Intelligent Cultural Ecologies Through an Analysis of Actors and Values for the Construction of Humanized Technological Futures

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Abstract
Technological transformations driven by the expansion of artificial intelligence and intensive digitization are profoundly reshaping cultural structures and value systems that guide social life. In this context, culture is increasingly organized as a complex sociotechnical ecology, in which heterogeneous actors interact, and whose positions, interests, and axiological orientations influence the construction of possible futures. This article analyzes these ecologies.
Methodologically, the study adopts a prospective qualitative-quantitative approach based on a review of specialized literature and the application of the MACTOR method, with the participation of a panel of 15 experts. The analysis identified the main actors in the system, their levels of influence and dependence, as well as the axiological convergences and divergences around eleven strategic values linked to technological humanization. The results show a broad convergence in values such as algorithmic justice, common digital well-being, and technological humanization, along with persistent tensions surrounding cultural autonomy and epistemological diversity.
The article concludes that the construction of humanized technological futures depends less on discursive consensus and more on the effective capacity to mobilize values within smart cultural ecologies, underscoring the need for philosophical approaches that integrate axiological analysis, sociotechnical agency, and cultural governance.
Keywords: philosophy of culture; axiology; smart cultural ecologies; actor analysis; technological values; humanized technological futures.

INTRODUCTION

Contemporary societies are experiencing an accelerated reconfiguration of their cultural structures driven by intensive digitization, the expansion of artificial intelligence (AI), and the consolidation of increasingly complex socio-technical systems (George, 2020). In this context, the values, practices, and forms of interaction that have historically guided social life are being transformed by the growing presence of smart technologies that mediate knowledge production, social organization, everyday experience, and collective decision-making (Webster & Leleux, 2018).

As Floridi (2014) warns, humanity is moving towards an "onlife" environment in which the distinction between digital and analog is blurring, generating new cultural ecologies where agency is distributed among humans, institutions, digital platforms, and algorithmic systems. This process not only modifies cultural dynamics but also the axiological regimes that guide social sense.

The philosophy of culture, following the statements of Simmel et al. (2011), Cassirer (2020), and Rosa (2010), has shown that values are not merely normative elements, but rather deep structures that shape practices, perceptions, and horizons of meaning. In hyperconnected environments, these values are strained by new logics associated with automated efficiency, adaptability, traceability, and hyperconnectivity, coexisting with, and sometimes conflicting with, classical values such as autonomy, dignity, justice, and recognition. This convergence between traditional and emerging values demands a philosophical reading capable of understanding how cultural ecologies are rearticulated in a world mediated by smart technologies.

Furthermore, contemporary culture is increasingly organized as a dynamic ecosystem of heterogeneous actors. From a systemic and posthumanist perspective, authors such as Sloterdijk (2011) and Latour (2005) have emphasized that current cultural environments cannot be explained solely by individual or collective human action, but rather as assemblages involving digital infrastructures, algorithms, institutions, epistemic communities, and regulatory frameworks. These configurations generate axiological tensions and negotiations that define the possible futures of technological societies. Consequently, understanding smart cultural ecologies requires analyzing not only the technical and social dynamics, but also the constellation of values that permeates the construction of these futures.

Despite the abundant literature on the ethics of technology, AI, and digital transformation, studies integrating a philosophical analysis of values with systematic models that identify the interdependencies between cultural variables, relevant actors, and axiological tensions in highly complex contexts remain insufficient. Therefore, this study proposes an innovative approach that combines a literature review and the MACTOR method with the participation of 15 experts, aiming to map the values, actors, and dynamics that shape smart cultural ecologies and their implications for building humanized technological futures.

The central purpose of this article is to offer a comprehensive and philosophically grounded analysis of how smart digitization processes reconfigure culture, transform value systems, and redistribute sociotechnical agency in contemporary societies. By identifying the relational structure between actors and values, this study seeks to contribute to the axiological understanding of emerging technological environments and provide input for critically thinking about the construction of futures where technology is not only efficient but also humanizing and culturally sustainable. From this perspective, the MACTOR method is not employed as a merely technical instrument but as a hermeneutic tool to reveal the axiological tensions that structure smart cultural ecologies.

THEORETICAL FRAMEWORK

Philosophy of culture and technological transformation

The philosophy of culture has historically addressed how symbolic systems, social practices, and values are reconfigured in response to structural changes in society. From Simmel and Cassirer to contemporary thinkers like Sloterdijk and Han, culture is understood as a dynamic framework where values act as guiding mechanisms, regulators of meaning, and shapers of collective action.

Recent technological transformations, especially smart digitization, have intensified the processes of mediatization, acceleration, and cultural reconfiguration. Hartmut Rosa (2013) links social acceleration to mutations in the experience of the world, while Luciano Floridi (2014) describes the transition to "onlife," a hybrid space where the digital and offline become indistinguishable. In this context, culture can no longer be understood solely as a set of human practices separate from technology, but rather as a complex ecology in which humans, artifacts, algorithms, and symbolic systems coexist and co-evolve.

Cultural ecologies: from the anthropocentric approach to socio-technical systems

The concept of "cultural ecology" has evolved from its initial anthropological meaning (Steward, 1972) to contemporary definitions that understand it as the structural interdependence between practices, values, technologies, and social actors. Recent perspectives, influenced by systems theory and posthumanist philosophy, suggest that culture is configured in a network of relations that are not exclusively human, but rather hybrid, socio-technical, and distributed.

Authors such as Sloterdijk (2011) and Latour (Latour, 2005) argue that contemporary cultural environments function as "spheres" or "assemblages" where agency is distributed among humans, institutions, and artifacts. These cultural-technological ecologies are organized as adaptive systems, capable of generating new forms of value, identity, relation, and experience. From this perspective, discussing smart cultural ecologies requires understanding how algorithmic processes, AI systems, and digital infrastructures intervene in the production of meaning, the shaping of habits, and the axiological transformation of society.

