

Product Development Process in the Fashion Industry: A Case Study in a Brazilian Footwear Company

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tional or personal conflicts of interest.

Abstract: The product development process (PDP) involves transforming a set of ideas into a tangible, marketable product. In highly dynamic sectors with short product life cycles, such as the fashion industry, the importance of a rapid and accurate innovation process becomes crucial. This research aimed to map the PDP of the Brazilian footwear industry. A qualitative, exploratory, and descriptive investigation was conducted through a case study. Data was collected via interviews with fourteen employees, participant observation, and document analysis. By identifying key elements of the innovation processes within the department, the study verified the critical and influential factors contributing to the successful development of new products. The identified stages of the PDP partially diverged from the generic models proposed in the literature. The findings also provided managerial insights geared toward optimizing resources and aligning strategies. Additionally, the study offered theoretical insights into innovation process models, highlighting their distinct features and adapting them to the analyzed context. The limitations of this research include the inability to generalize the findings due to the specific characteristics of the company studied. Furthermore, the importance of comparing PDPS across two or more industries within the same sector is acknowledged, as it could reveal commonalities.

Keywords: Development flow, innovation, product development process, fashion industry, fast fashion.

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Proceso de desarrollo de productos en la industria de la moda: estudio de caso en una empresa brasileña de calzado

Resumen: El proceso de desarrollo de productos (PDP) comprende la transformación de un conjunto de ideas en un producto tangible y comercializable. En sectores altamente dinámicos, caracterizados por ciclos de vida del producto reducidos, como es el caso de la industria de la moda, resulta fundamental disponer de un proceso de innovación ágil y preciso. Por ello, el objetivo de esta investigación fue mapear el PDP en la industria brasileña del calzado, mediante un estudio de enfoque cualitativo, de tipo exploratorio y descriptivo, basado en un estudio de caso. La recolección de información se realizó a través de entrevistas a 14 colaboradores de una empresa del sector, observación participante y análisis documental. La identificación de los elementos clave de los procesos de innovación en el área responsable dentro de la organización objeto de estudio permitió constatar los factores críticos e influyentes que contribuyen al desarrollo exitoso de nuevos productos. Las etapas del PDP identificadas presentaron divergencias parciales con respecto a los modelos genéricos propuestos en la literatura. Los hallazgos ofrecen aportes de carácter gerencial orientados a la optimización de recursos y a la alineación estratégica de los procesos de innovación. Asimismo, el estudio proporciona insumos teóricos relevantes sobre los modelos de procesos de innovación, destacando sus características distintivas y su adaptación al contexto específico analizado. Entre las limitaciones de este trabajo se encuentra la imposibilidad de generalizar los resultados, dada la singularidad de la empresa analizada. En este sentido, se resalta la importancia de realizar estudios comparativos del PDP en dos o más organizaciones del mismo sector, lo cual podría permitir la identificación de patrones comunes y contribuir al fortalecimiento del conocimiento en esta área.

Palabras clave: flujo de desarrollo, innovación, proceso de desarrollo de productos, industria de la moda, moda rápida.

Processo de desenvolvimento de produto na indústria da moda: um estudo de caso em uma empresa brasileira de calçados

Resumo: O processo de desenvolvimento de produto (PDP) envolve a transformação de um conjunto de ideias em um produto tangível e comercializável. Em setores altamente dinâmicos e com ciclos de vida curtos dos produtos, como a indústria da moda, a importância de um processo de inovação rápido e preciso torna-se crucial. Esta pesquisa teve como objetivo mapear o PDP da indústria brasileira de calçados. Foi realizada uma pesquisa qualitativa, exploratória e descritiva, por meio de um estudo de caso. Os dados foram coletados mediante entrevistas com 14 funcionários, observação participante e análise documental. Ao identificar elementos-chave dos processos de inovação dentro do departamento, o estudo verificou os fatores críticos e influentes que contribuem para o desenvolvimento bem-sucedido de novos produtos. Os estágios identificados do PDP divergiram parcialmente dos modelos genéricos propostos na literatura. As descobertas também forneceram *insights* gerenciais voltados para otimizar recursos e alinhar estratégias. Ainda, o estudo ofereceu *insights* teóricos sobre os modelos de processos de inovação, com destaque para suas características distintas, e adaptou-os ao contexto analisado. As limitações desta pesquisa incluem a impossibilidade de generalizar as descobertas devido às características específicas da empresa estudada. Além disso, reconhece-se a importância de comparar PDPS em duas ou mais indústrias dentro do mesmo setor, pois isso pode revelar pontos em comum.

Palavras-chave: fluxo de desenvolvimento, inovação, processo de desenvolvimento de produto, indústria da moda, *fast fashion*.

