EVALUATION OF PRACTICES AND PERFORMANCES OF COMPANIES IN THE METAL-MECHANICAL SECTOR IN A REGION IN SOUTHERN BRAZIL USING BENCHMARKING IN THE CONTEXT OF THE TRIPLE BOTTOM LINE

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Abstract. This article presents an analysis of different manufacturing systems in companies of the metal-mechanic sector in the northern region of Rio Grande do Sul, Brazil, in order to evaluate how these systems contribute to sustainability, using the benchmarking method. A survey was applied to eleven medium and large companies, considering that their activities directly and indirectly impact the development of the region. The sustainable development of an organization must be supported by the following pillars that make up the Triple Bottom Line: environmental (which refers to natural capital), social (refers to human capital) and economic (characterized by profit for stakeholders). The benchmarking method was chosen because it provides means to diagnose and compare the manufacturing systems used by companies. For the application of the benchmarking method, a checklist was created with aspects such as the manufacturing system, standards, as well as lean manufacturing practices. Thirty indicators were developed, based on the 85 indicators of the GRI Standards, categorized into three variables, in order to identify the levels of practice and performance of companies within the scope of the Triple Bottom Line. The data were obtained through the application of a questionnaire and face-to-face visits to the companies studied and, subsequently, the data were analyzed. The results of the study present the diagnosis of practices and performance of the companies studied, as well as the identification of possibilities for improvements in the manufacturing systems of the companies from the point of view of the Triple Bottom Line. The originality of this study is to propose the application of the interrelationship between the three dimensions of the Triple Bottom Line, which shows the presence or not of balance in the scope of sustainability in the organizations studied, reflecting the current state of the production system, which allows concluding that the application of this research in the future will enable comparing the indicators.

Keywords: Triple Bottom Line, Benchmarking, Metal-mechanic Sector, Manufacturing Systems, Lean Manufacturing

1. INTRODUCTION

The production system of an industry is defined by Moreira (2002) as the set of interrelated activities and operations involved in the production of goods or services. Slack, Chambers and Johnston (2006) propose that the production system gathers input resources (materials, information, facilities and personnel) in a controlled manner, and transforms them into outputs of products or services delivered to consumers.

The competitive context of industries has required the implementation of more flexible manufacturing systems, with quick responses to changes in market demand, reduced costs and, consequently, greater profitability and profitability for investors. At the same time, society has required companies with greater social and environmental responsibility.

From these premises, the choice of the production system becomes essential for the sustainability of an organization in a competitive economic scenario (Slack, Chambers and Johnston, 2006).

Sustainability implies that these organizations permanently seek to maintain a balance between economic, social and environmental dimensions. For the consolidation of a sustainable production system, it is necessary that such system contributes to sustainability at the global level, since current products and processes have been inefficient in terms of the use of the planet's resources (Kleindorfer, 2005).

The complexity of the planning and implementation process of a production system has been a concern of managers in the production area of organizations, which increases the relevance of the evaluation of the used practices.

In this context, benchmarking is a research method that enables making comparisons between organizations, objects or activities, creating a reference standard (Gariba Junior, 2005). In this way, the analysis of production systems with regard to inputs, transformation processes and outputs, can contribute to identify the improvement in the use of material resources and supplies, personnel, capital and goods, while reducing costs, idleness and waste in transformation processes. Such analysis should also seek to reduce waste, environmental impacts and effects on worker health. Thus, a

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production system must be economically viable, socially responsible and environmentally sustainable. This assumption is in line with the work of Ashley (2005).

From this perspective, the implementation of a production system that is compliant with the Triple Bottom Line can be an appropriate strategy for companies, as it promotes a better balance between the economic, social and environmental dimensions.

2. BACKGROUND

2.1 Production systems

According to Neumann and Scalice (2015), the classification of a production system allows identifying production planning and management techniques appropriate to each particular type of system, which rationalizes choice and decision making. Production management involves the manufacture of products as well as operations that generate services. Martins and Laugeni (2005) define production as a set of activities that lead to the transformation of a tangible product into another with greater utility. According to Tubino (2007), a production system will be as efficient as it manages to align strategic objectives with tactical activities and, from these tactical activities, to production operations and sale of the products. The correct planning and control of production influences directly the efficiency of the production system.

Different types of manufacturing processes allow a company to follow a course of action to organize operations. A manufacturing process can be understood as a group of tasks that are logically interconnected, which use the organization's resources to generate results, so that they can achieve their goals (Harrington, 1997).

The production layout is essential in the organization, being defined as the general view of the production process, which consists of positioning the various equipment and machinery seeking an arrangement as productive as possible (Gaither and Frazier, 2002).

Ghinato (2000) presents Lean Manufacturing as a management philosophy that seeks to optimize the organization in order to meet the customer's needs in the shortest time, with the highest quality and the lowest cost, while increasing safety. morale of its employees, involving and integrating not only manufacturing, but all parts of the organization

2.2 Organizational sustainability

Sustainable development refers to that which meets the needs of the present without compromising the capacity of future generations (WCED, 1987). The expression "sustainable development" was coined in order to include decision-making and political processes based on the interdependence and complementarity of economic growth and the preservation of the environment (Ramos, 2013).

