Revista ARACÊ
ISSN: 2358-2472

MANAGEMENT SYSTEM AND ITS COMPARISON WITH OPERATIONAL EFFICIENCY: A CASE STUDY IN A MINING COMPANY

https://doi.org/10.56238/arev7n2-268

Submitted on: 01/24/2025 **Publication date:** 02/24/2025

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ABSTRACT

Management system has been assigned as a way for companies to structure their governance model, ensuring that its purpose is translated throughout its organization through a clear strategy, disclosed and deployed in all departments that compose it. However, it is noted that many employees (including mainly leaders) have most of the time followed the management model adopted, but their belief that this model or management system can actually help the organization to have a cohesive team, building an organizational culture focused on continuous improvement is low and in turn their level of engagement ends up becoming weak to help their organization maintain and improve the system management. The objective of this study is to identify the differences in indicators of perceptions, barriers, impacts and pillars on a management system of a mining company in the view of its leadership staff. For this, a *survey* was administered and the data were tested in a quantitative analysis. The results show that when a company implements a management system and that for several years has the support of senior leadership, good communication and training for its employees, there are positive financial and non-financial impacts throughout the company.

Keywords: Management System. Management. Leadership. Continuous Improvement. Standardization. Organizational Culture. Operational Efficiency.

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INTRODUCTION

In a world where there is no longer commercial independence, where practically everything is interconnected from the initial phase of a good (product or service) to the final customer, the demands for production efficiencies generating higher profit margins and socio-environmental conditions increasing sustainability have become increasingly emphatic in the markets (Friedman, 2014).

It is not enough just to have the best product or service available, it is necessary to be constantly changing and adapting to the world dynamism to ensure competitiveness and consequently market *share.* Added to this is the fact of the rapid technological evolution in which we live, in which attention is required to the level of competence and technology necessary to seek more efficient processes (Kelm, *et al*., 2014).

Today's organizations face many obstacles, such as ethical dilemmas, regulatory barriers, and entry barriers. In addition, errors in internal decision-making can cause strategic failures. According to George (2003), the 'Seven Deadly Sins' identified in an organization include working without a clear mission, underestimating the *core business*, depending on a single product line, failing to detect changes in technology and market, changing strategy without changing culture, leaving core competencies and relying on acquisitions for growth.

A company is said to have a sustainable competitive advantage when it is implementing a value-creation strategy that is not being simultaneously implemented by any current or potential competitor and when those other companies are unable to duplicate the benefits of that strategy (Avolio; Gardner, 2005). Therefore, it is the inability of current and potential competitors to duplicate the strategy that makes a competitive advantage sustainable.

A company's competitive advantage is typically inferred from sustained periods of above-average performance (Rouse; Daellenbach, 1999). Based on this definition, we view sustained performance as the ability of the organization to achieve persistent performance and growth over a long period (Roberts; Dowling, 2002).

Organizations that create an environment that aligns the interests of employees with the organization's mission results in greater shareholder wealth and long-term sustainable growth (George, 2003). In addition, due to the growing importance of corporate governance, issues of public trust and integrity have become paramount.

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Mining plays a crucial role in the world economy (ICMM, 2012), providing essential raw materials for a variety of industries, including energy, construction, manufacturing, and technology (Garcia Viana and De Alencar Xavier, 2024). However, mining activity can also lead to significant socio-environmental impacts, such as environmental degradation (Chiaro, 1997), conflicts with local communities (Dillon *et al*., 2017), and workplace safety issues (Tubis, 2020). In the face of these challenges, the need for effective governance in the mining industry is widely recognized (García-Sánchez, 2022), both internationally and in the Brazilian scenario.

These different perspectives reflect the complexity of leaders' perceptions of the usefulness of a management system and highlight the importance of considering a variety of factors (Viana, 2018), such as organizational culture, external context, and internal dynamics of the organization, when evaluating the implementation and effectiveness of these systems. In view of all the information discussed, this study proposes to answer the following research question: What is the influence of a management system on the operational efficiency of a mining company under the perception of its leaders?

The general objective was to identify the differences in indicators of perceptions, barriers, impacts and pillars on a management system of a mining company in the view of its leadership staff.

METHODOLOGY

The research is classified as quantitative with a single method and cross-sectional type, which according to Pinsonneault and Kraemer (1993), and had the data collection of the stage carried out in a single moment. After collection, the data will be treated where a test of comparison of means will be carried out. The test to be chosen will be according to the result of the normality test.

The method used will be the *survey*, a research method that uses the questionnaire to collect primary data, which is suitable for research that involves the collection of information from a large sample of individuals (HAIR *et al*., 2005). The details of this stage of the research are developed below.

The target population was the total group of elements relevant to the research (Hair *et al.,* 2005), in this study being the number of employees involved in the operation of a mining company in the northern region of the country. The sample was a subset of the

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ISSN: 2358-2472

target population (Hair *et al.,* 2005), and therefore, for this study, it was composed only of managers of this mining company.

The mining company chosen for the research has a management system in place for 10 years and continuously seeks to make it robust and increase improvements in its way of managing. All managers undergo training once they enter the company or when one of the employees is promoted to a leadership position. The sample was non-probabilistic by trial (Aaker; Kumar; Day, 2009; Hair *et al.,* 2005). The respondents were accessed only electronically, through a form prepared through Microsoft Forms, and the distribution took place by e-mail and through a QR-Code.

