (2013) confirms that when lean methodology is applied to the supply chain, it really can be turned

into a success factor, allowing the company to enhance competitiveness between the supply chain and, furthermore, enhance customer satisfaction.

The literature outlines that lean methodology and its tools are more successful when it approaches all production flow, thus including the mobilization of suppliers in order to dominate the external opportunities, since new product developments, new methodologies implementation, or new tools that will boost the achievements of an organization.

Supply chain within lean implementation

As already mentioned, there is a direct correlation between a successful lean implementation and its supply chain functioning.

Supply chain management is considered a critical factor, along with lean manufacturing and environmental performance, in order to contribute to a well-defined lean implementation within a company. Supply chain performance relates to competitive strategies and to their alignment with market strategies and organizations goals. Soni and Kodali (2011) highlight the choice of supply chain strategies and competitive strategies since these have a significant impact on businesses and their supply chain performances. Arif-Uz-Zaman and Ahsan (2014) reinforce the idea that to maximize effectiveness and efficiency is necessary the full integration of their supply chain partners through the development of available lean measures and metrics. These cooperations are important and have the aim of enhancing a business core competitiveness.

The Honda case also demonstrates the appropriate balance developed between cooperating with suppliers and ensuring competitive pricing, which allowed the company to outsell all the cars among all retail customers in 1996. Lasseter (1998) reveals that balance is achieved through development and application of three organizational capabilities, such as modeling total cost, building and sustaining supplier relationships and leveraging supplier innovation, emphasizing once again the importance of supply chain management.

The establishment of a solid relationship between an organization and its potential suppliers can be based on other crucial aspects, beyond those already mentioned, such as exchange of information by both parts, where both gain knowledge about various situations or geographic proximity to each other, which will reduce the risk of unexpected incidents and delivery times (Silva & Carvalho, 2013).

Even though several advantages come from this beneficial relationship, sometimes, especially small companies, have it hard to establish and maintain long-term contact with their suppliers, knowing already that big companies are much more powerful and are required due to their conditions and market power. For this effect, there could be analyzed various practices that can and should be done by enterprises with less power to overcome difficulties, such as: early supplier involvement; geographical proximity, enhancing local suppliers and fostering supplier-buyer relationship; effort to build long lasting relationships, and shifting the focus to mutual growth, by sharing information and carrying out regular transactions.

Liker and Meier (2006) affirmed suppliers are extensions of their technical capabilities, and so, it is relevant to work and innovate closely to them throughout a company product development process.

After describing its importance, it can be pointed out some significant practices by companies such as consultancy of suppliers for design ideas; establishment of early supplier involvement in products development; keeping proximity with suppliers, if it is not possible geographically, remotely then; and establishment of collaborative efforts supporting green affairs (Bento et al, 2020).

On the other hand, Ugochukwu et al (2012) identified diverse essential characteristics of a lean supply chain, also mentioned by other authors as well, of which it is relevant to mention: effective communication and information sharing, end customer focus, low inventories and few but reliable suppliers, continuous flow and long-term contracts between supply chain, and quick response to quality problems.

All the previous characteristics and practices mentioned by the most diverse authors endorse the beneficial impact supply chain and lean achieve when combined for the greater good of both.

Methodology

Aiming to understand how VSM and JIT affect the supply chain of different industries within the same company, this research holds a qualitative methodological approach with an exploratory purpose. This study enabled analysis, over time, of the comparison between Lean tools, namely Just-In-Time and Value Stream Mapping, and its applications to diverse industries within the same company, as well as the advantages

each one provides, particularly actual themes like waste reduction, cost reduction and increased efficiency.

In view of the study's objective, a case study was purposely selected and developed. Transfor is a local company that has grown over the years and now operates throughout the country. In order to explore the topic, it was necessary for the company to work with lean philosophy implemented across its value chain and to have a solid supply chain management. In addition, the aim would be to showcase a company that does not belong to any of the major national cities yet has had and is having increasing success in the national market. The case study "allows the researcher to explore individuals or organizations, simple through complex interventions, relationships, communities or programs", being an organization the source of study in this context (Baxter & Jack, 2008, p.544).

Eisenhardt (1989) highlights that a case study is a research strategy focused on understanding the dynamics present within single settings, with the possibility of involving either single or multiple cases. For this specific case study, the one chosen was the single one, which contributed to the analysis of complex phenomena.

"Rigorous qualitative case studies afford researchers opportunities to explore or describe a phenomenon in context using a variety of data sources" (Baxter & Jack, 2008, p.544). "Case studies typically combine data collection methods such as archives, interviews, questionaries, and observations." (Eisenhardt, 1989, p.534). Keeping the purpose of the study in mind, the interview was the main source of data aiming for perceiving, in real time, all the details behind the theme, collecting more trustworthy information, and enhancing work conclusions. Primary data were complemented by secondary data.

The primary data consisted in semi-structured interviews, a type of interview that "involves a set of open-ended questions that allow for spontaneous and in-depth responses" (Baumbusch, 2010, p.255).

