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A COMPREHENSIVE REVIEW OF THE DEVELOPMENT OF BRAZIL'S ASSET MANAGEMENT SYSTEM ALIGNED WITH ISO 55001

Uma revisão abrangente sobre o desenvolvimento do sistema de gestão de ativos no Brasil, alinhado à ISO 55001

Una revisión exhaustiva del desarrollo del sistema de gestión de activos de Brasil alineado con la norma ISO 55001

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ABSTRACT

This article presents an evolutionary perspective on asset management, tracing its development from the foundations of Terotechnology in the United Kingdom to the consolidation of the ISO 55001 standard and its incorporation in Brazil. It examines the historical, institutional, and regulatory factors that shaped the discipline, as well as current trends and challenges that influence the maturity of asset management systems across diverse contexts. The study adopts a historical-comparative approach that revisits pioneering British initiatives among them, the investigations promoted by the Ministry of Technology during the 1960s and 1970s and subsequently analyzes Australian contributions, particularly the production of manuals and the integration of asset management into regulatory frameworks. The Brazilian trajectory is also addressed, marked by the transition from corrective and preventive practices to more strategic models, with emphasis on the role of ABRAMAN and the adoption of ISO 55001. Evidence from the ISO Survey 2023 and the ABRAMAN 2022 national survey supports an assessment of global and national maturity. The findings indicate a progression from technical approaches toward a governance- and value-oriented perspective.

RESUMO

Este artigo apresenta uma perspectiva evolutiva da gestão de ativos, examinando seu desenvolvimento desde os fundamentos da Terotecnologia no Reino Unido até a consolidação da norma ISO 55001 e sua adoção no Brasil. São analisados os fatores históricos, institucionais e regulatórios que moldaram a disciplina, bem como as tendências contemporâneas e os desafios que influenciam a maturidade dos sistemas de gestão de ativos em distintos contextos. O estudo adota um enfoque histórico-comparativo, revisitando iniciativas britânicas pioneiras, incluindo os estudos conduzidos pelo Ministério da Tecnologia nas décadas de 1960 e 1970 e, posteriormente, analisando as contribuições australianas, especialmente a elaboração de manuais e a incorporação da gestão de ativos em marcos regulatórios. Aborda-se também a trajetória brasileira, marcada pela transição de práticas corretivas e preventivas para modelos estratégicos, com destaque para o papel da ABRAMAN e a implementação da ISO 55001. Dados provenientes do ISO Survey 2023 e da pesquisa nacional da ABRAMAN de 2022 permitem avaliar a maturidade global e nacional. Os resultados evidenciam uma evolução de abordagens técnicas para uma orientação centrada em governança e criação de valor.

RESUMEN

Este artículo presenta una visión evolutiva de la gestión de activos, recorriendo su desarrollo desde los fundamentos de la Terotecnología en el Reino Unido hasta la consolidación de la norma ISO 55001 y su incorporación en Brasil. Se analizan los factores históricos, institucionales y regulatorios que moldearon la disciplina, así como las tendencias actuales y los desafíos que inciden en la madurez de los sistemas de gestión de activos en diversos entornos. El estudio emplea un enfoque histórico-comparativo que revisita iniciativas británicas pioneras, entre ellas, los estudios promovidos por el Ministry of Technology en las décadas de 1960 y 1970, y examina posteriormente las contribuciones australianas, especialmente la producción de manuales y la inclusión de la gestión de activos en marcos regulatorios. También se aborda la trayectoria brasileña, caracterizada por la transición de prácticas correctivas y preventivas hacia modelos estratégicos, con destaque para el rol de ABRAMAN y la adopción de la ISO 55001. Datos procedentes del ISO Survey 2023 y de la encuesta nacional de ABRAMAN de 2022 permiten valorar la madurez global y nacional. Los hallazgos señalan una evolución desde enfoques técnicos hacia una orientación centrada en gobernanza y generación de valor..

INTRODUCTION

According to ABNT-ISO 55000:2024 (ABNT, 2024), asset management is defined as the coordinated set of activities undertaken by an organization to realize value from its assets. Generating value generally requires balancing costs, risks, opportunities, and performance outcomes. The term *activity* may also encompass the application of components within an

asset management system. Its meaning is intentionally broad, covering approaches, planning efforts, plans themselves, and their subsequent execution.

Lafraia (2024) emphasizes that asset management is fundamentally distinct from the operational act of managing assets. It is primarily a managerial discipline rather than a collection of technical interventions. Thus, it is unsurprising that asset management, as a field of study, does not focus extensively on technical details of lifecycle stages; instead, it prioritizes the management competencies that enable individuals to perform sound decision-making.