AI and culture: values, mediation and reconfiguration of meaning

The incorporation of smart technologies has introduced new modes and forms of valued interaction into culture. Floridi (2015) argues that AI, in addition to being a tool, is a "morally significant agent" within socio-technical ecosystems. Authors such as Nissenbaum (2011) and Vallor (2016) have shown that all smart technologies incorporate an "axiological layer" integrated into their design, operation, and social deployment.

This implies that algorithmic systems act as filters that prioritize, shape, and transform cultural values, generating ethical tensions and redefining the relation between individuals, groups, and institutions (Mittelstadt et al., 2016). Within this framework, values such as adaptability, hyperconnectivity, cognitive efficiency, traceability, and automation emerge, coexisting with traditional cultural values such as autonomy, self-realization, solidarity, and justice.

Actors, values, and power dynamics in smart cultural ecosystems

A philosophical understanding of contemporary cultural systems requires examining the complex network of actors involved in the production and circulation of values. From the perspective of practical philosophy, Charles Taylor (1985) argues that values structure the "horizons of meaning" that guide societies. However, in highly technological settings, these horizons are influenced by multiple actors. This multiplicity of actors, as Latour (2005) points out, forms assemblages where power is not centralized. Consequently, analyzing the construction of humanized technological futures involves understanding how values are negotiated, prioritized, and transformed within these smart cultural ecologies.

Cultural prospective and structural analysis of values

Cultural prospective allows for studying long-term transformations in value systems, identifying profound relations between actors, trends, and structures. Methods such as MICMAC, MACTOR, and Régnier Abacus allow for understanding: the interdependencies between cultural variables, the power dynamics between actors and their axiological objectives (Godet, 1991), the consensuses and dissensions on emerging values, and the stability or fragility of socio-technical ecologies.

This analysis is justified because it allows for mapping how values guide (and are guided by) cultural transformations driven by smart technologies. From this perspective, smart cultural ecologies are understood not only as a technical or sociological phenomenon, but as a contested axiological field, where possible futures need to be evaluated in ethical, ontological, and political terms.

METHODOLOGY

This was a mixed-methods, prospective study (Angouri & Litoselliti, 2018) that sought to analyze the axiological configuration and positioning of key actors in smart cultural ecologies. To achieve this objective, the MACTOR (Matrix of Actors, Objectives, and Power Relations) method was used, as it is one of the most suitable techniques for examining convergences and divergences in complex systems involving values, interests, tensions, and power dynamics (Godet, 2001). This approach allows for understanding how different actors contribute to or oppose the construction of humanized technological futures, placing values as the interpretive core of the analysis.

The methodology was developed in two main phases: (1) specialized documentary review for the preliminary identification of values and actors, and (2) application of the MACTOR method with a panel of 15 experts to map the relational structure, axiological alignments, and socio-technical tensions present in smart cultural ecologies.

1. Document review for the identification of values and actors

The first phase consisted of a comprehensive review of academic literature in philosophy of technology, cultural studies, applied ethics, algorithmic governance, and socio-technical ecologies. The review included articles indexed in Scopus, Web of Science, Philosopher's Index, and Google Scholar, as well as key studies by Floridi, Han, Sloterdijk, Latour, Rosa, Nissenbaum, and Vallor. The literature analysis identified relevant values and socio-technical actors involved in the construction of smart cultural ecologies. These elements formed the conceptual basis for the subsequent application of the MACTOR method.

2. Composition of the expert panel

The study involved 15 experts selected based on their academic and professional experience in the following fields: philosophy of technology, cultural studies, ethics and axiology, technology policy, AI, digital governance and regulation, prospective, and strategic analysis. These experts contributed their independent judgment on values and actors, ensuring epistemological diversity and an interdisciplinary approach.

3. Application of the MACTOR method

The MACTOR method allowed for the analysis of actors' positions regarding identified values, their capacity to influence other actors, axiological alliances and conflicts, and the power architecture within the smart cultural ecology. The application consisted of four stages:

3.1. Identification of actors and values

Based on the document review and expert validation, the preliminary Actor-Value matrix was defined. This matrix contains the set of cultural and ethical values that shape smart cultural ecologies; the socio-technical actors involved in their production, regulation, or appropriation.

3.2. Matrix of influences between actors

The experts estimated each actor's capacity to influence others using the Actor-Actor matrix. The assessment included direct influence, indirect influence, levels of dependence, and power. This step allowed for the calculation of influence and dependence indices, which are fundamental to understanding the distribution of power in the analyzed cultural ecology.

3.3. Matrix of positions (evaluation of support or opposition)

Each expert evaluated the level of support, indifference, or opposition of each actor with respect to each value, using the MACTOR scale: +3 = strong support; +2 = moderate support; +1 = weak support; 0 = neutrality; -1 = weak opposition; -2 = moderate opposition; -3 = strong opposition (Arcade et al., 2014). This matrix allows for the identification of the most defended values, the most questioned values, and those that generate the greatest axiological polarization among the actors.

3.4. Calculation of axiological convergences and divergences

From the two previous matrices, the following were obtained: convergence vectors (actors who share values and directions of action), divergence vectors (actors with opposing axiological positions), and strategic positionings (leading, neutral, dependent, blocking, or facilitating actors). The philosophical interpretation of the analysis focused on understanding how the interaction between actors and values affects the construction of humanized technological futures.

The results of this study were integrated through an interpretive analysis grounded in the philosophy of culture and axiology. This phase allowed for the examination of ethical tensions between actors, the identification of conflicting and emerging values, an understanding of the socio-technical ecodynamics that define intelligent cultural ecologies, and the mapping of possible scenarios for human-centered technological futures.