The interviewees included the purchasing manager of carpentry and modular construction, and the managing director of Transfor Industry. The interviews had an order of reasoning, starting with the purchasing manager, in order to first understand the relationship with suppliers and the context behind the adoption of the lean tools mentioned above, and then, through the managing director knowledge, analyze the real cases and their advantages regarding VSM and JIT in the three different industries. The order was outlined to obtain information that would complement each other and provide

a more comprehensive case study. In addition, it was important to choose two interviewees with different positions within the company, making it easier to perceive the connection between all the value chains.

The interviews took place unevenly, with the purchasing manager in the company's factory while with Mr. Jorge was via WhatsApp, however both were always individual (one-to-one) and recorded with consent of both for later analysis within the scope of the work.

The purchasing manager interview took place at the end of Abril, for about 40 minutes, and shaped the direction of the work by clarifying some aspects related with the differences between the sub-industries explored by Transfor Industry. After analyzing the aforementioned interview, another one was developed to present to the managing director, so as to explore the real cases of Transfor that would be in line with the information already obtained. In turn, this interview took place at the end of May and took around 45 minutes, in addition to other inherent means of communication.

It is also important to point out the countless calls and messages exchanged with the managing director of Transfor Industry, to discuss and clarify some doubts in the course of the work.

Regarding the secondary data, it can be described as "information that is collected by someone other than the original user and/or for purposes other than those originally intended" (Pederson et al, 2022, p.10). Secondary data turns out to be accessible to everyone searching for information, and something that supports and complements the primary data. In this case study, secondary data was not only useful to put this research theme into context, through scientific articles, reports, books, but also in gathering insights of the company in study, as its products, business processes and other relevant information, that would help prepare the interview guides.

In turn, the combination of all the data, both primary and secondary, is what enabled this study to be conducted.

Case Study

Transfor

Transfor Group is an innovative leader in the fields of engineering and construction, with a strong presence in the Portuguese market and continuously growing throughout international operations.

The company was established two decades ago and, since then, it has evolved into a multifaceted group, operating through three specialized business units: Construction, Industrial Carpentry and metal work, and Refurbishment and Fit-out of Interiors. Aligned with these three specialized unites it also emerges Transfor Sustainability, bringing unique expertise to projects in all areas of the firm works.

Although headquarted in Lisbon, Transfor was created in Fátima by a local citizen who sought to respond to a market gap, where the significant production facilities are still established. The company's approach is characterized by a culture of continuous improvement, innovation and an increasingly focus on sustainability, particularly in the development of the three specialized business units mentioned earlier. The firm's growth is supported by a workforce composed of 303 employees, where almost half of them are allocated to the construction unit and only seven are assigned to the sustainability unit, with an increased tendency.

With recent investments, including new factories in Algarve and expanded operations in Fátima, Transfor reaffirms its position as a key player in the industry. The company searches not only to respond to the current national market, but also to the future of national and international construction and manufacturing demands, considering that Transfor is already working in entering in other European countries.

Just as the company itself indicates, it is an enterprise "driven by an energetic optimism, a pioneering spirit and resilience to create the best solution." highlighting also that Transfor "are determined to build a better tomorrow, guided by innovation with audacious attitude."

Engineering realities

To understand a little bit of Transfor products and their production processes it must be taken into account the several business units the company works through, each one focused in different market segments and production lines that can also complement each other, if necessary, although the study will be focused on the industry unit.

Transfor Construction aims to reinvent processes and maximize results. It is responsible for full construction and engineering services, including new builds, renovations, and complex projects in the civil and industrial sectors, where the focus is on tailoring solutions of clients engineering needs, while Transfor Industry is responsible for

industrial carpentry and metal work, such as steel structures, pre-fabricated modules and custom industrial solutions, all types of modular construction and precision engineered components needed to fulfill industrial and construction clients requirements.

Transfor Interiors consist in a unit focused on interior fit-out, refurbishment and transformation of commercial, office and industrial spaces where it specialties are project management, high quality finishes and adherence to tight deadlines.

The smallest unit, and the one with an increasing tendency is focused on sustainable construction solutions, including energy-efficient designs and eco-friendly building practices, integrating sustainable materials and technologies into projects developed.

Transfor Industry

The Industry unit of Transfor Group is subdivided into three specialized industries: carpentry, metal work and modular construction, presented in table I in Appendix A.

The carpentry division can be described as a specialized unit producing high-quality tailored woodwork to meet specific client and project requirements, either for construction or interior projects. In this sub-industry, the firm makes use of advanced manufacturing techniques and skilled craftsmanship to ensure durability and aesthetic appeal to all its produced components, including doors and paneling, linings and flooring, custom furniture, structures and outdoor decks.

In turn, the metal work unit works in a similar way but using metal instead of wood. This division utilizes various materials, such as iron, aluminum and stainless steel, in order to deliver robust and durable solutions to its clients. The manufacturing is focused on metal structures such as staircases, platforms, walkways, fencing and gates, steel lining and other products of add value through skilled metalworkers and developed machinery.

