

Asset Management Policy for Equipment Replacement

Ana Carolina Gandini Panegossi

carolinagandini@uol.com.br

Ethel Cristina Chiari da Silva

e-chiari@uol.com.br

Professional Master's Program in Industrial Engineering, University of Araraquara (UNIARA)
Araraquara, SP, Brazil

Abstract

Equipment replacement is an important decision all manufacturing companies must face, motivated by rising operating and maintenance costs or technological advances of assets. Although there are methods of analysis that indicate the necessity and the time equipment should be replaced, performance and expense data are required. The studied company has productive equipment to be replaced; however, its data have been insufficient for applying these methods. Thus, this study's purpose was to develop an asset management policy, focusing on critical assets replacement, based on ISO 55001:2014 requirements, with ISO 55002:2018 guidelines and alignment of financial and non-financial functions of ISO 55010:2019. Therefore, this work undertook a bibliographic review, and a case study has been carried out in a family-run medium-sized company located within the state of São Paulo. As a result, this work brings an asset management policy integrated into the organizational planning to guide and ensure the critical assets have the performance assured to deliver value to the company until its replacement. The development of this study has provided a support framework for asset replacement decision-making. Moreover, it enabled managers to understand how quality data availability can make the decision process safer and more professional.

Keywords

Asset management, Equipment replacement, ISO 55001:2014, ISO 55002:2018, ISO 55010:2019.

1. Introduction

Equipment replacement is an important decision all manufacturing companies must face, motivated by either rising operating and maintenance costs or technological advances of available assets in the market. (Hartman and Tan, 2014). However, equipment replacement is among the most relevant financial decisions since new equipment purchases are usually irreversible, involving high costs and compromising the company capital (Casarotto Filho and Kopitke, 2017).

Asset replacement decisions must be based on accurate information about its conditions, through analysis and diagnosis, by ensuring, for the organization, the best return on invested capital, the best operating performance, and the lowest risk (Zampolli et al., 2019). Although there are methods of analysis that indicate the necessity and the time equipment should be discarded or replaced, performance and costs data of equipment are required.

The Strategic Asset Management Plan (SAMP) is the starting point for developing the asset management policy, strategy, objectives, and plans, which lead to the assets life cycle activities optimal combination - according to criticality, condition, performance, and the level of risk. As per the company's strategic planning and values, the policy represents the mandatory principles and requirements (ISO, 2014). In addition, high-level responsibilities may also be established in policy, as approving capital asset acquisition/replacement plans and reviewing asset performance. (Hastings, 2015).

The studied company has productive equipment to be replaced; however, its data have been insufficient for applying these methods. Thus, for the construction of asset management policy focusing on equipment replacement, ISO 55001 requirements, Context of the Organization, Leadership, and Planning have been carried out. Additional tools have been used to accomplish the requirements, such as SWOT analysis (Strength, Weakness, Opportunity, Threat), Balanced Scorecard, among others. Based on the performance, costs, and risks indicators, the policy indicates which data should be pointed out by the various responsible areas defined in the SAMP so that the replacement analyses and decision-making be effective.

As a result, this work brings an asset management policy integrated into the organizational planning to guide and ensure the critical assets have the performance assured to deliver value to the company until its replacement. The development of this study has provided a support framework for asset replacement decision-making. As it is a family-run company, this work also enabled managers to understand how both the quality data availability and organizational tools insertion can make the decision process safer and more professional.

1.1 Objectives

This study aimed to propose an asset management policy, based on ISO 55001 requirements, along with the guidelines of ISO 55002:2018 and financial alignment of ISO 55010:2019, in a medium-sized metal mechanic company located within the state of São Paulo, which has productive equipment to be replaced.

2. Literature Review

Among the various policies formulated by an organization to achieve its objectives, expectations, and needs, there is the asset management (AM) policy. As with any policy, the AM policy must be authorized and adhered to by senior management, aligned with the organization's objectives and other policies. The development of the AM policy is a complex process, which must surround the strategic analysis of the organization's situation in the market (Zampolli et al., 2019). It serves to corroborate the organization's action in considering the influence of potential factors in its results (Lafraia, 2020a).

