# CIÊNCIAS SOCIALMENTE APLICÁVEIS E HUMANIDADES:

## SABERES, PRÁTICAS E HORIZONTES DE INVESTIGAÇÃO

JESÚS RIVAS GUTIÉRREZ
NELLY ALEJANDRA RODRÍGUEZ GUAJARDO
(ORGANIZADORES)

VOL VII

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## PRÓLOGO

Las transformaciones económicas, tecnológicas, ambientales e institucionales de las últimas décadas han modificado profundamente las formas de organización del trabajo, de gestión de las organizaciones, de producción del conocimiento y de toma de decisiones. En este escenario, comprender cómo empresas, instituciones y sujetos responden a nuevas exigencias de sostenibilidad, innovación y transformación digital se ha convertido en una cuestión central para las Ciencias Socialmente Aplicadas.

El séptimo volumen de ***Ciências Socialmente Aplicáveis e Humanidades: Saberes, Práticas e Horizontes de Investigação*** reúne quince capítulos organizados en cuatro ejes: **Gestión, Estrategia y Desarrollo Organizacional; Sostenibilidad, Liderazgo y Comportamiento de Mercado; Transformación Digital, Inteligencia Artificial y Gestión Institucional; y Transformación Institucional, Currículo e Innovación Aplicada**.

El primer eje presenta estudios orientados a la dinámica de las organizaciones y de los mercados. La producción científica en las escuelas de negocios latinoamericanas, la valoración del *know-how*, la gestión de los costos de calidad, la auditoría, el riesgo de fraude y los procesos de formalización empresarial son analizados como componentes de un entorno organizacional que exige una capacidad creciente de adaptación, planificación, control y toma de decisiones.

La sostenibilidad constituye el centro del segundo eje, en el cual el desempeño ambiental, el liderazgo responsable, la innovación, la conciencia ambiental y el comportamiento de consumo aparecen como dimensiones cada vez más integradas a las estrategias empresariales. Los trabajos muestran que las organizaciones enfrentan hoy el desafío de conciliar el desempeño económico, la responsabilidad socioambiental y las nuevas expectativas de los consumidores y demás actores involucrados.

En el tercer eje, los cambios asociados a la transformación digital adquieren protagonismo. La automatización de procesos, la inteligencia artificial, las competencias gerenciales, la toma de decisiones y la gestión integrada de riesgos son abordadas en estudios que revelan cómo las tecnologías digitales se incorporan tanto a pequeñas y medianas empresas como a estructuras institucionales más complejas. Más que adoptar nuevas herramientas, estos procesos exigen reorganización, capacidad de aprendizaje y formas responsables de gobernanza.

El cuarto eje traslada esta discusión hacia instituciones de formación y prácticas específicas de innovación. La reingeniería y adaptación curricular, la inteligencia artificial generativa, los escenarios clínicos ramificados, el aprendizaje basado en juegos y los objetos virtuales de aprendizaje ejemplifican diferentes formas mediante las cuales instituciones y profesionales responden a las transformaciones tecnológicas y sociales.

En este contexto, la innovación aparece no como un fin en sí misma, sino como parte de procesos más amplios de cambio institucional y perfeccionamiento de las prácticas.

El conjunto de los capítulos evidencia que gestión, tecnología, sostenibilidad e innovación son dimensiones cada vez más interdependientes. Las respuestas a los desafíos contemporáneos no dependen únicamente de la incorporación de nuevas herramientas o modelos, sino también de la capacidad de comprender sus impactos económicos, sociales, organizacionales y humanos.

Al presentar experiencias, análisis y propuestas procedentes de diferentes contextos, este volumen contribuye a ampliar el diálogo sobre las transformaciones que atraviesan las organizaciones y las instituciones y sobre los caminos posibles para construir prácticas más eficientes, responsables, sostenibles y socialmente relevantes.

¡Buena lectura!

