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Analysis of Product Innovation Through Co-Creation B2B in the Footwear Production Chain

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Abstract:
In a liquid society where companies prosper and can rapidly change, keeping an eye on both internal environments, characterised by the typical complexity of modern organisations, and on exterior, dynamic, and mutable environments may be the condition for companies to gravitate in profitable markets. This article aims at discussing operational results, provided by the innovation generated through the co-creation between the footwear and the chemical industries, located in the region of Vale do Rio dos Sinos, Brazil. The research-action was the adopted method since the necessity of the researcher's participation in important stages of the process of co-creation, such as the testing analysis in ready-made shoes, the testing production, the elaboration of documents, and the implementation of the pilot batch. The results evidenced that the co-creation of value is an important organisational strategy since it empowers the alliances among companies, promotes competitive advantage gain, and encourages the culture of innovation.

Keywords: *Co-creation. Collaborative processes. Product. Innovation.*

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I. Introduction

From the point of view of a liquid and fluid society, where organisations that can quickly react to change should sustain themselves, rather than those that have greater structures (Bauman, 2001), the former ones direct their gaze to the internal environment, characterised by the typical complexity of modern organisations, and mainly to the dynamic and changeable external environment. It may be a *sine qua non* condition for companies to be able to gravitate to more attractive markets. With this focus on increasing competition, virtually noticeable in all sectors of the economy, organisations need to adapt to the changes imposed by society as a necessary condition to remain competing and developing (Schreiber et al., 2023).

In this scenario of fierce competition, encouraging a culture focused on innovation can become a competitive advantage. Within 21st-century organizations, Innovation has become a watchword in the corporate

vocabulary, and the co-creation of value can figure as an innovative strategy since it seeks to build customer loyalty through the development of collaborative processes amongst business partners. The value of the co-creation process can be presented as a win-win relationship, as it allows the supplier to create higher-value proposals, whilst the customer is responsible for determining the perceived value (Payne et al., 2008). Expanding this reasoning, the value becomes derived and determined in usage (the integration and application of resources into a specific context) and not in exchange where it is embedded in production and price (Vargo et al., 2008).

From this perspective, the value of co-creation comes to be understood as an important organisational strategy, given that it enables the customer to actively participate in the creation of value with the supplier. Co-creation usually results in assertiveness in product launches and a better understanding of the customer's needs. However, it is important to understand that co-creation requires intense collaboration amongst participants. It seems clear that the greater the participants' perception of value in the activities is, the greater the motivation to participate in the project and, consequently, the greater the performance in the value of the co-creation process (Bloemer & Tontini, 2018).

From the point of view of industrial organizations, more specifically the footwear industries, the challenges are the same as those mentioned above and are constantly renewed. A report recently released by Abicalçados (2021) reveals that the sector has more than 85% of its sales concentrated in the internal market as well as it has lost space in the international market (Brazil is only fifth in the ranking of footwear-producing countries, behind China, India, Vietnam and Indonesia), being responsible for a little over 4% of world production. In this area, considering (only) the dependence of the Brazilian footwear industries on the national market, it becomes important to investigate what footwear organisations have been developing in terms of value of co-creation with their business partners.

From the above, this research aims to present and discuss the operational results provided by the innovation generated through co-creation between a footwear industry and a chemical industry, both located in the region of Vale do Rio dos Sinos, in the state of Rio Grande do Sul. The research-action was the adopted method since it was understood as necessary the participation of the researcher in relevant stages of the co-creation process, such as the description and the testing analysis on ready-made shoes, as well as the testing production, the preparation of documents, the implementation of the pilot batch, finally, verifying the coherence of the results found. In addition to this brief introduction, the text presents the theoretical foundation in section 2, the methodology in section 3, results and discussion in section 4, and conclusions in section 5.