AM policy is a brief statement that establishes the principles by which the organization intends to apply asset management to achieve its objectives and provide its intentions and direction (ISO, 2018). The policy must be consistent with the requirements of interested parties, be supported by senior management, be effectively communicated and regularly reviewed, and commit to a continuous improvement of the Asset Management System (AMS) (GFMAM, 2014).

Every company needs to have a clear policy for renewing its equipment, which must be replaced, not only when they are infallibly damaged, but also when (i) operating and/or maintenance costs over the asset exceeded the replacement cost; (ii) there is an imminent risk of asset failure; (iii) the impact of a likely failure exceeds the replacement cost; (iv) a presumed failure might compromise the reliability and the security of the system and the people; (v) assets have become obsolete and inefficient to operate; (vi) gains by replacing imply the improvement of indicators company performance, moreover, of the people safety and environment indicators (Zampolli et al., 2015).

Just as AM policy must be supported by top management, for ISO 55010, top management must adhere to and guarantee, through the established policy, the role of alignment between financial and non-financial functions. Also, a commitment to provide the information, knowledge, and resources needed to achieve, maintain, and continually improve this alignment is necessary. Technical and financial functions must be available for decision-making on replacement, renewal, maintenance, among others, ensuring that decisions are informed and balancing the financial needs and performance requirements of assets (ISO, 2019).

The replacement of an asset requires vast investments, and companies try to extend the life cycle of their machines through repairs and maintenance, but they must replace them with new and suitable ones at the end of their useful life. Many industry assets are older than the life for which they were initially designed. In many cases, do not replace the assets leads to high energy consumption, high maintenance costs, and an increased risk of accidents and calamities. Deciding between replacing or repairing an asset presents a significant challenge for asset owners. Knowing how to determine what option is best for the organization's operations and when assets should be replaced helps control downtime and unexpected costs (Madusanka et al., 2016). Effective repair or replacement decisions for physical assets are essential for organizations that compete in sectors with intensive physical assets. Beyond require substantial and significant capital investment, these decisions affect profitability and financial performance (Theron, 2016).

For long-life equipment, the life cycle is determined by obsolescence, lack of maintenance support, decreased reliability, loss of performance capacity, availability, and economical replacement viability. These decisions require cooperation between financial and non-financial functions (operations/maintenance) to allow the right decision to maintain the asset or replace it (ISO, 2019). The decision-making process considers the criteria and metrics to be

applied, the information required, the features, the level of complexity, the impact of this decision on the objectives, and the time constraints. The decision-making structure should be adapted to the organization's needs. There should be vertical alignment, from the organization context and expectations of interested parties to planning and operational control; furthermore, horizontal alignment, which are the internal and external stakeholders (ISO, 2018).

Physical asset owners must make a series of decisions to achieve effective and efficient management of these assets. Each decision is robust only when the information is available to provide objective evidence about all assets aspects (King and Crowley-Sweet, 2014). Although large amounts of data are increasingly collected to support asset management decision-making processes, the challenge is the best way to use these fragmented and disorganized data sets. It is essential to use and combine all relevant data, both technical and economic, to create new business knowledge to support effective decision-making (Kinnunen et al., 2016).

Value-based asset management, which is one of its foundations, is achieved when the organization uses the value delivered by assets as the primary decision criterion to choose between different options, both at the tactical and operational levels. Organizations must quantify the value delivered by their assets and manage them through informed and consistent decision-making (Roda et al., 2016). However, the value concerns the contribution to organizational objectives and can be expressed in several ways, and they are not always easy to quantify. The maximum total value is often equivalent to the asset life cycle's lowest cost (GFMAM, 2014).