The confidentiality of the experts, the responsible use of expert judgment, and methodological transparency were guaranteed. No sensitive personal data were used, nor were experiments conducted on human subjects, as participation was limited to the qualitative evaluation and analysis of cultural and technical variables.

RESULTS

The results are presented according to the phases established by the MACTOR methodology, in order to clearly show how the positions, convergences, divergences, hierarchies of influence, and power relations were configured among the actors involved in the construction of humanized technological futures.

1. Identification of actors and strategic values (Phase A)

The first phase of the MACTOR method consisted of identifying the key actors involved in shaping smart cultural ecologies and defining the strategic values that guide their interests, tensions, and convergences in relation to building humanized technological futures. Thus, a systematic literature review and a conceptual validation process were conducted with 15 experts, who provided criteria on the relevance, influence, and degree of involvement of each actor within the contemporary cultural-technological ecosystem. Based on this review, a preliminary inventory of actors was developed, which was subsequently validated and refined by the 15 experts convened during the application of MACTOR.

The selected actors correspond to four dimensions: Institutional-political, Technological-industrial, Sociocultural, and Ethical-regulatory. Table 1 presents the final list, consolidated with standardized codes (A1, A2, …), the actor's name, and their role within the analyzed system.

Table 1. Actors identified in the MACTOR analysis

Code	Actor (name)	Main role in smart cultural ecology
A1	Government institutions (ministries, public agencies)	They design policies, fund initiatives, regulate legal frameworks, and promote public agendas.
A2	Technology companies and digital platforms	They develop infrastructures, products, and algorithms that mediate cultural experience and the circulation of values.
A3	Regulatory agencies and supervisors (sector regulators)	They implement regulations, monitor compliance, and can influence technological deployments.
A4	Academic communities and researchers	They generate knowledge, critical frameworks, and evidence that inform public discourse and policies.
A5	AI developers and engineers (technical teams)	They build artifacts (algorithms, models) and translate values into technical design.
A6	Civil society organizations and NGOs (human rights advocates)	They represent citizen demands, monitor progress, and promote agendas for justice and equity.
A7	Cultural and educational communities (schools, cultural groups)	They produce and reproduce cultural practices; they are agents of appropriation and resistance.
A8	End users / citizens (including advanced users)	They are consumers and users; their practices legitimize or reject technologies and values.

Source: Prepared by the author based on document review and expert consultation

The second part of this phase consisted of defining the cultural and axiological values that structure the transition to smart cultural ecologies. These values emerge from contemporary debates in philosophy of technology, digital ethics, cultural studies, and technology policy. The selection was based on: fundamental theoretical concepts (Floridi, 2014; Han, 2013; Simmel et al., 2013; Rosa, 2013; UNESCO 2022), technological ethics frameworks, and a review of global cultural trends (algorithmization, virtualization, human-centered AI). Subsequently, the values were reviewed, redefined, and approved by the panel of experts to ensure their relevance and conceptual clarity. Table 2 presents the final list, consolidated with standardized codes (V1, V2, …), the name of the value, and a description of each one.

Table 2. Identified strategic values

Code	Values	Brief description
V1	Technological humanization	It prioritizes human well-being in the design and use of smart technologies.
V2	Cultural autonomy	It ensures the capacity of communities and actors to define their own cultural meanings and practices.
V3	Algorithmic justice	It promotes equity, transparency, and bias mitigation in smart systems.
V4	Epistemological diversity	It recognizes multiple forms of knowledge within digital cultural ecologies.
V5	Ethics of digital care	It encourages technological practices focused on protection, support, and responsibility.
V6	Sociotechnological sustainability	It advocates for a balance between technological innovation and cultural and social sustainability.
V7	Expanded cultural participation	It promotes the inclusion of diverse actors in decision-making regarding emerging technologies.
V8	Informational transparency	It facilitates clear and responsible access to information about digital processes and algorithms.
V9	Common digital well-being	It promotes infrastructures, practices, and technologies oriented toward community benefit.
V10	Responsible innovation	It establishes ethical and cultural boundaries for technological development.
V11	Cognitive integrity	It protects the human capacity to think, decide, and construct meaning autonomously in the face of algorithms.

Source: Prepared by the author based on document review and expert consultation

2. Construction of the Matrix of Direct Influence/Dependence (MDID) (Phase B)

Phase B consisted of the evaluation, by the 15 experts, of the level of direct influence between the actors. The result was an 8x8 matrix presented in Figure 1, which allowed the identification of asymmetrical influence relations, in which actors A3, A1, A3, and A2 stand out, since they are the rows with the highest numbers of 2 and 3; therefore, they are the actors with the most influence.

Figure 1. MDID

MDID	A1	A2	A3	A4	A5	A6	A7	A8
A1	0	3	2	3	3	2	2	2
A2	2	0	3	3	2	3	2	2
A3	3	3	0	3	2	2	1	3
A4	3	3	3	0	2	2	2	2
A5	1	2	1	1	0	2	1	1
A6	1	1	1	2	1	0	0	2
A7	0	1	1	0	1	1	0	1
A8	1	1	1	2	1	1	1	0

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Source: Prepared by the author based on expert consultation

The MDID processed in the LIPSOR-EPITA software resulted in the Matrix of Direct and Indirect Influence/Dependency (MDIID) shown in Figure 2. This matrix allowed for the classification of actors into the four categories of the MACTOR method (Dominant, Linking, Dependent, and Dominated). The position of each actor within the system is explained below using the diagram in Figure 3.