Azevedo (2019) defines asset management as a management process centered on achieving an optimal balance among costs, risks, opportunities, and performance benefits, often across different time horizons. Its effectiveness is inherently tied to the achievement of organizational objectives.

From a strategic perspective, asset management represents a transformative shift in corporate planning, integrating traditional perspectives of products and customers with a focus on assets and the value they generate (Azevedo, 2023). Conceptually, it marks a new phase in organizational administration and constitutes a fundamental practice for those pursuing business excellence. Asset management surpasses the boundaries of operational asset care and influences broader strategic direction.

Implementing asset management in alignment with the ISO 5500x family of standards entails adopting an internationally recognized framework for deriving value from assets, by balancing performance, costs, and associated risks (Lafraia, 2020). Over recent decades, the field has evolved substantially at the global level. A synthesis of this evolutionary pathway is presented below.

THE UK AS A FORERUNNER: FROM TEROTECHNOLOGY TO MODERN ASSET MANAGEMENT

During the late 1960s and early 1970s, British industry faced a sustained decline in global competitiveness. In response, the United Kingdom government, acting through the Ministry of Technology, launched research programs and specialized working groups to diagnose the structural causes of inefficiency in industrial operations (Husband, 1976). The objective was explicit: to restore productivity and strengthen the competitive position of the manufacturing sector relative to nations such as Germany and Japan.

As documented by Kelly and Eastburn (1982), PA Management Consultants was commissioned in 1968 by the Ministry of Technology to analyze engineering maintenance practices across British manufacturing. The resulting study identified that: (i) annual direct maintenance costs were approximately £1.1 billion in 1968 (equivalent to a 2025-adjusted value 18.32 times higher based on cumulative UK CPI); (ii) improving maintenance workforce productivity could have reduced annual maintenance expenditure by roughly £250 million; and (iii) enhanced maintenance practices could have avoided nearly £300 million per year in production losses attributable to downtime.

Drawing on this and related evidence, a Ministry of Technology working group issued a report in 1970 highlighting, among other points, the necessity of linking maintenance expenditures with design feedback for new plants. From these findings emerged a structured approach later termed *Terotechnology*. The term derives from the Greek *teros* (maintenance or care) and the

Latin *technologia* (systematic study of techniques) and is widely regarded as the precursor of contemporary asset management.

In 1970, the Ministry of Technology created the Terotechnology Committee, chaired initially by Major General Sir Leonard Henry Atkinson (1910-1990). Its purpose was to advise government authorities on promoting a multidisciplinary framework for managing physical assets across their entire life cycle, from conception and design to disposal. This effort culminated in the establishment of the National Terotechnology Centre in 1975, operated by the Electrical Research Association under contract to the Department of Industry. Among the earliest publications aimed at disseminating terotechnology were:

- *Terotechnology: An introduction to the management of physical resources (HMSO, 1975).*
- *Management aspects of terotechnology – 1: Life cycle costing (HMSO, 1975).*
- *Management aspects of terotechnology – 2: Management accounting (HMSO, 1975).*
- *Terotechnology handbook (HMSO, 1978).*

The core aims of Terotechnology included:
i. Maximizing the value generated by physical assets throughout their life cycle;

ii. Integrating engineering, operations, maintenance, and financial decision-making from design to decommissioning;

iii. Reducing total cost of ownership (TCO) through informed and predictive decisions;
iv. Establishing systematic physical asset management practices linking design, acquisition, operation, maintenance, and end-of-life stages.

Husband's (1976) *Maintenance Management and Terotechnology* offered a pioneering interpretation of maintenance within the emerging terotechnology framework. The work describes the evolution of maintenance from a predominantly corrective function to a comprehensive management discipline incorporating planning, cost control, and alignment with strategic asset considerations. Terotechnology is portrayed as an interdisciplinary field involving engineering, economics, and management, aimed at optimizing the value and performance of industrial equipment over their life cycle. Husband emphasizes the importance of integrating procurement and operating decisions with long-term economic analysis, asserting that asset performance must be evaluated based on life-cycle costs rather than acquisition cost alone. The book thus serves as a foundational reference in the development of contemporary maintenance and asset management thinking.

Harvey's (1978) doctoral dissertation at Loughborough University constitutes another milestone in the study of terotechnology and the application of life-cycle costing in the manufacturing sector. Harvey argues that effective industrial asset management requires an integrated perspective encompassing procurement, operation, maintenance, modernization, and eventual decommissioning. He positions terotechnology as a discipline at the intersection of engineering, economics, and management, aimed at maximizing efficiency, reliability, and return on asset investment.

