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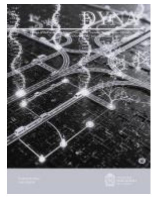

UNIVERSIDAD NACIONAL DE COLOMBIA

The adoption of cutting software in small furniture manufacturers: a survey in Brazil

Nádya Zanin Muzulon[a]*, Pedro Rochavetz de Lara Andrade[a], Rafael Henrique Palma Lima[a], Juliana Verga Shirabayashi[b] & Gislaine Camila Lapasini Leal[c]

[a] *Department of Production Engineering, Federal University of Technology - Paraná, Ponta Grossa, Brazil. * nadyamuzulon@gmail.com, pedroandrade@utfpr.edu.br, rafaelhlima@utfpr.edu.br*
[b] *Department of Production Engineering, Federal University of Paraná, Jandaia do Sul, Brazil. juliana.verga@ufpr.br*
[c] *Department of Production Engineering, State University of Maringá, Maringá, Brazil. gclleal@uem.br*

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Abstract
The scientific literature often addresses the Cutting Stock Problem in the furniture industry from the perspective of mathematical modeling and optimization. However, there has been little research exploring how companies—particularly small ones—adopt software tools that implement these methods. This study investigates the adoption of cutting optimization software in the Brazilian furniture sector, focusing on small and medium-sized enterprises (SMEs). A structured survey was conducted with 73 furniture manufacturers across different company sizes. The questionnaire covered company characteristics, production processes, and software usage. Descriptive statistical analysis and ANOVA tests were applied to examine the data. Additionally, a market analysis was conduct identify and characterize the main software tools currently in use. The findings reveal that adoption rates are significantly higher among medium and large companies, and the most common features of the software tools used in the sector were identified.

Keywords: cutting stock problem; furniture industry; software; small and medium-sized enterprises (SMEs)

Adopción de software de corte en pequeños fabricantes de muebles: una encuesta en Brasil

Resumen
El problema del corte de stock en la industria del mueble se aborda frecuentemente en la literatura científica desde la perspectiva del modelado matemático y la optimización. Sin embargo, existe poca investigación sobre cómo las empresas adoptan las herramientas de software que implementan estos métodos de solución. Este trabajo explora este tema y ofrece información sobre la adopción de software de optimización en la industria del mueble, con especial atención a las pequeñas empresas. El objetivo de este trabajo es identificar las características y necesidades de las empresas del mueble en Brasil con respecto al uso de software de optimización de corte. Se realizó una encuesta a 73 empresas, lo que permitió identificar el software utilizado, así como su propósito y características. Los resultados indican que la adopción de herramientas de software por parte de las grandes y medianas empresas es mucho mayor en comparación con las pequeñas empresas. Los datos recopilados también revelaron las características más comunes de los softwares utilizados por los fabricantes de muebles.

palabras clave: problema del corte de stock; industria del mueble; software; pequeñas y medianas empresas (PYME)

1 Introduction

Over the last five years, the Brazilian furniture sector has undergone an evolution in production, foreign trade, and distribution channels, with a growth trend expected to continue in the years to come [1]. In Brazil, most furniture manufacturers are micro and small enterprises (MSEs), which suffer from weak strategic planning and lower technological capabilities when compared to larger competitors. The country has 46 furniture manufacturing

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clusters spread across 11 states, with a greater concentration in the Southern and Southeastern regions. Production and consumption vary from residential, institutional, and office furniture, to armchairs and mattresses [2]. Micro and small furniture companies are found throughout the country, with a large portion of firms characterized as woodworking shops that produce customized items according to customer requests [3].

The production process in the furniture sector begins with cutting boards, wood, or its derivatives into smaller items needed to manufacture the final product. After the items have been cut, they may undergo a process of thickness adjustment by bonding additional layers, in order to match the specifications of the product design. Subsequently, the parts are glued and then milled, which provides the finishing touch. After these operations, the items are grouped, drilled, and assembled. In general, how the cutting patterns are planned and executed to obtain these smaller items is a significant challenge and differs from company to company. The cutting pattern generation and Cutting Stock Problems are complex mathematical optimization problems that require computational assistance to obtain reasonable solutions within practical time windows [4].

Although there is a vast offering of software tools for the furniture industry, adopting new technologies in these organizations is still a significant challenge, especially for self-employed carpenters and MSEs. [5] argue that the lower rate of software adoption by smaller companies occurs due to the traditional culture, lack of training and limited understanding of the benefits these software tools might bring to the firm's operations. The lack of optimization software causes these companies to continue making decisions based on empiricism.

Authors such as [6] point out that SMEs face significant barriers, including limited financial resources, a shortage of specialized labor, and insufficient technological capabilities. These challenges are often compounded by improvised problem-solving approaches. Moreover, the production technology used by most furniture manufacturers remains outdated, leading to the inefficient use of solid wood panels. This waste not only increases production costs but also generates the need for more effective waste management strategies [1,7].