**Jesús Rivas Gutiérrez**
**Nelly Alejandra Rodríguez Guajardo**

## SUMÁRIO

### GESTÃO, ESTRATÉGIA E DESENVOLVIMENTO ORGANIZACIONAL

# CAPÍTULO 9

## NEUROCOGNITIVE PROCESSES AND ARTIFICIAL INTELLIGENCE TO STRENGTHEN SUSTAINABLE MANAGERIAL SKILLS

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**ABSTRACT:** This study analyzes the convergence between neurocognitive processes and artificial intelligence as a strategic approach to strengthening sustainable managerial competencies and improving decision-making in organizational contexts characterized by uncertainty, information overload, technological transformation, and growing economic, social, and environmental demands. The study adopts a qualitative analytical approach based on the integration of theoretical and empirical evidence concerning executive cognitive control, cognitive load, explainable artificial intelligence, algorithmic governance, multi-criteria decision-making, Green AI, digital twins, and hybrid work environments. The findings suggest that combining neurocognitive principles with explainable artificial intelligence can contribute to more stable, traceable, and coherent managerial decisions by reducing unnecessary cognitive load, communicating uncertainty, facilitating actionable explanations, and preserving meaningful human control. Likewise, multi-criteria decision frameworks enable organizations to incorporate economic, social, and environmental objectives through explicit value functions, stakeholder participation, sensitivity analysis, and auditable decision criteria. The analysis also indicates that Green AI practices, including model compression, carbon-aware computing, and energy-efficient infrastructure, can align technological performance with environmental sustainability. Finally, algorithmic governance, lifecycle documentation, risk assessment, and continuous monitoring emerge as essential mechanisms for ensuring accountability, transparency, and responsible adoption of artificial intelligence. The study concludes that the integration of neurocognitive foundations, responsible artificial intelligence, sustainable

computational practices, and dynamic organizational learning constitutes a relevant framework for developing managerial competencies capable of supporting sustainable and evidence-based strategic decision-making.
**KEYWORDS:** neurocognitive processes; artificial intelligence; sustainable management; explainable AI; strategic decision-making.

## 1. INTRODUCTION

The proposal articulates a neurocognitive-sociotechnical approach to strengthen managerial competencies with a horizon of sustainability that integrates economic performance, social inclusion and environmental protection. From the neuroscience of control, strategic management requires maintaining long-term goals under uncertainty, managing effort and attention, and translating heterogeneous signals into coherent decisions. Artificial intelligence expands these capabilities by prioritizing information, providing explanations, and coordinating evidence flows without diluting human agency, as long as its design preserves traceability and ethical deliberation (Badre, 2024; Leow et al., 2024; Bogdanov et al., 2022).

Technological sustainability requires Green AI: estimating and reducing the carbon footprint of the life cycle of models, choosing infrastructure with lower energy intensity, and adopting compression strategies that maintain utility with lower computational cost. Evidence shows that improving technical and organizational efficiency allows environmental and financial benefits to be captured without sacrificing performance (Patterson et al., 2022; Lyu, et al., 2024).

Finally, hybrid work reconfigures executive coordination: evidence suggests benefits in retention and innovation if synchrony windows, disconnection norms, and asynchronous channels are designed to protect attention and preserve social capital. In this context, information architecture and meeting rituals influence the quality of collective reasoning, so the integration of analytical tools and interaction rules becomes part of the cognitive system of top management (Gibbs et al., 2024; Leonardi, 2024; Ochs et al., 2024).

## 2. STATEMENT OF THE PROBLEM

The following approach is proposed: the decision-making complexity faced by organizations often exceeds the neurocognitive capacity available to process it without falling into attentional overload, bias, or fatigue, while incorporating artificial intelligence systems that, while expanding human agency, introduce governance, transparency, security, and environmental sustainability risks. Under regulatory pressures and social

and climate expectations, this gap erodes executive judgment, traceability of decisions, and legitimacy in the eyes of interest groups; it is therefore necessary to articulate neurocognitive foundations, information architectures and responsible AI aimed at sustainable and auditable results.

Added to this tension is an epistemic dimension: the calibration of models under distribution change and incomplete or poorly documented data can bias the prioritization of interventions and the use of evidence in steering committees. Without standardized documentation of training sets and model cards, and without transparency mechanisms that can be translated into managerial language, algorithmic recommendations are perceived as opaque, reducing trust and the willingness to integrate them into strategic deliberations. (Mitchell et al., 2019).

From this problematic picture, three researchable questions emerge that guide the design and evaluation of solutions: How does a decision-focused dashboard design that incorporates actionable explainability, standardized documentation, and uncertainty metrics reduce cognitive load and improve the quality of executive judgment in decisions with simultaneous economic, social, and environmental goals? How to profile and assess the risks of AI systems to define human scaling thresholds, audit protocols, and logbooks that ensure accountability and regulatory compliance, without affecting the usefulness or agency of the expert user?, What engineering and governance configurations of Green AI maximize the environmental and economic return of analytics portfolios, preserving the quality of prediction, explainability and acceptance of stakeholders in hybrid work environments?.