To make effective decisions to be made when replacing equipment, it is necessary to build a policy with the criteria that must be considered. The asset replacement policy should be part of an organization's asset management policy, one of the Leadership requirements of ISO 55001. To develop the policy is necessary to create a Strategic Asset Management Plan (SAMP) and ISO 55001 requirements: Context of the Organization, Leadership, and Planning. ISO 55002: 2018 guidelines and the alignment between the financial and non-financial functions suggested by ISO 55010: 2019 could make the process easier and precise. Table 1 shows performance, costs, and risks indicators, proposed by Zampolli et al. (2015). Based on these indicators, the policy will indicate which data should be pointed out by the various responsible areas defined in the SAMP so that the replacement analyses and decision-making be effective.

Table 1. Performance, costs, and risks indicators

Performance Indicators or KPI's	Cost Indicators	Risk Indicators or KRI's
Regulated Indicators (DEC, FEC, DIC, FIC) MTBF – Mean time between failures Availability (hours without interruption) Failure rate / critical equipment Fault severity Mean time between repairs Maintainability Frequency of failures or repairs Technical losses / MWh installed or Total loss/km network Reliability Hours dedicated to asset management/team hours available Reliability Hours dedicated to asset management/team hours available	Total cost of maintenance/ total asset value Actual cost (sum of amortized repair costs (average acquisition cost - average depreciation X (1- average age of asset)) Operating Cost / MWh sold Maintenance Costs** / Estimated costs of asset replacement Maintenance Cost / Operating Cost Cost of operation / Asset base value Capex value provided / Performed capex value **Maintenance cost includes labor, contractors, support, overhead, training, spare parts, materials, and systems, excludes depreciation costs and downtime because of maintenance.	Exposure Degree/number of failures Probability of failure/maintenance costs Investment in training/costs of accidents and incidents Estimated costs of the company exposure/investments in maintenance and operation Rate of return per maintenance project Number of warnings from the regulator / MWh sold Cost fines/investments in maintenance

Asset management focuses on delivering declared capability, which depends on assets' performance (Lafraia, 2015). The capability is to measure an entity's capacity and ability to achieve its objectives (Lafraia, 2020b). To ensure the continuous improvement of assets performance and generate value for organizations, besides alignment, guarantee, and leadership, asset management fundamentals, the SAMP must be according to corporate planning.

Corporate planning (or strategic planning) must contain the following attributes: (i) the strategic purposes and clearly defined objectives; (ii) internal strengths and weaknesses, external opportunities, and threats are considered; (iii) alignment among the strategic planning, short-term objectives, and indicators, as short-term objectives work to achieve long-term objectives; (iv) integration between the strategic planning, the objectives and the budgets to achieve them; (v) connections that demonstrate how the strategic planning will meet stakeholder requirements (Lafraia, 2015). Some key questions must be asked before preparing a SAMP: what is the company's current situation? Where does the company want to be in the period considered? What are the objectives and associated risks? How to get there? How will they be measured? (Zampolli et al., 2019). For Arthur et al. (2016), the organization must start with the end in mind.

According to industry experts, ISO 55001 has a positive effect on all perspectives: financial, customer, business processes, and learning and growth, indicating that organizations that adopt the certification can obtain better performance from the effectiveness and efficiency of managing their assets (Alsyounf et al., 2018). Although asset management, through the implementation of ISO 55001, occurs only in large companies, Paris and Severino's (2017) research shows the relevance of applying an international standard model in small and medium-sized companies. For the authors, any entity, regardless of its size, must establish a strategy for managing its assets, and ISO 55001 can help develop that strategy. To deliver SAMP and requirements of ISO 55001:2014, the methodologies based on Meirelles' (2018) research, described in Table 2, will be followed.