According to [8], pressure from customers has a positive effect on the adoption of technologies in SMEs, rever as external support from the government and partners, support from senior management, and technical knowledge of employees, which reduces resistance to change. The author also found that lower acquisition costs have a positive influence on the adoption of new technologies.

Several papers discuss the Cutting Stock Problem in the furniture industry, including [9-14,15]. However, the existing literature has a strong focus on mathematical modeling and solution methods, thus lacking a practical view of the problem from the standpoint of the development of software tools and adoption by SMEs.

The contribution of this study is to address this gap by surveying Brazilian furniture manufacturers to map their characteristics and needs regarding cutting stock software and to identify the most commonly used software tools and their features. The survey covered a sample of 73 companies of various sizes, including micro, small, medium, and large organizations.

2 Theoretical foundation

Cutting problems belong to a category of NP-hard optimization and challenges where the goal is to extract a set of items from a limited number of larger objects, aiming to either minimize resource usage or maximize the total value of the resulting items. The layout of these items—known as cutting patterns—must ensure that no overlaps occur and typically must also account for geometric constraints related to the technical limitations of the cutting equipment [16-17].

Furniture such as tables, chairs, kitchen cabinets, shelves, wardrobes, among others, are the result of cutting problems [18]. Thus, a solution to the cutting problem, according to [19], can be called a cutting plan, which indicates how many times each provided cutting pattern will be used to meet the demand for all items. A cutting plan is generated according to the dimensions of all available objects and considers the demand for each item.

The one-dimensional cutting problem occurs when only one direction is essential to the cutting process, such as when bars and coils must be cut into smaller pieces.

Two-dimensional cuts have two relevant cutting directions, width and length, like larger regular boards, for producing smaller items.

Three-dimensional cuts involve greater complexity and geometric difficulty, such as those encountered in container loading. In these cases, there are three essential dimensions to be evaluated: length, width, and height, to pack different items [20].

The cutting problem can also involve irregular shapes, as in the case of cutting fabrics in garment factories, circular shapes, or vary in n dimensions.

Among the various dimensions mentioned, when the cutting problem is modeled for the furniture segment, it is common for it to be two-dimensional, as most of the raw materials available for this industry are rectangular wooden plates or sheets that vary in two dimensions.

Cutting Stock Problems are distinguished by the dimensions of their objects and items. There are also other important distinctions; some formulations consider the management of usable leftovers [19-20], which are cut objects that can be reused in future production. Another aspect in approaching the Cutting Stock Problem is its integration with other problems, such as the Lot Sizing Problem [21], which addresses the determination of optimal lot sizes, minimizing production costs, including setup and inventory costs, among others [22].

It is also essential to note that there are at least three characteristics that differentiate items and objects from each other:

- **Format:** Two figures can have the same format but vary in size and/or orientation.
- **Size:** Two figures can be the same size but vary in shape and/or orientation.
- **Orientation:** Two figures may have the same orientation but vary in shape and/or size.

In the works by [23-25], variations in shapes are used for the same segment.

Concerning the variety of items and objects, according to [3], these can be: identical (with the same shape, orientation, and size); weakly heterogeneous (with the same orientation, varying slightly in size); or strongly heterogeneous (with the same orientation, varying greatly in size)

The Cutting Stock Problem applied to the furniture segment has some relevant characteristics used as constraints when generating cutting patterns. It is common for cuts made in the cutting patterns to be guillotined, that is, made from one end to the other. This is due to the restriction of the cutting machine, which is mostly a disconnecting machine [16].

A cutting pattern, however, can be non-guillotined or nesting, meaning it cannot be cut by methods that go from one end to the other, requiring another type of equipment, different than a sectioning machine or saw.

The guillotined cutting pattern can also be divided into stages, determined by the number of times the object must be rotated by 90º to allow the guillotine cuts to be performed.

The one-stage cutting pattern is when longitudinal parallel guillotine cuts are produced. The two-stage pattern occurs when these already-cut strips are positioned one by one and new parallel transverse cuts are generated on them. If after the two stages there is no need for additional cutting, this pattern is called exact; otherwise, it is not exact and is called a three-stage pattern, up to n stages [17, 23].

A guillotined pattern can also be constrained, when there is a limit to the number of items to be cut from a given larger object, or unrestricted, when there is no such limitation.

Another strategy adopted by many industries is to allow items to be rotated ninety degrees when allocating cutting patterns. However, this is only allowed when the raw material to be cut is smooth, without textures, designs, or veins that could compromise the aesthetics of the cut items and, consequently, of the assembled product.

When the object is smooth and White, the item to be cut can be rotated 90° in the cutting pattern. With rotation, the resulting items have the same aesthetic characteristics. When the object has texture, the item is not allowed to be rotated in the cutting pattern. If the rotation happens, the resulting items will have different characteristics, which can compromise the product's aesthetics.

3 Research method

This research uses a survey methodology, which involves collecting data from companies through a structured questionnaire and performing descriptive and statistical analyses of the responses to generate quantitative insights about the target population—in this case, furniture manufacturers [26].