The questionnaire is a "structured technique for data collection that consists of a series of questions [...] that an interviewee must answer" (Malhotra, 2006, p. 290). The questionnaire of this research is self-administered, that is, they were filled out by the respondent without the presence of an interviewer, as it is assumed that the respondent has the knowledge to answer it alone (Hair *et al.,* 2005).

Based on the literature review, the indicators to be explored in the quantitative stage were defined. For the answers, the Likert scale will be used, with 5 points, with the first point meaning "strongly disagree" and the last meaning "strongly agree" (Malhotra, 2006).

The content validation was carried out with seven analysts from the management systems department and two PhD professors from the area of Administration. Content validation aims to verify the adequacy of the questionnaire, identifying whether they measure what they propose to measure (Hair *et al.,* 2005). Subsequently, face validity was performed, which aims to verify that the questionnaire does not have problems in its presentation (Hair *et al,* 2005). The pre-test was applied to a sample of about 8 respondents.

After data collection, the questionnaires were checked for data purification. Incomplete questionnaires, i.e. those containing blank answers, or that are not filled in properly, were eliminated. Data that presented 80% of the answers in the same item were also removed from the database, in accordance with what is recommended by Hair *et al.* (2014).

Next, the sociodemographic characteristics of the sample were analyzed, which are divided into individual characteristics (gender, age group and length of professional experience) and characteristics of participation in the researched company (which area works, position occupied in the organization and total time in the current company).

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In total, 101 respondents were evaluated. All the variables collected were submitted to descriptive analyses. For categorical variables, absolute (n) and relative (%) frequencies were calculated. For the numerical variables, the mean, median, standard deviation, quartiles 1 and 3 (which are equivalent to the 25th and 75th percentiles, respectively), and the minimum and maximum values (Kaur; Stoltzfus; Yellapu, 2018).

The validity of the questionnaires elaborated was evaluated by confirmatory factor analysis models. The Henze-Zirkler test (Henze; Zirkler, 1990) was used to verify whether the data showed multivariate normality, an assumption for the use of the maximum likelihood (ML) estimator (Brown, 2015). Since this assumption was not met, the MLR estimator (ML with robust Huber-White correction for non-normality) was used (Lai, 2018). All analyses were conducted using R software version 4.3.3 (R Core Team, 2023) and considered a significance level (α) of 5%.

LITERATURE REVIEW

Management systems have been widely recognized as instruments that structure corporate governance models, promoting continuous improvement and strategic alignment of organizations (George, 2003; Viana, 2024). They are essential to ensure that corporate objectives are translated into practical and measurable actions across the organization. According to Hair et al. (2005), these systems integrate practices and tools that allow standardization and effectiveness in the execution of processes.

In the mining industry, efficient systems management is particularly relevant due to the complexity and environmental impact of operations. The literature highlights the importance of effective governance to address challenges such as environmental degradation and social conflicts (Garcia-Sánchez, 2022; Chiaro, 1997). The integration of management systems with sustainability and operational efficiency strategies not only improves financial results, but also reinforces corporate social responsibility.

The implementation of management systems depends heavily on an organizational culture that values continuous improvement and employee engagement. Studies by Viana (2024) emphasize that leadership plays a crucial role in sustaining management systems by providing continuous training and clear communication. On the other hand, failures in leadership and communication have been identified as significant barriers to the effectiveness of these systems (Avolio & Gardner, 2005).

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Process management is a systematic approach to the organization and control of a company's activities, aiming at efficiency and quality. In the mining sector, the standardization of processes contributes to reducing waste and increasing operational reliability.

Recent literature also highlights the impact of Industry 4.0 technologies, such as the Internet of Things (IoT) and big data, on the management of industrial processes. These technological advances enable more accurate and real-time monitoring, promoting data-driven decision-making (Viana, 2024). In the mining sector, the application of these technologies can minimize environmental impacts and increase the efficiency of operations.

RESULTS

Most respondents are male (74.3%), between 30 and 59 years of age (93.1%) and between 15 and 24 years of experience (52.5%). There are approximately the same number of respondents in each area of activity. In addition, most respondents are supervisors or coordinators (66.3%), have been in the current company for 10 years or more (59.4%) and have already participated in the implementation of a management system (68.3%).

Table 1 - Descriptive statistics of the variables analyzed. N = 101

Variable	**n (%)**
Gender (n = 101)	
Male	75 (74,26)
Female	26 (25,74)
Age group (n = 101)	
Less than 30 years old	2 (1,98)
From 30 and under 45 years old	48 (47,52)
From 45 and under 60 years old	46 (45,54)
From 60 years old	5 (4,95)
Length of professional experience (n = 101)	
Under 5 years old	1 (0,99)
From 5 and under 15 years old	18 (17,82)
From 15 and under 25 years old	53 (52,48)
Equal to or greater than 25 years	29 (28,71)
Area in which you currently work in your organization (n = 101)	
Operation	35 (34,65)
Maintenance	33 (32,67)
Support	33 (32,67)
Position held in the organization (n = 101)	
Supervisor / Coordinator	67 (66,34)
Area Manager	22 (21,78)
Senior Manager	12 (11,88)