According to Elkington (1999), the Triple Bottom Line (TBL) is composed of the environmental (which refers to natural capital), social (human capital) and financial (characterized by profit) pillars. TBL suggests that economic development, environmental quality and social justice are relevant to understanding sustainability (Ramos, 2013).

For an organization to be sustainable, it must act in a balanced way in relation to the three dimensions of the TBL. In this sense, the organization needs to generate profit for shareholders, protect the environment and improve the lives of individuals with whom it interacts (Savitz and Weber, 2007). Munck *et al.* (2013) proposed an organizational sustainability framework based on studies by Elkington (1999) and Savitz and Weber (2007), as illustrated in Figure 1.

PS – Social pillar
PA – Environmental pillar
PE – Economic pillar
JAB - Environmental justice
ISC - Social insertion
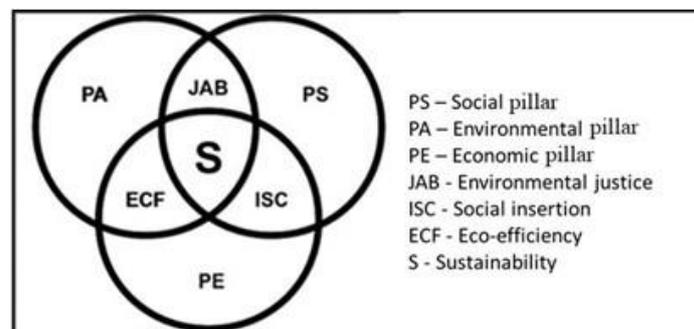ECF - Eco-efficiency
S - Sustainability

Figure 1. Elements of organizational sustainability (Munck *et al.*, 2013)

The integration between the economic and social dimensions constitutes Social Insertion; Eco-efficiency corresponds to the balance between the economic and environmental dimensions; and Environmental Justice is achieved by balancing the social and environmental dimensions (Munck *et al.*, 2013).

Regarding the production system, all phases of the life cycle (pre-production, production, use and post-use) must comply with the Triple Bottom Line so that the system can be considered sustainable (Brown *et al.*, 2014). In this way,

business policy and strategy combined with the decision-making process need to be integrated with economic, social and environmental aspects (Seiler *et al.*, 2004).

The Global Reporting Initiative model (GRI) was conceived in 1997, in a partnership between the Coalition for Environmentally Responsible Economies (CERES) and the United Nations Environment Program (UNEP), quickly becoming a leader among voluntary systems containing sustainability reports (Reis, 2014). The GRI seeks to provide means to help organizations understand and disseminate their contributions to achieving sustainable development (GRI, 2019). The GRI Standards version consists of a total of 85 indicators classified in the three dimensions of the Triple Bottom Line, being 13 economic, 32 environmental and 40 social indicators (GRI, 2018).

The GRI model seeks to consider all interested parties in its analysis dimensions, using a globally shared framework of concepts. Sustainability reports generated based on GRI allow benchmarking, as well as help organizations to contextualize themselves against other organizations in the same segment (Boada, 2015). GRI includes criticisms of the traditional reporting model, in which financial statements play a central role, recognizing the importance of non-financial aspects, intangibles and information about future events (Medel *et al.*, 2011).

Some of the advantages of using GRI guidelines are the following: (a) the possibility of comparisons between organizations' performance, promoting an external benchmarking; (b) measure elements of corporate sustainability, address elements of global interest, such as greenhouse gas emissions; (c) help organizations to balance the economic, social and environmental dimensions; (d) promote the interaction and communication of organizations with a variety of interested parties (stakeholders); (e) contribute to the organization's recognition at a world level (Medel *et al.*, 2011).

2.3 Benchmarking

The term benchmarking emerged by the end of the 1980's. It consists of a continuous and systematic research method that enables comparing organizations, creating a reference standard (Gariba Junior, 2005). This same author points out that benchmarking is characterized as an art in the search for the best practices that lead the company to maximize business performance.

According to Camp (2002), benchmarking seeks for the best practices that lead an organization to maximize business performance. Benchmarking is a tool used in decision making by the organization, allowing the company to prioritize its improvement actions. This is made possible because the analysis relating practices and performances provides a clearer understanding of the origin of the most relevant deficiencies (Tubino, 2008).

For the evaluation of practices and performances, sustainability indicators are measurable aspects that include the practices of the Triple Bottom Line to monitor changes in characteristics related to human and environmental well-being (Fiksel *et al.*, 2012). Sustainability indicators can be defined as quantitative or qualitative parameters of information or measurement, which enable describing situations and assess the possible or real effects of policies, plans and programs, allowing the projection of trends and verification of compliance with objectives and targets (Silva, 2014).

Lean Benchmarking (BME) is a diagnostic method based on the concept of Benchmarking Made in Europe (MIE) (Seibel, 2004). BME seeks to generate information to support the strategic planning for the implementation of Lean Manufacturing in the company, and it can be used both at the global level of the organization and at the sectorial level.