Introduction

The transformational fashion industry (Lee, 2022) is primarily characterized by rapid changes, driven by high seasonal demand (Bandinelli *et al.*, 2013). This industry also exhibits significant volatility in consumer behavior, making the market unpredictable (Bandinelli *et al.*, 2013; Fernandes *et al.*, 2022) and leading to increasingly dynamic fashion cycles (Dissanayake & Sinha, 2015).

As a result, product innovation becomes a fundamental principle guiding the strategies of companies in this sector. It requires an efficiently structured product development process (PDP), enabling quick replication with each new product demand (Lauff *et al.*, 2018). In certain fashion sectors, such as footwear, this context is even more complex due to the variety of sizes, models, and materials used in production. Footwear companies must manage and develop a substantial volume of items for each new collection (Abicalçados, 2022). However, for innovation to thrive, companies must map their processes to facilitate the replication of the PDP model for each product launch (Baxter, 2011).

Moreover, PDP models in the fashion industry differ from those used in other industries, as they account for the seasonality and dynamism inherent to the sector (Bandinelli *et al.*, 2013), where product life cycles are extremely short (Sullivan *et al.*, 2021; Wen *et al.*, 2019). Specifically, in the footwear industry, the PDP serves as a foundational strategic resource, as a company's innovative capability directly affects its market positioning (Davolio *et al.*, 2017).

Thus, product development is a critical component of all fashion business operations (Fung, 2021), making the diagnosis of PDP essential for driving improvements (Fernandes *et al.*, 2022) in alignment with other Industry 4.0 elements (Millatunnisa, 2022). Although some studies have explored product development processes in the footwear industry (Baxter, 2011; Davolio *et al.*, 2017; Fettermann *et al.*, 2017), research in this area remains limited (Bagno *et al.*, 2017). Therefore, developing agile methodologies to effectively integrate manufacturing into the PDP is a significant challenge for contemporary industrial practices (Zenkner & Forcellini, 2021).

Given that mapping processes for product development is fundamental for each new product launch, Davolio *et al.* (2017) suggest that further exploration of this topic may significantly contribute to the field. In this regard, Zenkner and Forcellini (2021) found that the PDP method generally consists of two stages. The first involves project planning through a visual tool for the delivery script, while the second focuses on the development and evaluation of the product. Youssef and Webster (2022) also confirm that this innovative process comprises multiple stages, allowing for the refinement of an idea to make it viable for commercialization. The authors argue that PDP relies on multi-criteria decision-making, where a set of criteria is assessed to determine the optimal course of action.

However, Venesz *et al.* (2022) argue that open innovation can improve the success rate of new product development, particularly by incorporating input from lead users. The importance of design

management in product development is also evident, especially for small and medium-sized enterprises (Carneiro *et al.*, 2021). At the same time, Briard *et al.* (2021) observed that data-driven design solutions are increasingly used to identify market opportunities in product development.



In this context, it is noteworthy that Brazil ranks fifth globally in footwear production, being the largest producer outside of Asia. The country produces an average of 734 million pairs annually, contributing 3.9% of global production (Abicalçados, 2022), and is the fourth-largest consumer of footwear worldwide (Fetterman *et al.*, 2017). Therefore, improving the PDP in this industry is likely to enhance the sector's competitiveness and provide systemic socioeconomic benefits to the country (Baxter, 2011).

Given this background, the present research study aimed to map the product development process of the Brazilian footwear industry, identify the fundamental elements of the PDP within the sector, and determine the key factors influencing the development of new products.

In addition to this introduction, the article is structured into five sections. The literature review presents theoretical and conceptual aspects of the PDP, with a focus on the fashion industry. The methodology outlines the research design and describes the data collection and analysis procedures. The next section presents the findings, followed by a discussion. Finally, the conclusions reflect on the main findings, limitations, and suggestions for future research.

Bibliographic review

This section presents conceptual aspects of PDP, emphasizing its evolution and critical factors. It also outlines theoretical elements concerning the different models of PDP and accentuates its use in the fashion industry.

Product development process (PDP)

Under the traditional approach typically employed in industrial departments, product development involves materializing a set of ideas that enable the manufacturing of a tangible good, primarily focusing on design-related aspects (Berndsen *et al.*, 2021). PDP seeks to facilitate this by following well-defined steps to transform intangible concepts into tangible products through a PDP model (Vargas *et al.*, 2020). This process is crucial for companies across various sectors and sizes, as it contributes to competitive advantage (Iqbal & Suzianti, 2021).

Initially, PDP was understood as a series of technical activities confined to the engineering department, where information regarding product development was centralized. However, over time, the concept of PDP has evolved from this traditional view to encompass a more strategic interrelationship between multiple departments, which now operate in a connected and interdependent manner (Rozenfeld *et al.*, 2006). From an integrative perspective, PDP today can be defined as a set of activities spanning from the initial conception phase to the final product evaluation by the consumer (Kaminski, 2012). Thus, PDP acts as a mechanism that enables product manufacturing through the involvement of all relevant stakeholders (Toledo, 1994).