The study was conducted in six stages, with steps 1 through 5 based on the survey process described by [27]:

1. **Context selection:** It was established that any Brazilian company within the furniture segment would be able to answer the survey questionnaire. The questionnaire was not limited to MSEs to allow for comparison of their reality with that of medium and large companies.
2. **Elaboration of the questionnaire:** The elaborated questionnaire contained 20 questions, including multiple-choice, checkbox and open-ended (discursive). The questions' dimensions included the respondents' characteristics, company characteristics (location, size, products), raw material and process characteristics, software usability, and satisfaction with the current cutting process. The survey design followed the guidelines proposed by [26].
3. **Survey validation:** The pilot test was conducted with the collaboration of 3 volunteers, owners of furniture companies, were able to assess whether the questions were clear, understandable and consistent. After testing, some updates were necessary before proceeding with data collection.
4. **Data collection:** The method used for data collection involved contacting companies through emails and social networks, as provided by unions in the segment. The purpose of the work was shared and the link to answer the questionnaire was provided, both were available on Google Forms for 45 days. The sampling process adopted was non-probabilistic for convenience, as defined by [28], being a sample extracted from a source conveniently accessible to the researcher. According to [29], this type of sampling prioritizes practical generalization, that is, ensuring that the knowledge obtained is representative of the population from which the sample was taken, in order to allow inferences from an accessible group. However, it is important to acknowledge that convenience sampling can introduce bias, as the sample may not fully represent the broader population, potentially limiting the generalizability of the findings.
5. **Analysis of the results:** To support interpretation, descriptive statistical techniques were applied using Excel® and Minitab® software. When appropriate, the ANOVA test was performed to identify statistically significant differences in quantitative variables among companies of different sizes.
6. **Software analysis**: In addition to the survey, a market analysis was conducted to identify available cutting optimization software. Tools mentioned by respondents and others found through online searches were analyzed. Only publicly available software (i.e., easily found on the internet) were considered. Information sources included manuals, websites, technical documents, and interviews with vendors.

4 Results and discussions

The results and discussions are divided into two sections: Section 4.1 presents the survey results, and Section 4.2 highlights the analysis of software tools.

4.1 Survey results

The questionnaire was distributed to approximately 150 companies in the segment, resulting in responses from 73 companies across 12 Brazilian states, as illustrated in Fig. 1.

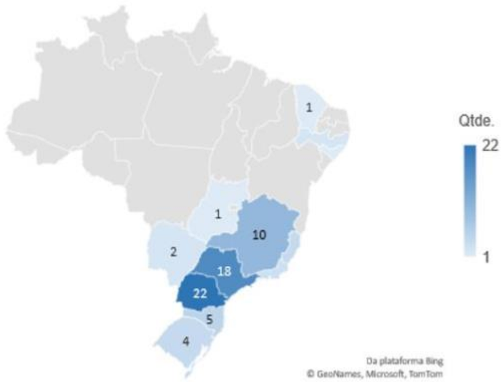

Figure 1. Geographic distribution of participating companies.
Source: The authors.

Fig. 1 indicates a greater concentration of participating companies in the South and Southeast of the country. Although these regions have the most significant furniture centers, this result may be a research bias, in which the sample was random and,conveniently, carried out in the north of Paraná.

Regarding the size, product line, and positions held by the respondents, Fig. 2 shows the profile of these companies.

According to the classification of company sizes, used by [30], among the companies that participated in the survey, 57% are micro-companies; 21% medium-sized; 17% small-sized and 5% large-sized. Concerning location, 48% are in the Southeast and 31% in the South of the country.

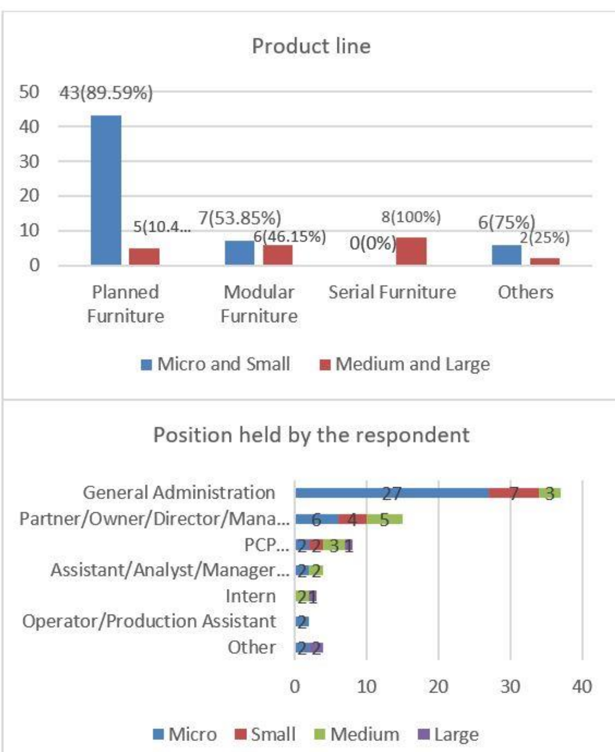

Figure 2. Profile of the companies
Source: The authors.