Modular construction is slightly different from the other two processes as it consists in off-site industrial production of prefabricated modules, such as modular bathrooms, housing units, electrical rooms, and other structural elements. This type of construction has the ability to shorten project timelines and support sustainable building practices by optimizing material use and reducing environmental impact. The manufacture of these modules occurs in a controlled environment where there can be the integration of both carpentry and metal work from the firm and is then transported to the construction site addressing current market demands and establishing a rapid assembly of the structure.

Buying process

Transfor Group philosophy goes beyond the backward thinking of hiring suppliers solely based on price. The company endeavours to find suppliers that meet its values, such as innovation, competence, sustainability, responsibility and above all, commitment to the client. In addition, the firm seeks always a relationship win-win, so that the partnership between both parts can be strengthened.

The buying process of Transfor Group begins by ranking the available suppliers from 1 to 3, regarding the criteria the firm consider crucial, which are respectively: material quality, relation between price and delivery dates, quantities available, and problem solving. Mrs. Vânia refers that this process works for the whole industry, where "given the assessment of the criteria, suppliers with the number 1 assigned are automatically dismissed with a detailed explanation of the causes, while the ones classified with the numbers 2 or 3 are hired or continue to work with Transfor Industry". The criteria was developed based on the needs of the company, specially the second one, since is important to understand the preference Transfor detains on buying raw materials earlier so that is possible to transform them within work deadlines, instead of buying cheaper ones that will slow down the works in question and, consequently, will have direct impact on the costs associated.

Although the recruitment of suppliers is similar between all the industry, Mr. Jorge Balsas refers that is important to have one person responsible for each industry unit because "This way, as well as ensuring that each person specialises in their area and maintains a closer relationship with a network of suppliers, we always have internal back-up. Besides, the most part of Transfor's purchases are still made through suppliers who visit the company, which makes it easier for the responsible of each unit to present feedback of the service to the supplier salesman, which will then pass the information on to its superiors, bearing in mind that the firm only contacts the supplier company in exceptional cases or to terminate the contract between them. The objective of this information sharing is specially to build a solid relationship amongst all the supply chain management, proving transparency and competence to inform suppliers when they are improving their service in the right path or when they are slacking on the agreed terms, improving the

efficiency of the entire buying process for both parts and emphasizing the continuous improvement culture and the situation win-win that is pretended.

Lean tools adoption

"The application of lean philosophy in Transfor had the basis of doing more with less" (Vânia, 2025).

The implementation of Lean was born in a very proactive way, especially when the company began to realize through others the advantages that emerged from adopting the mentioned tools. Transfor recognizes that it is present in a very competitive market, where the costumer has several choices, and therefore, innovation is increasingly something that differentiates itself from other enterprises. In this light, which complements the search for effective cost reductions and improved customer service, Transfor got in touch with Kaizen Institute. Mrs. Vânia recalled that the Institute mentioned visited Transfor facilities to perceive and analyse the firm context regarding the industrial process, so they can develop a project to present and educate the company directors and staff about Lean implementation at production level. Following some successful achievements in production, Transfor opted for extending the Lean philosophy to all SCM too, enhancing not only the production process but also the supply chain process. "At first, the objective of lean implementation was to improve the industry processes, but after realizing that the methodology would also bring significative advantages to the supply chain, Transfor did not think twice about it" (Vânia, 2025).

The priority of Lean tools was primarily the application to the industry processes and was then spread to the rest of the company.

The introduction of JIT and VSM into the supply chain was relatively easy since Transfor was keen to continue to work with the same suppliers, with whom there was already a trust relationship. "The company has always tried to implement these tools with the suppliers we already work with and, fortunately, it was a suggestion that was very well received by the other negotiating party, since they understood that it would be beneficial for both parties" (Vânia, 2025).

Transfor is a large company that, as a result, works with major suppliers who already possess the capacity to implement Lean practices. Consequently, Mrs. Vânia indicates

also that the adoption of Lean across the supply chain did not require significant additional investments from these suppliers, as they were already equipped to meet the operational standards expect by Transfor. Furthermore, when unforeseen events arise, either directly or indirectly related to the Lean tools in use, the company strives to resolve these problems internally, only reaching out to suppliers in cases of absolute necessity. "This proactive approach not only streamlines internal processes but also reduces the pressure on our supplier network" (Vânia, 2025).

Practical application of Lean tools

The production processes of metalwork, carpentry and modular construction share some common aspects but differ mainly in the materials used, manufacturing techniques, and degree of integration. While metal work and carpentry aim to transform raw materials into finished products aligned with customer needs, modular construction integrates components of both these areas, along with already transformed products from other suppliers, technical systems and logistics, resulting in complete modules for installation. These activities are directly linked with SCM, which will ensure the timely sourcing and delivery of all necessary materials and components.