3. PROPOSED METHOD

This work proposes the development and application of a method aimed at the production system of companies in the metal-mechanical sector, as well as how they act with regard to aspects related to the Triple Bottom Line.

For the development of this research, the selected companies had a history of transformation of their production processes, as well as participation in the local community and development of projects related to the environment, information verified after interviews with company employees and visits to company websites. Transformations are observed through the replacement of manual processes by automated ones, improvements in production and management processes, development and application of new tools, as well as the development of social projects together with the local community. Only medium and large companies were considered in this research, assuming that these companies have better financial conditions and a well-defined organizational structure, in order to enable investment in the implementation of new practices related to the Triple Bottom Line in their production system. In total, eleven companies agreed to participate in the survey responding a questionnaire designed to assess the practices and performance of their production systems within the scope of the Triple Bottom Line.

The criteria adopted in this research to define the size of companies is the same adopted by the Brazilian Institute of Geography and Statistics (IBGE) and by the Brazilian Support Service for Micro and Small Enterprises (SEBRAE). According to these bodies, companies are classified as: micro-enterprise (up to 19 employees), small business (from 20 to 99 employees), medium-sized companies (from 100 to 499 employees) and large companies (over 500 employees).

In order to preserve the identity of the participating companies, their names are not informed in this work, and each company was assigned codes E1, E2, E3, etc. Table 1 shows the main characteristics of the companies surveyed, regarding the number of employees, Company size, Company age, Main products manufactured and Certifications in Quality Management and/or Occupational Health and Safety Management. It can be seen that 82% (9) of the companies

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in the sample are classified as large, having a workforce above 500, and 18% (2) of the companies are classified as medium-sized, with between 100 and 499 employees.

Table 1. Sample characterization of the studied companies

Company	Number of employees	Size Company	Company age	Main products manufactured	Certifications in Quality Management and/or Occupational Health and Safety Management
E1	2600	Large	74	Stamped and welded components for the automotive, road, agricultural and construction segments; Manufacturing tools.	IATF 16949; ISO 9001; ISO 14001
E2	1200	Large	57	Agricultural implements (planters, platform for harvesting corn)	ISO 9001
E3	2500	Large	60	Agricultural Sprayers; Planters and seeders; Distributors.	ISO 9001
E4	1213	Large	88	Storage Silos for solid bulk, grain dryers, cleaning machines, agricultural elevators, horizontal conveyors, as well as metal structures an plumbing accessories.	ISO 9001; ISO 14001; OHSAS 18001
E5	500	Large	37	Carriages for transporting feed, poultry and swine; Special vehicles and ambulances.	ISO 9001
E6	1460	Large	56	Harvesters, Cutting Platforms, Corn Platforms and Planters.	ISO 9001
E7	609	Large	95	Equipment and accessories for logistical solutions in the agricultural, industrial and forestry segments	ISO 9001
E8	300	Medium	22	Agricultural Machinery and Equipment - Agricultural planters;	ISO 9001
E9	280	Medium	14	Agricultural Machinery and Equipment - Corn Platform, Knife Roller, Agricultural Cart, Pivot Trail Repairer, Tilt Platform.	ISO 9001
E10	688	Large	52	Gray and nodular cast iron, machining and painting.	IATF 16949; ISO 9001; ISO 14001; OHSAS 18001
E11	1200	Large	36	Bus bodies, micro, urban, intercity, road and DD lines	ISO 9001

Analyzing Table 1, it can be seen that 11 companies in the sample (100%) have quality management system certification (ISO 9001). In turn, considering the certification of the environmental management system (ISO 14001), 3 companies surveyed (27%) are certified.

As for the occupational health and safety standard (OHSAS 18001), 2 companies (18%) have the certification of this standard. Regarding the ISO 45001 certification (international standard for the Occupational Health and Safety Management System), company E4 is migrating to this standard, which represents 9% of the sample with this certification.

3.1 Method steps

In this research, data collection was developed following the steps:
1st Step: Conducting a bibliographic review about production systems, benchmarking method and sustainability in books, articles, dissertations, theses, and specialized sites.
2nd Step: The instrument for data collection was developed. A questionnaire was developed with the purpose of diagnosing the practices and performances of the companies' production systems.
3rd Step: The production systems used and/or being implemented in the sample companies were diagnosed, the manufacturing processes and the production management instruments used and/or being implemented in the sample companies were mapped through in-depth interviews, semi-structured applied to managers and engineers in the production area. The interviews assumed the previously elaborated questionnaire. The on-site observation technique was put into practice, consisting of systematic recording of information.
4th Step: The treatment and interpretation of the collected data was carried out.
5th Step: The results were obtained and analyzed.

A questionnaire was developed in order to diagnose the practices and performances (Seibel, 2004) of the companies' production systems. Initially, the questionnaire seeks to obtain information about the company to be interviewed, such as: location, number of employees, annual revenue, composition of the company's capital (national and international), percentage of the market in which it operates (internal and external), types of manufactured products, types of manufacturing processes present in the production system, layout(s) in the production system, received certifications, if there is application of any lean manufacturing program and tools in your production system. This information is intended to provide a view of how the company operates in its production system.