Table 2. Requirements and Proposed Methodologies

Requirements	Proposed Methodologies
4 Context of the Organization	
4.1 Understanding the organization and its context	SWOT analysis
4.2 Understanding needs and expectations of stakeholders	Identify and prioritize stakeholders and their asset management needs and expectations
4.3 Determining the scope of the asset management system	Identify, locate (geographically and within the organization), characterize (briefly), and classify the physical assets covered by the AMS
4.4 Asset management system	Make an initial diagnosis of the asset management current state Make a Balanced Scorecard Establish an activity implementation plan
5 Leadership	
5.1 Leadership and commitment	Prepare in SAMP
5.2 Policy	Define the AM Policy
5.3 Organizational roles, responsibilities and authorities	Demarcate the responsibilities and authorities of crucial roles, whether internal or subcontracted
6 Planning	
6.1 Actions to address risks and opportunities for the asset management system	Identify asset management risks/opportunities and define actions to minimize/maximize them Define the asset management objectives Develop contingency plans
6.2 Asset management objectives and planning to achieve them	Establish a plan to achieve the objectives defined in 6.1 Define a plan to manage the life cycle of assets that are part of the management scope

3. Methods

This work can be considered a case study, as it is an in-depth study of a theme, allowing its broad and detailed knowledge. For this study preparation, research was carried out on books, dissertations, scientific articles available in electronic journals - through search sites such as Scopus, Scielo, Google Scholar, websites of associations and asset management organizations, asset management congresses books, practical manuals, and others. The search was carried out using the following descriptors: equipment replacement; asset replacement; asset management; ISO 55000: 2014, ISO 55001: 2014, ISO 55002: 2014, ISO 55002: 2018, ISO 5010: 2019, NBR ISO 55002: 2020.

Collection procedures carried out by the researchers were: document analysis, company database, data from companies that provide service and sale of maintenance parts, external accounting, service providers from the ERP; open interviews with managers (managers and directors of the company), consultants (financial and quality) and employees; meetings with consultants, managers, and employees who are and will be involved in asset management plans. Operating procedures were performed, for the most part, by the researchers, company consultant, and the co-participation of employees involved in AM activities and who will be responsible for implementing the standard requirements in the company. Next, Data Collection is presented.

4. Data Collection

SAMP and Context of the Organization

In this requirement, internal and external issues pertinent to achieving the desired results with creating another management system, which should also be aligned with the organizational objectives, have been determined between the researchers and the company consultant. At the beginning of this work, the corporate goals were (i) Financial sustainability, (ii) Provide services that meet applicable legal requirements and those of customers, (iii) Continuously improve the management system processes, and (iv) Qualified employees with adequate resources in a safe environment. There was no specific objective for managing the infrastructure and productive equipment, even though the company assets' productive use provides the value and underpins all other company assets, being essential to its competitive business capacity.

As the company had already had a defined strategic plan, the SAMP and the policy were aligned with it. The quality management policy and the QMS (Quality Management System), which have existed for almost two decades in the company, are aligned with organizational planning. Thus, it was defined that the strategic planning would be redone. The quality management policy, asset management policy, and management systems were aligned and integrated with the same planning. In this requirement, the current strengths, weaknesses, opportunities, and threats were considered, through a SWOT analysis, for organizational management and the relevant internal and external factors that can affect its ability to achieve the intended results. Briefly, the pointed weaknesses were the absence of the following: an AM policy; extraction and analysis of information from the maintenance system; unavailability of AM indicators: MTTR and MTBF, among others; production capacity/equipment; installations; execution of maintenance as per plan; factory structure/machinery and deficient equipment; deficient IT server.

The interested parties identified in the literature and relevant to the organization are: shareholders, customers, suppliers, managers, and employees. The relevant stakeholders for AM are: engineering, maintenance, financial, commercial, production planning and control (PPC), quality, environmental policy. In addition to the data already collected, the scope is the asset portfolio that will be covered by asset management. As AM allows its scope to cover part of the assets, initially, the AM manager elected fourteen assets as critical. The selection criteria were: age, corrective maintenance costs, hours in corrective maintenance, hours in operation (availability). Through the organizational context, identification of risks and opportunities, and understanding stakeholders' expectations and needs, the Integrated Management System (IMS) was built on AMS elements. Although it is a family-run company, the manufacturing structure is not complicated. Due to the few assets elected as critics, the gaps and the priorities were obvious. The plans, objectives, and performance indicators to reduce these gaps are in the SAMP and described in the Results and Discussion.