Figure 2. MDIID

MDIID	A1	A2	A3	A4	A5	A6	A7	A8	Ii
A1	10	13	12	13	12	13	9	12	84
A2	11	13	12	13	11	13	9	13	82
A3	11	14	12	14	12	13	9	13	86
A4	11	14	12	14	12	13	9	13	84
A5	7	8	8	8	8	9	7	9	56
A6	7	7	7	8	7	7	7	8	51
A7	5	5	5	5	5	5	4	5	35
A8	7	8	8	7	8	8	7	8	53
Di	59	69	64	68	67	74	57	73	531

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Source: own elaboration

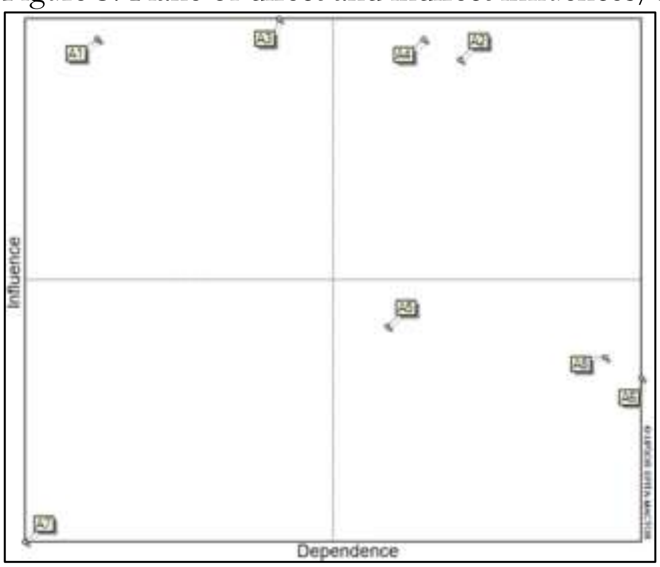
Governmental institutions (A1): with a total Influence (Ii) of 84 and a Dependence (Di) of 59, it is located in the quadrant of the Dominant actors (top left of the plane) of the map of influence/dependence, they have the ability to set agendas, laws and funds, which gives them a determining role and, although they interact with companies and civil society, their dependence is relatively low in structural terms.

Meanwhile, Technology companies/platforms (A2), with Ii = 82 and Di = 69, are positioned in the quadrant of linking actors, as they are considered the technical and economic engine of the system (infrastructure, data, algorithms), hence their high influence. However, they depend on social legitimacy, regulations, capital, and technical ecosystems (hence their high dependency). This dual condition makes them linking/broker actors, since they can drive change but need to negotiate with other powers.

Regulatory agencies (A3), with Ii = 86 and Di = 64, were classified as Dominant because they possess coercive and supervisory capacity; they can influence the actions of companies, and are therefore considered dominant alongside A1 (although with a different nature: A1 is more political, A3 more technical-legal). Academic communities (A4), with Ii = 84 and Di = 68, generate knowledge and interpretive frameworks; their influence is strong in discourse and evidence, but they depend on funding, publication platforms, and networks. Therefore, they were placed in the upper right quadrant as a linking actor in an epistemological sense, since these actors mediate between theory and practice.

Developers/engineers (A5), with Ii = 58 and Di = 67, have concrete technical influence (design decisions), but depend on companies, mandates, and resources. In the systemic

dynamic, they operate as technically influential but institutionally dependent actors; for this reason, they are classified as dominated, located in the lower left quadrant of the map. As for civil society organizations/NGOs (A6), with Ii = 51 and Di = 74, their influence is limited in relation to corporate/governmental resources and power, as they depend on funding and networks to exert influence. Therefore, they are located in the quadrant of dominant actors (lower right of the map).
For their part, the Cultural and educational communities (A7), with Ii = 35 and Di = 57, maintain their own practices and meanings that are not always instrumentalized by the system; their low dependence means they operate according to their own logic (local autonomy), although their overall influence is limited. These actors are therefore located in the lower left quadrant of the map, where the autonomous actors are located. Finally, the Users/citizens (A8), with Ii = 53 and Di = 73, are classified as dominated actors. Individually, they have little capacity to influence platforms and regulators; they depend heavily on infrastructure, policies, and business models. Collectively, they can mobilize, but in terms of structural influence and dependence on the system, they tend to remain dominated.
Figure 3. Plane of direct and indirect influences/dependencies between actors



Source: own elaboration

3. Construction of the matrix of valued positions (Phase C)
In Phase C, the Matrix of valued positions (2MAO) of the MACTOR method was constructed. This matrix shows the degree of support or opposition of each actor to the system's objectives, in this case, to the values for building humanized technological futures. It uses a scale (from -3 to +3). Its purpose is to identify alliances, conflicts, and strategic trends, allowing for analysis of how actors align with or oppose different values. The 2MAO matrix shown in Figure 4 was obtained as a result of this process.
As can be seen, the 2MAO matrix shows a strong predominance of favorable positions, indicating that most actors tend to support the construction of smart and technologically humanized cultural ecologies. Actors A3 (regulatory agencies), A4 (academia), and A6 (civil society organizations) showed high levels of support, demonstrating their structural alignment with values such as V3, V8, and V9.
For its part, A2 (technology companies) has a heterogeneous profile, showing significant support for values such as responsible innovation, but with reservations or tensions

regarding cultural autonomy and epistemological diversity. This is consistent with the typical dilemmas between market dynamics and ethical demands. In contrast, actors A7 (cultural and educational communities) and A8 (end users) showed stable and moderate support for most values, reinforcing the general trend of social support for the humanization of technology.