## 3. BACKGROUND

### 3.1. TRANSFORMATION OF MANAGERIAL COMPETENCIES TOWARDS SUSTAINABILITY

In the last decade, corporate management has moved from optimizing isolated processes to creating value that integrates financial results with measurable social and environmental impacts, under comparable parameters across industries. This shift reconfigures managerial competencies towards analytical capabilities, systemic risk management, data literacy, and understanding of ethical frameworks that link economic performance with stakeholder expectations and climate goals (Krueger et al., 2020).

Under competitive and regulatory pressures, the executive agenda incorporates transition plans, carbon price sensitivity analysis, energy efficiency goals, responsible procurement, and inclusive labor practices. These lines of action require new skills to

negotiate compromises between objectives that coexist in tension, such as operating margin, decarbonization, and supplier development, and to build narratives consistent with medium-term investment cycles (Berg et al., 2022).

### 3.2. NEURO AI CONFLUENCE IN DECISION SUPPORT

When neuroscience findings on load and control are combined with explainable analytical tools, assistants emerge that support multi-criteria deliberations with transparency and traceability. These assistants can present value functions that integrate environmental, social, and financial objectives, and produce explanations focused on sensitivity to assumptions relevant to the committee. The key is that the representation of evidence helps reduce extrinsic effort, offers alternatives with explicit costs and benefits, and notes assumptions that require external confirmation, preserving the human agency that AI risk management frameworks claim (Raji et al., 2020).

### 3.3. DISTRIBUTED WORK MODALITIES AND EFFECTS ON LEADERSHIP

Remote work and hybrid schemes altered patterns of coordination, identification, and organizational learning. Experimental and observational studies report heterogeneous effects on productivity and collaboration according to type of task, communication practices, and technological support. In knowledge companies, remote work reduced bridges between teams and made collaboration networks more static, with implications for the dissemination of ideas and innovation. This suggests that leadership must redesign rituals, windows of synchronicity, and equipment to reconnect teams and sustain social capital without overloading the agenda (Choudhury et al., 2021; Yang et al., 2022; Gibbs et al., 2023).

Healthy management of boundaries between work and personal life becomes critical competence. Contemporary evidence on recovery shows that psychological disconnection and quality sleep play a more decisive role in sustaining well-being than mere physical activity, encouraging executive teams to institutionalize after-hours communication norms, redesign practices for meetings and micro-breaks, and to incorporate organizational health indicators into monitoring dashboards (Maslach & Leiter, 2022).

### 3.4. EMERGENCE OF THE COMPUTATIONAL EFFICIENCY APPROACH

The increase in the size of models and data brought computational efficiency to the center. A set of studies quantified emissions and energy consumption associated with

the training of large models, proposing practices to reduce footprint without sacrificing performance. These include selecting a region with lower carbon intensity, using renewable energy hubs, scheduling loads at convenient times, and tracking energy and carbon metrics by experiment. (Patterson et al., 2021; Schwartz et al., 2020; Henderson et al., 2020).

### 3.5. SUSTAINABILITY-ORIENTED ORGANIZATIONAL LEARNING

The integration of external evidence into internal policies demands learning routines that connect exploration and exploitation, avoiding the trap of adopting technological fads without an empirical basis. Recent literature on capability dynamics and sustainability insists on identifying, appropriating, and reconfiguring assets to compete in regulatory and technological transition scenarios (Berg et al., 2022).

Financial analytics based on machine learning has increased its presence in risk classification, forecasting and anomaly detection. However, responsible adoption requires data drift controls, uncertainty calibration, and clear separation between experimentation and production. The review literature highlights mature applications and research paths, noting the importance of comparable metrics and robust cross-validation to sustain performance under regime changes (Hoang, 2023; Gao et al., 2024; Noriega et al., 2023).

### 3.6. REGULATORY FRAMEWORKS AND CHECKLISTS FOR TECHNICAL RELIABILITY

Emerging risk management frameworks in artificial intelligence center human agency, lifecycle documentation, and accountability. The need to classify risks, assess biases, and establish continuous monitoring mechanisms translates into guides and checklists detailing algorithmic decisions, data sources, labeling processes, and validity limits. These practices enable internal and third-party audits, promote transparency and articulate a common language between legal, technological and business areas (Raji et al., 2020).