"The application of VSM and JIT in the production process and supply chain enables the mapping and optimization of material and information flows, identification of waste, and ensures that each component produced and delivered only when needed, increasing efficiency and reducing costs" (Mr Jorge, 2025). Thus, despite technical differences, the use of VSM and JIT as it will be seen, is essential to harmonize and synchronize both production and supply chain flows across the different areas, promoting a more agile and integrated value chain.

VSM

"Value Stream Mapping was crucial in Transfor's entire industry, in this case the company's three sub-industries" (Jorge, 2025). This tool allowed the company to map the three industrial processes, as can be seen in appendix A, B and C. Mr Jorge referred also that "when VSM was applied in the firm, there were no processes being removed, however it was essential on simplifying and modifying them, and, as a consequence,

establishing metrics that allow us to record and guarantee that the processes are being carried out" (Jorge, 2025).

The highlight of the advantages recognized by the company extends to the entire industry, with greater emphasis on modular construction, where the product life cycle is longer.

As an example, Mr. Jorge explains drywall problem. "Transfor had a problem with the management of waste from the drywall that was coming from the supplier to use in modular construction". The company claimed that during the processing of drywall for use in the desired module, the waste generated was immense, and, subsequently, Transfor had to spend its financial resources hiring companies to collect this waste.

"When mapping out this entire process, and after a little debate about the situation with our supplier, I realized that he was not the first one in the product´s production line and that there was a factory behind it" (Jorge 2025). Later, the responsible for modular production decided to contact the factory and explain the situation of the residual material left in the company, Mr. Jorge explained that the one responsible for supplying the factory not only understood the problem, but quickly thanked him for the contact, because he could be using the waste to recycle and give it a new life.

"This way, Transfor started buying drywall directly from the factory, which in turn carried away the waste from the previous load, for free, when unloading new material, turning a problematic situation for our company into a win-win situation (Jorge 2025).

Consequently, with the approach taken by the company, there was a total reduction in the waste stored in the firm, freeing up space for more important needs, the cost previously allocated for the removal of the drywall's waste has been saved, and yet, the margin corresponding to the supplier between Transfor and the factory was amortized, once they started buying directly from the factory at a lower cost.

In another instance, Mr. Jorge gives context about the metal structures needed for modular industry. "So as not to overload the metal work industry, Transfor opted for buying metal structures for modular construction to another company but was quickly realized that the supplier rarely had the quantities needed on time" (Jorge, 2025). After analysis, the company understood that the problem was the payment method, since the supplier of Transfor would only pay his supplier at the end of each month, which led to liquidity problems.

The solution presented by Mr. Jorge was simple and allowed the building of a solid relationship between Transfor and both suppliers. The company proposed to oversee the

transportation of material from the first to the second supplier, and prompt payment of all the necessary cargo in exchange for a reduction in cost. In turn, the second supplier would transform the material into the metal structure, as it already did under the designs of Transfor, and then transport the products to the firm, where it would continue its production process.

"We then have a more available service, with no material flaws, in exchange for a prompt payment that does not impact significantly the company's economy" (Jorge, 2025).

As to understand the difference VSM approach can have in a company projects, Mr. Jorge quoted the reaction of Transfor when winning public projects of a big dimension, although without capacity to develop them while with other projects on hands. "Both on carpentry and metal work, there are always ongoing projects that cannot be overshadowed by even bigger ones" (Jorge, 2025).

The realization of this big projects at the company would make it impossible to do any others and, beyond that, it would fulfil storage, forcing it to be restructured. As Mr. Jorge describes, the solution is to carry out outsourcing like the example given for metal structures. Transfor buys the base material, forwards it to a partner to transform, and then the products return to the company's industry in order to be finished and sent immediately to the construction site. "In theory, this proposal almost doubles production capacity", to the extent that the company is working internally, and having work done externally.

Outsourcing in the type of situations mentioned earlier is something more less usual for the company, since "There is always specific manufacturers for these types of construction, whose production capacity is superior to Transfor's due to the specificity of its products" (Jorge, 2025). It ends up being easier to exchange services with companies that are specialist in a single base product, which will then allow Transfor to give the final finishes in its industry and forward the product to the end consumer.

JIT

"Transfor needed evolution, and the principal objective was to do better in the shortest possible time, and with Just-in-Time, this is possible. It is a powerful tool that allowed the company to coordinate all the activities and especially increase the speed of business processes" (Vânia, 2025). JIT, as a lean tool, seeks to minimize wastage, increase quality

and reduce costs, however, Mrs. Vânia admits the difficulty of its implementation by being a long process due to the perfect coordination required, both with customers and suppliers.