Figure 4. Matrix of valued positions 2MAO

2MAO	V1	V2	V3	V4	V5	V6	V7	V8	V9	V10	V11
A1	2	1	3	1	2	3	2	3	3	2	2
A2	1	-1	-1	0	-1	1	0	-2	-1	3	-2
A3	2	1	3	1	2	2	1	3	3	1	2
A4	3	2	3	3	2	2	2	2	2	2	3
A5	1	0	1	1	0	1	0	1	1	3	0
A6	3	3	3	2	3	2	3	3	3	1	3
A7	3	3	2	3	3	2	3	2	3	1	3
A8	2	2	2	2	2	1	2	2	2	1	2

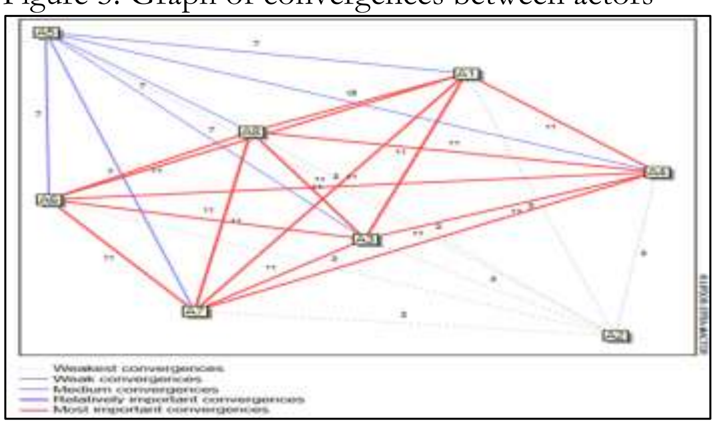
Source: own elaboration

4. Axiological convergences and divergences (Phase D)

The convergence graph (Figure 5) shows a highly interconnected system, where most actors exhibit significant overlap in their orientations toward strategic values. The most significant convergences (thick red lines) are concentrated around actors A1 (Government institutions), A3 (Regulatory agencies), A4 (Academic communities), and A6 (Civil society organizations), demonstrating a strong alignment among these actors with respect to the analyzed ethical, cultural, and technological principles.

Likewise, moderate and relatively significant convergences are observed between A5 (AI developers) and institutional actors such as A1, A3, and A4, suggesting a relatively robust technical-regulatory articulation. In contrast, A2 (Technology companies) shows weaker convergences with much of the system, indicating less alignment with the values shared by public, academic, and social actors. Finally, A8 (End users) maintains moderate convergences, reflecting selective affinities but without a dominant structural influence.

Figure 5. Graph of convergences between actors

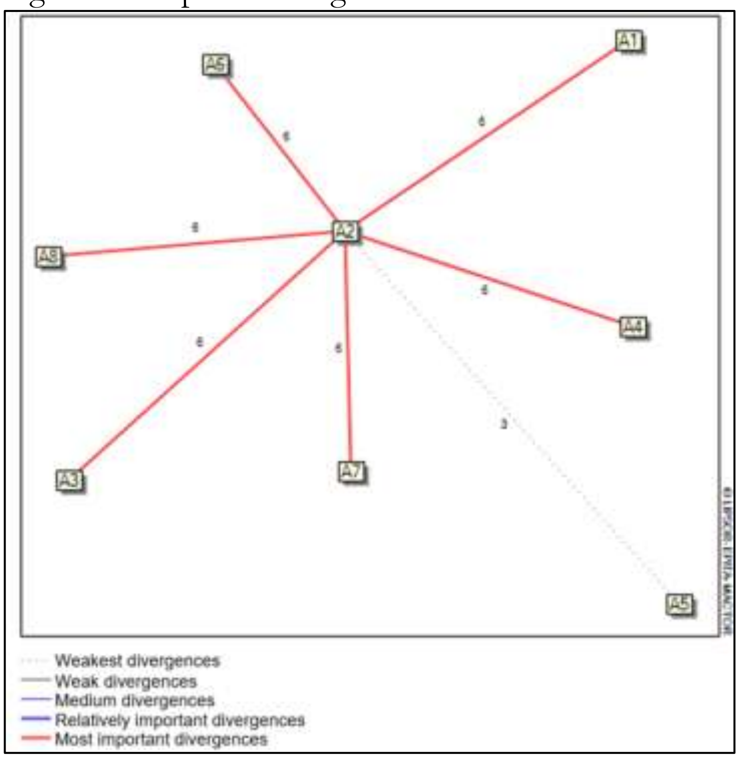


Source: own elaboration

Regarding the divergences, the graph in Figure 6 shows that the most significant divergences within the system are concentrated around A2 (Technology companies and digital platforms), which acts as the core of disagreements with multiple actors. The red lines representing the most important divergences show that A2 maintains significant differences with A1 (Government institutions), A3 (Regulatory agencies), A6 (Civil society organizations), and A7 (Cultural and educational communities). This conflictive centrality indicates that A2 holds particular, likely more critical, ethical, or reflective value positions regarding sociotechnological processes, reflecting the structural tension between market logic, accelerated innovation, and the normative, cultural, and ethical demands promoted by other actors in the system.

Likewise, a smaller but relevant divergence is observed between A2 and A5 (AI developers and engineers), suggesting that some tensions also arise regarding societal expectations of technology adoption. In summary, the graph shows that A2 is the main point of value tension in the system, expressing broad and deep disagreements. Most of the other actors maintain relatively convergent positions, with their divergences being less intense or peripheral.

Figure 6. Graph of divergences



Source: own elaboration

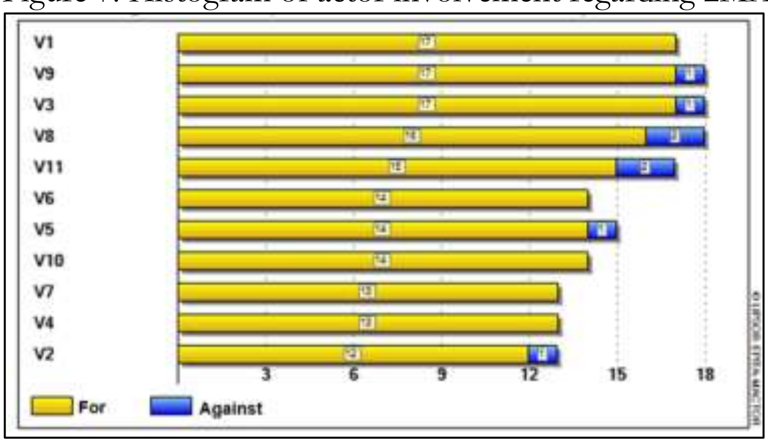
Furthermore, the histogram in Figure 7 presents the level of actors' involvement (A1–A8) with respect to each of the strategic values (V1–V11) defined in the MACTOR analysis. Yellow bars indicate positive or convergent involvement (“For”), while blue bars reflect negative involvement or opposition (“Against”). The values are ordered from highest to lowest overall level of involvement, allowing visualization of which values are most supported by the actors' group and which encounter the greatest tensions or resistance.

