Journal of
Value Creating in Business Management
https://www.jvcbm.ir
Volume 6, Issue 2, Summer 2026, Pages 157 to 180

Original Article (Mixed)

eISSN: 2980-8359

Analytical Study of Stakeholder Relationships in the Artificial Intelligence Ecosystem of Iran's Automotive Industry

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Receive:
07 January 2026
Revise:
14 March 2026
Accept:
18 April 2026

Keywords:
Technology Ecosystem;
Artificial Intelligence;
Stakeholders;
Automotive Industry;
Innovation;
AI Ecosystem

Abstract

The primary aim of this study is to provide a comprehensive and systematic analysis of the complex relationship patterns among stakeholders within the artificial intelligence ecosystem of Iran's automotive industry, and to precisely identify the loci of power concentration, interest misalignments, and potential capacities for strategic convergence. To this end, a mixed-method (qualitative–quantitative) research design grounded in futures studies was employed. In the first phase, through a systematic literature review and expert panel consultations with industry and academic specialists, 48 key stakeholders along with their core objectives were identified. In the second phase, the required quantitative data were collected through standardized impact–influence matrices and actor–objective position matrices, and subsequently analyzed by the mathematical model implemented in the MACTOR software.

The findings from the internal analysis indicate that the network structure is highly unbalanced; specifically, 66.7% of stakeholders fall within the "strategic isolation" quadrant, while the only actor positioned in a state of "mutual dependence" is the automotive manufacturing sector. Conversely, the external analysis reveals the formation of a powerful coalition within the industrial–governmental bloc (including automakers; the Ministry of ICT; the Ministry of Industry, Mine and Trade; and the military sector), primarily aligned around hardware-driven objectives such as infrastructure development and data security. In contrast, actors such as media, universities, and civil society organizations exhibit minimal convergence with these strategic objectives.

Please cite this article as (APA): Darvish, M, Khodadad Hosseini, S H, Mansourimoayyed, F and Goudarzi, G R. (2026). Analytical Study of Stakeholder Relationships in the Artificial Intelligence Ecosystem of Iran's Automotive Industry. *Journal of value creating in Business Management*, *6*(2), 157-180.

https://doi.org/10.22034/jvcbm.2026.571128.1705

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Publisher: Research Center of Resource Management Studies and Knowledge-Based Business

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Extended Abstract

Introduction

Today, artificial intelligence (AI) has emerged as a significant driving force across various industries (Soleymanpoor et al., 2025). This transformative technology plays a pivotal role, particularly in the automotive industry—a sector recognized as a leading economic engine in many nations. AI not only optimizes manufacturing processes and supply chains but also facilitates the design of innovative products such as autonomous vehicles and advanced driver-assistance systems (ADAS) (Tripathi et al., 2024). Furthermore, AI-driven smart after-sales services have enhanced customer satisfaction and operational efficiency (Mehta et al., 2024). Nevertheless, AI remains an emerging phenomenon within the automotive technological ecosystem; its sustainable development, involving diverse stakeholders with multifaceted objectives, necessitates rigorous investigation (Pourshahabi, 2023). Stakeholder interactions within technological ecosystems are critical dimensions of their development and success. These ecosystems comprise complex networks of relationships among organizations, individuals, and resources involved in the creation, production, and commercialization of new technologies (Tripathi et al., 2024). Deciphering these relationships—including the identification of key stakeholders, their goals, and their interaction patterns—is a fundamental necessity for managers and policymakers. Through a meticulous analysis of these relations, more effective strategies can be formulated for resource allocation, collaboration facilitation, and risk management (Khizar et al., 2025). Moreover, examining the structures and dynamics governing these ecosystems can foster open innovation, improve organizational performance, and enhance global competitiveness (Iglesias-Sánchez et al., 2022). Ultimately, managing stakeholder relations in technological ecosystems contributes to sustainable development and value creation for all participants (Li et al., 2022). Addressing stakeholder relations is essential because technological ecosystems represent interconnected clusters of agents collaborating to advance innovation and technological growth (Reiter et al., 2024). Understanding these relationships assists policymakers in leveraging the ecosystem's full potential by creating efficient and effective policy environments (Grimm & Walz, 2024). Identifying the mutual interests and objectives of diverse stakeholders—including technology firms, academia, investors, and the government—enables the formulation of strategies that encourage collaboration and innovation while mitigating dysfunctional competition (Hayatmehr et al., 2025). In the contemporary era, the automotive industry has undergone a paradigm shift from a purely mechanical domain to a "software-centric" and "intelligent" industry. This transition is fraught with fundamental challenges and conflicts of interest among stakeholders. The current status quo reflects a "strategic rift" between the various layers of this ecosystem. On one hand, large automakers, characterized by traditional and bureaucratic structures, often resist the agile transformations necessitated by AI. On the other hand, the innovation landscape and AI firms face obstacles such as lack of access to automakers' operational data, absence of sustainable cash flow, and a void of transparent regulatory standards. Consequently, these challenges have prompted the researcher to address the following core question: What is the nature of stakeholder relations within the AI ecosystem of Iran's automotive industry?