Regarding the product line and characteristics of the production line represented in Fig. 2, 62% of the companies are focused on planned furniture and 17% on modular furniture, which reflects production of micro and small companies. Among those who answered series production, 62.5% are medium and 37.5% are large companies. Manufacturers of decorative, rustic, children's furniture, office furniture, and gaming furniture also participated in the research.

To plan cuts and achieve good results, it is essential that the person responsible for the activity has the necessary knowledge to execute it effectively. Thus, those responsible for this step in these companies were evaluated and represented in Fig. 3.

The highlight in Fig. 3 represents the difference between those responsible for cutting planning in micro and small companies when compared to medium and large companies. In medium and large companies, Planning and Production Control (PCP) sectors and programmers predominate in the execution of this function.

With regard to micro and small companies, there is a wide variation between the positions responsible for this activity, where the owners, carpenters or operators often plan the cut, representing 46.3% of them. This shows how specific sectors for programming, planning, and production control can still be scarce in smaller companies.

For the descriptive analysis of the data, the size of each company was also related to the characteristics of the objects and items used, the percentage of losses, and the quality of the cutting processes. Fig. 4 illustrates the variation in raw materials according to the company's size.

Fig. 4 shows a higher frequency of weakly heterogeneous objects. Micro and small companies exhibit greater variability among themselves in terms of the type of raw material, as there is no standard for this issue among companies of this size.

The raw materials used in medium and large companies are also similar to each other, predominantly weakly heterogeneous objects.

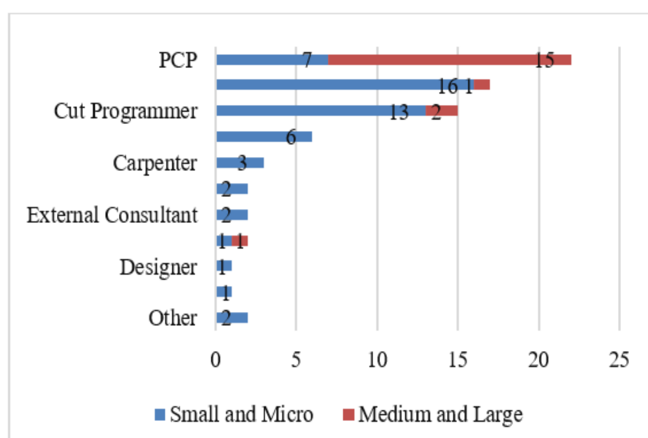

Figure 3. People responsible for cutting planning
Source: The authors.

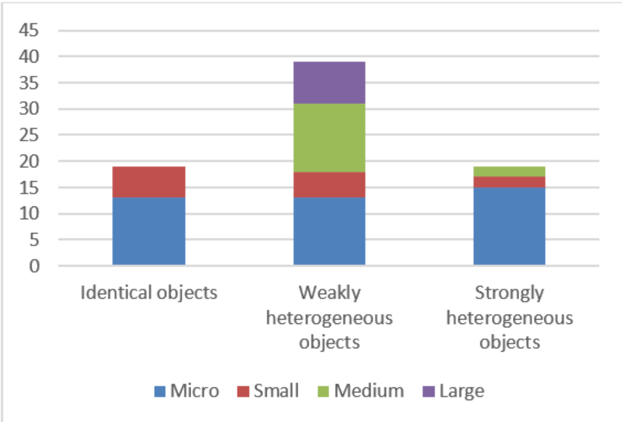

Figure 4. Variation of raw material
Source: The authors.

Fig. 5 lists the variety of demand for items, categorized by company size.

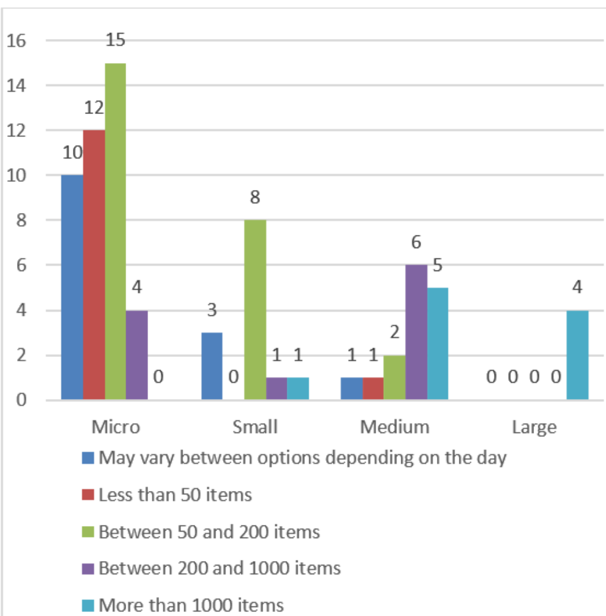

Figure 5. Demand for items
Source: The authors.