As can be seen, most values show substantial support (yellow areas), indicating that the system of actors generally leans toward a positive orientation for building smart cultural ecologies. This suggests a broad axiological alignment on issues such as algorithmic justice, technological humanization, and socio-technological sustainability. The values Technological humanization (V1), Digital common welfare (V9), Algorithmic justice

(V3), and Informational transparency (V8) top the ranking and are therefore the most supported. This implies that the actors share a deeply ethical and humanistic vision regarding technological development, prioritizing minimizing harm, protecting rights, ensuring transparency, and orienting technology toward collective well-being.

Similarly, values such as Digital care ethics (V5), Sociotechnological sustainability (V6), and Cognitive integrity (V11) show high positive scores, although small bars of opposition also appear. This indicates that, while there is a favorable trend, some actors, such as technology companies or developers, may have reservations about the regulatory requirements or limitations that these values could impose. On the other hand, Cultural autonomy (V2) and Epistemological diversity (V4) are located at the bottom of the ranking. This could be interpreted as tensions between globalized logics of innovation and the defense of local cultural identities, and difficulty in integrating multiple epistemic frameworks into technological processes dominated by corporate or academic standards. The fact that most values are represented by predominantly yellow bars indicates that the system is oriented towards cooperation and that conditions are favorable for building humanized technological futures. However, the presence of opposition, although in the minority, points to areas where normative, ethical, or governance conflicts should be anticipated.

Figure 7. Histogram of actor involvement regarding 2MAO values



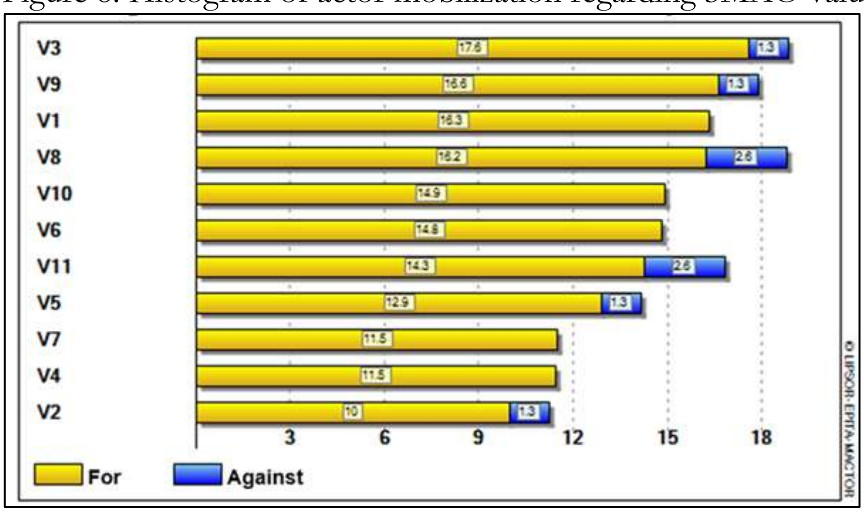
Source: own elaboration

On the other hand, the histogram of actor mobilization regarding values (3MAO) in Figure 8 represents the degree to which each actor actively influences, either for (yellow bar) or against (blue bar), the achievement of each of the system's strategic values. Unlike the histogram of involvement (2MAO), which shows the actors' declared position, this graph demonstrates their capacity for effective action; that is, the actual mobilization they can exert on the analyzed values.

The values are ordered from highest to lowest total mobilization, allowing for identifying which ones are the most actively promoted or resisted within the prospective system. As can be seen in Figure 8, value V3 (Algorithmic justice) emerged as the one that generated the greatest mobilization. This reveals that a significant number of supporting actors possess considerable capacity to mobilize it. Therefore, V3 can be understood as a structuring axis of the socio-technological ecosystem, and V9 (Digital common welfare) and V1 (Technological humanization) also point to indicators of high mobilization: these

are values that are the subject of general mobilization efforts, allowing for concluding that they are "driving" values that channel significant levels of operational consensus.
V8 (Informational transparency) also ranks among the top, reflecting the central importance of the digital opacity problem and the evaluation that actors place on addressing it through concrete actions. V10 (Responsible innovation), V6 (Socio-technological sustainability), and V11 (Cognitive integrity) show moderate levels of mobilization, indicating significant support but without reaching the level of urgency or concern among actors regarding the other values.
In contrast, V5 (Ethics of digital care), V7 (Expanded cultural participation), and V4 (Epistemological diversity) are at the lowest levels of mobilization. Although the values are present, effective action to promote them is weaker, suggesting that these values should have specific strategies to strengthen their dynamism within the system. V2 (Cultural autonomy) is in last place, being the least activated value. This implies that, while it may be recognized as relevant in discourse, key actors are not generating substantial actions to promote it. Perhaps it is a more fragile value that may be subordinated to other values more closely related to technological and regulatory priorities.
The previous results indicate that the difference between involvement and mobilization reflects a common gap in smart cultural ecologies between normative agreement and the capacity to become action, a key element of contemporary philosophy of technology.