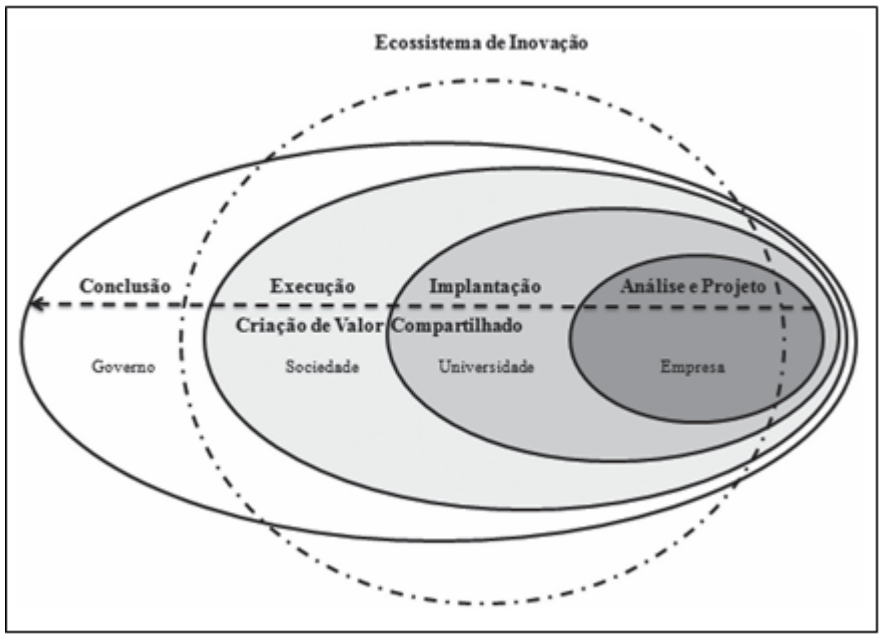
II. Theoretical Foundation

The competitive environment is guided by the speed in the creation of new technologies and the rapid obsolescence to which these technologies are subjected. In addition to the importance given to technological evolution, the co-creation of new products with consumers is a strategy that can give companies a competitive edge. The value of creation is not inherent in the development of an innovative product and is subject to motivational, emotional, and situational factors. It is worth pointing out that the value of an innovation is conferred by the consumer since this is the one who determines the success or failure of an innovation (Dias et al., 2022).

The participation of the customer in the product development process emerges as a differentiating factor for generating innovation through co-creation. In the development model, resulting from the client-company relationship, there is an environment conducive to the generation of innovation, the co-creation of value, and, as a consequence, the enhancement of customer loyalty by organisations (Preikschas et al., 2014). Improving value and innovation in co-creation strategies can generate different types of innovations, making it possible to improve communication between the company and business partners, to promote sustainability, as well as to improve processes and new standards for the supply chain (Barile et al., 2020).

Innovation must be globally perceived, and the innovation management process can be carried out in a coordinated way by organisations. In this process, the different participants can be seen as a key element in the process of merging internal and external knowledge, aiming to accelerate the achievement of results that add value to all involved (Palmeira, 2014). In this area, the value of co-creation is successful when collaborative practices between companies and the community align. However, co-creation fails when there is no alignment between the practices used by its peers. In this sense, it is possible to highlight three realignment strategies that seek to solve the problems of misalignment between companies and customers: compliance, interpretation, and guidance (Skalém et al., 2015). Figure 1 presents a conceptual framework of innovation based on value sharing.

Figure 1: Conceptual framework of innovation from value sharing



From Bittencourt and Figueiró (2019 p.1005).

As can be seen in Figure 1, from the conceptual framework proposed by Bittencourt & Figueiró (2019), the interaction and cooperation between a network formed by different participants foster the creation of value with emphasis on sharing this value among stakeholders. As these different actors cooperate and interact with each other, they end up relating and forming a network of value of creation for all involved, and this interaction works as an innovative ecosystem that generates competitiveness and opportunities for all involved in the system. The concept of value of co-creation goes beyond the conventional activities of production, exchange, and usage, and is anchored in the interactivity between business partners (Ramaswamy & Ozcan, 2018).

Modern organisations seek to innovate in order to cope with the issues of a rapidly changing world. The concept of liquid modernity seems current, for, in contemporary times, it is not the largest organisation that overcomes the smallest, but the one that has the ability to change more quickly, adjusting to the new context (Bauman, 2001). The challenges related to the lack of efficiency in promoting innovation can be addressed through the involvement of stakeholders in value of co-creation processes. Therefore, the commitment of these actors to new projects, networking, collaboration, and knowledge sharing can be important for value creation, as it contributes to the innovation process (Atkočiūnienė & Siudikienė, 2021).

It seems simple to infer that organisations that are receptive to the B2B (business to business) context make use of value of co-creation strategies in order to build customer loyalty (Ribeiro et al., 2018). However, understanding what really creates value may require a more accurate analysis. According to Grönroos & Voima (2013), the actions of business partners can be categorised by spheres – supplier, consumer, and a joint sphere – and their interactions can be direct or indirect, leading to different forms of value of creation and co-creation. It is necessary to clarify that, in the supplier sphere, there is no value of creation, only the expectation of potential value, and that it is only in the customer sphere that value of creation occurs.

It is clear that customers are increasingly demanding, and organisations do not measure efforts to retain them. If once the relationship between company and consumer was one-way (the company only sold and delivered products to customers), today, digital technologies have enabled this relationship to become more collaborative and interactive (Poel et al., 2022). Co-innovation emerged to be understood as a form of innovation from external and internal sources in order to generate shared value. Collaboration and co-creation between stakeholders stand out as a basic imperative in value of creation (Lee et al., 2012).

The co-creation of business value has undergone a revolution due to the new methods of communication and exchange of information that global connectivity enables. Through this connectivity, customers and stakeholders are increasingly closer to organisations, demanding differentiated experiences and interactions, and higher quality services. In this context, innovation in how to communicate, connect, and interact with these customers and stakeholders can become an important successful factor. Companies, such as Orange and Cisco, are examples of using innovation to create value. The companies gained a competitive advantage by using the concept of co-creative corporate business, and, thus, managed to generate sustainable growth and co-creation of customer experience environments (Ramaswamy, 2010).

Music, video games, and television markets, among others, related to the creative aspect, have been especially receptive to innovation by co-creation. These markets represent a paradigm shift in which customers and suppliers cooperate together to generate new goods and services. Through co-creation, companies can learn about customers' future needs, and in which features they are most interested. Co-creation brings benefits to organisations by inviting customers to participate in their activities and increasing the value attributed to their services (Czarnota, 2017). Vargo & Lusch (2004) propose a market approach aimed at establishing a successful innovation policy in postgraduate courses at universities. The authors present a proposal that takes into account various groups of interest for graduate courses, considering the relationship amongst adult students, their employers, and the people who are part of the educational institution.