## 4. THEORETICAL FRAMEWORK

### 4.1. NEUROCOGNITIVE FOUNDATIONS OF EXECUTIVE PERFORMANCE

Contemporary evidence on executive functions describes a prefrontal control system that allocates working memory resources, inhibition, and flexibility based on goals and perceived costs of effort. Executive performance emerges from a balance between the expected benefit of exercising control and the subjective cost of maintaining it, which

directly impacts the planning and prioritization tasks of senior management (Badre, 2024; Musslick & Cohen, 2021; Skulmowski, 2023)

The expected value theory of control proposes that the brain calculates whether control is worth investing in based on probabilities of success, magnitude of the goal, and costs of effort. This calculation is relevant for managerial roles where high-leverage stocks demand sustained attention. Having operational metrics of perceived difficulty and managerial utility allows for the design of decision sequences that maximize the benefits of cognitive control and minimize fatigue

## 4.2. SOCIAL NEUROSCIENCE AND COORDINATION IN SENIOR MANAGEMENT TEAMS

Interpersonal brain synchrony is associated with better collaborative outcomes when tasks require fine coordination and joint construction of meaning. Recent reviews and meta-analyses with hyperscanning methods indicate that synchronization in prefrontal and temporoparietal regions coevolves with cooperative behaviors and may be an indicator of quality of interaction in executive teams. While challenges persist in inferring causation, the observed patterns guide practices of meeting preparation and intervention sequencing to facilitate attentional convergence (Réveillé et al., 2024).

Cognitive preparation prior to critical sessions increases the likelihood of efficient speaking turns and attentional alignment. Operational recommendations include distributing agendas in advance, limiting guiding questions and making explicit expectations about the evidence that will be presented, so that participants activate shared representations and interference is reduced. In senior management teams, alternating between option generation phases and evaluation phases reduces channel conflicts by separating exploration moments from filtering moments (Réveillé et al., 2024; Begemann et al., 2024).

## 4.3. COGNITIVE ERGONOMICS AND INFORMATION ARCHITECTURE FOR EXECUTIVE DECISIONS

Cognitive ergonomics applied to executive dashboards and reports seeks to minimize extrinsic load and highlight relevant signals. Clear visual hierarchies, prudent use of graphic elements, and updating with a stable cadence are recommended. Recent studies show that the complexity of the information and the cognitive style of the user influence the perceived load, so it is advisable to offer tiered views, filters by role and executive summaries to guide navigation (Skulmowski, 2023; Cheng et al., 2024).

Explanation formats must balance brevity and traceability. Executive summaries present the what and why in plain language, while causal narratives and evidence annexes allow for subsequent auditing. In steering committees, traceability is strengthened with decision logs, temporary stamps of updates and links to controlled primary sources. The measurement of perceived load, using validated scales and, where relevant, non-intrusive physiological markers, guides the recalibration of contents and cadences. (Skulmowski, 2023; Yu et al., 2024; Chen et al., 2023; Ke et al., 2023).

## 4.4. EXPLAINABLE ARTIFICIAL INTELLIGENCE AT THE SERVICE OF HUMAN AGENCY

Explainability is understood as a set of properties of systems that allow users to understand, trust, and act. A distinction is made between local explanations focused on particular cases, global explanations that summarize operating rules, and counterfactuals that describe minimal changes to achieve another result. In managerial contexts, the appropriate combination depends on the cost of error and the immediacy of the decision, so it is advisable to specify guidelines for use where each type of explanation is linked to available actions. (Verma et al., 2024; Freyer et al., 2024)

The feasibility and actionability of counterfactuals in management require respect for organizational constraints, regulations, and intergroup equity. Recent reviews underscore that the value of these explanations increases when they incorporate modifiable variables, realistic costs, and collateral risk assessment (Verma et al., 2024; Rožanec et al., 2024)

## 4.5. MULTI-CRITERIA DECISION AND VALUE FUNCTIONS FOR ECONOMIC, SOCIAL AND ENVIRONMENTAL OBJECTIVES

The multi-criteria decision provides a scaffolding to integrate heterogeneous objectives and stakeholder preferences. The explicit construction of value functions, with justified weightings and consistent scales, provides transparency and legitimacy. Recent reviews document its application in supply chains, health and sustainable design, highlighting the need for participatory processes and methodological auditing. (Su, Chen, Zhang, & Wang, 2024; Theilig, Schillig, & Wallbaum, 2024).