Figure 8. Histogram of actor mobilization regarding 3MAO values



Source: own elaboration

The results of the MACTOR analysis show that smart cultural ecologies are configured as highly interdependent sociotechnical systems, where values function not only as normative principles but also as structuring axes of power relations, cooperation, and conflict among actors. The differentiated distribution of influences, dependencies, convergences, and mobilizations demonstrates that the construction of humanized technological futures does not depend on a single actor but rather on the dynamic interaction among public institutions, regulators, epistemic communities, technological actors, and civil society.
Furthermore, the results reveal that, although there is a widely shared axiological orientation toward humanist values and digital justice, significant asymmetries persist

between the discursive recognition of certain values and their actual capacity for mobilization within the system. These tensions anticipate structural challenges for the cultural governance of technology, especially regarding cultural autonomy, epistemological diversity, and the effective participation of less influential actors.

This scenario confirms that smart cultural ecologies must be understood as contested axiological fields, where possible technological futures are defined as much by ethical consensus as by power relations and differential capacities for action.

DISCUSSIONS

The results obtained through MACTOR analysis allow for interpreting smart cultural ecologies as dynamic axiological configurations in which technology does not act as a neutral element but rather as an active mediator in the production of meaning, values, and power relations. In line with contemporary cultural philosophy, the analyzed system reveals that humanized technological futures are not created spontaneously, but rather are shaped by structural tensions between actors with unequal capacities for influence and with partially convergent and divergent axiological orientations.

First, the predominance of values such as technological humanization, common digital well-being, and algorithmic justice in the implication and mobilization histograms confirms that the axiological dimension occupies a central place in the cultural governance of digital environments. This finding aligns with the thesis of Floridi (2014) and Hofkirchner (2010), according to which contemporary societies are organized as infospheres where values not only regulate human action but are also embedded in the very architecture of technological systems. From this perspective, the high level of implication of the actors with these values indicates a growing awareness that technological development needs to be guided by ethical and cultural principles, and not solely by criteria of efficiency or instrumental innovation.

However, the analysis of convergences and divergences reveals that this shared idea, axiologically oriented, translates into a non-dissonant confluence. There is significant convergence among academic communities, civil society organizations, and cultural communities, but more as the existence of a kind of reflexive-normative core from which, paradoxically, a profoundly humanizing, critical vision of technology emerges. This dimension acts as what Taylor (1985), Grunwald (2020), and Klenk (2021) call a shared moral horizon in which values are interpreted as frames of reference for evaluating the meaning and consequences of technological action.

In contrast, significant divergences exist between technology companies and regulatory agencies and government institutions, revealing a structural tension between logics of innovation, control, and cultural legitimacy, widely documented in the algorithmic governance literature. This literature points out how advanced technological systems tend to generate power asymmetries that dilute value systems such as justice, well-being, cultural autonomy, and transparency (Nissenbaum, 2011). Following this line of argumentation and analysis, the data obtained confirmed that smart cultural ecologies exhibit this dissonant coexistence of rationalities rather than the harmonious integration of interests.

Similarly, the classification of actors based on influence and dependence reinforces the idea that contemporary digital culture is configured as a sociotechnical assemblage, in the sense proposed by Latour (2005), where no actor possesses absolute control over the system, although some exhibit a disproportionate capacity not only for influence but also for axiological orientation. The dominant position of technology companies, combined with their moderate dependence on regulatory frameworks and social legitimacy, explains their central role in the practical configuration of technological values, even when these values do not always coincide with the cultural ideals declared by other actors (Taylor, 2021; Markard et al., 2016).

Regarding axiology, it is interesting to find that values such as cognitive integrity and cultural autonomy are highly mobilized, but also face points of opposition. The observed pattern is what Byung-Chil Han describes as the cultural ambivalence of digitalization; that is, while technology favors maximizing the capacities for action and expression, it also presents an underlying form of control, homogenization, and erosion of critical judgment (Han, 2013). The simultaneous existence of support and opposition indicates the emergence of centers of cultural creation rather than normative consolidation.

Taken together, the results suggest that the construction of humanized technological futures depends less on the adoption of specific technologies and more on the axiological configuration of the cultural ecologies in which these technologies are embedded. As Rosa points out, the fundamental issue is not technological acceleration itself, but rather the capacity of societies to establish resonant relations with their technical systems, so that these systems do not become alienating forces, but rather mediators of meaning (Rosa, 2013; Bantwal et al., 2015).

Finally, this research contributes to the philosophy of culture by showing that methods of actor and value analysis can be used not only as prospective tools, but also as hermeneutical instruments for interpreting the axiological transformations of contemporary culture. Smart cultural ecologies emerge, as well as spaces of symbolic, ethical, and political dispute, in which the technological future is decided both in terms of innovation and in terms of the values that guide collective life.

CONCLUSIONS

The analysis developed using the MACTOR method allows for understanding smart cultural ecologies not as homogeneous or harmonious systems, but as dynamic axiological configurations characterized by asymmetrical power relations, partial convergences, and structural tensions among actors with unequal capacities for influence. From this perspective, the construction of humanized technological futures is seen less as the result of technical progress and more as a contingent cultural process stemming from the constant negotiation of values among actors in complex sociotechnical contexts.

One of the most significant findings is that the humanizing will of technology has a broad normative consensus, as most actors demonstrate a high level of positive implication with values related to the ideal of technological humanization, algorithmic justice, common digital well-being, and informational transparency. However, this consensus does not translate uniformly into a willingness to engage in any kind of action, revealing a significant gap between axiological adherence and mobilization. This gap underscores that while values are shared discursively, they do not occupy the same position within the various hierarchies of power or in the strategic agendas of dominant actors.