In this sense, it is necessary to reflect on how to take into account the needs of this interest group to establish a marketing approach focused on innovation and value of co-creation (Vargo & Lusch 2004). This reflection should be extended to the B2B environment as the participation of the customer with the supplier in the process of developing new technologies. co-creating solutions may be a way to innovate in products, processes, and services, building value for both, the market and the society as a whole.

Therefore, it is about understanding that the value of the co-creation process is presented as a protagonist in the corporate scenario and becomes the object of academic studies as a surrounding concept that describes collaborative processes between business partners (Prahalad & Ramaswamy, 2000). The art of highlighting value of co-creation as a driver of innovation and the development of new products and services has contributed to empower organisations that operate in competitive markets (Alves et al., 2016).

III. Methodology

The present research, concerning its nature, may be considered as applied. It aims to produce and disseminate knowledge, as it had as an application in the field a project between a footwear industry and a chemical industry in this specific case. As to the objectives, the study can be classified as exploratory. According to Gil (2022), exploratory research is characterised by greater familiarity with the problem, making it more explicit.

To continue with the study, the authors chose the predominantly qualitative approach, with some quantitative aspects. The method used was research-action, from participant systematic observation, given the involvement of one of the researchers with the phenomenon described in this article. In research-action, the stages determined at the beginning of the study are constantly revisited, given the dynamics derived from the relationship between the researchers and the situation studied (Gil, 2022).

The steps used in the present research are close to and correspond to the methodology proposed by Mello et al. (2012). Through a conceptual-theoretical study, the author proposed a structure consisting of 5 stages for a research-action. In this perspective, the method consists of the following steps: a) planning the research-action; b) collecting the data; c) Analysing data and planning actions; d) Implementing the action plan; e) Evaluating results and presenting reports.

The research was carried out collaboratively between two large industries located in the Vale do Sinos region, in the state of Rio Grande do Sul. The collaborative business partnership was due to the positive relationship between customer and supplier. The customer company has been operating in the footwear segment for over 60 years and is located in Nova Hartz, in the state of Rio Grande do Sul.

The company that figures in this relationship of partnership of value of co-creation as a supplier operates in the segment of collage and painting and is located in the city of Novo Hamburgo, in Rio Grande do Sul. The company has 55 years of history, employs more than 500 employees, and is one of the leaders in the adhesives segment in Latin America and in adhesives for footwear in Brazil.

The use of participant observation aimed at the author's active participation in the development of the product and the process with the researcher observing and interacting in real-time with the other actors in all phases of the project development process. The researcher was able to observe the main variables found, the adoption of process validation criteria, the evaluation of performance results, and the multiple connections between the actors, the characteristics of the development of the value of co-creation process.

The project was developed over a year of research, being guided by the structured process of co-creation of ideas (ideation), followed by the adoption of technical procedures for approval of the product, and the developed process. At the end of the stipulated period, the teams came up with an ideal product combined with a specific process, which were able to meet the demands of the footwear industry.

IV. Results And Discussion

This section aims to present the steps used in the collection and analysis of research data, beginning with the description and the analysis of the test in ready-made footwear, a necessary condition to proceed with the production test. In a continuous act, it has proceeded with the elaboration of the documents and implementation of the pilot batch. Finally, the follow-up step is presented, aimed at confirming whether the

results observed during the production of the pilot batch were consistent with the results that were projected throughout the development process.

Test on ready-made footwear

This research deals with the development of a product and a process. Depending on the field studied, it presents a description of a very technical nature. Initially, the board of directors of the footwear industry proposed a meeting with the technical staff responsible for the organisation's processes in order to discuss the guidelines, regarding the policy for the use of VOC (Volatile Organic Compounds) and to consider ways to reduce the costs of processes. Thus, the company's technical staff began a survey to assess the impact of reducing VOC and the effects on manufacturing costs. After the approval of the process and of the candidate product in the test body, tests on prefabricated shoes started.

In the first stage of tests, held in December 2021, 12 pairs of shoes were made and sent for laboratory and field tests. The assembly of the prefabricated shoes followed the same process that was carried out in the prefabricated approval stage. For the bonding of leather to the sole, the following process was performed: (a) the application of base in solvent medium to the upper; (b) drying for 3 minutes with the aid of a north wind oven heated to 45°C; (c) the solvent-based adhesive application to the upper; (d) the aqueous-based adhesive application to the outsole; (e) drying for 5 minutes with the aid of a north wind oven heated to 45°C; (f) the reactivation of the adhesive films of the outsole and the EVA midsole at a temperature of 60 to 70°C; and (g) pressing for 10 seconds at 90 pounds in an M 102 press.

After 72 hours from the bonding date, the shoes were forwarded for laboratory testing and field testing. The laboratory tests were completed 8 days after forwarding. For ease of differentiation, pairs produced immediately after mixing the components of the VULC system were numbered 9 UK, and pairs produced 5 hours after mixing the components were numbered 5 UK. Figure 2 shows the approval report of the VULC system in ready-made shoes, with the surface preparation performed, right after the mixing of the 3 components.