While the expanded scope of PDP allows organizations to learn from and improve the product life cycle (Rozenfeld *et al.*, 2006), its execution can be complex. This complexity arises because documenting tasks, establishing patterns, and ensuring their replicability are key to building a robust and effective process (Kaminski, 2012). Therefore, identifying and developing critical success factors can reduce PDP duration, lower manufacturing costs, and ensure product differentiation (Cheng & Shiu, 2008).

It is recognized that the literature lacks consensus regarding the critical factors inherent to PDP, resulting in a diversity of parameters. Nevertheless, the success of the PDP is largely determined by how it is managed (Clark & Fujimoto, 1991; Wheelwright & Clark, 1992) and by the skills of the areas involved (Cooper & Kleinschmidt, 1987). Table 1 presents the critical factors within PDP, according to some of the authors on the subject.

Table 1. Critical factors of the PDP.

Critical PDP factors	
Utterback (1970)	(i) Design; (ii) invention; (iii) industrialization; (iv) disclosure.
Temaguide (1998)	(i) Environment; (ii) strategic innovation efforts; (iii) available resources; (iv) ability to implement innovation; (v) learning.
Jonash and Sommerlatte (2001)	(i) Culture; (ii) leadership; (iii) learning; (iv) internal organizational factors.
Panne <i>et al.</i> (2003)	(i) Factors related to the company; (ii) product-related factors; (iii) project-related factors, (iv) market-related factors.
Urnau <i>et al.</i> (2021)	(i) Integration with the supply chain.
Guimarães <i>et al.</i> (2021)	(i) Combination of complementary management methods.
Vidner <i>et al.</i> (2022)	(i) Project automation.
Patil <i>et al.</i> (2022)	(i) Time; (ii) cost; (iii) quality.
Zenkner and Forcellini (2021)	(i) Project planning; (ii) interaction; (iii) collaboration.

Source: authors.

Utterback (1970) identifies key aspects of the PDP as critical factors for success. Similarly, Temaguide (1998) suggests that these factors significantly influence innovation. Jonash and Sommerlatte (2001) expand on this by considering critical factors that shape the innovative process and drive strategic decision-making. Urnau *et al.* (2021) and Panne *et al.* (2003) further corroborate that in an environment of accelerated innovation, integration with the supply chain becomes essential for reducing time and improving the accuracy of the PDP, given the crucial exchange of information. At the same time, Guimarães *et al.* (2021) emphasize that combining complementary management methods enhances resource utilization and contributes to the efficiency of the PDP, including in the context of sustainable innovation.

Vidner *et al.* (2022) agree that project automation systems, in line with new industrial technologies, can streamline the PDP. From a lean perspective, Patil *et al.* (2022) identify time, cost, and quality as the key requirements for gaining a competitive advantage by optimizing the PDP. Zenkner and Forcellini (2021) stress that effective integration of manufacturing into the PDP requires project planning based on the build-measure-learn cycle, characterized by interaction and collaboration, as seen in the lean startup approach.

Nevertheless, regardless of the product type, the PDP involves critical factors that vary according to its specific characteristics and the peculiarities of the industry (Kaminski, 2012). It is also important to note that while multiple points can initiate and conclude innovation processes, their implications for innovation management practices in companies are far-reaching (Bagno *et al.*, 2017). Therefore, establishing standardized PDP models remains an emerging area of research.

In the fashion industry, specifically, the PDP must consider that processes should be continuously reviewed, even after products have been commercialized. Additionally, it is essential to recognize the industry's unique characteristics, such as high seasonal demand, that require a dynamic and adaptable PDP (Bandinelli *et al.*, 2013).

PDP models

Multiple authors have proposed PDP models, which, despite certain peculiarities, generally outline pre-established steps for transforming an idea into a product (Machado & Toledo, 2008). By adopting a reference model, an organization can implement a specific PDP framework and use it as a procedural guide for developing new products, allowing for the replication and refinement of practices (Rozenfeld *et al.*, 2006).

Each innovation management model, including those related to the PDP, presents gaps, biases, weaknesses, and strengths from both theoretical and practical perspectives (Bagno *et al.*, 2017). Consequently, a variety of innovation process models exist, each with its own specific activities and unique characteristics (Salerno *et al.*, 2015). In light of this, table 2 provides a summary of the three phases of the PDP recommended by Rozenfeld *et al.* (2006), comparing them with models proposed in scientific literature.

Table 2. PDP models and phases.

PDP Models	PDP Phases		
	Pre-development	Development	Post-development
Cooper (1994)	Idea Preliminary study Study the business plan	Development	Validation test Launch
Toledo et al. (2008)	Feasibility analysis	Technical development Building prototypes	Product and market testing Commercial launch
Bandinelli et al. (2013)	Design	Modeling/prototyping Engineering Material source	Production and distribution
Azariadis et al. (2018)	Conceptualization Concept screening	Preliminary project Evaluation and improvement Prototyping	Final project
Lauff et al. (2018)	Planning Concept development System-level design Detailed project	Test and refinement	Production

Source: authors, based on the works cited..