Harvey (1978) critically reviews traditional costing methodologies and demonstrates their limitations in assessing long-term economic consequences of asset decisions. He advocates for the systematic use of life-cycle costing to support more rational and transparent choices capable of balancing upfront expenditure with future operating costs. His research draws upon case studies from British manufacturing firms, showing the advantages of integrated

cost analysis for strategic decision-making. He also highlights the cultural and organizational transformation required to integrate engineering, maintenance, and financial functions—arguing that terotechnology demands not only analytical tools but also a mindset aligned with life-cycle thinking and cross-functional coordination. Harvey concludes that life-cycle costing provides a pathway to enhance industrial competitiveness, reduce waste, and reinforce long-term economic sustainability.

Asset management gradually became institutionalized in the United Kingdom as a structuring discipline for infrastructure organizations, particularly in the wake of the political and economic reforms of the 1980s and 1990s. The privatization and deregulation policies introduced by the Thatcher government revealed tensions between financial efficiency and service quality (Detter & Fölster, 2016). In this environment, regulatory practices and maturity-assessment methodologies emerged as essential mechanisms for sustaining service standards and improving asset governance.

The privatization of key sectors—such as energy, transportation, and water—was intended to reduce state involvement and increase economic efficiency. Nonetheless, the profit-driven orientation of newly privatized companies generated criticism related to deteriorating service quality, especially in rail and sanitation services. This scenario required more robust regulatory oversight and closer monitoring of asset performance to maintain required service levels.

The UK experience demonstrates that privatization not only introduced challenges but also catalyzed the consolidation of regulatory and asset management frameworks. Organizations such as AMCL and the Institute of Asset Management (IAM) played a decisive role in advancing the discipline by developing models, standards, and methodologies that influenced asset management practices internationally.

In the 1990s, the British Standards Institution advanced this evolution through the publication of BS 3843-1:1992 (BSI, 1992a), which defined terotechnology as an approach designed to secure optimal value for users from the acquisition and use of physical assets. The standard highlighted that terotechnology, though initially developed for large organizations, was equally applicable to smaller enterprises and individual consumers, given its emphasis on maximizing value for money.

Annex A.2 of BS 3843-1:1992 identifies several potential benefits from adopting terotechnology, including:

(a) increased profitability through appropriate balancing of short- and long-term objectives;

(b) enhanced communication and shared purpose among organizational functions, encouraging delegation and promoting constructive attitudes within junior management;

(c) reduced executive workload related to asset oversight while improving control and management processes;

(d) lower development and production costs through performance optimization, elimination of non-essential features, design simplification, standardization, and improved documentation practices;

(e) increased reliability through wider use of proven designs, improved testing, simplified architectures, and enhanced quality control;

(f) improved maintainability via design-for-maintenance principles, better test procedures, improved accessibility, and standardization of support equipment;

(g) strengthened support operations through lower subsystem proliferation, reduced parts diversity, decreased labor requirements, common support infrastructures, and more efficient logistics.

Advancing the Field of Asset Management: The Australian Contribution

Beyond the pioneering developments in the United Kingdom, Australia stands out as one of the most influential environments in the contemporary advancement of asset management, characterized by the production of technical manuals, the dissemination of professional practices, and the incorporation of asset management principles into regulatory structures (AMC, 2014). Early adoption of lifecycle-based approaches, sector-specific standardization, and later alignment with the ISO 5500x family were fundamental to the consolidation of mature practices, particularly within subnational governments and regulated infrastructure sectors.

Historical evidence from the Australian asset management community places discussions on maturity as early as the mid-1980s, with increasing emphasis on asset renewal, lifecycle-informed decision-making, and the economic stewardship of public assets. The *National Asset Management Manual* (NAMM), issued in 1994 by the former Institute of Municipal Engineering Australia (IMEA), served as a watershed in structuring concepts, processes, and information requirements for municipal and state assets. Subsequently, the *International Infrastructure Management Manual* (IIMM), developed in 2000 through collaboration between NAMS (New Zealand) and IPWEA (Australia), established a unified terminology and practical roadmaps for asset management implementation, influencing local governments across Oceania and internationally. Beginning in 2009, the *Australian Infrastructure Financial Management Guidelines and Manual* (IPWEA, 2009) strengthened the relationship between public financial management and asset management by promoting long-term planning aligned with service levels and risk.