Leadership

As the organization is medium-sized, leadership, commitment, authorities, responsibilities, and organizational roles requirements have been unified. As QMS already has leaders, they will remain with the same roles in AMS, but not

with all the responsibilities, since AM will be divided among several departments. Maintenance personnel will, of course, be included. And for obvious reasons, a member of the finance department as well. All critical asset operators will be part since each one is responsible for the asset it operates. For the AM policy construction, the researchers asked for managers, through open interviews, what they would expect of it. As fourteen machines will be updated, an immense amount of data will be necessary for the decisions to be assertive and to be able to indicate the sequence, in order of priority, of the machines to be replaced.

Planning

In the risk analysis, the following factors were taken into account: Safety and Environment, Quality, Failure Frequency, Failure Cost for three levels of probability and severity: low, medium, and high. Failure and the maintenance cost are the main critical factor for the company to achieve its objectives since the unavailability of a machine could interrupt the production line. Critical assets were elected by the GA manager, which are assets selected to be replaced. The objectives and indicators were chosen by the researchers and company consultant based on the literature. AM plans are all actions that the researchers, consultant, and employees thought to mitigate the risks highlighted in the SWOT analysis and stakeholder requirements analysis.

5. Results and Discussion

Through the organization's context, identification of risks and opportunities, and understanding of stakeholders' expectations and needs, the Integrated Management System (IMS) was built on AMS elements. After its adequate implementation, it should be maintained and improved. The company increased from four to five organizational objectives, and *Infrastructure Management* has become a corporate perspective. The corporate goal is (v) *Adequacy and Efficiency of Assets*. Its strategy is: *Ensure critical assets' productivity, focusing on delivering value (balancing performance, costs, and risks)*. The integrated policy was defined as *Offering products and services that meet the legal (ethical) and customer requirements through an integrated management system that promotes financial sustainability; commercial performance; customer satisfaction; effectiveness and continuous improvement of its processes; qualification and safety of its employees; adequacy and efficiency of its assets*.

On the other hand, the asset management policy is: *Ensure critical assets' productivity, focusing on delivering value (balance between performance, costs, and risks) until replacing all production equipment in the AM portfolio*. Therefore, asset management strategies are: *Comply with preventive maintenance plans, reduce failures and unproductive hours of physical assets; build and comply with technological update plans through equipment replacement; align technical and financial data and information on productive equipment within the AM scope for replacement decisions*.

Through the SWOT analysis, it was possible to survey the company's weaknesses and perform a risk analysis, calculating the probability of the event occurring versus its severity, resulting in its impact and the affected processes. Thus, actions to mitigate the risks were proposed, allowing employees to realize the activities, necessary resources (capital, time, people, technological systems), initial term, and final term to deal with the action.

Table 3, prepared by the researchers and collaborators from each department, shows stakeholders' needs and expectations relevant to AM, collected through open interviews and meetings with the employees involved in this work. Table 4 brings AM objectives and indicators for three levels: strategic, tactical, and operational. Figure 1 brings the part of the IMS, referent to AM, due to this work. Figure 2 shows the matrix, set up by the researchers and company consultant, to monitor the AM policy through AM strategic, tactics, and operational indicators. Figure 3 shows a dashboard (dynamic spreadsheets shared across multiple departments) developed by the researchers to monitor, in all possible aspects, each production equipment for replacement and technological updating decision-making. Figures 2 and 3 need to zoom.

Table 3. Needs and expectations of stakeholders relevant to AM

Stakeholders	Needs	Expectations
Shareholders	Efficient equipment; Safe Environment	Reduced operating and production costs; Improvement in ROI or (net profit); Sales growth; Increase in revenue
Commercial	Lead time reduction (delivery time in the market); Improvement of quality, reliability of products/services; Competitive prices	Sales growth; Higher customer satisfaction
Engineering	Demand analysis, reliability analysis, and production capacity of each equipment	Equipment acquisition/replacement, renovation, or rental projects; Lifecycle planning; Scheduled maintenance
Maintenance	Preventive and predictive maintenance plans	Better maintenance performance Reliable and available equipment
PPC	Reliable and available equipment	Compliance with Production Planning
Quality	Adequate production and measuring equipment, qualified employees	Improvement of quality, reliability of products/services by reducing errors, non-conformities, rework
Employees/ Human Resource	Safe installations and equipment	Better performance in working conditions, health, and safety; Avoid leaves, fines, and processes related to accidents at work
Financial	Costs and revenues of each equipment	Quality data and information for equipment purchase and replacement decision making
Environment Policy	New machines (energy efficiency)	Waste reduction (oil)