Despite their specificities, all these PDP models converge with Cooper's (1994) Stage-Gate proposal, arguably the most widely recognized innovation process model (Bagno *et al.*, 2017). According to Cooper, project portfolios should be managed through sequential phases (stages) and decision points (gates). This model offers both a conceptual and operational framework for transitioning new product designs from development to launch, enhancing the overall effectiveness and efficiency of new product development (Rosa *et al.*, 2022).

The Stage-Gate model serves as an integration and management mechanism between the PDP and the manufacturing process, with the latter being the first "customer" of the development process. Cooper's model ensures that production constraints and capacities are accounted for within the PDP, thereby increasing the likelihood of the final product's success in the production plant (Conceição, 2021).

Projects undergo continuous review throughout development, facing approvals or rejections at various stages. The process consists of five stages: (i) scoping; (ii) building the business case; (iii) development; (iv) testing and validation; and (v) product launch. Progression from one stage to the next is contingent upon checkpoints that assess and control key decisions, which may lead to project approval, cancellation, or further revision (Cooper, 1994; 2008).

Methodology

The research is qualitative in its approach and exploratory and descriptive in its purpose. A case study was employed for operationalization, given the importance of the context and the close relationship between the object of study and its environment (Yin, 2004). Considering the representativeness of the case and its non-deterministic approach (Stake, 1995), the empirical validity of this method was emphasized (Eisenhardt, 1989).

The object of study was a footwear company headquartered in Rio Grande do Sul, with manufacturing units distributed across Brazil. This organization has been active in the industry for about forty years and employs over twenty thousand people. On average, it launches 140 new footwear models each month, necessitating effective PDP management for successful replication.

Data collection involved semi-structured interviews guided by a script based on Cooper (1994), Rozenfeld *et al.* (2006), Toledo *et al.* (2008), Bandinelli *et al.* (2013), Azariadis *et al.* (2018), and Lauff *et al.* (2018), which was later validated by field experts. The interview questions addressed the phases and stages of the PDP, linking them to the employees' working environment. Upon reaching theoretical saturation (Rowlands *et al.*, 2016), a sample of 14 respondents was analyzed, determined based on Rowley's (2012) guidelines, as presented in table 3.

Table 3. Characterization of respondents.

Department	Respondent	Occupation	Company Time
Engineering	A	Process engineering supervisor	10 years
	B	Engineering analyst	7 years
	C	Lead project management analyst	7.5 years
Sales	D	Export operations coordinator	20 years
	E	Sales operations supervisor	21 years
Supplies	F	Raw material buyer	4 years
Matrix	G	Die casting project coordinator	32 years
Marketing	H	Lead brand and communications analyst	27 years
Costs	I	Price and cost management analyst	12 years
	J		6.5 years
Business management	K	Product specialist I	11 years
Factory	L	Process development coordinator	7 years
Design management	M	Planning intelligence analyst	7.5 years
	N	Kids line product development supervisor	9 years

Source: authors.

Data collection took place virtually via the Chat Teams platform between July 27 and August 16, 2021. The interviews were recorded, transcribed, and subsequently validated by the respondents. For the analytical procedure, content analysis was employed, which involves systematically interpreting and describing the collected content to extract meaning (Bardin, 2013).

In addition to interviews, participant observation and document analysis were used as data collection methods. The participant observation focused on systematically monitoring daily activities related to the PDP. Moreover, files containing relevant information, such as historical records, flowcharts, and other management documents, were consulted.

The research adhered to methodological rigor by applying the principle of triangulation, which enhances the reliability of case studies (Yin, 2004). The data obtained from various sources were cross-referenced and compared with relevant literature to ensure a comprehensive analysis.

Results

This section presents the results obtained from the empirical investigation. Initially, it is evident that the company under study develops products that involve processes such as injection molding, cutting, sewing, and footwear assembly. However, before initiating the manufacturing

processes, the company integrates nine distinct departments into its PDP, all working in collaboration. These departments, prior to this research, had not been systematically mapped. As a result, the stages of the company's PDP were identified and are summarized in figure 1.

The company's PDP is organized into five stages: conception, mockup creation, prototype release, prototype revision, and scale-up. The following departments are involved in these stages: business management, design management, marketing, cost analysis, engineering, supply chain management, sales, and the entire industrial sector, including the molding department and prototyping factories (injection factory and assembly factory). The following details of each of these stages are presented in figure 1.