Assumption sensitivity analysis, along with thresholds and intertemporal commitments, avoids fragile decisions. The incorporation of risk tolerance models and error cost asymmetries clarifies regions of acceptance, rejection or need for additional information. In sustainability contexts, it is advisable to integrate qualitative evidence with

quantitative metrics, documenting inclusion criteria and aggregation rules. (Su et al., 2024; Theilig et al., 2024)

### 4.6. STRATEGIC SIMULATION AND DIGITAL TWINS TO SUPPORT SUSTAINABLE DECISIONS

Strategic simulation integrates real-time and historical data to explore operating scenarios, capital allocation, and intervention policies. In energy-intensive assets, digital twins make it possible to model consumption, prioritize retrofits, and evaluate trade-offs between performance, costs, and environmental goals. Recent reviews show benefits in operations and maintenance, although they point to interoperability and governance challenges. (Céspedes Cubides et al., 2024; Timperi et al., 2024; Omrany et al., 2024)

### 4.7. HYBRID WORK MODALITIES AND ORGANIZATIONAL HEALTH IN SUSTAINABLE MANAGEMENT

Collaborative networks and the dissemination of ideas are transformed into hybrid schemes. Recent evidence suggests that certain remote configurations can hinder innovation when there is a lack of coordination of co-presence rhythms and informal exchange mechanisms, although controlled trials also report that arrangements with defined days away from office preserve performance and improve retention. The key is to design synchrony windows and specific forums for creative exploration and socialization of learning. (Gibbs, Mengel, & Siemroth, 2024; Bloom, Han, & Liang, 2024; Wu, Wang, & Li, 2023; Vartiainen, 2024)

The design of synchronous and asynchronous channels must make explicit rules of use. Well-designed asynchronous communication offers time for reflection and reduces interruptions, but requires clear rules of response and urgency tagging. Evidence suggests that conscious management of time distances and time zones, with rituals of summary and distributed responsibility, improves coordination and reduces rework costs. (Chauvin et al., 2024; Wu et al., 2023; Heitmayer & Lahlou, 2024)

Psychological disconnection, sleep, and well-being impact performance. The intensive use of after-hours mail is associated with less recovery and more work-family conflict, so policies of breaks, redesign of meetings and planned micro-breaks become instruments of organizational health. The combination of device-free windows, limits on notifications, and sleep hygiene education supports sustained performance. (Bloom et al., 2024; Vartiainen, 2024).

### 4.8. ETHICS, RESPONSIBILITY AND CULTURE FOR SUSTAINABLE MANAGEMENT COMPETENCIES

The principles of human agency and the centrality of expert judgment demand that algorithmic systems complement, not replace, informed deliberation. The ethics of explainability invites teams to establish criteria of transparency proportional to the risk, articulate the recipients of the explanation and document limits of understanding. Recent reviews emphasize that useful transparency is that which allows responsible decisions and is inserted into accountability processes. (Cheong et al., 2024; Freyer et al., 2024)

Ecological coherence and dual materiality guide decision-making when financial and outward impacts must be considered simultaneously. Recent studies discuss methods for assessing materiality and point out the importance of involving stakeholders in the definition of relevant issues (Mezzanotte & Riccaboni, 2024; Miettinen & Virtanen, 2024).

## 5. EXAMPLES OF IMPLEMENTATION IN COMPANIES OR ORGANIZATIONS

### 5.1. EXPLAINABLE ANALYTICS FOR CREDIT AND REGULATORY COMPLIANCE

Banks and fintechs are integrating *local explanations* (e.g., SHAP) into their *underwriting* flows to document the *rationality* of the opinion, enable *recourse* for requesters, and facilitate internal audits; in practice, this involves dashboards that show risk *drivers*, thresholds, and *counterfactual simulations* to adjust policies under the *risk appetite* and regulatory limits. Risk areas establish *usage rules* that separate explanation for analysts (detailed) and for customers (concise and *actionable*), and that archive the *traceability* of each decision for later examinations. In implementation, *model committees* combine criteria of utility (reduction of error costs), *calibration,* and *fairness* by selecting explanation techniques and communication templates. (Černevičienė & Kabašinskas, 2024).

### 5.2. DIGITAL TWINS FOR ENERGY OPTIMISATION AND MAINTENANCE

Manufacturing companies, corporate real estate, and hospitals are deploying *digital twins* that integrate *BIM*, IoT sensors, and efficiency models to optimize *setpoints*, detect *anomalies,* and simulate *retrofits*. In operations, *facilities-data* teams co-design *dashboards* by *line of sight*: from executive KPIs of energy intensity and $CO_2$ *savings* to *engineer views* with *asset-level diagnostics*. For predictive maintenance, *work orders* are triggered from the twin with *priority* based on *impact* on operational continuity and *return*. Successful organizations document model *validity limits* and *scenario versioning* for *audit*

and *postmortems*. (Céspedes-Cubides & Jradi, 2024; Jradi, 2023; Wang et al., 2022; Ni et al., 2022).