As an example, it was mentioned the first Just-in-Time action the firm applied with its supplier chain. "Transfor owns a very large industry and, as such, dozens of orders arrive every week for all three sub industries, so we began to demand that any order, without exception, arriving at the company must have a Transfor's specific order note on the invoice, otherwise it will not be received" (Vânia, 2025). The interviewee explains that due to the large number of employees in the industry and the large number of orders arriving every day, most of which need to be processed or assembled immediately, this method has become extremely necessary. Before this measure, Mrs. Vânia refers there were several orders that arrived and were merely forgotten in the warehouse, since there was no indication to allocate them to the right place. "The order note comes with a number provided when the order is placed, which is different for each industry or process, meaning that when the materials are delivered to the firm, both the supplier already knows in which industry it has to be unloaded, and the employees also know for what purpose the order is" (Vânia, 2025). This particular situation allowed the elimination of time spent by suppliers searching for the indicated spot to unload the cargo as well as the time materials were misplaced in storage while machinery continued working, wasting unnecessary energy, and consequently, wasting monetary resources.

Mrs. Vânia concludes by explaining that the implementation of the order form was not difficult to carry out, but it took time due to the suppliers getting used to it, which turns out to be normal.

In other cases, JIT is part of the process due to clients' specifications. The example of metal structures is not only provided by VSM but also reveals Just-in-Time as a crucial tool.

After the transportation of material from the first to the second supplier, the latter will be waiting for indications from Transfor on "how to cut and drill just-in-time the metal profiles according to the project at hand" (Jorge, 2025). In turn, depending on the size of the project in question, the company may ask for everything to be sent at once, in the case of a small project, or "choose to receive the order in a staggered manner when the production batch turns out to be huge, setting periodic delivery times allowing Transfor

to constantly move the order to the customer, saving on stock levels in the warehouse" (Jorge, 2025).

Unlike in the past, the Transfor Industry has been developed and now works with very little stock. "There are materials produced or ordered to be kept in stock throughout the industry, but nowadays, this represents a little percentage of each sub-industry" (Jorge, 2025). In all three sub-industries of Transfor, the products kept in stock are only the ones that have an above-average demand, such as beams, slats, fittings or panels in carpentry; structural pipes, profiles or commercial plates in metal work; PVC products, insulation materials or drywall plates in modular construction, and this products constitute only between 5 and 10% of all sales.

So, this means that around 90% of every sub-industry in Transfor works with products following the Just-in-Time, which leads to low stock levels and low storage costs. "This is due to the fact that the company builds the final product according to each client, which ends up combining different materials with different transformation activities and consequently with different types of orders for different suppliers" (Jorge, 2025).

It is also important to remember that Just-in-Time results from the coordination between the company and its suppliers. Mrs. Vânia highlighted an interesting slightly difference between the supply chain of carpentry and metal work from modular construction. If, by any chance, one supplier of wood or metal fails to deliver the raw material, the responsible for each business industry will immediately have another supplier available from whom they can request material, while in the case of modular construction, and because it is a unit that works a lot with brands and specific models of products, there will not be a second option available to handle the situation because, generally, when there is a problem with a specific brand by any means, it will not depend on the suppliers, but will have impact both on them and on companies. "This factor is what often makes JIT less efficient in the modular industry than in carpentry or metal work.

Discussion

Comparison between VSM and JIT

Value Stream Mapping and Just-in-Time are two different lean tools who evaluate different metrics within a company however can and should complement in its analytical

approach. Both play a fundamental role in transforming the production and, in this case, the supply chain of industrial companies.

VSM stands out as a visual and analytical tool essential for mapping and understanding the flow of materials and information throughout the value chain while JIT aims to synchronize production and supply chains in order to provide reduction of costs and stocks, wastage elimination and customer satisfaction.

When comparing these two approaches in the context of Transfor, it becomes clear that VSM provides the strategic vision and diagnosis necessary to support improvement decisions, while JIT turns those improvements possible with its coordination through all the value chain, especially the delivery and use of materials at the right time. Analysing the characteristics of both is understandable that, and as Ladeira (2017) mentioned, these tools are constantly combined with others for further analysis.

However, considering the practical cases mentioned above, it is also clear that these tools have a different impact across the three Transfor's sub-industries.

VSM was crucial in all the three industries, allowing the company to map complex flows, discover outsourcing options for productions considered impractical or even on clarifying logistical problems and waste, as the drywall example mentioned. On the other hand, JIT had a notoriously disparate impact, acting accordingly with predictability and supplier flexibility, proving to be very effective in carpentry and metal work, where the supply chain is more flexible and where the products are more standardized, contrary to what Benton et al (2011) describes and what can be seen in modular construction, where demand is not uniform and suppliers are limited too and, in consequence, JIT does not show the same type of usable capability.

Considering other aspects VSM showed very useful in identifying wastes, like drywall surplus, and in redesigning supplier relationships in order to resolve this type of problems. In this topic, JIT had also its importance on reducing waiting times and stocks through the demand of a strict alignment, the synchronization of company's activities.

Both tools strengthened supply chain collaboration but in different ways with Value Stream Mapping revealing improvement opportunities while Just-in-Time requiring close coordination.

In terms of complexity VSM was easier to implement, as it mainly required internal analysis, mapping and communication. JIT, in contrast, demanded a higher level of

coordination with external suppliers, discipline in internal operations and cultural adaptation, making it more challenging to establish across aal sub-industries equally.