Conception

In the footwear conception phase, the business management department initiates the development process by analyzing market conditions and identifying trends for new product development. Based on these insights, the department prepares a briefing document containing key information about the prospective product, such as brand, product type, price range, and target audience. This briefing is then presented to other departments during an "Inspire + Meeting."

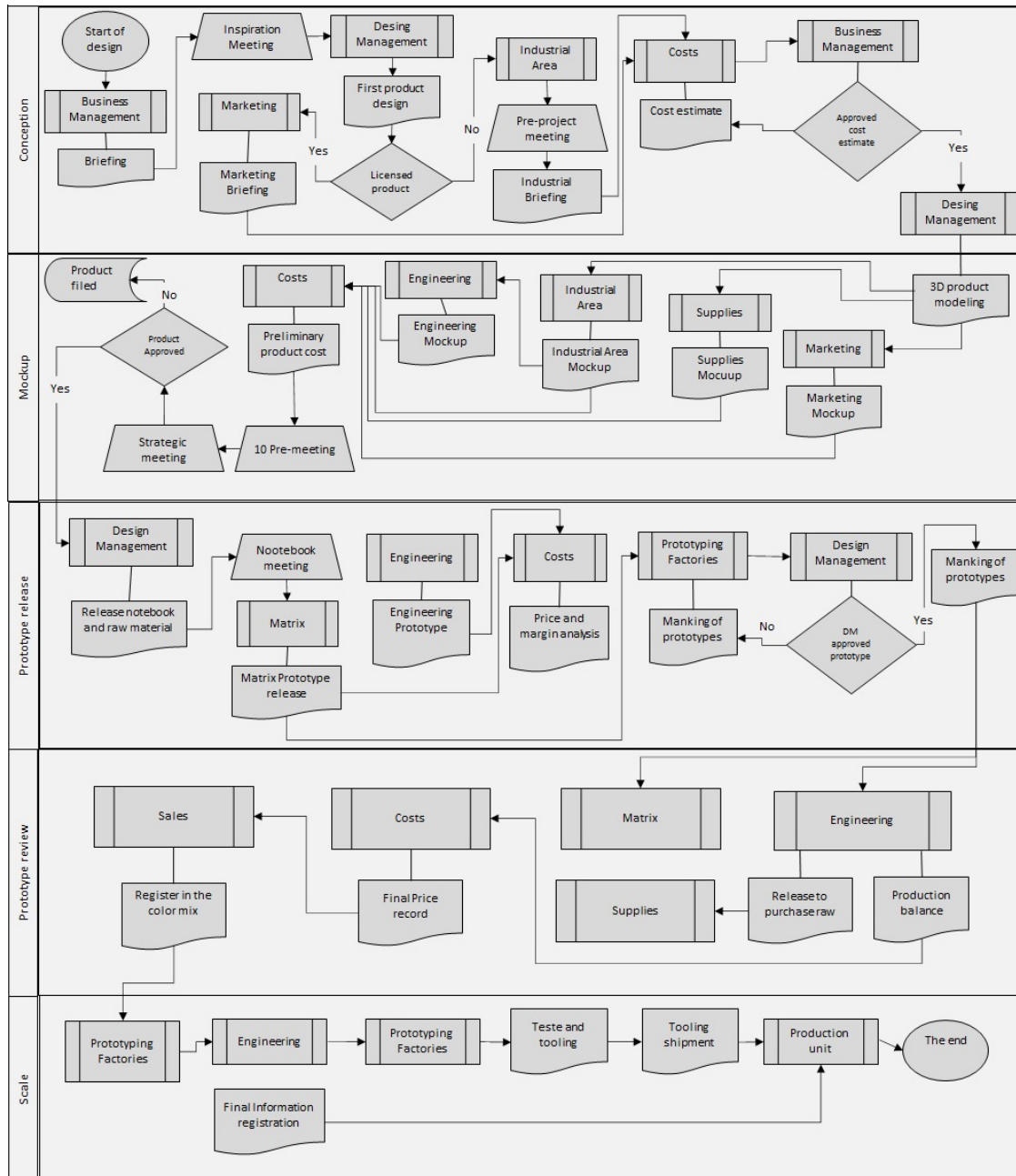
Following this meeting, the design management department develops options to address the business management's demands. Using the briefing as a guide, the design management team creates the first product layout—a 2D drawing representing the initial concept. For products involving licensed brands, the design management department works with the marketing department to contact the relevant legal representatives when necessary.

Once the initial layout is completed, the industrial area, which includes the molding, injection, and assembly departments, conducts an analysis to determine the necessary processes for the product's development. They assess whether existing tools can be used, identify any new tools that need to be manufactured, and quantify the number of new dies required, which will be factored into the product's final cost. These findings are then discussed in a "Pre-Design Meeting."

After these preliminary assessments, the cost department reviews the information provided by the other departments and conducts a financial feasibility analysis. This analysis is forwarded to the business management department, which evaluates whether the project aligns with expectations and can move forward. If the project does not receive approval, it returns to the cost department for revisions aimed at improving financial viability. The final approval from the business management department marks the conclusion of the footwear conception phase.