Australia's trajectory toward institutionalized asset management has been underpinned by two central mechanisms: (i) the development of technical and methodological resources (manuals, frameworks, models, and training) produced by IPWEA and NAMS, and (ii) the professional ecosystem created by the Asset Management Council (AMC), a technical society within the engineering community that disseminates maturity models, promotes capability development, and engages with international networks such as GFMAM and WPiAM.

In 2016, the *Asset Management Accountability Framework* (AMAF) (Victoria, 2016) introduced mandatory requirements for public agencies, including strategies, governance structures, performance expectations, systems, and continuous improvement processes, accompanied by annual compliance reporting and a triennial maturity self-assessment. Independent audits have demonstrated the framework's contribution to strengthening leadership, accountability, and decision-making throughout the asset lifecycle. The evolution of AMAF reflects methodological leadership, strong institutional consolidation, and integration into regulatory systems. The progression, from practical manuals in the 1990s to compulsory adoption in state policy and sector certification, has created an environment in which service value, risk management, and financial sustainability guide lifecycle decision-making.

The ongoing application of this framework, in alignment with ISO 55001:2024 and the *Asset Management Landscape* (GFMAM, 2024), is expected to further enhance the maturity of data, competencies, and governance across both public and private organizations.

The Evolutionary Trajectory of Asset Management in Brazil

Asset management in Brazil has developed along a trajectory shaped by international influences, the consolidation of professional institutions, and the progressive creation of standards and practices that mirror the evolving maturity of the nation's industrial and infrastructure sectors. The discipline emerged as a response to the growing need to enhance the reliability, efficiency, and safety of complex systems in strategic domains such as oil and gas, mining, energy, and transportation. What initially originated within the scope of corrective and preventive maintenance gradually evolved into an integrated, value-driven approach aligned with international frameworks (Lafraia, 2015).

Throughout the 1970s and 1980s, concepts such as planned maintenance and reliability-centered maintenance (RCM) gained prominence in Brazil, influenced strongly by the United States and the United Kingdom (Moubray, 2001). In this period, major state-owned enterprises, most notably Petrobras, were instrumental in disseminating structured practices associated with reliability engineering and process safety.

The establishment of the Brazilian Maintenance Association (ABRAMAN) in 1984, and its subsequent expansion in 2012 to also encompass asset management, played a decisive role in spreading methodologies, indicators, and performance benchmarks. Renamed the Brazilian Association of Maintenance and Asset Management while retaining the acronym ABRAMAN, the institution has made its annual Brazilian Congress of Maintenance and Asset Management a cornerstone for professional exchange and sectoral consolidation.

The evolution of asset management in Brazil reveals steady progress from corrective maintenance toward strategic, standardized, and internationally harmonized practices. Institutional support through ABRAMAN, combined with the adoption of ISO 55001, has reinforced a pathway toward higher maturity and global alignment. Looking ahead, the advancement of the discipline in Brazil is expected to depend on deepening digitalization, sustainability initiatives, and corporate governance, elements increasingly essential for organizational competitiveness.

Asset Management in a Post-ISO 55001 Context

In 2004, the British Standards Institution (BSI) introduced PAS 55 as a public specification for the management of physical assets, aimed principally at sectors such as utilities (water and energy), transportation, and manufacturing. PAS 55:2004 (BSI, 2004) established a set of 28 best-practice requirements for optimizing physical infrastructure management and incorporated a competency model for asset management professionals. Its second edition, PAS 55:2008 (BSI, 2008), further strengthened reliability through a risk-based approach across the asset lifecycle. Despite these advancements, PAS 55 remained largely confined to the British context and focused narrowly on physical assets, with a structure not fully aligned with integrated management system models.

In January 2014, the first edition of the ISO 55000 series was issued, comprising: ISO 55000 – Overview, Principles, and Terminology (ABNT, 2014a); ISO 55001 – Requirements for an Asset Management System (ABNT, 2014b); ISO 55002 – Guidelines for the Application of ISO 55001

(ABNT, 2014c); and ISO/IEC TS 17021-5:2014 – Competence Requirements for Bodies Auditing and Certifying Asset Management Systems (ABNT, 2014d). Developed between 2010 and 2013 by Technical Committee ISO/TC 251 with broad international collaboration, the series drew extensively on PAS 55:2008. This evolution introduced: a *management system framework* based on the High-Level Structure (HLS), incorporating organizational context, leadership, planning, operations, performance evaluation, and continual improvement; a *continuous PDCA cycle*, shifting the discipline from a reactive posture to a systematic, evidence-based, value-focused approach with strategic alignment and assurance; and *broad applicability*, extending to physical and non-physical assets across diverse sectors and integrating with other corporate management systems.