In conclusion, these two lean tools are truly complementary. VSM enables the company to understand and design more efficient systems, while JIT is crucial for executing those systems in a synchronized way. Their combined application at Transfor has proven effective in enhancing supply chain processes, with each tool bringing unique strengths, depending on the specific operational context of each industrial unit.

Case study analysis

It would be interesting to first describe the context of the industries within Transfor Industry together with the method of relationship with the network of suppliers, since suppliers are extensions of their technical capabilities (Liker and Meier, 2006) and so, they are the result on how Transfor and other companies work with them in a mutual cooperation relationship at process development.

Transfor Industry is divided into three sub-industries: carpentry, metal work and modular construction, each with its own supply chain purchasing manager. The company chooses to hire and retain suppliers based on their willingness to evolve, their sharing of the same values, and their commitment to Transfor, consequently, to the end customer.

All the supply chain, in whatever industry within Transfor, was and is built on trust and mutual cooperation, in order to create a win-win situation where both parties benefit from the relationship. The fact that Lean tools have been successfully integrated into the entire supply chain, underpins the existing relationship between company and supplier, since to maximize effectiveness and efficiency is necessary the full integration of their supply chain partners through the development of available lean measures and metrics (Arif-Uz-Zaman and Ahsan, 2014). Otherwise, if there is no cooperation from the supplier to implement these tools, company's challenges will not be surpassed, and Lean characteristics will no longer be useful.

The implementation of VSM and JIT is something progressive, a condition where mutual learning is the key for constant innovation. The fact that the suppliers' employees take the time to stop by Transfor and share feedback with the head of each department, and vice versa, is what allows adjustments to be made.

The company is aware of the management required for the approaches to have the desired impact at all levels, stocks, costs, optimization, sustainability, and even reputation, and

seeks the combination of them in order to achieve a boost in their results, although it does not work across the board in all sub-industries.

VSM and JIT are the chosen tools regarding the study of the impact of Lean philosophy into Transfor, where each one have different ways of implementation but both can be complementary in an ideal scenario.

Thus, how VSM and JIT affect the supply chain of different industries within the same company? Both Lean tools demonstrated a huge impact on the mechanisms of Transfor, with proactivity coming from the company but results coming from cooperation with its suppliers. This chapter provides a critical reflection on how VSM and JIT influenced operations within the supply chain in the three sub-industries of Transfor, carpentry, metal work and modular construction, based on both the empirical case study and supporting literature.

Value Stream Mapping is widely acknowledged in Lean literature as a foundational diagnostic tool. It allows organizations to visualize material and information flows, identify non-value-adding activities, and propose future-state improvements. Studies have confirmed its utility in reducing lead time, clarifying bottlenecks and enabling process redesign. (Rother & Shook, 2003).

Just-in-Time, on the other hand, is a pull-based logistics system aiming for a synchronized production and ordering with actual demand, eliminating excess inventory and reducing lead time. However, and as analyzed, the successful application of JIT is directly dependent on a stable and responsive supplier base, predictable demand, and tight coordination across all stakeholders (Ohno, 1988).

The literature emphasizes that while VSM has been used to find out and eliminate redundant operations and even trigger strategic decisions such as outsourcing or reconfiguring supply chains, JIT can yield substantial benefits, however with its impact often constrained in contexts with high product variability or/and limited sourcing flexibility.

The case study highlights the differences that arise from the implementation of the Lean approaches mentioned in different sub-industries:

Faced with the cases presented by Mr. Jorge Balsas, it is noticeable that VSM does not provide homogeneous solutions but depends on the characteristics of each industry. In carpentry unit, VSM facilitated a clear mapping of material flows and revealed inefficiencies in panel handling and task sequencing while in metal work, this tool

revealed internal capacity limitations at specific production stages. Finally, in modular construction, VSM played a decisive role by uncovering inefficiencies in drywall supply. In the first situation, the insights gained led to internal reorganization and to the establishment of new performance indicators. On the second occasion, Transfor perceived that outsourcing certain structural components would make it possible to carry out various other simpler works, thereby alleviating internal constraints. Lastly, and based on the mapping exercise, it revealed that indirect sourcing via intermediates was leading to excessive waste stock and poor information flow, so Transfor responded by negotiating a direct agreement with the factory, which improved delivery speed and reduced waste, which would actually be valuable for the factory.

Although the approach is the same, VSM presents different solutions tailored according to needs for each industrial sector, which does not apply to JIT approach, which depends on other business factors.

Regarding the carpentry unit, JIT was effectively applied, supported by the availability of multiple suppliers and relatively standardized materials. In metal work, this approach was also implemented but with greater logistical complexity where the team adopted staggered deliveries for steel inputs, which reduced inventory holding, requiring careful coordination. In the third sub-industry, this tool was far less effective due to the technical specificity of the components and the reliance on single-source suppliers, which constrained significatively its implementation.