Co-branding strategies for B2B SMEs

Figure 1. The PDP flowchart of the company studied.



Source: authors.

Mockup

After the business management's approval, the second stage of the product development process begins, focusing on the footwear mockup. In this phase, the design management department creates multiple versions of the product models approved in the previous step. Typically, two or more versions of the same product are developed to allow further analysis by other departments. At this stage, the cost department re-evaluates the preliminary financial study before presenting the product to top management during the "Strategic Meeting."

During the Strategic Meeting, managers carefully review the various product versions to either approve them for the next development phase or reject them. If a product fails to meet expectations, its PDP is closed, and the project is archived in the company's system for future reference, serving as a learning opportunity for subsequent projects. Once the product version is selected and approved during the Strategic Meeting, the development progresses to the prototype release stage, managed by the design department.

Prototype release

In the prototype release stage, the design management department creates a detailed Technical Product Notebook, which outlines the processes required to manufacture the footwear and identifies the materials to be used. This document also specifies the matrices necessary for the model, indicating whether these matrices already exist or need to be produced or modified. Additionally, it includes a visual component called the Provisional Product Map, which lists input codes such as colors, fabrics, paints, materials, and pigments, ensuring the product is properly represented at this stage.

Armed with this concrete data, the other departments can begin working with tangible information, even though the product is still in its virtual design form. Once the prototype matrices are finalized, the industrial area produces the first physical pairs of the footwear model. These prototypes are then sent to the design management department, where they are checked for conformity with the original virtual designs developed in the earlier phases. If the physical prototypes meet the expectations, the design management department issues a "Prototype Approval" document, which includes an image of the actual product and notes any necessary adjustments to be made in the subsequent stages, allowing the prototype review phase to begin.

Prototype review

In the prototype revision stage, the design management department updates the Provisional Product Map to create a Final Map. This finalized version enables the engineering department to

input data regarding the consumption of inputs, and the supply department can begin purchasing the raw materials necessary for the production batch. If the design management team does not approve the model at this stage, they issue a Prototype Reapproval document, which sends the product back to the industrial area for remanufacturing. This keeps the model in the prototype release stage until the necessary adjustments are made and approval is granted.

Once the Prototype Approval and Final Map are issued, the mold factory begins producing the dies and tooling required for the upcoming scale-up stage. Concurrently, the cost department conducts a final analysis of all production-related data and issues a Final Price Register document, determining the product's sale price. During this phase, the sales department initiates the footwear commercialization process. They assess the market demand and record the quantities of each color and size of footwear to be produced, ensuring that production aligns with consumer demand.

Scale

With the scale dies and tooling completed, the injection and assembly plants initiate preparations for full-scale production. The sample pairs are distributed to both the company's commercial representatives and production units to balance and optimize the production scale. At this stage, the engineering department calculates the production rate, determining how many units can be produced per hour and estimating the necessary labor for this volume. This information is documented and input into the ERP Matrix, an integrated management system that organizes the production flow, balancing operations across different production units.

In addition to ERP Matrix, the company utilizes ERP TOTVS, which registers the input codes necessary for manufacturing each product. This system generates production programs that help control the number of hours required to produce specific footwear models. These programs also track what has been produced and what remains to be manufactured to meet the company's commercial demand.

Following the creation of the sample pairs, the injection and assembly factories proceed to produce a pilot lot. This pilot production involves making one pair of each shoe size to test all tools and matrixes thoroughly. Once the tooling and processes have been successfully tested, the necessary equipment is transferred to the relevant production units, thereby concluding the product development process and enabling full-scale production.

Discussion

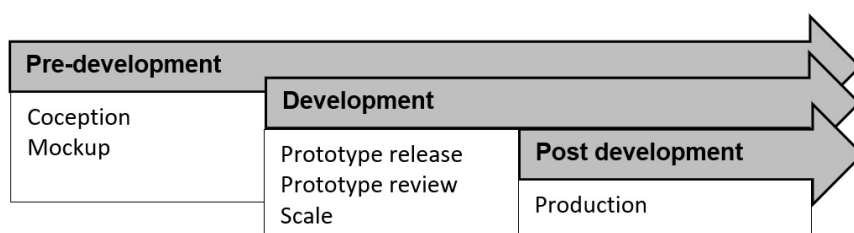
The present research aimed to map the PDP of a Brazilian footwear company, comparing this process with theoretical and applied perspectives. Based on Cooper's (1994) widely recognized

model, the PDP is divided into six stages: idea, preliminary study, business plan study, development, test, validation, and launch. According to this framework, each stage builds upon the other to form a structured and phased approach to product development.