### 5.3. ALGORITHMIC GOVERNANCE AND INTERNAL/EXTERNAL AUDITS

Several corporate groups have institutionalized *AI committees* with defined *roles and responsibilities* for data *due diligence*, *lifecycle documentation*, *checklists,* and *decision logs*. Mature practice aligns *controls* and *evidence* with risk profiles (e.g., *generative AI profile*), and delivers *audit packages* with *data lineage*, *robustness testing,* and *impact assessments*. An operational *playbook* distributes *control points* by stage (definition, development, deployment, monitoring), and provides for *human escalation* in the face *of red flags*. *Ethics-based* audits are used as an *accountability mechanism*, complementing technological *compliance* and third-party reviews. (NIST, 2023; NIST, 2024; Laine, Minkkinen, & Mäntymäki, 2024; Mökander & Floridi, 2022).

### 5.4. GREEN AI AND CARBON-CONSCIOUS ORCHESTRATION

Analytics-intensive organizations are adopting Green AI portfolios: *computing location* in lower *carbon intensity* regions, *scheduling* jobs *in* carbon-aware *windows, and* hardware/software *optimization* to reduce energy. Model *compression* (pruning, *quantization*, *distillation*) is key to reducing *latency* and consumption in production, especially at *the edge*. The *reporting* of emissions per experiment is standardized and accuracy-efficiency *trade-offs are compared* at the *portfolio* level of use cases. IT departments design *SLAs* that include *energy budgets and* emissions limits *per* pipeline. (Patterson et al., 2022; Lopes, Barbosa, & Vieira, 2024; Pan et al., 2024).

### 5.5. PERIMETER DEPLOYMENTS WITH COMPRESSION AND EDGE DESIGN

Retail, logistics, and *utilities* migrate models to *edge gateways* and *on-device* devices to improve *privacy*, resiliency, and *response time*. *Model engineering* relies on *knowledge distillation* to preserve key *signals*, *8–4-bit* quantization to accelerate *inference,* and *neural architecture search* geared toward *memory constraints*. Lightweight drift *monitors and* local calibration *are integrated, and reversion routes* to the *cloud* are defined *in the event* of *degradation*. Edge *MLOps* includes *firmware signing*, *OTA updates,* and *privacy-friendly telemetry*. (Lopes, Barbosa, & Vieira, 2024; Pan et al., 2024; Dakkak et al., 2024).

### 5.6. MANAGEMENT OF RISK UNDER DISTRIBUTION CHANGE AND OPERATIONAL EQUITY

For *dynamic businesses*, models are degraded with data *shift*. Leading companies integrate OOD *test batteries* and *pre-deployment sensitivity, and in production they apply drift* detection*,* stepwise *retraining*, and segment *error cost assessments*. Data *augmentation practices* with *generative models* and *uncertainty quantification* improve *robustness* and *fairness* in/out-of-distribution. Performance *metrics* differentiated by population and *explicit* risk tolerance are reported in decision-making *committees*. (Paul et al., 2024; Ktena et al., 2024; Javed, Ali, & Hussain, 2024).

## 6. RESULTS

The qualitative results suggest that when organizations combine neurocognitive processes with explainable artificial intelligence, algorithmic governance, and Green AI practices, they improve the calibration of their decisions, the traceability of justifications, and the coherence between their strategic goals and operational indicators. This pattern is most clearly observed when explainability is designed for managerial use and is aligned with risk profiles and utility criteria, avoiding generic explanations and favoring those that guide action and allow subsequent auditing. In such contexts, governance and computational efficiency are not appendages, but integrated components of performance and trust.

From the perspective of multi-criteria alignment, the findings show that value functions built with stakeholders, together with explicit sensitivity analyses, reduce decisional fragility in the face of assumption changes and correct error cost asymmetries. Incorporating multi-criteria analysis tools into supply chains and early design stages makes it easier to translate sustainability aspirations into verifiable commitments, while making cross-temporal trade-offs transparent. This practice also increases the legitimacy of the decision when weights and thresholds are reviewed periodically. (Wang et al., 2024; Boix-Cots, Pons et al., 2022).