In the second stage of the questionnaire, 30 indicators were evaluated, categorized into the three dimensions of the TBL, assigned with 10 indicators each, in order to analyze and measure the levels of practice and performance of companies within the scope of the TBL. These indicators were based on the 85 indicators of the GRI Standards (GRI, 2018), as shown in Table 2, which were optimized to be properly applied to the reality of the companies in the sample, with the background of the TBL. In turn, categorization as practice or performance follows the concept of Seibel

(2004). In this study, the practice indicators are correlated to the implementation of techniques in the production system, while the performance indicators refer to the measurable results obtained by practices implemented or not in the company.

To assess the indicators, each multifunctional or individual team obtained an answer card, which can be of three types: economic indicators, environmental indicators, or social indicators. A version of the questionnaire describing each indicator was also handed out.

Table 2. Economic, environmental and social indicators

Economic indicators					Environmental indicators				
Code	Title	GRI Standards	Practices	Performance	Code	Title	GRI Standards	Practices	Performance
IE-01	EBITDA	201-1		X	IA-01	Greenhouse Gas Emissions	305-1		X
IE-02	Net earnings	201-1		X	IA-02	Water (consumption)	303-1/303-5		X
IE-03	Invested capital (ROI)	201-1		X	IA-03	Water (discharge)	303-2	X	
IE-04	Investment in Research and Development	201-1	X		IA-04	Land use	304-1		X
IE-05	Spending on local suppliers	204-1	X		IA-05	Solid waste generation	306-2		X
IE-06	Corporate governance	203-1	X		IA-06	Energy	302-2/302-4	X	
IE-07	Anti-competitive behavior	206-1		X	IA-07	Ecosystems	304-2		X
IE-08	Net worth	201-1		X	IA-08	Materials	301-1	X	
IE-09	Gross operating revenue	201-1		X	IA-09	Endangered plant and animal species	304-4		X
IE-10	Market value	202		X	IA-10	Product Recyclability	301-1		X

Social indicators				
Code	Title	GRI Standards	Practices	Performance
IS-01	Employee education, training and development	404-2/404-3	X	
IS-02	Diversity and opportunities	405-1	X	
IS-03	Attracting and retaining talents	401-1		X
IS-04	Health and safety	403-1	X	
IS-05	Job creation	401-1		X
IS-06	Corporate citizenship	413-1	X	
IS-07	Customer relationship	416-1/418-1		X
IS-08	Relationship with local suppliers	414-1	X	
IS-09	Quality	417-2	X	
IS-10	Socioeconomic Compliance	419-1		X

Table 2 shows the indicators developed for the questionnaire in this research. The description of each indicator is presented in Maciel (2020). According to the format adopted for the method, the indicators to be measured within each of the three dimensions are divided between practice indicators (PR) and performance indicators (PF). The fourth and fifth columns indicate whether the indicator is characterized as practice or performance.

From the calculation of the partial indices of practice and performance observed for each of the three dimensions of sustainability, these were consolidated into two final indices, one of practice and the other of performance, as illustrated in Figure 2. These consolidated indices will represent the current state of the company, diagnosed in relation to the production system. The consolidation of partial outcomes into the final result was obtained by the simple average based on the percentage of the partial values measured.
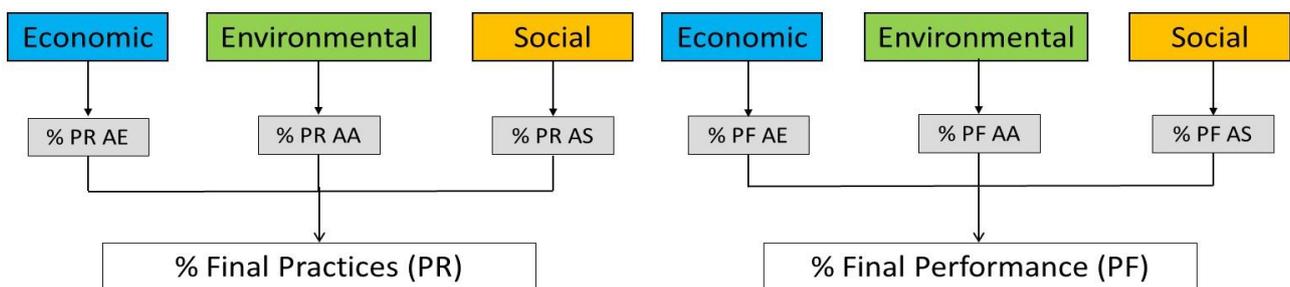

Figure 2. Consolidation of practice and performance results

The definition of the indicators that make up the benchmarking method within the scope of the Triple Bottom Line was established from the literature review on the themes, and were validated through visits made to companies to apply the proposed method. The indicators were presented and described in Maciel (2020).

In evaluating each indicator, a scoring system was adopted that ranged from 1 to 5. This scoring system comes from the Lean Benchmarking Method (Tubino *et al.*, 2008). For each score, the following detailed description was adopted:
• Grade 1 - Equivalent to an insufficient level of practice or performance (20%);
• Grade 3 - Equivalent to an intermediate level of practice or performance (60%);
• Grade 5 - Equivalent to excellence in practice or performance (100%).