Figure 2 VULC system approval report - test right after mixing

FGT- Report

Factory Name	RAM		**Colour**			**Retest Date**	
Stage	Development		**P.O No**			**Laboratory Name**	Lab RAM
Category	Raning		**Size**	9 UK		**Sent by (facty)**	Jaderson
Model Name	Lambda		**Production Month**	12		**Tested by (lab)**	Fábio
Aricle No			**Test Date**	12/12/21			

Protocol: 11390- Process Volcanic System- test right after mixin

Final result:

Test	Norm	Conditions	Specifications	Result	Observations
Hydrolysis	FGT-01	60ºC /95%/7 days	No changes	**APPROVED**	
Detachment	FGT-13		Minimum: 2,7 N/mm	**APPROVED**	
Detachment after washing	FGT-14 +FGT13		Minimum: 2,0 N/mm	**APPROVED**	

Source: Owner

It is observed in Figure 2 that the bondings made with the VULC system were approved in all the tests required in the laboratory soon after mixing the 3 components. Figure 3 shows the approval report of the VULC system in ready-made shoes, with the surface preparation performed, 5 hours after mixing the 3 components.

Figure 3 VULC system approval report - test 5 hours after mixing

FGT- Report

Factory Name	RAM		**Colour**			**Retest Date**	
Stage	Development		**P.O No**			**Laboratory Name**	Lab RAM
Category	Raning		**Size**	5 UK		**Sent by (facty)**	Jaderson
Model Name	Lambda		**Production Month**	12		**Tested by (lab)**	Fábio

Aricle No			**Test Date**	12/12/21	
Protocol: 11390- Process Volcanic System- test right after mixin **Final result:**					
Test	**Norm**	**Conditions**	**Specifications**	**Result**	**Observations**
Hydrolysis	FGT-01	60ºC /95%/7 days	No changes	**APPROVED**	
Detachment	FGT-13		Minimum: 2,7 N/mm	**APPROVED**	
Detachment after washing	FGT-14 +FGT13		Minimum: 2,0 N/mm	**APPROVED**	

Source: Owner

It can be seen in Figure 3 that the bonding performed with the VULC system, 5 hours after the mixture of the 3 components, passed at all the tests required in the laboratory, as it had occurred in the pairs that were glued shortly after the mixture. The pairs that were sent for field tests were collected in February 2022 for a qualitative analysis of bonding performance. After the analysis, it was found that there were no changes in the performance of bonding. The pairs of shoes produced under both conditions were approved. Thus, a meeting was scheduled with the team responsible for the development of the VULC system to continue the project.

At this stage, it was observed that the product and process development was quite advanced and the performance results were positive. It is noteworthy that, by the end of the manufacturing phase of the ready-made pairs of shoes, the technical teams of the two companies had been responsible not only for the product and process adjustments but also for carrying out the operations to perform all the tests, which the scientific literature recommends for the co-creation process (Alves et al., 2016). The two dimensions of integration, both horizontal (initial processes) and vertical, constitute the backbone of the processes of value of creation and capture, innovation development and integration, as well as knowledge sharing (Takahashi & Takahashi, 2022).

In this sense, co-creation requires intense collaboration between participants. The greater the participants' perception of the value of the activities, the greater the motivation to participate and, consequently, the greater the co-creation performance (Bloemer & Tontini, 2018). After the approvals observed at this stage, the project was authorized to perform the production test covered in section 4.2.

Production test

In a meeting held with the group of actors involved in the project, the format of the production test of the VULC system was defined as follows:

The starting period of the tests and the volume to be tested (50 pairs);

- The production test would obey the same process guidelines carried out in the testing of ready-made shoes.
- Laboratory tests would be performed in 3 pairs, taken randomly from the batch of 50 pairs made.
- Field testing would be performed on 3 pairs, randomly selected from the batch of 50 pairs made.
- The field test would last at least 90 days;
- After the approval of all tests, a pilot batch of 600 pairs would be performed for approval of the process.

The production test had the full support of the technical team of the chemical industry as well as the footwear industry in all phases of the process, which can be divided into three phases with different proposals:

1. Surface preparation – This phase took place in the rubber vulcanisation sector, where the VULC system was applied to the soles.
2. Prefabricated – This phase took place in the prefabricated sector, where the rubber sole was glued to the EVA midsole.
3. Assembly – This phase took place in the assembly sector, where the uppers were glued to the soles.

After making the 50 pairs of shoes, 6 pairs were randomly removed for testing, 3 pairs for laboratory testing, and 3 pairs for field testing. The pairs were rested for 72 hours before performance testing began. Figure 4 shows the approval report of the VULC system in the production test.