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How long have you been with your current company? (n = 101)	
Less than 1 year	5 (4,95)
From 1 year old and less than 5 years old	19 (18,81)
From 5 years old and less than 10 years old	17 (16,83)
Equal to or greater than 10 years	60 (59,41)
Have you ever participated in the implementation of a management system in any company you worked for? (n = 101)	
Yes	69 (68,32)
No	32 (31,68)

The question referring to Perception with the highest disagreement was "For me, a management system is only to achieve certifications", with 93.1% of the sample answering 1 or 2. The question with the highest agreement was "for me a management system is too much bureaucracy", with 15.9% of respondents scoring 4 or 5. These results are detailed in Table 2 and represented in Figure 10.

Table 2 - Absolute (n) and relative (%) frequencies of the answers, on a Likert scale, to questions related to Perception. N = 101

Question	1	2	3	4	5
For me, a Management System is a lot of bureaucracy	27(26,73%)	38(37,62%)	20(19,80%)	13(12,87%)	3(2,97%)
For me, a Management System is very complex and consumes a lot of resources	32(31,68%)	37(36,63%)	17(16,83%)	14(13,86%)	1(0,99%)
For me a Management System is rigid and not flexible	36(35,64%)	38(37,62%)	18(17,82%)	6(5,94%)	3(2,97%)
For me, a Management System is just to achieve certifications	79(78,22%)	15(14,85%)	6(5,94%)	1(0,99%)	0 (0,00%)

The confirmatory factor analysis model with MLR estimator and with Perception as the only factor showed the following fit indices: $\chi2(2) = 3.098$, $p = 0.213$; RMSEA = 0.065, 95% CI = [0.000, 0.254], $p = 0.326$; SRMR = 0.034; CFI = 0.992; TLI = 0.976. Table 3 shows the standardized factor loadings obtained for each of the items.

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Table 3 - Standardized factor loadings and reliability and validity measures obtained for the confirmatory factor analysis model with Perception as the only factor.

Factor	Item	Standardized factor loading
Perception	Bureaucracy	0,702*
	Intricacy	0,959*
	Rigidity	0,560*
	Certifications	0,426*

This model presented acceptable internal consistency (= 0.754; McDonald's Omega = 0.798). * for p < 0.050. N = 101.α

The adjustment indices for Perception were adequate and all the items of this questionnaire were statistically associated with this factor. In the subsequent analyses, two calculations for the Perception Score will be considered: one with the values predicted by the confirmatory factor analysis and the other with the mean of the answers to the items that make up this questionnaire.

The question referring to Barreiras with the highest disagreement was "Lack of financial resources", with 51.5% of the sample answering 1 or 2. The questions with the highest agreement were "low organizational culture" and "inefficient leadership", with 59.4% of respondents scoring 4 or 5. These results are detailed in Table 4 and represented in Figure 12.

Table 4 - Absolute (n) and relative (%) frequencies of answers, on a Likert scale, to questions related to Barriers. N = 101

Question	1	2	3	4	5
Low ORGANIZATIONAL CULTURE	6(5,94%)	12(11,88%)	23(22,77%)	33(32,67%)	27(26,73%)
Lack of COMMITMENT FROM TOP MANAGEMENT	25(24,75%)	10(9,90%)	11(10,89%)	17(16,83%)	38(37,62%)
Inefficient LEADERSHIP	13(12,87%)	15(14,85%)	13(12,87%)	33(32,67%)	27(26,73%)
Lack of FINANCIAL RESOURCES	21(20,79%)	31(30,69%)	28(27,72%)	14(13,86%)	7(6,93%)
Lack of COMMUNICATION / TRAINING	12(11,88%)	13(12,87%)	15(14,85%)	38(37,62%)	23(22,77%)
Lack of collaboration from EMPLOYEES	8(7,92%)	18(17,82%)	25(24,75%)	30(29,70%)	20(19,80%)

The confirmatory factor analysis model with MLR estimator and with Barreiras as the only factor presented the following fit indices: $\chi 2(9) = 21.900$, p = 0.009; RMSEA = 0.088, 95% CI = [0.000, 0.197], p = 0.241; SRMR = 0.034; CFI = 0.981; TLI = 0.969. Table 5 shows the standardized factor loadings obtained for each of the items.

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Table 5 - Standardized factor loadings and reliability and validity measures obtained for the confirmatory factor analysis model with Barreiras as the only factor.

Factor	Item	Standardized factor loading
Barriers	Organizational culture	0,719*
	Top management	0,846*
	Leadership	0,847*
	Financial resources	0,737*
	Communication training	0,815*
	Employees	0,822*

This model showed excellent internal consistency (= 0.911; McDonald's Omega = 0.916). * for p < 0.050. N = 101.α

The adjustment indices for Barreiras were adequate and all items of this questionnaire were statistically associated with this factor. In the subsequent analyses, two calculations for the Barrier Score will be considered: one with the values predicted by the confirmatory factor analysis and the other with the average of the answers to the items that make up this questionnaire.