Concurrently, the Global Forum on Maintenance and Asset Management (GFMAM) recognized the need to harmonize these developments and provide a shared conceptual basis for organizations implementing asset management systems worldwide. The first edition of the *GFMAM Asset Management Landscape*, released in November 2011 (GFMAM, 2011), was designed as a reference framework and was later updated following publication of the ISO 5500x series. Although originally intended for limited use, its adoption expanded rapidly; however, its initial level of detail proved insufficient for specialized applications such as auditor qualification. The second edition, published in 2014 (GFMAM, 2014), substantially broadened the articulation of asset management practices and became the foundation for developing bodies of knowledge among GFMAM members and for defining professional competencies within global certification schemes. Requirements for ISO 55001 assessors and asset management professional designations were incorporated during this phase.

Nevertheless, the international community increasingly confronted pressures arising from population growth, expanding and complex asset portfolios, technological advancements, evolving societal expectations, and the imperatives of sustainability, resilience, and climate adaptation. In light of scientific evidence presented by the IPCC, planning and implementing resilient asset management systems has become even more critical. The third and most recent edition of the *GFMAM Asset Management Landscape*, released in June 2024 (GFMAM, 2024), introduced significant updates across all disciplinary areas and added new thematic domains, particularly reinforcing governance and value realization, thereby aligning the discipline with contemporary governance demands and the objective of maximizing value creation.

The International Landscape of Asset Management Based on the ISO Survey

The ISO Survey (ISO, 2024) is compiled annually with the purpose of collecting data on certifications issued for ISO management system standards. The survey provides a detailed account of the number of valid certificates worldwide, disaggregated by country, year, and specific standard, including ISO 9001:2015, ISO 13485:2016, ISO 14001:2015, ISO/IEC 20000-1:2018, ISO 20121:2012, ISO 22000:2018, ISO 22301:2019, ISO/IEC 27001:2013, ISO 29001:2020, ISO 37001:2016, ISO 39001:2012, ISO 44001:2017, ISO 45001:2018, ISO 50001:2018, and ISO 55001:2014, among others.

It is essential to note that the International Organization for Standardization (ISO) does not itself conduct certification activities. Organizations seeking certification to an ISO standard must work with independent and formally recognized certification bodies. The survey's function is to compile the number of certificates issued by such bodies, provided they are

accredited by members of the International Accreditation Forum (IAF), the global authority responsible for ensuring the credibility of accreditation processes. In this way, the ISO Survey constitutes an official and reliable source of information for tracking trends and developments in the global adoption of management system certifications.

Table 1. ISO management system standards certifications worldwide

Most current version of the ISO standard	Subject of the standard	Year of 1st ed.	Worldwide certificates valid	Worldwide total installations	Certificates valid in Brazil	Total Installations in Brazil	% Certificate Brazil/World
ISO-9001:2015	Quality Management	1987	837978	1250243	17589	26352	2.10%
ISO-14001:2015	Environmental Management	1996	300410	526046	3535	7331	1.18%
ISO-45001:2018	Occupational Health and Safety Management	2018	185166	309056	1436	3525	0.78%
ISO-IEC-27001:2022	Information Security Management	2005	47291	79213	309	380	0.65%
ISO-13485:2016	Medical Device Quality Management	1996	32963	52950	180	243	0.55%
ISO-22000:2018	Food Safety Management	2005	30011	36630	98	104	0.33%
ISO-50001:2018	Energy Management	2011	24924	61370	96	178	0.39%
ISO-37001:2015	Anti-bribery Management	2016	7895	15953	194	553	2.46%
ISO-20000-1:2018	Information Technology Service Management	2005	3670	6652	56	96	1.53%
ISO-22301:2019	Business Continuity Management	2012	3524	11232	20	39	0.57%
ISO-39001:2012	Road Safety Management	2012	1670	2982	32	73	1.92%
ISO-55001:2024	Asset Management	2014	668	2134	12	25	1.80%
ISO-20121:2024	Sustainability Management in Events	2012	293	433	1	3	0.34%
ISO-29001:2020	Quality Management for the Oil, Gas, and Petrochemical Industry	2003	206	244	6	6	2.91%
ISO-44001:2017	Collaborative Labor Relations Management	2017	132	163	0	0	0.00%

Source: ISO (2024)

The most recent survey corresponds to the year 2023 and provides an estimate of the number of valid certificates as of December 31 of that year. According to the ISO Survey (ISO, 2024), the study traditionally encompasses three principal categories of information: the number of valid certificates issued in each country for fifteen ISO international management system standards; the number of sites included under these certificates; and the economic sectors represented in each country for the various international management system standards. Collectively, the survey offers a comprehensive depiction of the global distribution and scope of ISO certifications, enabling comparisons across countries, sectors, and standards.