A consistent result is that the usefulness of explainability increases when explanations become feasible, actionable, and readable to decision-makers, rather than being limited to technical outputs. Combining updated XAI conceptual frameworks with uncertainty communication practices and recoding clinical and organizational trust promotes faster learning and reduces the risk of automation bias. In this process, management teams particularly value counterfactual explanations that describe paths for improvement without completely reconfiguring the operation, as well as experience

design guides that anticipate questions from non-technical users. (Freyer et al., 2024; Balasubramaniam et al., 2023).

In governance, documented model lifecycles, checklists, and risk profiles specify checkpoints, human escalation, and assumption traceability, enabling early interventions in the event of anomalies and providing a clear signal of accountability. The use of model cards and datasheets provides a common structure for comparing use cases and their validity limits, while mapping responsibilities and evidence. Finally, risk management frameworks for generative AI reinforce the shared language between technical, legal, and business areas.

The results also confirm that the environmental and economic benefits of analytics depend on conscious decisions about where and when to execute loads, the reporting of emissions per experiment, and the explicit comparison of trade-offs between accuracy and efficiency. The literature on Green AI suggests that the standardization of footprint calculation, together with carbon-aware computing practices and the evaluation of energy cost by prediction, allows reducing emissions without compromising production performance, especially when considering time windows and regions of low carbon intensity.

On the technical-operational level, model compression supports edge deployments and improves latency and consumption, without significantly sacrificing accuracy in well-characterized tasks. Post-training quantization, knowledge distillation, and edge optimization facilitate operational privacy and resiliency against intermittent connectivity, while lightweight architectures preserve business-relevant signals. These patterns are strengthened by integrating with drift telemetry and local calibration, particularly in energy and manufacturing.

The use of digital twins emerges as a strategic capability when governed with scenario catalogs, limits of validity and traceability of assumptions, so that simulation is not an isolated exercise but an inter-area learning system. The qualitative results suggest that these approaches accelerate the transfer from pilots to operations by allowing shared sensitivity with non-technical actors, reducing overconfidence and prioritizing investments with comparable impact criteria. In manufacturing and territorial planning, its maturity depends on interoperability standards and common metadata frameworks. (Timperi, Turunen, & Lanz, 2024; Huang, 2024; Jørgensen, Brunoe, Nielsen, & Rösiö, 2024).

At the neurocognitive level, the articulation between cognitive control, allocation of effort and design of dashboards with adequate information load is linked to more stable decisions under time pressure and with less decisional fatigue. Evidence suggests that

more demanding goals can encourage longer and more precise deliberations, modulated by dopaminergic signals, while too much information and poor usability deteriorate the performance of management teams.

## 7. CONCLUSIONS

The implications presented show that the convergence between neurocognitive foundations, decision-centric interfaces and explainable artificial intelligence brings more reliable, traceable and sustainable decisions as long as the explanation is useful for action, uncertainty is communicated honestly and there is meaningful human control. In this horizon, the governing agency is strengthened when systems produce actionable reasons calibrated to the cost of error, rather than isolated technical descriptions that do not translate into comparable options or feasible improvement paths (Ali, Shrestha, Osmanaj, & Nur, 2023; Verma, Boonsanong, & Gummadi, 2024; Freyer, Ugar, & Neitzke, 2024).

Evidence is consolidated that algorithmic governance gains effectiveness when lifecycle documentation, checklists, and human scaling criteria are connected to strategic indicators and continuity plans, so that technical alerts are translated into executive decisions with traceability and accountability. The standardization of artifacts such as datasheets and model cards avoids overtrust, facilitates internal and external audits, and creates a common language between technical, legal, and business areas in regulated and highly socially sensitive contexts (NIST, 2023; NIST, 2024; Mitchell et al., 2019).

Therefore, it is supported that a pragmatic Green AI strategy is a condition of possibility to align economic value with environmental goals. Practices such as quantization, pruning and distillation, combined with infrastructure selection in regions of lower carbon intensity and with analytics at the edge when the case requires it, allow to reduce consumption, latency and data exposure, maintaining usefulness if the degradation is monitored and calibrated locally. Measuring the environmental and economic return throughout the model's lifecycle anchors these decisions in corporate climate strategy (Patterson et al., 2022).

For innovations to go from promising pilots to sustained value, the capacity for absorption and the dynamic capacities that transform external knowledge into stable routines emerge as decisive. Inter-area structures, hypothesis repositories, and continuous feedback shorten the distance between discovery and application, connecting the digital transition with the ecological transition and reducing the gap between promise and execution in project portfolios (Mecca, Cinelli, Kadziński, & Scotti, 2023; Ncube, Chitimira, & Rashidi, 2024; Sáez-Martínez, & Albort, 2022).