Figure 4 - VULC system approval report - test 5 hours after mixing

FGT- Report							
Factory Name	RAM		**Colour**			**Retest Date**	
Stage	Development		**P.O No**			**Laboratory Name**	Lab RAM
Category	Raning		**Size**	9 UK		**Sent by (facty)**	Jaderson
Model Name	Lambda		**Production**	03		**Tested by (lab)**	Fábio

			Month				
Aricle No			**Test Date**	08/03/22			
Protocol: 11390- Process Volcanic System- test right after mixin **Final result:**							
Test	**Norm**	**Conditions**	**Specifications**		**Result**	**Observations**	
Hydrolysis	FGT-01	60ºC /95%/7 days	No changes		**APPROVED**		
Detachment	FGT-13		Minimum: 2,7 N/mm		**APPROVED**		
Detachment after washing	FGT-14 +FGT13		Minimum: 2,0 N/mm		**APPROVED**		

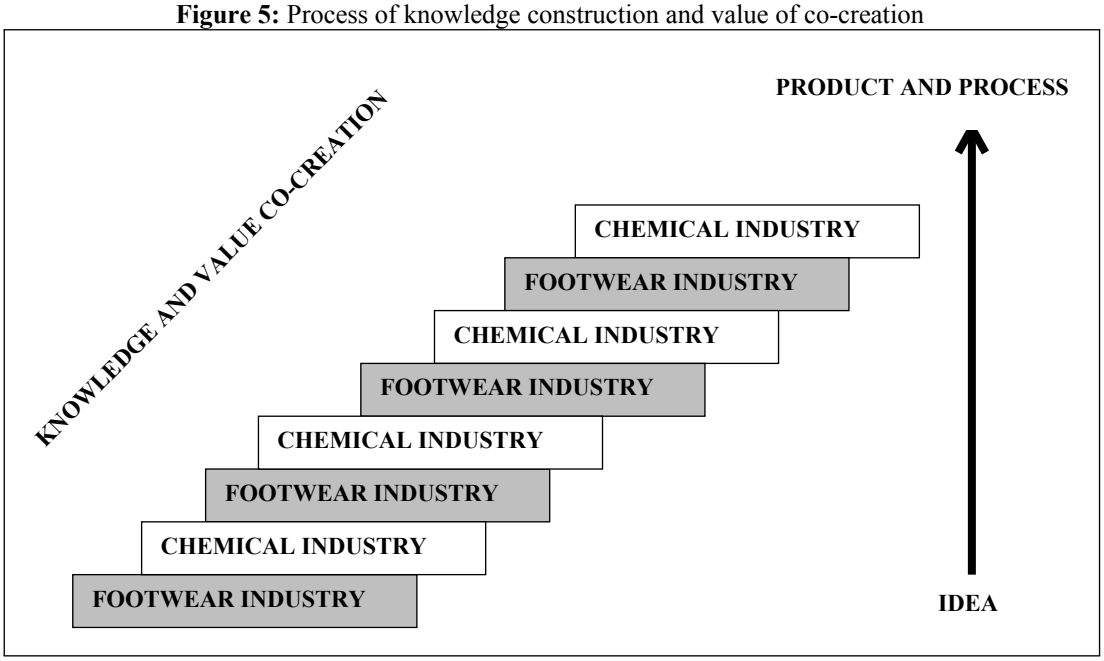
Source: Owner

It is possible to observe, from Figure 4, that the VULC system was approved in all tests performed on footwear made in the production test. After 90 days after the release of the 3 pairs of shoes for field testing, the shoes were collected and evaluated by the sector in charge. The sector in charge assessed the shoes as being within compliance and approved the continuity of the project.

At this stage, the technical teams of the two companies had an important follow-up role, which is considered essential by several authors who deal with the subject to enable co-creation (Barile et al., 2020). It was the first test in which the operational part was not in charge of the teams. There was great concern about the reproducibility of the parameters that had been success factors in the previous stages. As a result, there was a great mobilisation of the teams to ensure that everything would be done within compliance since failure at this stage would cause a 90-day delay in the project. The approval in the production testing stage officially ended the process and product development stage.

At the end of this stage, the field team of the two organisations met to deal with technical details which are relevant to the preparation of the process standardisation documents. At this meeting, the project success factors were discussed, from the perspective of each actor, and the joint way in which knowledge was being built (Atkočiūnienė & Siudikienė, 2021). Figure 5 illustrates the process of knowledge construction and value of co-creation from the perspective of the actors of the two companies that were the objects of the study.

Figure 5: Process of knowledge construction and value of co-creation



Source: Owner

When analysing Figure 5, it is possible to observe that in the view of business partners, the construction of knowledge and the creation of value in each stage of the project served as a step that led to the transformation of the idea into a product and an innovative process at the end of the ladder. As an innovative project, knowledge was built at each stage, and the steps that propelled the next stage were directly related to the interaction of the actors and the two organisations. This interaction between business partners aims to create

value for the customer since this is the only one who has the perception of value in use (Merz et al., 2018; Vargo et al., 2008).

It is important to emphasise that the participation of customers in the product development process emerges as a differentiating factor for innovation generation through co-creation (Preikschas et al., 2014). In the development model resulting from the relationship between customer and supplier, an environment conducive to innovation generation and to the value of co-creation is observed (Fernando & Las Casas, 2018). Thus, we began the preparation of the necessary documents, layout adjustments, planning, and execution of the pilot batch production, which are discussed in section 4.3.

Preparation of documents and implementation

Due to the difficulty of decoupling the phases of documentation and implementation in the project, both were addressed jointly. During the process of the generation of standard documents, the preparation of the pilot lot was organised as a way of implementation (Palmeira, 2014). Thus, it is noted that it is standard in the footwear industry research that all surface preparation and bonding processes are mapped and described. Whenever a product is developed, the mapping of all processes relevant to the product and the description of all operations that make up the process is carried out (Schreiber et al., 2023).