The demand for items shown in Fig. 5 refers to the daily quantity of individual parts that need to be produced to make up the final products. According to the figure, smaller companies have different behaviors, with a large variation in the number of items. Approximately 30% of the microenterprises have demands of less than 50 items, while small companies predominantly have demands between 50 and 200 items, and may reach a demand greater than 1000 units.

Evaluating the demand of medium-sized companies, it is noted that they share the size of the demand with smaller companies but with less variability and predominating demands of 200 to 1000 items and greater than 1000.

Thus, there are indications that the growth in demand for items is accompanied by an increase in the size of companies. That is, the larger the company, the greater the daily demand for items to be cut. This is confirmed by examining the demand for items from large companies, which consistently exceeds 1000 units.

This demand is not limited to the number of types of items required, but also to the quantity of units of each type. In microenterprises, this demand tends to be lower, both in variety and volume, while in larger companies, the quantity of items generated daily is significantly higher. This is because, as the company grows, the complexity of production increases, requiring a greater variety of parts to meet the diversification of final products. This increase in the diversity of items makes the problem of cutting inventory more challenging, as there are more possible cutting patterns to be considered, directly impacting the efficiency of material use. As a result, larger companies invest more in specialized software to optimize this process, reducing waste and improving the quality of production planning.

To evaluate whether the percentage of material loss differs according to the company size, a one-way ANOVA was performed using Minitab. The analysis compared loss percentages reported by companies categorized as micro, small, medium, and large. The results indicated no statistically significant difference among the groups ($p = 0.699$), suggesting that company size does not have a measurable impact on the percentage of material loss in the sample analyzed.

Although the one-way ANOVA indicated no statistically significant differences in loss percentage among company sizes ($p = 0.699$), the boxplot revealed notable distribution patterns across the groups (Fig. 6). Micro and small companies demonstrated higher variability in material loss, with several outliers observed in the micro category, suggesting inconsistency in production processes or less efficient cutting operations. In contrast, medium-sized companies showed the lowest median loss and a more compact distribution, indicating greater process stability. Large companies also demonstrated a relatively low median loss, though with broader variability. These visual trends suggest that, despite the lack of statistical significance, company size may still influence cutting efficiency and material waste in practical terms.

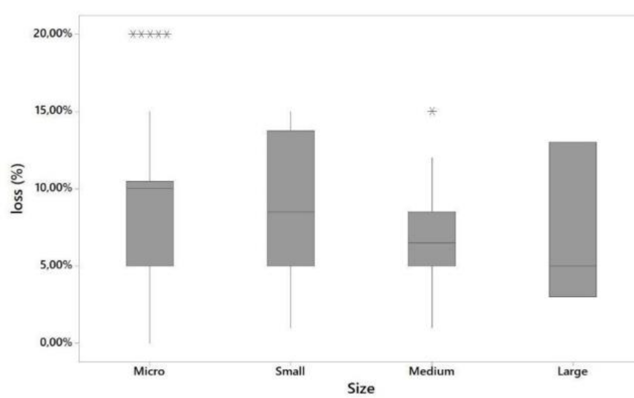

Figure 6. Percentage of losses
Source: The authors.

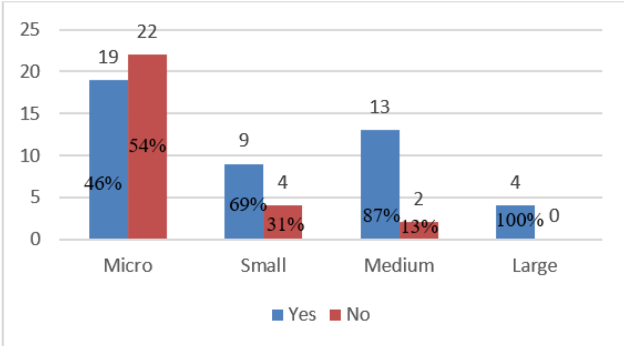

Figure 7. Use of software tools
Source: The authors.

The use of software tools in the planning and execution of the cutting plan was also evaluated in the applied questionnaire (Fig. 7).

In Fig. 7, it is possible to observe that approximately 46% of micro companies, 69% of small companies, 87% of medium companies, and one 100% of large companies use software, which represents 62% of the total. Thus, a propensity to increase software adoption is noticeable as company size increases, and the number of "No" responses regarding software usage decreases accordingly.

A comparison between the boxplot of material loss and the chart on the use of software tools reveals a potential relationship between cutting software adoption and process efficiency across company sizes. As illustrated, microenterprises exhibit both the lowest adoption rate of software tools (46%) and the highest variability in material loss, with several outliers, suggesting inconsistent or inefficient cutting practices. In contrast, medium and large companies, which report higher adoption rates (87% and 100%, respectively), show lower median losses and more compact distributions in the boxplot, indicating greater process control and reduced waste.