The outcome of the three situations reinforces the broader academic consensus that JIT is an added-value tool in low complexity and flexible environments, the other way around of modular construction, where this approach turns out to be very vulnerable. Yet, in the metal work, even though there is a medium-complexity environment, JIT can be successfully applied if the supply chain is reliable and communication is well-structured.

The comparative analysis of the impacts mentioned leads to several insights.

VSM demonstrated consistent solutions across all contexts, regardless of the complexity or structure of the sub-industry. It served as an effective planning and improvement tool enabling the identification of systemic inefficiencies and led to tangible structural changes.

JIT reveals itself to be highly context-dependent, something perceived by analyzing the different cases, proving high effectiveness in environments with flexible suppliers and

standardized inputs, as carpentry and metal work, but less so where supplier choice was limited and component specifications are rigid, as in modular construction.

Finally, it can be concluded that the two tools can be complementary, where JIT enhances daily operational control and efficiency depending on strategic diagnosis and redesign by VSM. When applied together, their combination leads to the strongest Lean outcomes.

In conclusion, this study shows that the impact of Lean approaches is shaped less by the tools themselves and more by the operational and relational conditions in which they are inserted. These findings are consistent with the literature review, arguing that Lean implementation must be tailored to the organizational environment (Liker, 2004; Rossetti et al., 2023).

In a company like Transfor, which operates across diverse production contexts, understanding these differences is essential to maximizing the value of lean methodologies.

Conclusion

The focus of the present project was to understand in what way can lean tools, namely VSM and JIT, impact the supply chain of different industrial sectors within the same company, all of which are somehow connected.

Lean implementation involves initiatives throughout the value chain, which includes supply chain and production process and a healthy connection between them. In this study, it is noticeable that Lean methodology provided some changes, most of them taking into account the relationship with suppliers and the coordination between the production process and the supply chain.

From an early stage it was possible to comprehend that how industries work with different products and in different ways, the implementation of the same tools in the three sub-industries would lead to disparate results, and therefore, this would be the main area of study.

In addressing the research question “how VSM and JIT affect the supply chain of different industries within the same company” it is possible to take at least two fundamental findings.

While VSM proves to be universally applicable, JIT proves to depend heavily on the context. The case study showed how VSM was easily implemented in each of the sub-industries, emphasizing a more visible and in-depth understanding of the industrial context. On the other hand, the effectiveness of JIT has been shown to depend on the predictability of demand and the flexibility of suppliers, in this case, revealing much more impact in carpentry and metal work rather than in modular construction.

In terms of continuity, another conclusion emerges: Lean is not a one-size-fits-all solution. The practical application showed that the Lean approach must be adapted to the specific reality of each sector considering the type of production, the degree of customization, variability and, above all, the relationship with suppliers. While JIT depends mainly on the type of suppliers' relationship, VSM aims higher structural changes.

In addition, it is important to highlight how important it is that the synergy of both tools can boost results. While VSM is useful for planning and redesigning processes, JIT reveals itself effective for ensuring fluidity, reducing inventories and synchronizing operations.

Limitations and future research

Due to scheduling constraints, it was not possible to interview any supplier in order to gather information on the implications and benefits of cooperating with Transfor on the adoption of Lean tools. In addition, it would be enriching to collect some quantitative data regarding the costs associated with stocks, waste and operations before and after implementation of VSM and JIT, making the advantages of this philosophy more visual and easily perceptible. It should also be noted that the company operates in three sub-industries from the industrial sector, in other words, nothing is exploited beyond the same industry, which, in a way, would be interesting to analyze in future research.

Looking ahead, a long-term study could reveal how Lean implementation evolves over time, including sustainability of practices, long-term benefits or setbacks, what would do another good opportunity for future research.

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Appendix

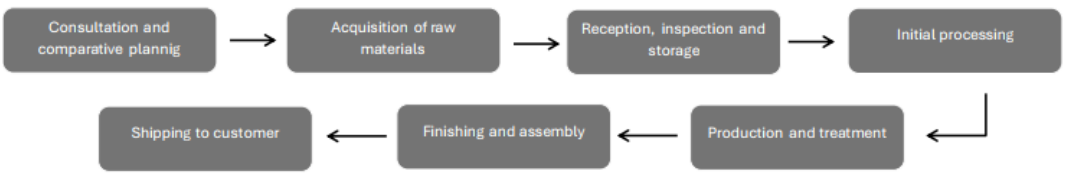
Appendix A: Support Tables

Table I – Products manufactured by Transfor Industry

Sub Industry	*Manufactured products*
Carpentry	**Wardrobes and Closets** Occasional furniture Doors and panels Linings and flooring Structures Outdoor decks
Metal work	**Metal structures** Staircases Platforms walkways Fencing and gates Steel lining
Modular construction	**Prefabricated bathrooms** Modular structural elements Technical rooms Modules with finished interiors