At the end of the development, based on the information and experiences observed, the technical teams of the two industries defined the working parameters and process conditions of the VULC system. The main points defined were:

(i) The 3 components of the product will only be mixed at the time of use;
(ii) The shelf life of the product, after mixing the components, shall be a maximum of 5 hours;
(iii) The minimum sole temperature for the application of the VULC shall be at least 80°C;
(iv) The time window between extraction of the matrix and application of the product shall be a maximum of 5 minutes (respecting the minimum 80 ºC required);
(v) The service life of the prepared sole shall not exceed 30 days after preparation;
(vi) The application gun must be stainless steel or plastic components.

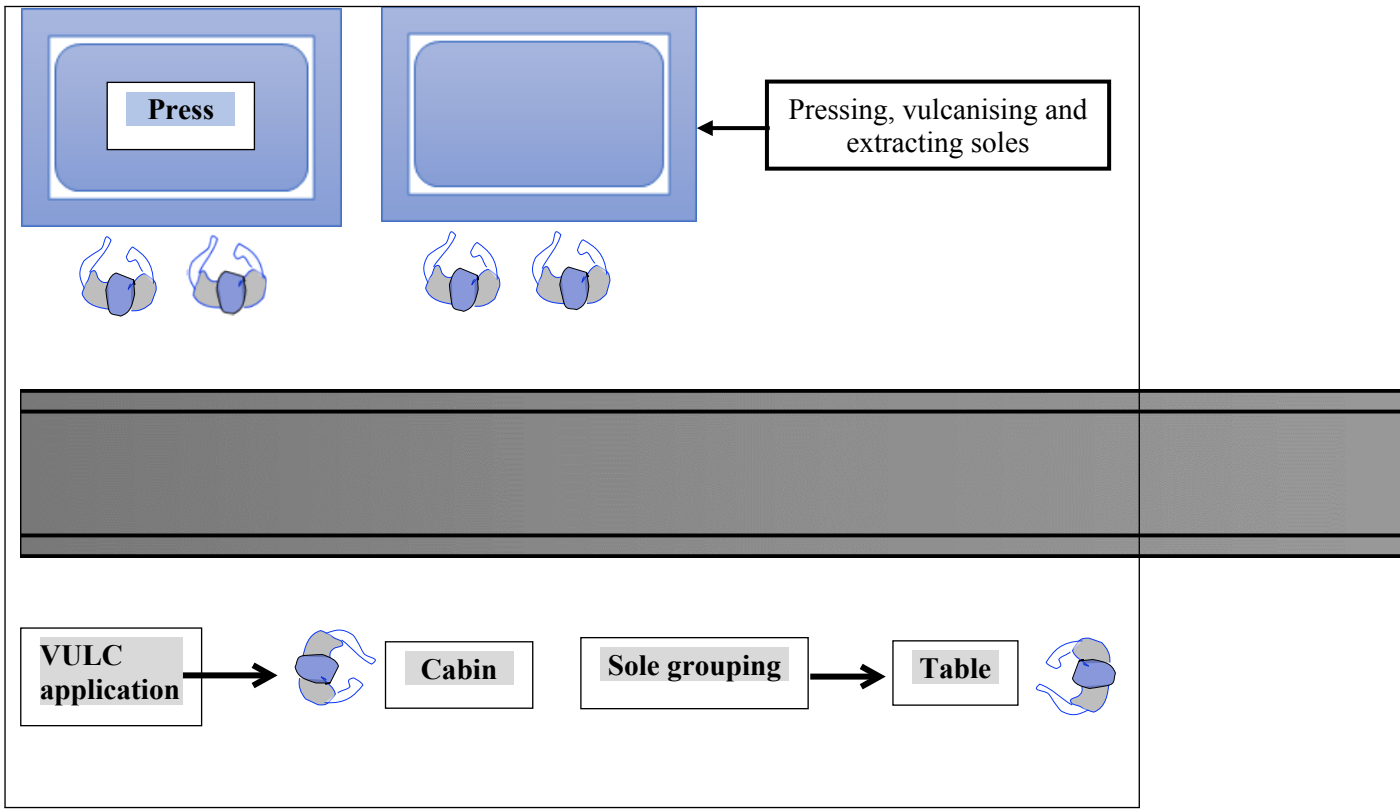
After the working parameters of the VULC system were defined, the processes were updated and operations were described to be presented to the sectors involved. This stage relied on the strong performance of all actors, and all information collected during the process served as a basis for the development of the documents. The relevance of the process of sharing data and information between the two companies involved in the project to ensure its success is highlighted, which is considered a structuring element of co-creation (Takahaschi & Takahaschi, 2022).

At the request of the management of the company, a meeting was held in the areas of maintenance, of work safety, of prefabricated, of rubbers, of assembly, and of laboratory with the participation of the project actors. This meeting aimed to present the project, explain the attributions of each sector, review the updated processes, and inform about the pilot batch and the production start dates. Each actor had the opportunity to talk about the particularities of the process in order to instruct the teams in their assignments. The planning stage and the identification of roles as well as the assignment of responsibilities and activities have been highlighted in the literature as a basis for collaboration to innovate (Bloemer & Tontini, 2018). The assignments of the sectors were defined as follows:

- Laboratory: defining the delivery number of the pilot batch to control traceability.
- Work safety: defining suitable cabin and mask for product application.
- Prefabricated: assembling the sole in the midsole from the pilot batch.
- Maintenance: layout assembly.
- Rubbers: Surface preparation of the soles with the VULC system.
- Assembly: final shoe assem.