It is important to emphasize that the ISO Survey does not constitute a formal database. Data are supplied voluntarily by certification bodies accredited by IAF member organizations, and participation levels fluctuate between editions. Such variability may influence the results, particularly regarding country-level figures. Consequently, interpretations and conclusions related to trends must take these limitations into account.

As shown in Table 1, the number of valid ISO 55001 certificates remains below 1,000 worldwide, indicating relatively limited adoption over the eleven years since the publication of the standard's first edition. This contrasts markedly with ISO 9001 for quality management systems—introduced thirty-eight years ago, which remains the most widely adopted ISO standard. In terms of global dissemination, ISO 55001 ranks twelfth overall and eleventh specifically in Brazil. Nevertheless, the data suggests a gradual upward trend, notably in

sectors such as critical infrastructure, energy, and oil and gas, even though the global certification base remains small relative to other management system standards. In Brazil, ISO 55001 certifications account for 1.8% of the global total, a proportion close to the country's 2.1% share of ISO 9001 certifications.

The Status of Asset Management in Brazil ss Reported by Abraman

ABRAMAN, the Brazilian Association of Maintenance and Asset Management, periodically conducts a nationwide survey to assess the status of maintenance and asset management practices within Brazilian organizations. This paper draws on the edition conducted between October 3 and November 4, 2022, involving 1,762 managers from medium- and large-sized companies across the manufacturing and service sectors. A total of 290 companies or business units provided responses, including multiple independent submissions from large organizations. The survey achieved a 95% confidence level with a margin of error of ±4.5%. While the complete questionnaire is composed of 11 thematic blocks, this paper focuses on the respondent profile and Block 10, which contains 26 items specifically related to the maturity of asset management in Brazilian companies.

Respondent organizations in the 2022 edition were distributed across a broad set of macro-sectors, including Agribusiness; Food; Alcohol; Automotive and/or Aeronautical; Rubber; Ceramics and/or Glass; Commerce; Construction and/or Assembly; Energy; Pharmaceutical; Electronics and/or Appliances; Healthcare; Wood; Machinery and/or Equipment; Mechanical and/or Metallurgical; Mining and/or Steel; Pulp and/or Paper; Oil, Gas, and Petrochemical; Plastics; Building; Chemicals; Sanitation and/or Infrastructure; Services; and Transportation.

The 2022 ABRAMAN survey also gathered contextual data such as: the state in which each responding company or unit is located; the formal designation of the respondent's department; the respondent's hierarchical position; length of service; age group; and professional contact details. Respondents were also invited to provide open comments regarding asset management practices in their companies or units.

With respect to asset management itself, the survey addressed issues such as: whether the organization had conducted an asset management maturity assessment using a recognized methodology; whether an asset management system compliant with ISO 55001 was in place; and whether the company employed Certified Asset Management Assessors (CAMA).

Regarding implementation, the survey examined whether the organization's asset management system was being deployed through a top-down process led by senior leadership; whether implementation was integrated with strategic planning; and whether a specific organizational unit, headed by a designated leader, was accountable for managing the system.