The question referring to the Pillars with the greatest disagreement was "quality will not be impacted when we optimize the flow (of product and/or information) as much as possible for greater productivity", with 17.8% of the sample answering 1 or 2. The question with the highest agreement was "standardization is the basis of a management system", with 96.0% of the respondents scoring 4 or 5. These results are detailed in Table 6 and represented in Figure 14.

Table 6 - Absolute (n) and relative (%) frequencies of answers, on a Likert scale, to questions related to Pillars. N = 101.

Question	1	2	3	4	5
Standardization is the basis of a Management System	2(1,98%)	0 (0,00%)	2(1,98%)	31(30,69%)	66(65,35%)
Expectations agreements with KPIs defined and verified in daily meetings between customer and supplier (internal) are essential for the success of the organization	1(0,99%)	0 (0,00%)	4(3,96%)	33(32,67%)	63(62,38%)
Quality will not be impacted when we optimize the flow (of product and/or information) as much as possible for greater productivity	8(7,92%)	10(9,90%)	16(15,84%)	34(33,66%)	33(32,67%)

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Dedicated Working Groups are the best alternative in the search for solutions to chronic problems	2(1,98%)	1(0,99%)	8(7,92%)	39(38,61%)	51(50,50%)
The Leader is the protagonist for the implementation / maintenance of an effective Management System	2(1,98%)	3(2,97%)	2(1,98%)	27(26,73%)	67(66,34%)

The confirmatory factor analysis model with MLR estimator and with Pillars as the only factor presented the following fit indices: $\chi2(5) = 6.596$, $p = 0.252$; RMSEA = 0.059, 95% CI = [0.000, 0.172], $p = 0.370$; SRMR = 0.049; CFI = 0.984; TLI = 0.968. Table 7 shows the standardized factor loadings obtained for each of the items.

Table 7 - Standardized factor loadings and reliability and validity measures obtained for the confirmatory factor analysis model with Pillars as the single factor.

Factor	Item	Standardized factor loading
Pillars	Standardization	0,687*
	Agreements between the parties	0,849*
	Optimized flow	0,302*
	Dedicated group	0,578*
	Leading leadership	0,611*

This model presented questionable internal consistency (= 0.695; McDonald's Omega = 0.687). * for $p < 0.050$. N = 101.α

The adjustment indices for Pillars were adequate and all items of this questionnaire were statistically associated with this factor. In the subsequent analyses, two calculations for the Pillar Score will be considered: one with the values predicted by the confirmatory factor analysis and the other with the mean of the answers to the items that make up this questionnaire.

The question referring to Impacts with the greatest disagreement was "in your opinion, considering the interconnection between different areas of the organization, the assurance of the quality of the product or information will be achieved only if the organization uses tools...", with 6.9% of the sample answering 2. The question with the highest agreement was "does a management system promote an organizational culture focused on efficiency, encouraging employees to make improvements, reducing waste and consequently the costs of an organization", with 96.0% of respondents scoring 4 or 5. These results are detailed in Table 8 and represented in Figure 16.

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Table 8 - Absolute (n) and relative (%) frequencies of responses, on a Likert scale, to questions related to Impacts. N = 101.

Question	2	3	4	5
Think about the companies that are a benchmark in terms of operational efficiency. The presence of a Management System is common in these cases. In your opinion, is this a determining factor?	2(1,98%)	4(3,96%)	37(36,63%)	58(57,43%)
In his opinion, considering the interconnection between different areas of the organization, the guarantee of product or information quality will be achieved only if the Organization uses Tools	7(6,93%)	9(8,91%)	49(48,51%)	36(35,64%)
A Management System promotes an organizational culture focused on efficiency, encouraging employees to make improvements, reducing waste and consequently the costs of a	2(1,98%)	1(0,99%)	27(26,73%)	71(70,30%)
When considering the importance of the work environment for individual and collective performance, does a Management System have full relevance for the promotion of a healthy organizational climate?	3(2,97%)	6(5,94%)	37(36,63%)	55(54,46%)
In your opinion, the only way to maintain occupational safety, health of our employees and environmental issues (according to the legislation) is through a Management System?	3(2,97%)	18(17,82%)	38(37,62%)	42(41,58%)

The adjustment indices for Impacts were not adequate ($\chi2(5) = 18.703$, $p = 0.002$; RMSEA = 0.170, 95% CI = [0.089, 0.257], $p = 0.003$; SRMR = 0.066; CFI = 0.885; TLI = 0.770). The modification indices suggested the addition of a covariance between Production and Costs, which was inserted into the model. The confirmatory factor analysis model with MLR estimator and with Impacts as the only factor showed the following fit indices: $\chi2(4) = 5.962$, $p = 0.202$; RMSEA = 0.071, 95% CI = [0.000, 0.194], $p = 0.304$;

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SRMR = 0.034; CFI = 0.984; TLI = 0.959. Table 9 shows the standardized factor loadings obtained for each of the items.

Table 9 - Standardized factor loadings and reliability and validity measures obtained for the confirmatory factor analysis model with Impacts as the single factor.