Grade 2 (equivalent to 40% practice or performance) and Grade 4 (equivalent to 80% practice or performance) refer

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to the intermediate evaluation positions of the indicator. These grades are assigned when the company has some practices or performances in both neighboring columns, or it is in a situation of developing practices in the lower column without having reached the status described in the upper column. Fractional values such as 3.5 cannot be used.

For the diagnosis of the interrelationship between the three dimensions of the Triple Bottom Line, the results of the calculations of the observed partial indices of practice and performance were used. Through a simple average, the practice and performance values were obtained for each of the interrelationships. In this way, the partial indices of the interrelationships are obtained: Social Insertion Practice (average of Practice of the Economic and Social dimensions), Social Insertion Performance (average of Performance of the Economic and Social dimensions), Eco-efficiency Practice (average of Practice of the dimensions Economic and Environmental), Eco-efficiency Performance (average of Performance in the Economic and Environmental dimensions), Environmental Justice Practice (average of Practice in the Environmental and Social dimensions) and Environmental Justice Performance (average of Performance in the Environmental and Social dimensions), as shown in the Figure 3.
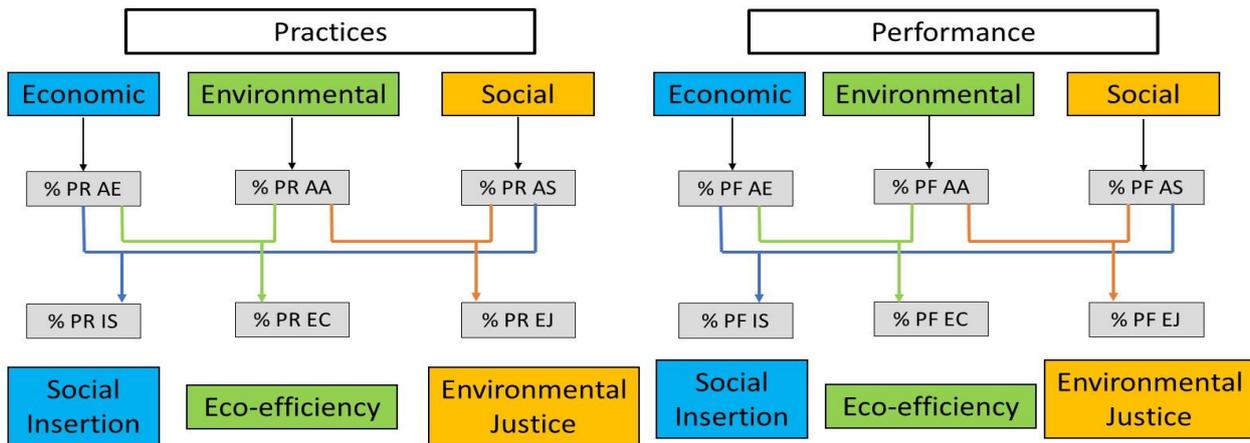
Figure 3. Consolidation of practice and performance results for interrelationships

In the following step, data were processed and presented for discussion of the diagnosis. In this step, the results of the indices obtained through interviews in the companies for each of the three dimensions are presented. The presentation of the results was expressed through the following charts: Practice versus Performance chart, Radar chart and Bar chart.

4. RESULTS AND DISCUSSION

After processing the data obtained through the 30 indicators of the questionnaire, the general result of practices and performances obtained for the 11 companies surveyed was consolidated in the Practice versus Performance chart (Figure 4), enabling identifying the quadrant in which the companies were classified.

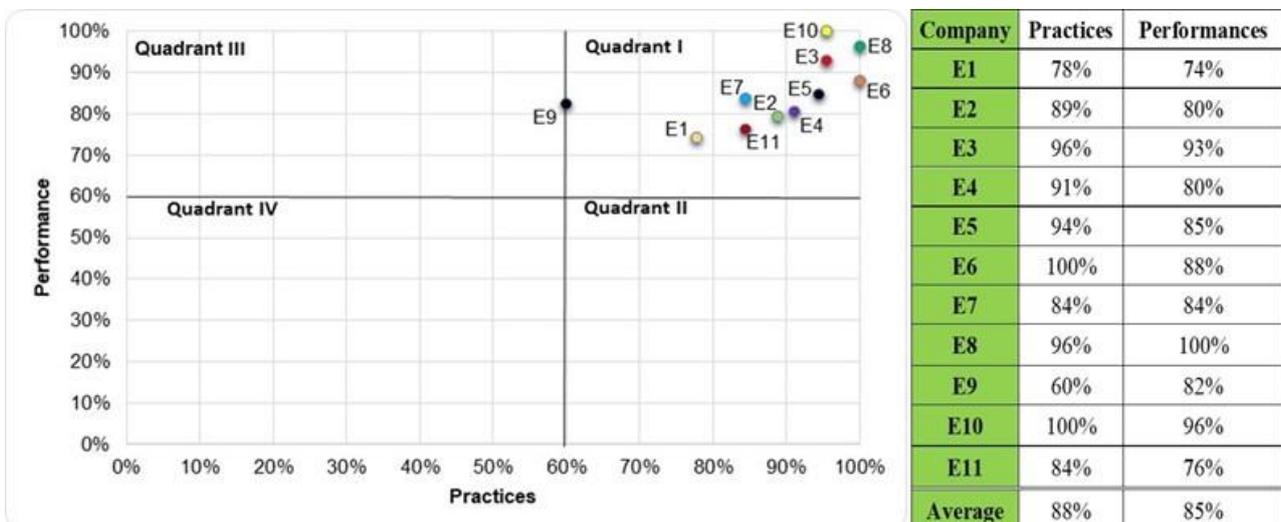| Company	Practices	Performances
E1	78%	74%
E2	89%	80%
E3	96%	93%
E4	91%	80%
E5	94%	85%
E6	100%	88%
E7	84%	84%
E8	96%	100%
E9	60%	82%
E10	100%	96%
E11	84%	76%
Average	88%	85%