The multi-criteria decision is consolidated as the operational scaffolding to sustain the double materiality: value functions, weightings with stakeholders and sensitivity analysis convert strategic visions into observable and auditable criteria. When these frameworks are linked to clear executive and responsible dashboards, controversies over priorities are reduced, intertemporal trade-offs are made explicit, and biases towards what is exclusively measurable but little material for relevant actors are avoided (Theilig, Schillig, & Wallbaum, 2024).

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## ÍNDICE REMISSIVO

### A



### B



### C



### D



### E

## F



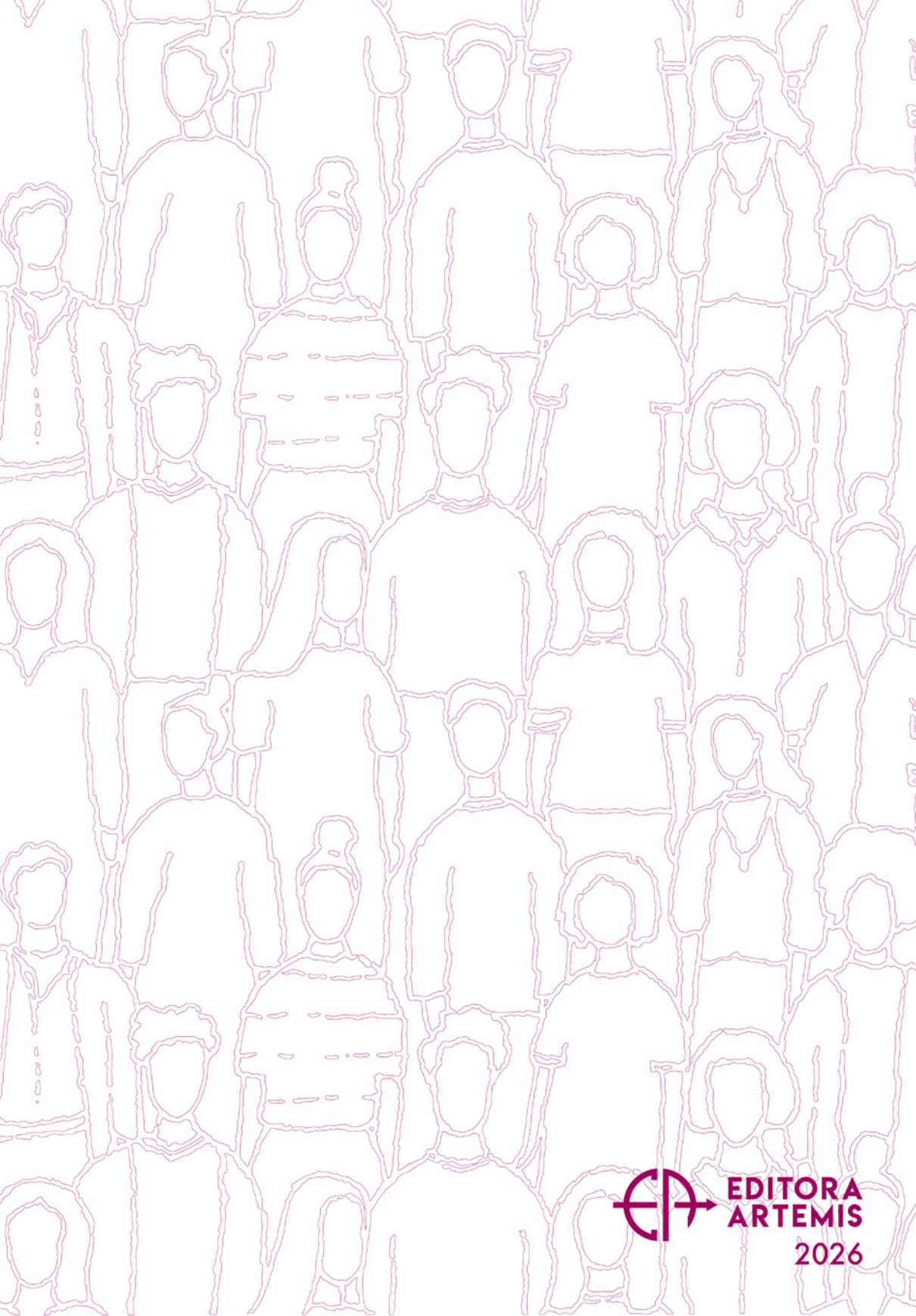
## G



## I



## K



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