Factor	Item	Standardized factor loading
Impacts	Production	0,547*
	Quality	0,692*
	Costs	0,534*
	People	0,788*
	Sustainability	0,549*

This model presented acceptable internal consistency (= 0.770; McDonald's Omega = 0.741). * for p < 0.050. N = 101.α

This model presented adequate fit indices and all items of this questionnaire were statistically associated with the factor. In the subsequent analyses, two calculations for the Impact Score will be considered: one with the values predicted by the confirmatory factor analysis and the other with the average of the responses to the items that make up this questionnaire.

The correlations between the perception, barriers, impacts, and pillar scores are low. For the scores calculated from the means of the responses to the items, there were only two significant correlations: between perception and impacts, and between pillars and impacts. The correlation between perception and impacts (r = -0.310) was negative and weak, indicating that respondents who scored more in perception tended to score less in impacts. The correlation between pillars and impacts (r = 0.517) was positive and moderate, indicating that respondents who scored more on pillars also tended to score more on impacts.

This same pattern was observed for the scores obtained from the factor analysis model. In addition, the scores calculated from the mean showed very high and positive correlations with the scores calculated from the factor analysis. This result indicates that the simplest version of the score calculation, performed from the mean, is adequately representing the constructs. Pearson's correlations between the variables analyzed are detailed in Table 10 and represented in Figure 18.

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Table 10 - Pearson's correlation matrix for perception, barriers, pillars, and impacts scores. N = 101

	Perception Score	Barrier Score	Pillar Score	Impact Score	Perception Factor Score	Barreiras Factor Score	Pillars Factor Score
Barrier Score	0,030						
Pillar Score	-0,092	-0,081					
Impact Score	-0,310*	-0,046	0,517*				
Perception Factor Score	0,925*	0,064	-0,080	-0,245*			
Barreiras Factor Score	0,030	0,999*	-0,085	-0,056	0,064		
Pillars Factor Score	-0,147	0,015	0,905*	0,546*	-0,121	0,008	
Factor Score Impacts	-0,307*	-0,076	0,482*	0,975*	-0,263*	-0,085	0,506*

* for p < 0.05 in the correlation test. Factor score refers to the score calculated via confirmatory factor analysis. The other scores were calculated by the average of the answers to the items that make up the questionnaire.

Factor score refers to the score calculated via confirmatory factor analysis. The other scores were calculated by the average of the answers to the items that make up the questionnaire. The perception, barriers, pillars and impacts scores did not vary according to the position occupied. Respondents from different positions had similar scores. These results are detailed in Table 11 and represented in Figures 19 to 16.

Table 11 - Comparison of Perception, Barriers, Pillars and Impacts scores according to the position you occupy in the organization. N = 101.

Variable	Position you hold in the organization			p	$h2_{[H]}$
	Supervisor / Coordinator (n = 67)	**Area Manager (n = 22)**	**Senior Manager (n = 12)**		
Perception Score				0,201	0,012
Mediana (Q1; Q3)	1,75(1,25; 2,50)	1,75(1,25; 2,00)	2,38(1,69; 2,75)		
Mean (SD)	1,94 (0,77)	1,77 (0,62)	2,23 (0,69)		
Barrier Score				0,269	0,006
Mediana (Q1; Q3)	3,33(2,17; 4,08)	4,00(3,04; 4,17)	4,00(2,50; 4,00)		
Mean (SD)	3,18 (1,16)	3,63 (0,86)	3,32 (1,11)		
Pillar Score				0,348	0,001
Mediana (Q1; Q3)	4,40(4,00; 4,80)	4,20(4,05; 4,40)	4,40(3,95; 4,65)		
Mean (SD)	4,37 (0,67)	4,28 (0,38)	4,33 (0,50)		
Impact Score				0,837	-0,017
Mediana (Q1; Q3)	4,40(4,10; 4,80)	4,40(4,05; 4,60)	4,60(4,15; 4,65)		
Mean (SD)	4,38 (0,57)	4,35 (0,49)	4,43 (0,47)		

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Perception Factor Score				0,206	0,012
Mediana (Q1; Q3)	-0,13(-0,79; 0,57)	-0,13(-0,79; -0,07)	0,57(-0,35; 0,63)		
Mean (SD)	0,00 (0,77)	-0,18 (0,60)	0,31 (0,74)		
Barreiras Factor Score				0,268	0,006
Mediana (Q1; Q3)	0,02(-0,85; 0,60)	0,52(-0,16; 0,65)	0,50(-0,60; 0,55)		
Mean (SD)	-0,09 (0,85)	0,25 (0,63)	0,02 (0,82)		
Pillars Factor Score				0,310	0,004
Mediana (Q1; Q3)	0,19(-0,24; 0,36)	-0,09(-0,30; 0,24)	0,24(-0,14; 0,30)		
Mean (SD)	0,01 (0,50)	-0,05 (0,31)	0,03 (0,43)		
Factor Score Impacts				0,760	-0,015
Mediana (Q1; Q3)	0,06(-0,15; 0,28)	0,01(-0,19; 0,20)	0,12(-0,08; 0,21)		
Mean (SD)	0,00 (0,35)	-0,02 (0,28)	0,04 (0,28)		

Kruskal–Wallis test. $\eta 2_{[H]}$ = ordinal eta-square. SD = standard deviation; Q1 = first quartile (25th percentile); Q3 = third quartile (75th percentile). Factor score refers to the score calculated via confirmatory factor analysis. The other scores were calculated by the average of the answers to the items that make up the questionnaire.