Table 4. Asset Management Objectives and Indicators

	AM Objectives	Indicators
Strategic	Ensuring/increasing reliability Ensure / increase availability Ensuring/increasing capacity Reduction of operating costs Capital cost reduction	Reliability Availability Costs
Tactical	Failure reduction Reduction of unproductive hours Reduction of corrective maintenance Power reduction Elimination of operational bottlenecks	Failure rate MTBF MTTR Corrective Maintenance Cost /Total Sales. Maintenance Cost /Total Sales. Maintenance Cost/Asset Replacement Value (MC/RAV)
Operational	Maintenance, calibration, lubrication plans Reduction in the number of stops for corrective maintenance, external to the company Reduction of corrective maintenance actions, internal to the company	Compliance with preventive maintenance, calibration, and lubrication plans Note of the number of corrective stops Note the total number of corrective actions Total corrective maintenance costs Total maintenance costs (monitoring of all preventive, corrective, parts, labor costs) Corrective maintenance costs of each equipment (monitoring of all corrective actions, parts, the labor of each asset)

Corporate Objective	Corporate Strategy	Integrated Policy	Corporate Perspective
Adequacy and Efficiency of Assets	Ensure critical assets' productivity, focusing on delivering value (balancing performance, costs, and risks)	Offering products and services that meet the legal (ethical) and customer requirements through an integrated management system that promotes financial sustainability; commercial performance; customer satisfaction; effectiveness and continuous improvement of its processes; qualification and safety of its employees; adequacy and efficiency of its assets	Infrastructure Management

Figure 1. Part of Integrated Management System regarding Asset Management

Asset Management System: Policy, Strategy, Objectives, Plans, Indicators, and Responsible Department or Employee																		
Asset Management Policy: Ensure critical assets' productivity, focusing on delivering value (balance between performance, costs, and risks) until replacing all production equipment in the AM portfolio						Asset Management Strategies: Comply with preventive maintenance plans, reduce failures and unproductive hours of physical assets; build and comply with technological update plans through the replacement of equipment; align technical and financial data and information on productive equipment within the AM scope for replacement decisions							Asset Management Objectives: Consult SAMP and assets dashboards					
AM Portfolio: Fourteen critical assets selected by the AM manager for replacement (technological update)																		
AM Indicators	2021 Target	2020 Results	Analysis Frequency	RESP	Critical Analysis	AM Tactical Indicators	2021 Target	2020 Results	Analysis Frequency	RESP	Critical Analysis	AM Operational Indicators	2021 Target	2020 Results	Analysis Frequency	RESP	Critical Analysis	
Critical Assets Performance																		
Reliability						Failure Rate				Monthly	Financial	Quarterly	Compliance with the Maintenance Plan				Maintenance	
						Mean Time Between Failures (MTBF)				Monthly	Financial	Quarterly	Number of corrective stops				Machine Operator	
Availability						Mean Time to Repair (MTTR)				Monthly	Financial	Quarterly	Total number of corrective actions				Machine Operator	
Costs						Corrective Maintenance Cost / Total Sales	0,50%			Quarterly	Financial	Yearly	Total corrective maintenance costs				Maintenance /Financial	
						Maintenance Cost / Total Sales	0,75% - 1%			Quarterly	Financial	Yearly	Total costs of maintenance, parts, materials, services, and labor				Maintenance /Financial	
						Maintenance Cost/Asset Replacement Value (MC/RAV)	>2,5%			Quarterly	Financial	Yearly	Total costs of maintenance, parts, materials, services, and labor by each equipment				Maintenance /Financial	