Other scholars, such as Toledo *et al.* (2008) and Bandinelli *et al.* (2013), have proposed models with five stages, emphasizing that the development phase of PDP requires particular attention. Meanwhile, Azariadis *et al.* (2018) and Lauff *et al.* highlight that the pre-development stages are critical. These authors suggest that early planning and design unfoldings are the most relevant for ensuring the success of the PDP.

In the case of the footwear company analyzed, it was identified that their PDP consists of five distinct stages: conception, mockup, prototype release, prototype review, and scale-up. In convergence, the production is considered a stage of the product post-development phase. In this sense, Figure 2 presents the PDP phases practiced by the investigated company.

Figure 2. PDP Phases in the analyzed company.



Source: research findings, based on Rozenfeld *et al.* (2006).

The in-depth investigation of the evaluated case process provided a detailed understanding of the steps performed in the PDP, the unfolding activities, and the interrelationship between departments (figure 1). Figure 2 illustrates how the stages of the company's PDP align with the model proposed by Rozenfeld *et al.* (2006). The stages that make up the pre-development are relevant because, at this moment, the concept of the stage gate is applied to which the project must be maintained and sent to the development and production stages.

It is observed that, contrary to Kaminski's (2012) suggestion, the company does not include consumer assessment as a distinct phase within the PDP. However, in line with the models proposed by Azariadis *et al.* (2018) and Lauff *et al.* (2018), the results indicate that the footwear company's PDP is heavily focused on the pre-development phase. This focus arises from the significant involvement of employees during this stage, reflecting the company's emphasis on ensuring accuracy and precision when introducing new products to the market. Furthermore, the strong involvement of top management during this phase leads to a higher frequency of both product approvals and rejections.

Table 4 lists the stages identified in the PDP of the evaluated case and their relationship with the theory and theme developed.

Table 4. Characterization of respondents.

Stage	Step (Rozenfeld <i>et al.</i> , 2006)	Considerations
Conception	Pre-development	Strategic and decision steps
Mockup		
Prototype release	Development	Refinement steps
Prototype review		
Scale		
Production	Post-development	Production stage

Source: authors.

In the evaluated case, the pre-development stages (conception and mockup) are considered strategic, as key decisions regarding product development are made during these phases. The selection of which products to continue developing helps reduce efforts on products deemed irrelevant to the organization, thereby increasing agility in focusing on appropriate products and lowering costs by avoiding work on disregarded projects.

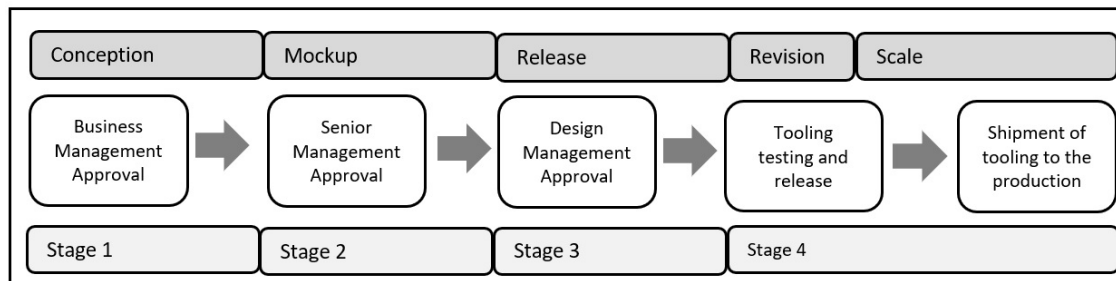
It is also noted that, during the pre-development phase, the departments responsible for new product development—business management and design management—are considered strategic by the company for transforming market needs into viable products. Other departments play a supportive role, providing assistance and insights into these core areas.

Consequently, interdependence among administrative areas is thus evident, allowing for cross-functional discussions and coordinated efforts to drive innovation. This approach contrasts with more traditional perceptions of product development (Krishnan & Ulrich, 2001), suggesting that the integration of multiple organizational perspectives can enhance the accuracy and success of development processes (Sarpong & Maclean, 2012). This finding aligns with the conclusions of Rozenfeld *et al.* (2006) and Kaminski (2012), who observed that while the PDP was once confined to operational areas, it has now evolved to encompass the entire organization in a systemic manner. Furthermore, frequent meetings are held during the pre-development phase for management to analyze and approve or reject proposed products.

Another important observation relates to the innovation funnel model, where the sequence of PDP stages serves to "filter" projects based on the criteria assessed at different stages (Wheelwright & Clark, 1992). This logic has been integrated into innovation management models (Cooper *et al.*, 2002), including in the company under study.

The findings also show that the company's product development phase consists of three stages, refined through a lean production approach tailored to footwear manufacturing, with an emphasis on cost optimization. Although the company does not adhere to a specific PDP model, it follows the Stage-Gate methodology outlined by Cooper (1994). Figure 3 illustrates the company's stages as supported by scientific literature.