In this sense, the results show that the actors with the greatest structural capacity to influence the system (government institutions, regulatory agencies, and technology

companies) are key in shaping the system, but not necessarily in all its axiological priorities. The conflicting centrality of technology companies in the divergence graphs demonstrates that contemporary digital innovation is marked by divergences between market logics, regulatory requirements, and ethical-cultural demands. This reinforces the idea that smart cultural ecologies are spaces of axiological dispute; that is, technological humanization cannot be taken for granted but must be deliberately constructed.
On the other hand, the study showed that certain core values for a plural and democratic technological culture, such as cultural autonomy, epistemological diversity, and broadened cultural participation, occupy peripheral positions in terms of mobilization. This suggests that, while they are axiologically recognized in the theoretical sphere, their axiological character has not been accompanied by institutional and strategic mechanisms that would make them drivers of the cultural transformation process. In this sense, these values constitute areas of axiological vulnerability, susceptible to being hegemonized by more operational or technocratic priorities, either due to saturation or, conversely, due to the configuration of specific policy axes, educational practices, or inclusive forms of governance.
From the perspective of the philosophy of culture, the results suggest that smart technology does not exist as a neutral medium but rather as a mediator of values, capable of strengthening or weakening certain cultural orientations depending on the configuration of the actors who regulate, design, and appropriate it. The resulting cultural ecology is, therefore, an open system where technological humanization depends on the collective capacity to place ethics, culture, and power within coherent contexts of action.
Finally, this work also offers a methodological and theoretical contribution, demonstrating that the prospective analysis of actors and values can serve as a valuable resource for the philosophy of culture, enabling the translation of abstract axiological debates into verifiable relational structures. Along these lines, envisioning humanized technological futures involves not only imagining desirable situations but also clearly identifying which actors, values, and power relations enable or hinder the realization of those desirable outcomes. The construction of a smart cultural ecology is thus presented as a cultural and axiological task whose viability depends on informed, reflective, and ethically guided collective decisions.

1. REFERENCES

2. Angouri, J., & Litoselliti, L. (2018). Quantitative, qualitative, mixed or holistic research? Combining methods in linguistic research. *Research methods in linguistics*, 35-55.
3. Arcade, j., Godet, M., Meunier, F., & Roubelat, F. (2014). Structural analysis with the MICMAC method & actors' strategy with mactor method. *Futures Research Methods*, 1- 48.
4. Bantwal, M., Jongerden, J., Lemmens, P., & Ruivenkamp, G. (2015). Technological mediation and power: Postphenomenology, critical theory, and autonomist marxism. *Philosophy & Technology, 28(3)*, 449-474.
5. Cassirer, E., Lofts, S., & Gordon, P. (2020). *The philosophy of symbolic forms, Volume 1: Language.* . Routledge.
6. Floridi, L. (2014). *The fourth revolution: How the infosphere is reshaping human reality.* OUP Oxford.
7. Floridi, L. (2015). *The onlife manifesto: Being human in a hyperconnected era.* Springer nature.
8. George, É. (2020). Digitalization of society and socio-political issues 1: digital, communication, and culture. John Wiley & Sons.

9. Godet, M. (1991). Actors' moves and strategies: The mactor method: An air transport case study. . *Futures, 23(6)*, 605-622.
10. Godet, M. (2001). Creating futures. *Economica.*
11. Grunwald, A. (2020). The objects of technology assessment. Hermeneutic extension of consequentialist reasoning. *Journal of Responsible Innovation, 7(1)*, 96-112.
12. Han, B. (2013). *La sociedad de la transparencia.* Barcelona: Herder Editorial.
13. Hofkirchner, W. (2010). How to design the infosphere: The fourth revolution, the management of the life cycle of information, and information ethics as a macroethics. *Knowledge, Technology & Policy, 23(1)*, 177-192.
14. Klenk, M. (2021). How do technological artefacts embody moral values? *Philosophy & Technology, 34(3)*, 525-544.
15. Latour, B. (2005). *Reassembling the social: An introduction to actor-network-theory.* . Oxford university press.
16. Markard, J., Wirth, S., & Truffer, B. (2016). Institutional dynamics and technology legitimacy–A framework and a case study on biogas technology. *Research Policy, 45(1)*, 330-344.
17. Mittelstadt, B., Allo, P., Taddeo, M., Wachter, S., & Floridi, L. (2016). The ethics of algorithms: Mapping the debate. *Big Data & Society, 3(2).*
18. Nissenbaum, H. (2011). Privacy in context: Technology, policy, and the integrity of social life. *Journal of Information Policy, 1*, 149-151.
19. Rosa, H. (2010). *Alienation and acceleration: Towards a critical theory of late-modern temporality (Vol. 3).* Aarhus University Press.
20. Rosa, H. (2013). *Social acceleration: A new theory of modernity.* Columbia University Press.
21. Simmel, G., Frisby, D., Bottomore, T., & Lemert, C. (2011). *The philosophy of money.* . Routledge.
22. Sloterdijk, P. (2011). *Bubbles: Spheres Volume I: Microspherology.* Semiotext(e).
23. Steward, J. (1972). *Theory of culture change: The methodology of multilinear evolution.* University of Illinois Press.
24. Taylor, C. (1985). *Philosophical papers: Volume 1, Human agency and language (Vol. 1).* Cambridge University Press.
25. Taylor, L. (2021). Public actors without public values: Legitimacy, domination and the regulation of the technology sector. *Philosophy & technology, 34(4)*, 897-922.
26. Unesco. (2022). Recommendation on the ethics of artificial intelligence. *United Nations Educational, Scientific and Cultural Organization*.
27. Vallor, S. (2016). *Technology and the virtues: A philosophical guide to a future worth wanting.* Oxford University Press.
28. Webster, C., & Leleux, C. (2018). Smart governance: Opportunities for technologically-mediated citizen co-production. *Information Polity, 23(1)*, 95-110.