The scores of perception, barriers, pillars and impacts did not vary according to the area of activity. Respondents from different areas had similar scores.

Table 12 - Comparison of Perception, Barriers, Pillars and Impacts scores according to the Area in which you currently work in your organization. N = 101

Variable	**Area in which you currently work in your organization**			**p**	**$h2_{[H]}$**
	Maintenance(n = 33)	**Operation(n = 35)**	**Support(n = 33)**		
Perception Score				0,548	-0,008
Mediana (Q1; Q3)	1,75(1,50; 2,50)	1,50(1,25; 2,50)	2,00(1,50; 2,50)		
Mean (SD)	1,97 (0,77)	1,88 (0,82)	1,98 (0,60)		
Barrier Score				0,643	-0,011
Mediana (Q1; Q3)	3,50(2,67; 3,83)	3,83(2,58; 4,17)	3,67(2,00; 4,17)		
Mean (SD)	3,27 (0,91)	3,40 (1,14)	3,21 (1,24)		
Pillar Score				0,070	0,034
Mediana (Q1; Q3)	4,40(4,00; 4,80)	4,80(4,20; 5,00)	4,20(4,00; 4,60)		
Mean (SD)	4,27 (0,70)	4,51 (0,49)	4,24 (0,55)		
Impact Score				0,160	0,017
Mediana (Q1; Q3)	4,20(4,00; 4,60)	4,60(4,40; 4,90)	4,60(4,00; 4,80)		
Mean (SD)	4,22 (0,63)	4,47 (0,52)	4,44 (0,43)		
Perception Factor Score				0,540	-0,008
Mediana (Q1; Q3)	-0,13(-0,70; 0,60)	-0,17(-0,81; 0,57)	-0,09(-0,24; 0,55)		
Mean (SD)	0,04 (0,77)	-0,05 (0,83)	0,02 (0,60)		
Barreiras Factor Score				0,697	-0,013
Mediana (Q1; Q3)	0,09(-0,48; 0,53)	0,37(-0,55; 0,64)	0,31(-0,96; 0,62)		
Mean (SD)	-0,02 (0,67)	0,07 (0,84)	-0,06 (0,91)		

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Pillars Factor Score				0,144	0,019
Mediana (Q1; Q3)	0,11(-0,34; 0,29)	0,28(-0,17; 0,38)	0,12(-0,30; 0,34)		
Mean (SD)	-0,12 (0,60)	0,10 (0,34)	0,01 (0,36)		
Factor Score Impacts				0,212	0,011
Mediana (Q1; Q3)	0,01(-0,20; 0,16)	0,10(-0,07; 0,33)	0,09(-0,19; 0,23)		
Mean (SD)	-0,09 (0,38)	0,04 (0,33)	0,04 (0,24)		

Kruskal–Wallis test. $\eta 2_{[H]}$ = ordinal eta-square. SD = standard deviation; Q1 = first quartile (25th percentile); Q3 = third quartile (75th percentile). Factor score refers to the score calculated via confirmatory factor analysis. The other scores were calculated by the average of the answers to the items that make up the questionnaire.

The Kruskal-Wallis test indicated that the Impact score, calculated from the mean, varied according to the length of professional experience. The Dunn-Bonferroni post-hoc indicated that the scores of the "Equal to or greater than 25 years old" group are statistically higher than the scores of the "From 15 years old and younger than 25 years old" group. These results are detailed in Table 13 and represented in Figures 35 to 42.

Table 13 - Comparison of Perception, Barriers, Pillars and Impacts scores according to Length of professional experience. N = 101

Variable	**Length of professional experience**			**p**	**$h2_{[H]}$**
	Up to 15 years (n = 19)	**From 15 to under 25 years of age (n = 53)**	**Equal to or greater than 25 years (n = 29)**		
Perception Score				0,385	-0,001
Mediana (Q1; Q3)	2,00(1,50; 2,38)	2,00(1,25; 2,50)	1,50(1,25; 2,25)		
Mean (SD)	2,07 (0,80)	1,96 (0,67)	1,83 (0,81)		
Barrier Score				0,866	-0,018
Mediana (Q1; Q3)	3,67(2,42; 4,00)	3,67(2,67; 4,00)	3,83(2,00; 4,17)		
Mean (SD)	3,28 (1,02)	3,39 (1,05)	3,14 (1,25)		
Pillar Score				0,319	0,003
Mediana (Q1; Q3)	4,20(4,00; 4,60)	4,40(4,00; 4,80)	4,40(4,00; 5,00)		
Mean (SD)	4,21 (0,55)	4,35 (0,64)	4,42 (0,54)		
Impact Score				0,048	0,042
Mediana (Q1; Q3)	4,60(3,90; 4,80) ab	4,40(4,00; 4,60) a	4,60(4,40; 5,00) b		
Mean (SD)	4,34 (0,61)	4,30 (0,51)	4,54 (0,51)		
Perception Factor Score				0,428	-0,003
Mediana (Q1; Q3)	-0,13(-0,42; 0,50)	-0,09(-0,77; 0,60)	-0,17(-0,79; 0,55)		
Mean (SD)	0,06 (0,73)	0,04 (0,72)	-0,11 (0,78)		
Barreiras Factor Score				0,844	-0,017
Mediana (Q1; Q3)	0,16(-0,59; 0,56)	0,29(-0,46; 0,59)	0,33(-0,99; 0,62)		
Mean (SD)	0,00 (0,76)	0,06 (0,77)	-0,12 (0,91)		
Pillars Factor Score				0,130	0,021