The definition of the new layout was the responsibility of the director and the process analyst of the footwear industry. The working parameters that were defined in the partnership with the technical team of the chemical industry were taken into consideration when designing the new layout: Figure 6 shows the layout defined for the implementation of the VULC.

Figure 6: Layout defined for system deployment VULC.



Source: Owner

As shown in Figure 6, it is possible to see the introduction of a conveyor belt to bring the sole to the application booth. The conveyor belt was introduced so that an operator could apply the product to two rubber pressing stations. It is noteworthy the introduction of a cold stabiliser that performs the function of cooling the outsoles so that they can be clustered.

The manufacturing of the pilot batch was scheduled for mid-June 2022. Once the adjustments were completed by maintenance, the surface preparation of the 600 pairs of rubber outsole started. The technical teams of the two companies involved followed all the preparation of these soles in order to ensure that no anomalies occurred in the process that was previously standardised. It should be noted that no problems related to product life, applicability, or bonding performance were observed. Concomitantly with the preparation of rubber soles with the VULC system, the product approval process was initiated, and the chemical industry sales supervisor was the main responsible for this stage. Figure 7 shows the product of the completed and registered VULC system.

Figure 7: Product figure of the VULC system

Source: Owner

Figure 7 shows the adhesive VULC, a component that is part of the VULC system. It is recalled that the VULC system is the junction of a product with a certain applicating condition. Therefore, the innovation developed was called the system, because the product does not work without the correct processing condition, and the process, even in the ideal conditions, does not work without the product, that is, they are interdependent. Amongst the purposes already mentioned, the pilot batch had the purpose of confirming the results in relation to VOC. These results are presented in section 4.4.

Follow-up

All stages of product and process development were monitored by field actors from both companies, from laboratory tests to elect the candidate product, to implementation. This condition finds support in the scientific literature, regarding collaboration in activities related to innovation, whether for product or process (Fernando & Las Casas, 2018). However, it was necessary to confirm whether the results observed during the production of the pilot batch were consistent with the results that were projected throughout the developing process. The first information to be confirmed pertained to VOC consumption. To this end, a procedure consisting of the following steps was performed:

- Emptying the application gun.
- Weighing an amount of VULC adhesive.
- Depositing the heavy adhesive on the gun.
- Applying in the soles.
- Quantifying the soles produced with the amount of heavy product.

In order to be able to continue with this important step of the value of co-creation process, it is necessary to present Table 1, which shows the comparison of waste generation and VOC consumption between the traditional process and the VULC system.

Table 1 Comparison of waste generation and VOC consumption between the traditional process and the VULC system.

Operation	Generation of rubber residue in the traditional process (grams/pair)	Traditional process VOC consumption (grams/pair)	Generation of rubber residue in the VULC system (grams/pair)	VOC consumption VULC system (grams/pair)
File	3,9	0	0	0
Cleaning	0	4,4	0	0
Heating	0	0	0	0
Polarisation	0	7,5	0	6,3
Total	**3,9**	**11,9**	**0**	**6,3**

Source: Owner

According to Table 1, the VULC system presents total reduction of rubber waste when compared to the traditional process. In relation to VOC consumption, the VULC system presents a reduction of 5.6 grams per pair when compared to the traditional process. Table 2 shows the amount of VULC adhesive used per pair of shoes.

Table 2 VULC adhesive used by pair of shoes.

Product quantity (g)	Quantity of produced sole	Grams consumed per pair of prepared sole
740	**119**	**6,22**

Source: Owner

Table 2 shows that 6.22 grams of adhesive are consumed per pair of shoes. The result was quite consistent with the number observed in Table 1, which was 6.3 grams per pair. This small difference in consumption, in favor of the pilot batch, is due to the quantity of pairs produced. Previously, a smaller quantity of soles was produced, which increased the size of the loss.

It is noteworthy a pertinent adjustment in relation to the perspective of pairs to be produced with rubber soles. The estimated production with rubber soles went from 3600 pairs per day to 6000 pairs per day. The increase in this production perspective is due to the fact that similar models to the Lambda model have been introduced in the production line; therefore, more models can count on the surface preparation technology of the VULC system.

Table 3 Estimate of no waste generation and reduced VOC consumption.

	Non-generation day (Kg)	Non-generation month (Kg)	Non-generation year (Kg)
VOC consumption	33,6	705,6	7761,6

Residue generation	23,4	491,4	5405,4

Source: Owner

As can be seen in Table 3, for a production of 6000 pairs per day, with the implementation of the VULC system, up to 7761.6 kg of VOC may be saved over a year. This figure corresponds to a drop in consumption of more than 66.6% of VOC when compared to the perspective in Table 1. Regarding the generation of rubber waste, there was also an increase of 66.6% in the non-generation perspective from a value of 3243.24 kg to 5404.4 kg per year.