These trends suggest that the use of cutting optimization software may be associated with lower material losses and greater operational consistency. Although causality cannot be confirmed from this observational data, the pattern whereby microenterprises exhibit both lower levels of software adoption and higher, more variable material losses highlights the potential role of technology in improving production efficiency.

Regarding the difficulties faced by companies, Table 1 shows that most problems stem from a lack of qualified labor or a person responsible for implementing the cuts, as well as high material loss and delay in cutting planning. Such problems may be directly related to the lack of a software tool or the presence of a tool that is difficult to use, which is often the case in smaller companies.

Cutting planning carried out without an adequate software tool or empirically, which is the case of smaller companies, results in high losses (as shown in Fig. 9) and excessive times for generating cutting plans, becoming susceptible to errors and combinations of standards that are not great. When the lack of tools is combined with the absence of a qualified employee, the likelihood of mistakes can be even greater.

Table 1.
Difficulties faced by companies in the furniture segment

Difficulty	Micro and Small Companies (%)	Medium and Large Companies (%)
Lack of skilled labor	31.5%	26.3%
Demanded items not cut in stipulated time	27.8%	26.3%
High material loss	22.2%	26.3%
Cut planning is carried out empirically without prior planning	18.5%	21%
It takes time to plan cutting plans	14.8%	5.3%
Tool or Software difficult to use	9.2%	10.5%
There is no one responsible for cutting planning	7.4%	5.3%

Source: The authors.

The software used by the participating companies is shown in Fig. 8.

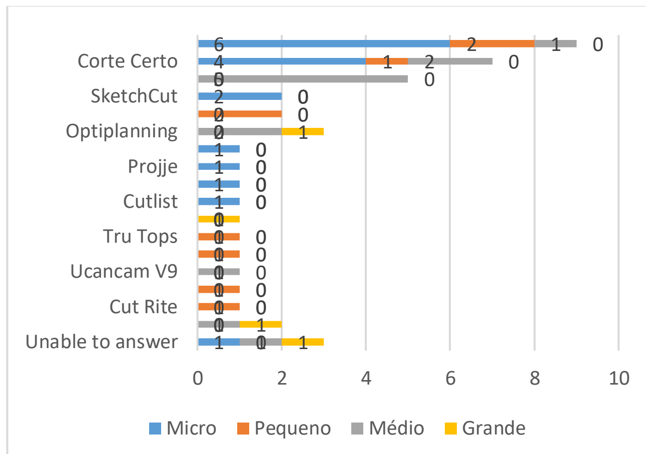

Figure 8. Software tools
Source: The authors

Among the Information Systems used by the 45 companies, there is a wide variety, which reflects the availability of software on the market. The software tools Promob Cut Pro, Corte Certo, and Ardis Cutting Optimizer appeared more often among the responses, but large companies did not report their use.

Among the responses, Enterprise Resource Planning (ERP) and Corel Draw were cited, but such tools, although used by some companies, do not generate cutting plans independently. Thus, they were not considered in the graphical analyses. Such responses indicate that micro and small companies lack adequate knowledge on this subject. The Audacis software was also mentioned by one of the companies that manufactures sofas, but it is used in the fabric-cutting process and not in wood and derivatives.

To better analyze the behavior of losses by company size and software usage, a boxplot was generated, as shown in Fig. 9.

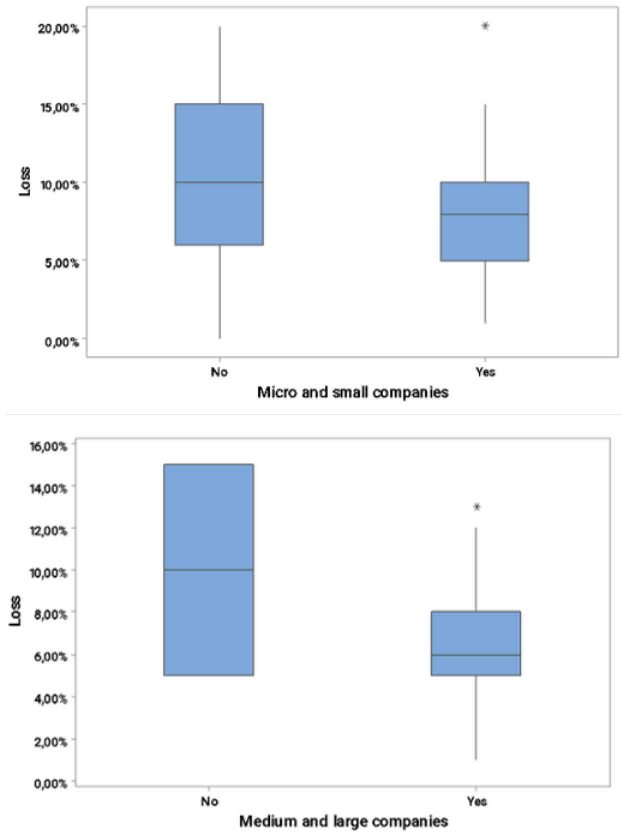

Figure 9. Losses and use of software according to the size of the company
Source: The authors.