Figure 4. Practice versus Performance chart

From the average values of practices and performances for each variable that compose the benchmarking method within the scope of the Triple Bottom Line, the Radar chart was obtained, considering the average of all surveyed companies, as shown in Figure 5.
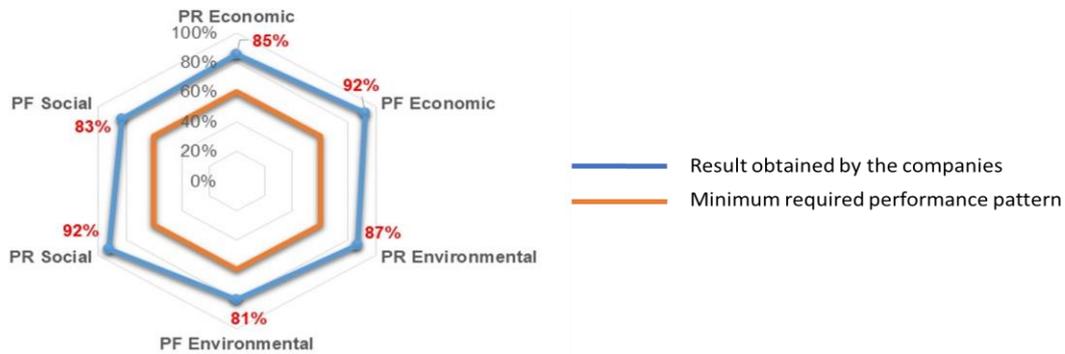

Figure 5. Radar chart

The result obtained by the companies is represented by the blue line in the chart in Figure 5. The orange line represents a minimum required performance pattern (60%). Analyzing the Radar chart, it is observed that all points are positioned outside the hexagon formed by the red line, that is, the average of the partial results of practices and performance of the companies, for each variable surveyed, was above 60%, showing the good result of the companies.

It is also observed in the Radar chart that the best results of the average of the companies were for the variables Practices in the Social Dimension and Performance in the Economic Dimension, both with 92%. The other variables had the following results: Practices in the Environmental Dimension (87%), Practices in the Economic Dimension (85%), Social Dimension (83%), Performance in the Environmental Dimension (81%). In general, it can be inferred that the level of practice was higher than the level of performance in the companies, which shows that they still face some difficulty in consolidating their actions.

4.1 Indicator results for each dimension

Figure 6 shows the results of the indicators for each of the dimensions of the Triple Bottom Line. The Bar chart in Figure 6 contains the average of the scores of the companies studied for each indicator in each of the pillars of sustainability. Fig. 6(a) presents the results obtained by companies in the economic pillar, Figure 6(b) presents the results obtained by companies in the environmental pillar, and Figure 6(c) presents the results obtained by companies in the social pillar.
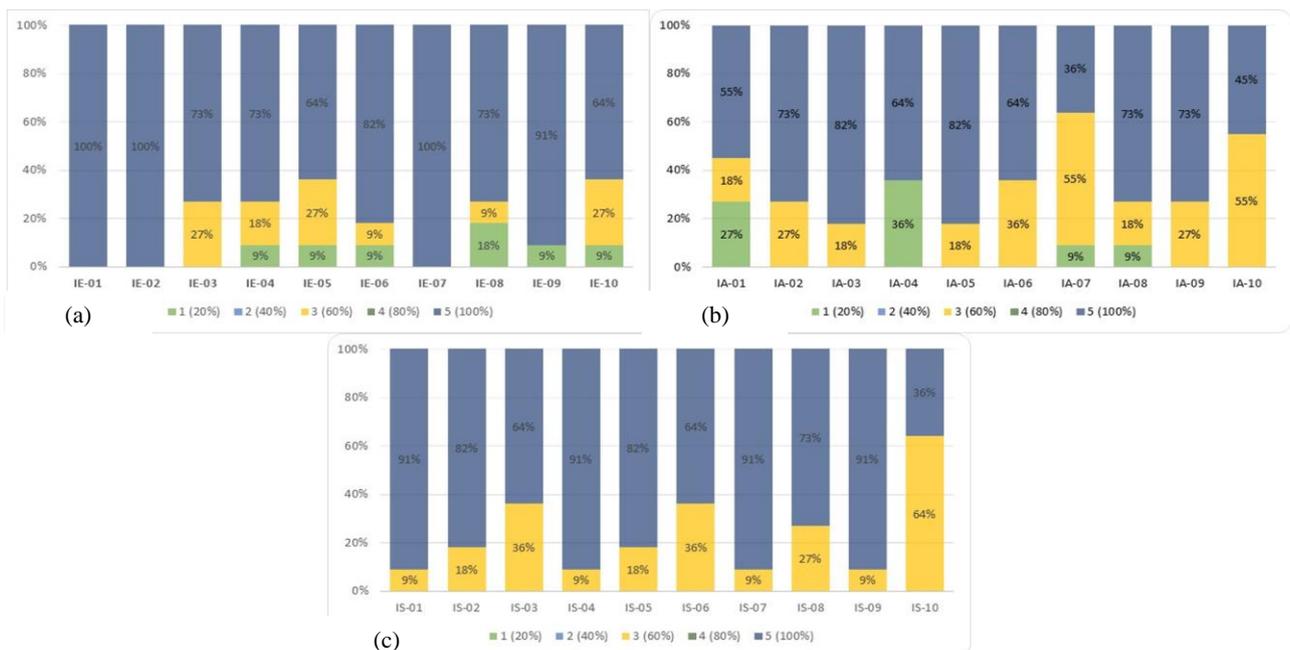