Figure 2. Asset Management Policy Matrix

ASSET DATA DASHBOARD																		Start Date:		01/01/2020					
																		Final Date:		31/12/2020					
Identification/Financial Information	Corporate Strategic Objectives	AM Strategic Indicators	AM Tactical Indicators	AM Operational Indicators	Target	1	2	3	4	Critical Analysis	5	6	6	8	Critical Analysis	9	10	11	12	Critical Analysis	Annual Average	2020 Target	RESP	RESP	
ID	Productivity	Reliability																					Engineering	AM	
Property tag number			Failure Rate																				Maintenance	AM	
Localization			MTBF																				Maintenance	AM	
Asset type			Compliance with Maintenance Plan Number of corrective maintenance stops Total number of corrective maintenance actions																				Maintenance	AM	
Asset function																							Maintenance	AM	
Manufacturer																								Maintenance	AM
Year of manufacture	Productivity	Availability																					Engineering	AM	
Date of acquisition			MTTR																				Maintenance	AM	
Date of putting into service			Productive hours																					Machine Operator	AM
Acquisition costs			Hours available																					Machine Operator	AM
Asset value			Set up hours																					Machine Operator	AM
Expected service life			Cleaning hours																					Machine Operator	AM
Depreciation			Tool change hours																					Machine Operator	AM
Residual value			Measuring instrument hours																					Machine Operator	AM
			Corrective maintenance hours																					Maintenance	AM
			Preventive maintenance hours																					Maintenance	AM
			Other unproductive hours																					Machine Operator	AM
	Total number of unplanned hours																					Machine Operator	AM		
	Productive hours/Available hours																						PPC	AM	
Total equipment revenue (year)	Financial Sustainability			Equipment revenue																			PPC/Financial	AM	
Total operational costs (year)	Financial Sustainability			Equipment operational costs																			PPC/Financial	AM	
Total maintenance costs (year)	Financial Sustainability	Maintenance Costs																					Financial	AM	
			Corrective Cost /Total Sales																				Maintenance/Financial	AM	
			Mainte nance Cost /Total Sales																				Maintenance/Financial	AM	
			MC/RAV																				Maintenance/Financial	AM	
			Corrective maintenance costs - external service Preventive maintenance costs - service and labor Preventive maintenance costs - parts Total mainte nance costs																					PPC	AM
																								Maintenance/Financial	AM
																								Maintenance/Financial	AM
																								Maintenance/Financial	AM
Non-quality costs	Quality	Number of scrap and rework pieces/Number of total pieces																					Quality	AM	
				Number of pieces produced																			Machine Operator	AM	
				Scrap pieces number																				Machine Operator	AM
				Rework pieces number																				Machine Operator	AM

Figure 3. Assets Data Dashboard

The plans are concomitantly from top to bottom and from bottom to top. Corporate strategies are asset management objectives; asset management strategies are tactical and operational objectives; the compliance with operational plans ensures each asset's performance will incur in the execution of tactical plans and, finally, in the reach of strategic plans. In summary, AM plans to achieve the respective objectives are: preventive maintenance plans to reduce failures; failure reduction, to ensure/increase reliability; increased reliability, to minimize downtime, to ensure/increase availability; reduction of unproductive hours (stops for corrective maintenance, cleaning, setup) to increase availability; minimize of corrective maintenance and energy diminution to reduce operating costs; elimination of operational bottlenecks to minimize capital costs; invest in more energy-efficient equipment, new facilities to reduce energy costs; replacement of assets and reduction of unproductive hours to ensure/increase capacity; replacement of equipment for technological updating and guarantee of the asset capability; alignment of data and technical and financial information of the equipment for substitution decisions. Furthermore, as long as the company does not parameterize its ERP to facilitate its access to assets data, and as long as there is no more extended data history that will become robust information, the asset AM policy matrix, and the asset dashboard will be used for critical assets.