The graphs in Fig. 9 indicate that micro and small companies that do not use software demonstrate variability and a greater amplitude in the percentage of losses. They also present losses greater than 10%. Regarding companies that use software, 50% of micro and small companies have losses lower than 8%, while 50% of medium and large companies have losses lower than 6%.

It is not possible to draw conclusions about the losses of medium and large companies that do not use software tools due to the small sample size; although, it is possible to infer that their losses also increase significantly.

4.2 Analysis of software tools

In order to analyze some software tools available on the market and used by companies participating in the survey, a selection was made based on their responses, and an exploratory search was conducted for commercial Cutting Stock Problem software usable to the furniture sector.

The characteristics of these software were analyzed and listed based on information contained in manuals, websites, and online interviews carried out with suppliers.

Table 2 presents a summary and analysis of these software tools, based on the characteristics of the cutting problem and software requirements. The information was obtained from manuals and observations resulting from using these tools.

The software tools are available in several formats: web-based, downloadable, or as smartphone applications. Some also offer diagrams of the automatically generated section planes, while others require manual construction. Additionally, there are cases where the automatically generated section planes can be manually adjusted.

Some of these software tools offer free versions, which may have limitations in functionality, paid versions, or personalized services tailored to customer needs. Cortecloud, Dinabox, and CutList tools can be used as plugins in Sketchup. Likewise, Ottimo Perfect Cut, Cut Rite, Optiplanning (Biesse), and Titanium are available as Promob plugins.

However, the table presented in Annex 1 provides attributes that can guide companies in the furniture segment seeking to acquire software tools.

Information was collected from 19 different software tools that create cutting plans for the furniture segment. This table lists commercial software that can help different companies, especially small ones, to choose and adhere to information technology for a daily process that can be repeated countless times and is normally performed manually.

5 Final considerations

This study offers a practical perspective on the cutting problem in the furniture sector from the viewpoint of companies that need to adopt software solutions to address their issues. This process is important for understanding what the difficulties and real needs of this segment are and how companies' behavior may vary according to their size.

In this context, the survey enabled the identification of key difficulties faced by furniture manufacturers, including lack of skilled labor, high material waste, and delays in planning, which align with the barriers discussed in the literature. The findings reinforce that outdated production technologies and empirical planning practices remain prevalent among small manufacturers, leading to increased waste and reduced operational performance.

The study supports the understanding that software usage is associated with lower material losses and greater consistency in operations. Even though the ANOVA did not find statistically significant differences, the visual trends observed suggest that company size—and by extension, software adoption—can influence cutting efficiency in practical terms.

Moreover, this work contributes by providing a mapping of commonly used software tools in the sector and by making this information accessible to micro and small companies, which often lack structured processes and guidance in selecting appropriate technologies. The list of software tools identified, along with their features, offers practical value for decision-making regarding digital investments and the adoption of cutting optimization systems.

The process of selecting a software tool for a company in the furniture sector is complex in itself, primarily due to the vast diversity of tools available on the market. The different applications, characteristics, costs, and acquisition processes make this task difficult and, in most cases, time-consuming. When these difficulties are added to the lack of investment, insufficient employee knoledge, and personal resistance, the process of acquiring a tool becomes even more challenging.

Thus, guiding these businesses to choose a tool that boosts their results becomes essential, once the difficulties these companies have in obtaining it, permeate from the self-assessment of their needs to the lack of guidance on where to find such tools, as well as a lack of direction for these processes.

Thus, the findings of this research can inform policymakers, business associations, and technology providers on how to better support digital transformation initiatives within small and medium-sized enterprises (SMEs), particularly in traditional sectors like furniture manufacturing.

However, this study is limited by the geographic scope of its sample, which focused predominantly on companies located in the Southern and Southeastern regions of Brazil. These areas are historically more industrialized and technologically developed, which may not fully represent the national reality. Future research could expand to include furniture manufacturers from other regions and explore how regional disparities impact technology adoption and production efficiency.

As future work, we suggest the development of support tools to help small manufacturers assess their technological needs and identify suitable software solutions, considering the diversity of available tools and the multiple criteria involved in this decision. Further studies may also investigate the critical success factors and barriers to software implementation, as well as the impact of digital tools on productivity and competitiveness in SMEs.

Declaration of interest statement

The authors declare that they have no conflicting interests in this publication.