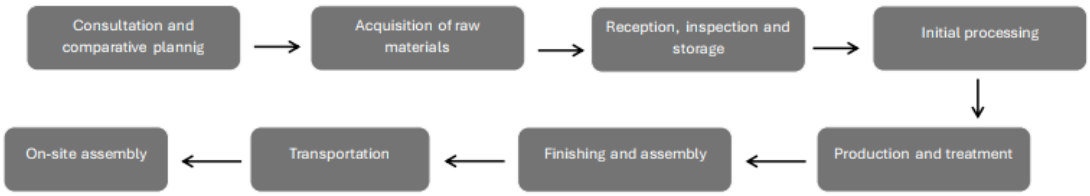
Source: Elaborated by the author, based on Transfor (2025)

Appendix B: Production Process Transfor Carpentry and Metal work



Source: Elaborated by the author, based on Transfor (2025)

Appendix C: Production Process Transfor Modular Construction



Source: Elaborated by the author, based on Transfor (2025)

Appendix D: Interview Guide – Vânia Maia

0. Thank you for your availability and a brief introduction to the thesis topic.

1. To begin with, it is important to understand whether the company has adopted Lean Tools within its supply chain or even in ither internal process, and if so, why

1.1 Has the company adopted any Lean tools in its processes, particularly in the supply chain or production process?

1.2 What were the main reasons that led the company to adopt these tools?

1.3 Considering the range of Lean tools and their implementation, was there any tool the company attempted to implement but was unsuccessful?

2. Regarding suppliers, I would like to understand what are, in order of relevance, the key criteria for their selection, and how these influence the choice of Lean tools. Which one is the most “critical”? And why?

3. Has the company ever considered changing suppliers in order to implement a specific Lean tool, or has the goal always been to find a mutually beneficial solution for all parties involved in Lean implementation?

4. After the adoption of Lean tools, how were the company’s activities altered, particularly in the supply chain?

4.1 And following this adoption, what were the main success factors that you would immediately highlight? Cost reduction? Customer and/or supplier satisfaction? Process optimization? Quality improvement? Other?

5. Concerning the implementation of the Just.in-Time and Value Stream Mapping tools:

5.1 What were the main challenges faced during the implementation of each Lean tool?

5.2 How did the company overcome these challenges? Are there any that remain unresolved?

5.3 Was the implementation of Lean and its tools a unilateral decision, or did the supply chain also need to adapt?

5.4 Considering that these two tools are among the most important for this study, are there any mapped situations in which the company's desire to become Leaner led to changes in network actors? For example, changes in suppliers sue to Lean requirements?

5.5 When Mapping any of your production volumes, how do changes by suppliers impact the respective mapping?

5.6 Regarding time, and more specifically Just-in-Time, how often do delays or failures occur?

5.6.1 If this happens frequently, how does the company handle demand fluctuations?

5.7 If applicable, what mechanisms are in place to collect suggestions and feedback from suppliers regarding the Lean tools in use?

5.8 In your opinion, how can the company ensure the sustainability of Lean practices over time?

6. When an unexpected issue arises, directly or indirectly related to the implemented Lean tools, does the company try to solve it internally or seek collaboration with suppliers?

7. To conclude, I would like to understand whether the changes brought by the Lean philosophy have been beneficial overall, in financial terms, in terms of reputation, and in managing stakeholders.

Finally, thank you once again for your time and availability.

Appendix E: Interview Guide – Jorge Balsas

0. Thank you for your availability and for the opportunity to introduce the topic of this final master work.

1. To begin with, I would like to understand whether the Lean tools were implemented simultaneously across all three sub-industries, or if it was initially tested in just one as a pilot project.

2. How would you describe the role of Lean in Transfor's growth and differentiation strategy?

3. Lean tools depend greatly on supplier relationships, especially JIT

    3.1. To complement the information provided by Mrs. Vânia, what would you say are the main distinctions between the suppliers of the three sub-industries?

    3.2. Is there a dedicated person responsible for procurement within each sub-industry, or is there a central figure managing all purchasing?

    3.3. Is the material delivery process to the company standardised, or is there someone who regularly evaluates and determines what is needed?

4. With regard to practical cases and resulting operational decisions:

    4.1. Could you describe two or three practical examples of each tool (VSM and JIT) and their application across the sub-industries?

    4.2. Have JIT demonstrated their advantages in the three sub-industries

    4.3. Where there noticeable differences in inventory levels before and after the implementation?

    4.4. What specific changes has VSM brought to Transfor?

    4.5. How is the progress mapping structured across the three sub-industries?

5. Finally, I would like to ask which of the tools you believe had the greatest impact on Transfor.

Once again, thank you for your availability, not only this interview, but also for all the support and engagement beyond it.

Artificial Intelligence

Throughout the writing of this thesis, artificial intelligence tools were occasionally used to enhance the quality of the text. Specifically, AI was used to improve some vocabulary choices, ensuring more academic language, and to assist in formatting references in accordance with the Harvard style. These tools were used responsibly as a mere support mechanism to refine the final presentation of the work, without compromising the originality of the research or its critical analysis.