Figure 6. Indicator results for each dimension: (a) Economic, (b) Environmental; (c) Social

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4.2 Results of the interrelation between dimensions

From the framework in Munck *et al.* (2013), the interrelationship between the three dimensions of the Triple Bottom Line in the production system of the companies studied was analyzed (Figure 7). This analysis allows verifying the presence or not of balance between the three dimensions of the Triple Bottom Line within the organization.

The average obtained for the Social Insertion interrelation (Figure 7(a)) in the category of practices was 89%, and for performance the average index obtained was 88%. It was observed that the average of practices is higher than the average of performances for this interrelation, which suggests that there is an opportunity for improvement in the production system. Since the result of the performance is inferior to the efforts made through the practices, it is possible to develop activities to improve the performance, prioritizing the indicators with the worse results.

For the practices of the Eco-efficiency interrelation (Figure 7(b)), an average of 86% was obtained, whereas for the performances an average of 86% was obtained. Although with similar values (86% of practices and 84% of performance) for the Eco-efficiency interrelation, there is an opportunity to improve the production system. The practice index being slightly higher than the performance index suggests that companies can improve results by seeking to concentrate efforts so that they prioritize the indicators with the worse results. Such improvements indicate the possibility of better performance and balance between the environmental and economic dimensions in the company's production system.

The average obtained for the practices of the Environmental Justice interrelation (Figure 7(c)) was 90%. This interrelation led to the lowest overall average for performance considering the three interrelations, with a result of 82%. In the same way as for the previous interrelationships, Social Justice presented averages of practices superior to those of performance, showing the opportunity for better results from the development of activities that prioritize the indicators with the worse results. Such improvements will enable a better performance and balance between the environmental and social dimensions in the company's production system.

(a)

	E1	E2	E3	E4	E5	E6	E7	E8	E9	E10	E11
Practices	80%	97%	100%	100%	95%	100%	90%	93%	47%	100%	77%
Performance	81%	95%	95%	79%	90%	85%	81%	100%	85%	94%	79%

(b)

	E1	E2	E3	E4	E5	E6	E7	E8	E9	E10	E11
Practices	73%	87%	93%	87%	97%	100%	80%	93%	53%	100%	87%
Performance	71%	74%	94%	86%	84%	97%	86%	100%	89%	94%	74%

(c)