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N.Z. Muzulon, graduated and MSc. in Production Engineering from the State University of Maringá (UEM) and PhD student in Production Engineering at the Federal University of Technology - Paraná (UTFPR). Develops research in the areas of Operational Research and in the development of workforce skills in the digital age.
ORCID: 0000-0003-2882-5402

P.R. de L. Andrade, graduated and MSc. in Production Engineering from the Federal University of Paraná (UFPR). PhD in Production Engineering from the São Paulo State University Júlio de Mesquita Filho (UNESP), Bauru campus. He is currently a professor of Production Engineering at the Federal University of Technology - Paraná (UTFPR), Londrina campus. He is a researcher at the Data Mining and Optimization Research Group (GPOMD), working in the optimization research line.
ORCID: 0000-0001-8142-4195

R.H.P. Lima, graduated the BSc. in Computer Science from the State University of Londrina (UEL) in 2004, he obtained his PhD. in Production Engineering from the São Carlos School of Engineering (EESC) / University of São Paulo (USP) in 2012. He is currently an adjunct professor in the Department of Production Engineering at the Federal University of Technology - Paraná (UTFPR Campus Londrina). He works as a teacher and researcher in the areas of Logistics and Supply Chain Management, Operations Management, Computational Intelligence and Quality Management.
ORCID: 0000-0002-9098-3025

J.V. Shirabayashi, graduated the BSc. in Mathematics from the Universidade Estadual Paulista (2005), a MSc. in Electrical Engineering from the Universidade Estadual de Campinas (2009) and a PhD in Electrical Engineering (2014) from the same university. She completed her Post-Doctorate (2022 to 2023) at the Universidade Estadual de Maringá under the supervision of Prof. Dr. Linnyer Beatrys Ruiz Aylon. She is currently an Adjunct Professor - level D at the Universidade Federal do Paraná, Advanced Campus in Jandaia do Sul. He has experience in the area of Operational Research.
ORCID: 0000-0003-2453-0017

G.C.L. Leal, PhD in Electrical Engineering and Industrial Informatics from the Federal University of Technology - Paraná. Graduated in Production Engineering - Software from the State University of Maringá (2007) and in Data Processing from the University Center of Maringá (2004), with a Msc. in Computer Science from the State University of Maringá (2010). She is an associate professor at the Department of Production Engineering (DEP) and a permanent professor at the Graduate Programs in Production Engineering (PGP) and Computer Science (PCC) at UEM. She develops research in the areas of: Support for Decision Making in Production Systems and Occupational Health and Safety, Software Startups, Quality Improvement and Productivity in Software Development and Process Improvement.
ORCID: 0000-0001-8599-0776

Annex 1 –
Software tools for Cutting Stock Problem in the furniture segment

FEATURES / TOOL	Promob Cut Pro	Right cut	Ardis Opti-mizer	Sketchcut	Dinabox	Optiplanning (Biesse)	Project	Cortecloud	Simula*	Gplan	Ucancam V9	Titanium	Great Perfect Cut	Cut rite	Cut-Planning	Gmad	Maxcut	Cutlist	Cut micro
Number of citations in the *survey*	9	7	5	2	2	3	1	1	1	1	1	1	2	1	0	0	0	1	0
Data transmission to machine		✓	✓		✓	✓				✓			✓	✓	✓				
Manual item and plate data entry	✓	✓		✓	✓	✓	✓	✓	✓		✓		✓	✓	✓		✓	✓	✓
It has a library of registered items and plates					✓			✓											
Imports item and plate data	✓	✓	✓	✓		✓		✓	✓	✓	✓		✓	✓	✓		✓	✓	
Limit on the amount of input data		✓																	
Considers cutting blade thickness			✓	✓	✓			✓	✓				✓	✓			✓	✓	
Consider edge tapes	✓	✓	✓	✓	✓			✓						✓	✓		✓	✓	✓
Considers holes	✓				✓			✓									✓		
Considers fibers and grooves in the material	✓	✓	✓	✓	✓			✓	✓		✓		✓	✓	✓		✓	✓	✓
You can choose whether the item can rotate					✓				✓					✓					
Provides number of stages		✓			✓				✓									✓	
Provides number of cuts					✓				✓									✓	
Provides item priority	✓				✓									✓					
Provides costs					✓			✓	✓					✓			✓		
Provides cutting time														✓					
Provides solutions chart	✓	✓	✓	✓	✓	✓	✓		✓		✓		✓	✓	✓		✓	✓	✓
Allows manual edits to solution charts	✓	✓		✓		✓			✓		✓			✓	✓				✓
Has use of leftovers	✓	✓		✓	✓	✓			✓		✓			✓	✓				
Provides guillotine cutting	✓	✓		✓	✓			✓	✓				✓	✓	✓		✓	✓	✓
Provides nesting cut	✓				✓			✓			✓				✓				
Allows printing of results	✓			✓	✓			✓	✓				✓	✓	✓		✓	✓	✓
Provides labels	✓	✓	✓		✓	✓		✓	✓				✓		✓		✓		
Allows integration with other software	✓				✓	✓			✓	✓		✓	✓	✓					
Free Acquisition				✓	✓			✓			✓		✓				✓	✓	✓
Paid Acquisition	✓	✓	✓	✓	✓			✓	*	✓			✓	✓	✓		✓	✓	
Available online					✓			✓										✓	
Available as software	✓	✓	✓	✓					✓	✓	✓		✓	✓	✓		✓		✓
Available as an app				✓				✓							✓				
Personalized service								✓	✓	✓									

Note: *Not currently marketed
Source: The authors.