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Mediana (Q1; Q3)	-0,02(-0,37; 0,20)	0,24(-0,23; 0,36)	0,19(-0,29; 0,38)		
Mean (SD)	-0,13 (0,40)	0,02 (0,51)	0,04 (0,37)		
Factor Score Impacts				0,070	0,034
Mediana (Q1; Q3)	0,06(-0,24; 0,26)	-0,06(-0,19; 0,16)	0,16(-0,04; 0,36)		
Mean (SD)	-0,02 (0,37)	-0,04 (0,31)	0,09 (0,32)		

Kruskal–Wallis test. $\eta 2_{[H]}$ = ordinal eta-square. SD = standard deviation; Q1 = first quartile (25th percentile); Q3 = third quartile (75th percentile). Distinct letters indicate groups that differ statistically from each other ($p < 0.05$).

Head of Kruskal-Wallis, followed by post-hoc Dunn-Bonferroni. Different letters indicate groups that differ statistically from each other ($p < 0.05$). N = 101.

DISCUSSION AND RECOMMENDATIONS

The result of the analysis allowed us to see some important points in this mining company in relation to the way the management system is seen by its leaders. The objective of this session is to make some relevant highlights that demonstrate the achievement of the desired objective in this work and then propose some recommendations based on what was captured during the process of quantitative analysis of the data.

As already mentioned in this work, leadership plays a fundamental role in directing, coordinating and motivating people to generate operational results (Lopes and Silva, 2019), but for this, the success of implementing and maintaining an effective management system is closely associated with how the organization's leadership is engaged in using it with discipline (Collins, 2001). The result of this work was able to identify how closely this mining company (object of research and analysis) adheres closely to this concept, that is, how much its leadership is cohesive and has a positive perspective in relation to the use of the management system (Drucker, 2019).

With regard to perception, the negative response of leaders (93.07%) regarding the management system being used only to achieve certifications in standards was massive. On the contrary, 94.06% of leaders attribute that companies that are a reference in terms of operational efficiency mostly have a management system in place, corroborating what Drucker (2019) wrote, in which a well-implemented management system can provide structure, direction, and control for an organization, allowing leaders to make more informed and effective decisions to achieve organizational objectives.

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When leaders were asked about the main barriers to a management system acting efficiently in their organization, the lack of financial resources stood out predominantly (51.49%), this confirms what was said by Slocum & Hellriegel (2019), that this applies especially to the implementation of management systems, where financial commitment is required for obtaining and maintaining certifications and compliance with standards.

Regarding the pillars, the leaders were almost unanimous (96.04%) in stating that standardization is the basis for an efficient management system, in line with Dale (2003), when he says that the standardization of processes and procedures allows organizations to more effectively manage multiple management systems, such as quality, environment, occupational health and safety.

Finally, the leadership was also cohesive (97.03%) in saying that the main positive impact on the use of the management system is on the company's operating cost. This confirms the theory that management systems can help reduce operating costs, minimize waste, and improve process efficiency, resulting in more effective financial management (Garvin and Edmondson, 2008).

Although the leadership staff is predominantly male (74.26%), we did not observe significant differences in opinion between genders in relation to the favorability of the use of the management system in the mining company. The same happened for the different levels of management. The vast majority of leaders (66.34%) are at the 1st level of management (Coordinator / Supervisor), followed by 21.78% of Area Managers (2nd level of management) and finally Senior Managers (highest level before the company's board of directors), with 11.88%. It is interesting to note that between these levels different perceptions of the system were also not identified.

Therefore, an alignment of the organization as described by George (2003) is observed, in which organizations that create an environment that aligns the interests of employees with the organization's mission, results in greater wealth for shareholders and long-term sustainable growth. Apparently, it is part of the organization's culture that all managers are aligned in relation to the implemented management system, which in turn generates the engagement of everyone to work in line with the model adopted in the organization.

The same occurred in relation to the areas in which the manager works. We had a balance of respondents between the areas of activity: Operation, Maintenance and Support with 34.65%, 32.67% and 32.67% respectively, but when analyzing the main barriers,

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perception, impacts and pillars in relation to the system, a homogeneity in the responses is perceived, which reveals a uniform implementation in all fields of the company, which according to Viana (2020), An organization's management system must encompass all its management subsystems, which are composed of standardized practices. These systems cover a variety of areas such as operation, maintenance, including human resources, finance, communication, and logistics.

When we analyzed the correlations between the perception, barriers, pillars and impacts scores, we found interesting points. The first of them is the correlation between pillars and impacts (r = 0.517), both by the mean and by the factor analysis the result was positive and moderate, which may suggest that the leaders that the impact of the management system is positive on the business, but that it depends on the pillars of the system, that is, the choice of these pillars or fundamentals influences the consequence of the result (impact) on the business. In the mining company that is the object of this study, the correct choice of the pillars of its management system has generated the achievement of its results as answered by its leadership.