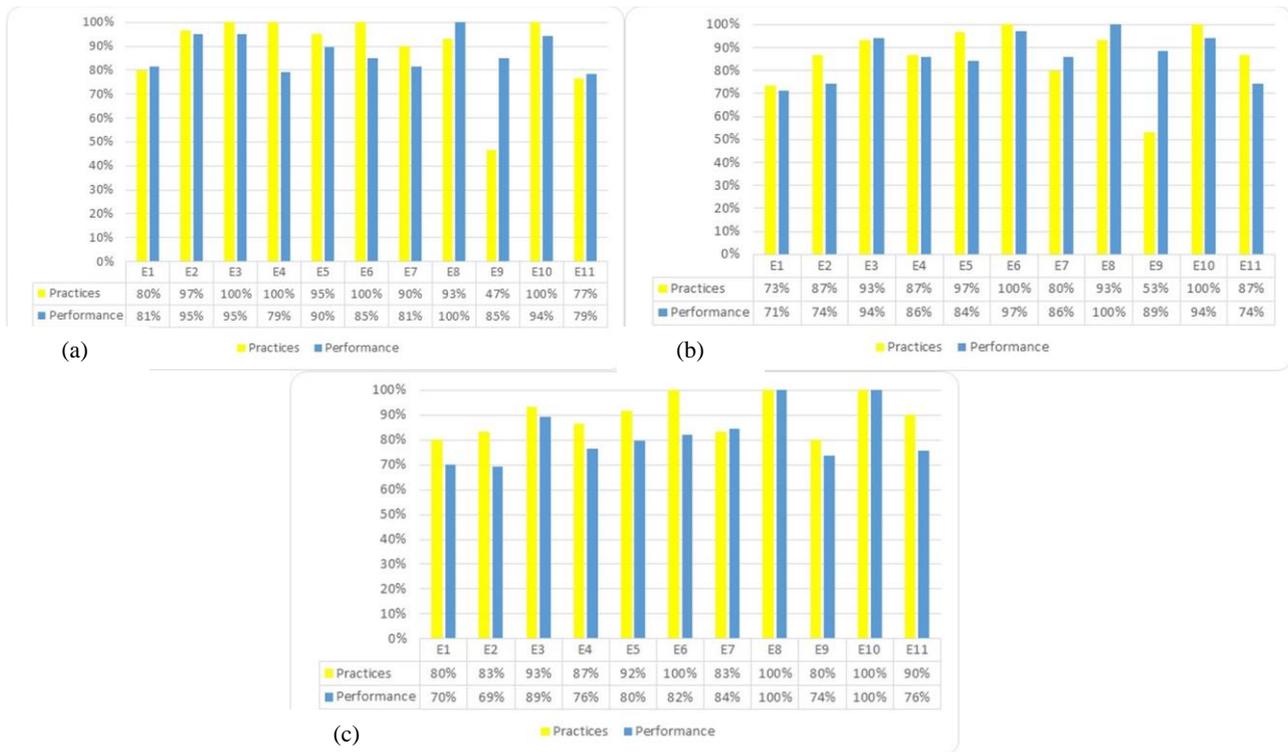|	E1	E2	E3	E4	E5	E6	E7	E8	E9	E10	E11
Practices	80%	83%	93%	87%	92%	100%	83%	100%	80%	100%	90%
Performance	70%	69%	89%	76%	80%	82%	84%	100%	74%	100%	76%

Figure 7. Results of the interrelation between dimensions: (a) Average for the Social Insertion interrelation, (b) Average for the Eco-efficiency interrelation, (c) Average for the Environmental Justice interrelation

5. CONCLUSIONS AND FUTURE WORK

This work applied the benchmarking method to analyze the contribution to sustainability provided by production systems in medium and large-sized companies of the metal-mechanical sector located in the Southern region of Brazil.

For the analysis of the contribution to sustainability, indicators were elaborated based on the GRI Standards (GRI, 2018), in order to diagnose the practices and performances of the production systems of companies. Within the scope of this study, the practice indicators are correlated with the implementation of tools and techniques in the production

system, while the performance indicators refer to the measurable results obtained by the practices implemented or not in the company.

For the development of this research, it was chosen to select companies that, preferably, have a history of transformation of their productive processes, participation in the local community and development of projects related to the environment, aspects verified by surveys on company websites and observed from interviews with company employees and on-site visits to the company.

For this research only medium and large companies were considered, assuming that these companies have better financial conditions and a well-defined organizational structure, in order to enable investment in the implementation of new practices related to the Triple Bottom Line in their production system. In total, 11 companies agreed to carry out the survey and made themselves available to answer the questionnaire designed to assess the practices and performance of their production systems within the scope of the Triple Bottom Line.

All analyzed companies have implemented the Quality Management System (ISO 9001). Furthermore, considering the ISO 14001 environmental management system, 3 surveyed companies are certified. As for the occupational health and safety standard, OHSAS 18001, two companies have the certification of this standard.

Analyzing the results, the adoption of best practices leads to better production performance, that is, good practices lead to good performance results. The result in the Practices versus Performances chart illustrates that all companies were positioned in quadrant I, showing that they are on the right path to achieve an excellent result in their production system within the scope of the Triple Bottom Line.

With an average result of 88% for practices and 85% for performance, it can be inferred that these companies contribute significantly and positively to sustainability. It is noteworthy that the average index of practices being higher than that of performance shows the opportunity for improvements in the companies' production system, improving activities so that the performance results are consistent with the efforts made by the practices.

The analysis of the interrelationships identified a balance between the three dimensions of the Triple Bottom Line. However, it is noticed that there is greater investment in practices within the scope of Environmental Justice (environmental and social dimensions). It was also found that this same interrelation led to the lowest performance results.

The evidence from this study, limited to a time frame, allows us to conclude that the balance between the three dimensions of sustainability, presented by the industries in the sample, contributes significantly and positively to sustainability. The indexes consolidated in this study represent the current state of the companies, diagnosed in relation to the production system, which allows us to conclude that the application of this research in a future period will enable a comparison of the indexes.

Finally, benchmarking within the scope of the Triple Bottom Line in metal-mechanical companies, besides enabling diagnosing their production process in the three dimensions of the TBL, guides companies on activities that need to be improved and results to be achieved regarding decision-making in the context of sustainability.

As a suggestion for future work, it is recommended the application of the proposed method in other medium and large companies in the metal-mechanic sector, but located in other regions. It is also recommended the application of the method in companies belonging to the same segment of activity, such as textiles or plastics.

6. ACKNOWLEDGEMENTS

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8. RESPONSIBILITY NOTICE

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