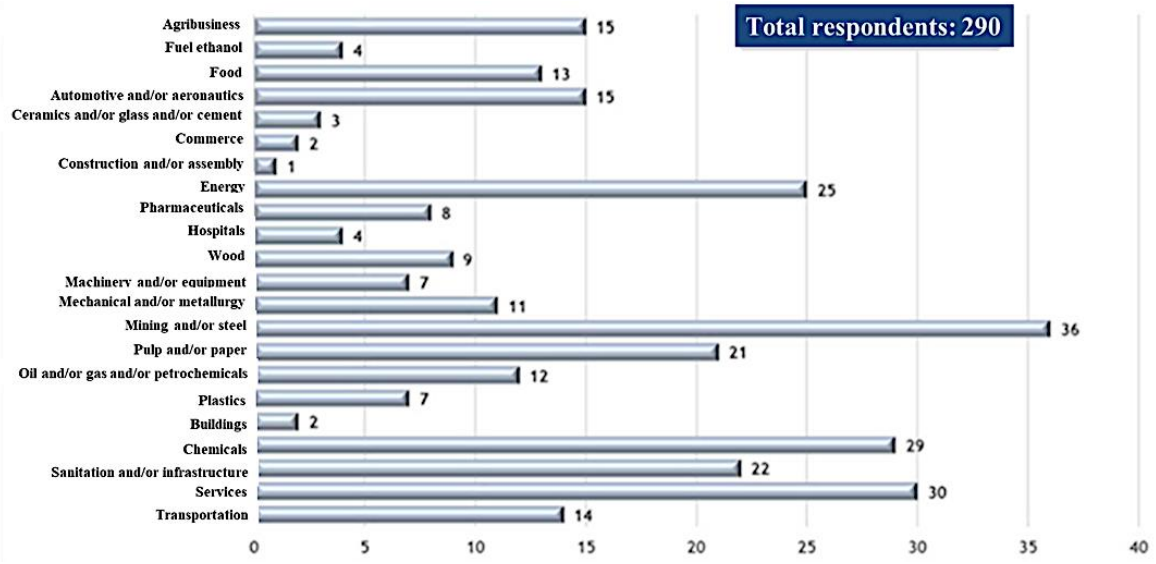
In terms of scope, the survey investigated whether organizations had: an asset management policy aligned with their organizational plan; senior management commitment; asset management objectives approved by senior leadership; integration with other management systems (quality, environmental, occupational health and safety); a Strategic Asset Management Plan (SAMP) supporting sustainability objectives; comprehensive asset coverage; monitoring and measurement plans; coherent Asset Management Plans (AMPs); stakeholder engagement mechanisms; life-cycle coverage; competency records; risk assessment and assignment of responsibilities for outsourced processes; performance

indicators; decision-making criteria; commitment to continual improvement; an internal audit program; senior management review records; nonconformity registers; and evidence of at least three years of results demonstrating system effectiveness and continuous improvement.

Finally, the 2022 edition of the National Document (ABRAMAN, 2022) explored the primary cultural barrier to implementing an asset management system, identifying the following potential obstacles: insufficient awareness among senior management; insufficient knowledge among senior management; lack of resources (personnel, skills, financial capacity); challenges associated with interdepartmental integration; or other specified constraints.

Figure 1 illustrates the composition of business segments represented in the 2022 ABRAMAN survey, highlighting the breadth, diversity, and representativeness of the participating organizations.

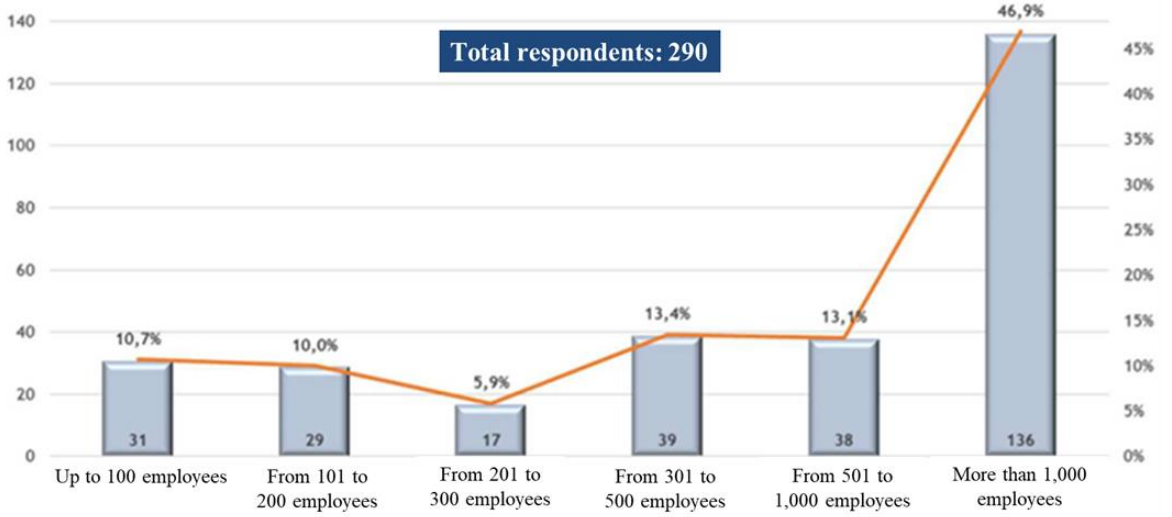
Figure 1. Business segments in the ABRAMAN 2022 survey



Source: ABRAMAN (2022)

Figure 2 illustrates the organizational size profile of the entities that participated in the 2022 ABRAMAN survey, indicating that the study encompassed companies of diverse scales.