When it comes to the position occupied in the organization, the scores of perception, barriers, pillars and impacts obtained through confirmatory factor analysis did not vary. In this case, it can be said that from the degree of relevance in relation to the management system is the same from the operational to the strategic level of the organization. In other words, part of the success of this mining company's management system can be attributed to the way the organizational culture values, or makes relevant to the entire management line, its way of conducting business through standardized methods.

The same occurred in relation to the area in which the manager works. In the confirmatory factor analysis, there was also no variation in the scores of perception, barriers, pillars and impacts. It is assumed, therefore, that the influence of the management system is not limited only to the operational areas, but also to maintenance and business support areas such as supplies, human resources, infrastructure, new projects, communication, HSE (health, safety and environment) and social relations. Once again, the success of the organization when using the management system, as in this mining company, is due to the fact that all the departments necessary for its operation are aligned with the management model implemented and governed through its system.

Finally, it was identified that the length of professional experience calculated from the mean (through the Kruskal-Wallis test) was statistically higher in the group "Equal to or

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greater than 25 years" in the Impacts score. This demonstrates that leaders with longer careers (even at different levels of leadership) more easily attribute the positive impacts of a management system on the business.

Today, with so many generations sharing the same workspace in an organization, it is natural that younger leaders do not associate the positive results of a business with the management system instituted there. Therefore, in an organization that seeks to be cohesive throughout its leadership board, those with greater experience need to be aware that the process of favorability on the part of younger people in relating the management system to the impacts on results is something natural, it will occur in the long term with discipline and cooperation on the part of all.

FINAL CONSIDERATIONS

This work sought to understand from a leadership framework of a mining company how a management system already implemented, what are the main barriers to successful implementation as well as the perception of this group of leaders about this management model, what are the main pillars (fundamentals) and whether, from the perspective of leadership, the management system generates positive impacts (financial and non-financial) on the business.

In this mining company surveyed, according to the perception of the leaders, the management system is not implemented to seek or guarantee the maintenance of international management standards, such as ISO standards, for example, in fact this comes as a consequence, as a way to legitimize the management model adopted. In other words, the focus is not on the award, but on the continuous improvement of its processes.

According to the evaluation of the leaders of this mining company surveyed, it is not financial limitation that prevents a management system from being successfully implemented and maintained, but the organizational culture, the support of senior leadership, the deployment (communication / training) to employees, which can be a barrier to the implementation and maintenance of a management system. In fact, according to the survey results, standardization, clear expectations between the parties and leadership are the main foundations for an efficient management system.

It was also very clear how much a management system promotes a culture focused on continuous improvement. A company that has a long-term vision must be concerned with how its purpose is understood by all employees and how this is reinforced day by day

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in its processes. A management system aims to keep alive in everyone's mind what the purpose of the company is and how each one has a daily participation in it.

It is also important to highlight that the longer you have in your career, the greater your favorability in working governed by management systems that promote standards, organization, discipline and clear expectations between parties. In view of this, I suggest a more specific look at leaders with shorter career time, in order to maintain a level of engagement in the use of the management system as perceived in leaders with longer career time.

Data collection took place with a questionnaire, applied to the leaders (managers between 3 levels of leadership) of a mining company in the north of Brazil during an annual event held for the leadership of this company and obtained 101 valid responses (after data cleaning). The analysis was carried out using the R software version 4.3.3 (R Core Team, 2023).

The model was evaluated through a Confirmatory Factor Analysis. In addition to the sociodemographic questions, the other questions were grouped into 4 groups: Perception, Barriers, Pillars and Impacts. With this, it was confirmed that the vast majority of leaders attribute a large part of the success of the company in which they work to the management system. No matter what area of activity, the position you occupy in the organization or length of professional experience, once implemented with the involvement of everyone, the company starts to have a cohesive and well-directed leadership. With this, the objective of the work was achieved: all the relationships between the indicators of perceptions, barriers, impacts and pillars on a management system of a mining company in the view of its leadership staff were verified.

For those who wish to use the questionnaire elaborated, I recommend the use of the score by the mean, since the correlation between the score calculated by the mean and the score calculated by the Confirmatory Factor Analysis were very high and positive. The result indicates that the simplest version of the score calculation, performed from the mean, is adequately representing the constructs.

In the Brazilian context, we have many national or multinational mining companies (medium and large), with different approaches to management systems, each contributing with a certain degree of success. If this questionnaire were applied, we could compare which approaches have been more successful, which are the main barriers in the Brazilian

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market, as well as a greater understanding of what is most important for leadership in relation to the pillars of an efficient management system.

As noted, this work was limited only to researching the degree of success of the management system measured through the opinion of the group of leaders of only one mining company in the north of the country. In addition, the mining company surveyed has been operating the management model for more than 10 years and this may end up weighing on the favorability of the responses by most of the leadership.

For future work, it is suggested to identify the necessary steps to implement a management system that has the engagement of leadership and employees. In addition, it is important to check which management tools are most used in these systems as well as the level of importance of these for each sphere of strategic, tactical and operational management. Finally, it is interesting to see if there is any correlation between the success of the management system and some program that recognizes the improvements made by employees.

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