Another important result concerning the reduction of production costs was one of the requests of the company's management. During the production of the pilot batch, the controllership team monitored part of the batch production. In this follow-up, it was observed that due to the smaller number of operations, the process with the VULC system has a lower operating cost than the traditional process. During this follow-up, the VULC adhesive application time was measured for later comparison with the traditional process. Table 4 presents the process times in the traditional and VULC system processes.

Table 4 Operational time of the traditional process and the VULC system

Operation	Traditional time operational process (seconds)	VULC System time (seconds)
Cleaning rubber	0,595	0
Polishing rubber	0,213	0
Polarising rubber	0,269	0,487
Total	**1,077**	**0,487**

Source: Owner

As shown in Table 4, the total operational time of the traditional process is 1.077 seconds, whilst the total process time in the VULC system is 0.487 seconds. It is possible to state that the total process time in the VULC system represents 45.2% of the total time of the traditional process, presenting a reduction of about 55% in the total process operational time. After this step, the project was considered officially concluded. The technical teams of the two companies involved adjusted a process follow-up schedule since it is a new method of surface preparation. There was a consensus between the companies that a differentiated follow-up is necessary, confirming the findings of similar studies that addressed the theme of innovation through interorganisational collaboration and B2B co-creation (Lee et al., 2012).

At the end of the development process, the business partners held a closing meeting to discuss the project, analyse the results, as well as evaluate the product and the process development trajectory. The enthusiasm regarding the results obtained was evident, it is noteworthy that a great feeling of "when we will start the next project" took over the meeting. In this sense, Fernando & Las Casas (2018) emphasise that co-creation in the B2B model can generate a more lasting customer/supplier relationship due to the interdependence between them and that co-creation, when applied in this sense, tends to generate great value for both.

It was also observed the great satisfaction of the actors by the way the project was conducted and a rapprochement between the two organisations. In the value of the co-creation process, the customer interacts in such a way that one takes an active role in the creation of the value experience and the final perception of value (Vargo & Lusch, 2011). The actors presented a great alignment throughout the project, sharing the goal of decreasing the consumption of VOCs and the decrease of operational costs in a very clear way. It is observed that the value of co-creation is successful when the collaborative practices between companies and customers are aligned (Skalém et al., 2015).

Last but not least, the actors also highlighted the innovative character of the innovation recognised by the market through an important award and expressed the perception that they presented the market with an entirely new way of carrying out the preparation of the rubber surface. It seems unequivocal that joint participation in the value of co-creation stages contributes decisively to the generation of commercial, intellectual, and collaborative values. The development of the VULC system, as understood by business partners, represents a paradigm shift in terms of rubber surface preparation, in addition to showing an innovative form of collaboration with the purpose of innovating (Liu et al., 2019). The innovative nature of the process and product that were the object of the development was widely discussed, with the actors sharing their perceptions about the development of a “unique process in the world”. This phrase was referred to several times by several actors.

So far, all the steps used in the practical development of the research have been displayed in detail, from the description and analysis of the test on ready-made shoes, the production test, the preparation of documents, and the implementation of the pilot batch, as well as the follow-up stage, making it possible to proceed with the final considerations of the research.

V. Conclusions

The objective that led to the research presented here was to present and discuss the operational results provided by the innovation generated through co-creation between a footwear industry and a chemical industry, both located in the region of the Vale do Rio dos Sinos, in the state of Rio Grande do Sul. It was possible to evidence the relevance of structuring elements, such as the sharing of knowledge, data, and information, unrestricted collaboration and shared use of assets, such as machines, equipment, and laboratories, for innovation and co-creation to occur.

It was also found that the greater the perception of the participants regarding the value of the activities, the greater the motivation in participation and, consequently, the higher the performance of all those involved in the co-creation process. After all, the scientific literature on the subject is rich in evidence that the participation of customers in the product development process is a differentiating factor for innovation generation through the co-creation of value.

By using the development model based on the relationship between customer and supplier, it was possible to verify the emergence and consolidation of a favorable environment for the generation of innovation and co-creation of value, noticeable from the enthusiasm of business partners in relation to the results obtained and the expectation of starting a next project. Still on the various possibilities of value creation, the B2B model can configure and strengthen a more lasting customer/supplier relationship due to the interdependence between the business pairs, and that co-creation, when It is in the co-creation of value that the client interacts in such a way that he takes an active role in the creation of value experience and the final perception of value, which results in the convergence of efforts of all those involved in the project. The same is true of the innovative character of the process and the product, as the participants in the trial demonstrated a sense of belonging by sharing perceptions about having developed a "unique process in the world".

It is possible to infer other gains resulting from the value co-creation process since the actors highlighted the unprecedented nature of the project, which was recognized by the market through an award. They understand that they presented the market an entirely new way to perform rubber surface preparation. From this perspective, it is possible to state that the development of the VULC system was a paradigm break as far as rubber surface preparation is concerned.

As a limitation of the study it is possible to infer that the research demonstrates the results of co-creation, but does not portray what the determining factors or multifactors for the generation of these results were, because despite indicating some possibilities, it does not point out the driving forces that determined the success of this partnership, which suggests as an opportunity for future research the study of the success factors of co-creation in the B2B environment and what the main influences of each factor are.

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