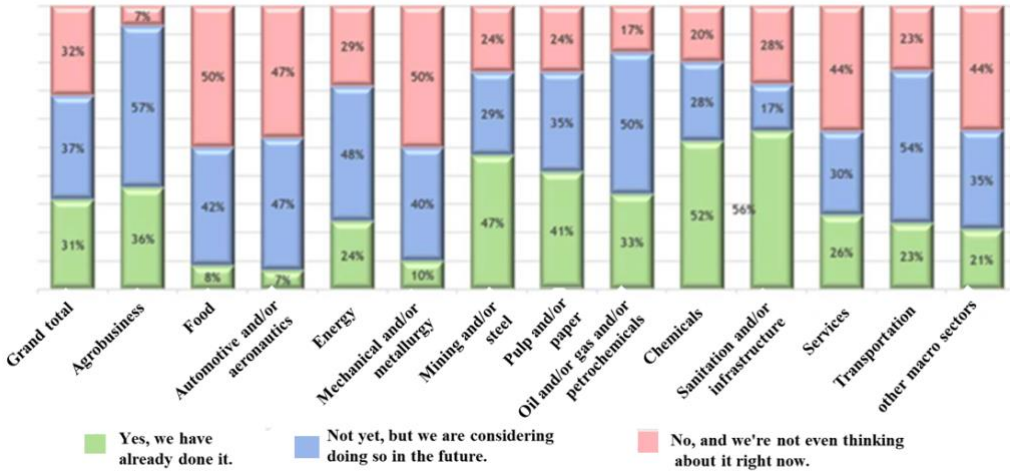
Figure 2. Size of organizations in the ABRAMAN survey



Source: ABRAMAN (2022)

With respect to the evaluation of asset management maturity conducted by the responding companies and/or units, the 2022 ABRAMAN survey indicates substantial variability across the economic sectors analyzed.

Figure 3. Status on conducting asset management maturity assessment



Source: ABRAMAN (2022)

The aggregated results across all surveyed sectors indicate that, on average, 31% of participating organizations have conducted at least one asset management maturity assessment. Among the segments that have neither performed such an assessment nor expressed intentions to do so are companies in the food industry and the mechanical/metallurgical sector. In contrast, agribusiness stands out among those that have not yet undertaken a maturity assessment but are considering doing so in the future. The sanitation and infrastructure sector leads the group of industries that have already implemented an asset management maturity assessment, followed by the chemical sector.

A detailed examination of the 2022 National Document (ABRAMAN, 2022), including the results of ABRAMAN's national survey, shows that asset management in Brazil is progressing toward consolidation and maturity, supported significantly by ABRAMAN's institutional role as a disseminator of practices. ISO 55001 certification emerges as an important reference, although its adoption remains largely concentrated among large enterprises and regulated industries that perceive clear value in international recognition.

The ABRAMAN's 2022 National Document underscores varying degrees of maturity across sectors, noting that energy, oil, and mining organizations demonstrate stronger implementation of structured asset management practices, whereas less regulated industries continue to exhibit substantial gaps. It further confirms that the asset management approach in Brazil is evolving beyond a purely technical and maintenance-focused orientation, becoming increasingly strategic, lifecycle-based, governance-driven, and centered on value realization. Despite this progress, several challenges persist: broadening the asset management culture within small and medium-sized enterprises, expanding professional qualifications, and enhancing the measurement of outcomes associated with economic, social, and environmental value.

CONCLUDING REMARKS

Some key conclusions emerge from this study, including:

i. Asset management originated from the progressive development of maintenance practices, gradually transforming into a broader strategic discipline focused on governance and value creation.

ii. The United Kingdom and Australia stand out as foundational ecosystems and primary accelerators of the discipline, whereas Brazil—despite its advantageous position and continued progress—remains on the path toward full maturity.

iii. The ISO 5500x family of standards has provided structural consolidation to the field, although worldwide implementation remains comparatively limited.

iv. In the Brazilian context, ABRAMAN has assumed a central role in promoting and disseminating asset management practices; however, notable gaps persist in less regulated sectors and among small and medium-sized enterprises.

v. Emerging directions for asset management include digitalization, sustainability, and resilience, elements already reflected in the most recent edition of the GFMAM Asset Management Landscape (GFMAM, 2024).

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The author confirms that the research supporting this article was conducted in complete accordance with established ethical standards governing academic inquiry. All procedures adhered to the relevant principles of integrity, transparency, and accountability, ensuring full compliance with ethical guidelines throughout the study's design, implementation, analysis, and dissemination.

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