Figure 3. Stage-Gate PDP model of the studied company.



Source: research findings, based on Cooper (1994).

Although Cooper (1994) outlines five stages in the Stage-Gate methodology, only four were identified and concluded by decision points in the company under study. The initial stage corresponds to the "scope," encompassing all activities within the product conception phase. This stage is finalized with the approval of the cost estimate by the business management area, after it is reviewed by the cost department based on briefings provided by other departments.

The second stage, "construction," integrates the mockup phase, where the decision gate involves top management's approval of the mockup. Stage three involves the activities related to the release of the prototype, concluding with its approval by the design management department. This stage aligns with the development phase as described by Cooper (1994).

Stage four corresponds to the validation test, encompassing the prototype and scale-up revisions in the company. This stage is concluded after testing and releasing the tooling, which is then transported to other manufacturing units. However, unlike Cooper's model, the company did not identify a fifth stage involving product launch, as it considers product development complete once the development phase ends.

As noted by Salerno *et al.* (2015), innovation projects do not always fit into the traditional linear process from idea to launch. The authors highlight the inherent uncertainties in such processes, which shape the structure and dynamics of innovation, including the PDP. Consequently, although there is no universal approach suited to all cases and departments (Shenhar, 2001), the complexity of today's market environment necessitates the use of tools, techniques, and management models that prioritize innovation (Pich *et al.*, 2002; Rice *et al.*, 2008). This underscores the importance of this study in exploring such processes.

Conclusions

Given the dynamism of the fashion market, where products rapidly become obsolete, the strategic importance and complexity of the product development process (PDP) in this industry are evident. Our research sought to map the PDP in the Brazilian footwear industry. This objective was accomplished through an empirical investigation supplemented by theoretical contributions, primarily drawn from established PDP models, allowing us to observe how the process occurs in an object of study of national representation.

While some studies have explored PDP in the footwear industry (Baxter, 2011; Davolio *et al.*, 2017; Fettermann *et al.*, 2017), research in this area remains limited. Theoretical gaps persist, as noted by Bagno *et al.* (2017), who concluded that PDP models often exhibit gaps, biases, or insufficient analysis, suggesting the potential for new models to be proposed on the subject.

Although the company under study does not adhere to a specific PDP model, the results indicate that it follows the Stage-Gate methodology and employs development stages similar to those presented in the literature. The findings emphasize that the pre-development phase is critical in ensuring the market success of a new product. This stage lays the foundation for determining which products will be included in the company's portfolio, and the decisions made here align with the concept of the "decision funnel" in innovation development. However, since the company has not fully mapped its PDP flow, key information remains confined to the project management area, limiting its innovative competencies.

Like many studies, this research has its limitations. One limitation is the inability to generalize the findings, preventing us from inferring that the Brazilian fashion industry's PDP follows a uniform approach. For future research, it is suggested to incorporate additional units of analysis to enable comparative verification of PDP practices across different companies. Further studies could focus on identifying specific stages within the process where modifications could yield significant improvements in new product development outcomes. Finally, an in-depth analysis of the pre-development phase is recommended, as this stage appears to guide the entire product development process.

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Appendix A

No.	Question	Objective of the question	References
1	What department do you work for in the organization, and what is your responsibility?	Identify the PDP phase related to the department where the interviewee works and his/her responsibility.	Rozenfeld <i>et al.</i> (2006).
2	Is the department you work in related to the shoe's creation stage? If so, how does the creation process begin?	Identify the steps of pre-development of footwear for subsequent analysis to which the theoretical model is related to the evaluated case.	
3	If it is unrelated to the creation stages, please describe the PDP stage of your activity's footwear development.	Identify and relate the stages of development and post-development of footwear.	Toledo <i>et al.</i> (2008), Bandinelli <i>et al.</i> (2008); Azariadis <i>et al.</i> (2008); Lauff <i>et al.</i> (2008).
4	What are the main difficulties you face in the development activities in which you work?	Identify aspects that are executed with some deficiency or difficulty.	
5	What are the PDP steps before and after your step? If so, name them.	Identify knowledge about the company's PDP process and map its stages by comparing the answers collected through the interviews.	Rozenfeld <i>et al.</i> (2006); Toledo <i>et al.</i> (2008); Bandinelli <i>et al.</i> (2008); Azariadis <i>et al.</i> (2008); Lauff <i>et al.</i> (2008).
6	Which stage of the PDP process precedes your activity? And what needs to be approved to start your PDP stage? This approval comes from which department or employee of the company?		
7	About the validation process, how is it performed? Were there problems in the development of your activity because of previous poorly executed activities? It is possible to cite examples.	Validate the company's PDP flow and identify the decision gates.	Cooper (1994)
8	What is the step after you in the PDP process? And what do you need to finish to complete your activity? Which department or employee do you send the next PDP step to?		