AM policy construction required the review of processes and procedures that already been existing in the organization. The policy structure demanded to build an asset management system aligned with organizational planning and integrate it with the quality management system, resulting in an integrated management system. Thus, the main research objective has been achieved. The company now has an asset management system with strategic, tactical, and operational purposes integrated into the organizational planning, and an asset management policy has been defined. Although their machines are the assets that generate value and sustain all the other company's assets, the organization underestimated them and their proper management at the beginning of the research. When monitoring critical assets performance, which are the critical factors for achieving business objectives, the company ensures that they will fulfill the required tasks. Simultaneously, it will have a set of data that will become information relevant to replacing its machines. The company had not had contingency plans for its machines when this research started, and now it has plans for all of its equipment. That is, any machine will not stop the production line. A matrix has been created to monitor strategic and tactics indicators and dashboards to monitor operational indicators and a complete view of each asset part of the portfolio. Although the company has migrated from the reactive information stage to the preventive information stage, it is clear that quality data is still the greatest threat to AM objectives since the company continues to underuse its ERP and has not yet replaced its server.

6. Conclusion

This work emerged from an equipment replacement and technological updating problem that would be strategic for the studied company. However, it could not be concluded due to a lack of operational data. As the work went on, it was clear that the company did not have an established policy on how its equipment was managed or how they were elected to be replaced, and it was the main problem. In addition, data were not reliable to the due replacement analysis. Just as the availability of quality data is a determining factor in decision-making, the success of implementing asset management, through the requirements of ISO 55001:2014, is intrinsically linked to the organizational culture, integration, and dynamic communication between departments. Only with leadership based on the example and visible commitment can asset management and information management be established.

Search limitations

The research's main limitation was time, as it could not follow the accomplishment of the other standard requirements.

Future Research

Although the research ends with this work, it is essential to state that consolidation and improvement in the company equipment management policy continue. It will be possible to realize a performance evaluation and a critical analysis when the company develops the other support requirements and effectively adheres to the AM Policy, SAMP, and actions to mitigate the risks. Thus, future studies will be able to monitor and analyze this evolution.

Impacts on the Organization

AMS's construction integrated with the QMS, SAMP, and asset management policy has initiated a new phase in the studied company in partnership with a consultant, manager, and employees. Moreover, it has provided a support framework for asset replacement decision-making. As it is a family-run company, this work also enabled managers to understand how quality data and organizational tools insertion can make the decision process safer and more professional. Assuming the company invests in training, uses its ERP effectively, and complies with the processes and

procedures required by ISO 55001, it can be certified with this standard, which is still uncommon in the manufacturing industries and perhaps nonexistent in medium-sized companies.

It is expected that this research can guide other small and medium-sized companies, whose equipment is critical to the business success, and providing support to family-run companies, which do not have a professional with skills in asset management.

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Biography

Ana Carolina Gandini Panegossi, Master, was born in Matão SP, Brazil, on April 11, 1979. She holds a degree in Industrial Engineering - Chemistry - from Federal University of São Carlos (UFSCar), a specialist in Ethanol Quality

from Federal Institute of São Paulo (IFSP), campus Matão, and a Masters Degree in Industrial Engineering from University of Araraquara (UNIARA). She has been working on research involving asset management and equipment replacement and has been published and presented her research at congresses. She is also an associate of ABRAMAN (Brazilian Maintenance and Asset Management Association) and a member of ABNT/CEE-251 - Special Study Commission on Asset Management of the Brazilian Association of Technical Standards.

Ethel Cristina Chiari da Silva, Ph.D., was born in São Carlos, SP, Brazil, on February 27, 1966. She graduated in Industrial Engineering - Materials - from Federal University of São Carlos (UFSCar) in 1990; she got a Masters Degree in Mechanical Engineering (research area: Industrial Engineering) from University of São Paulo (USP) in 1994. She obtained her Ph.D. in Mechanical Engineering (research area: Industrial Engineering) at the same institution in 1999. She coordinates the undergraduate course in Industrial Engineering at Centro Universitário de Araraquara (UNIARA) and teaches in the Professional Master's Program in Industrial Engineering at the same institution. She has been working on research involving lean manufacturing and operations management.