Theoretical Foundations

Technology Ecosystem

A technology ecosystem is a complex and multidimensional concept referring to a network of activities, actors, and technologies that operate in a coordinated and interdependent manner to generate innovation and create value (Hayatmehr et al., 2025). The origin of this concept dates back to the past two decades, coinciding with the growing attention of scholars and managers to the development and management of inter-organizational relationships and technology-driven activities. Specifically within the domain of digital technologies, the ecosystem concept is employed to facilitate innovation and entrepreneurship, benefiting from advanced developments such as blockchain and financial technologies (Hijriah et al., 2024; Kitsantas & Chytis, 2022).

Soleymanpoor et al. (2025) examined the development of a model for identifying factors influencing the socialization of artificial intelligence technologies. Their study, applied in purpose

and quantitative in method, was conducted as a descriptive–survey research design. The results indicated that both independent and dependent variables had a direct, positive, and statistically significant relationship. Rostam Zadeh Ganji et al. (2025) explored a model for developing cognitive trust among employees in the context of artificial intelligence. Their findings revealed that causal factors—including transparency, training and awareness-building, ethical alignment, and the definition of shared roles and objectives—alongside contextual factors such as organizational culture and resources, as well as intervening factors like employee resistance and system complexity, all contribute to shaping cognitive trust. Additionally, strategies such as employee training and empowerment were identified as key tools for enhancing human–machine interaction.

Research Methodology

This study is applicable in purpose, and qualitative-analytical in nature, employing a futures studies approach combined with stakeholder analysis. The core methodological framework is grounded in actor-based analysis and designed using the strategic MACTOR model. To this end, key stakeholders and the strategic objectives of the artificial intelligence ecosystem in Iran's automotive industry were initially identified through a systematic review of policy documents and relevant literature. Subsequently, the required data were collected by means of a specialized questionnaire and based on the insights of an expert panel comprising technical specialists, industrial managers, and policymakers selected through purposive sampling. The final analysis was conducted by constructing matrices of mutual influence and actor–objective positions (3MAO), enabling the extraction of levels of influence, dependency, and strategic coalitions among the actors.

Research Findings

The findings of this study indicate that the network structure is highly unbalanced, with most stakeholders positioned in isolation, while primary power and bilateral interactions are concentrated exclusively within the automotive manufacturing institutions. This configuration stems from a predominantly top-down managerial orientation and limited cross-sectoral collaboration. In fact, a strong coalition has formed among industrial, governmental, and defense-related sectors, whose central focus is confined to hardware-oriented and security-driven issues, whereas academic, media, and civil stakeholders possess minimal influence within this ecosystem. Therefore, overcoming this condition requires governance mechanisms to be reformed through legal and economic incentives that would enable private-sector and academic actors to integrate more effectively into the core of power and decision-making.

Discussion and Conclusion

According to the findings of the influence matrix, although professional drivers operate within the operational layer, their direct impact on macro-level policymaking is estimated to be zero. Nevertheless, their central objective is "reducing human error and increasing safety in long-distance driving." The analysis reveals that shareholders are among the most powerful economic actors. Their primary focus lies in "profit maximization" and "improving financial returns." This result is fully consistent with the findings of Kanani et al. (2023) and Laskin & D'Agostino (2024), who argue that the main driver behind the adoption of artificial intelligence in the automotive industry in developing countries is not environmental concerns, but rather the reduction of operational costs and the enhancement of the financial attractiveness of automotive firms. The public expresses a diverse set of concerns, including "improving safety" and "data security." The results show that society views AI as a tool for promoting fairness in mobility and reducing accidents. This perspective aligns with Karimlou & Zakeri (2020), who emphasized the role of "public trust" derived from enhanced safety. The findings also indicate that startups, due to their very low influence, have not yet secured their true position within the Iranian automotive industry. Their limited focus on "autonomous vehicle technologies" reflects the significant barriers to entering this highly exclusive market. This result corresponds with the concerns raised by Kolekar et al. (2021) regarding the "gap between innovative ideas and the production lines of large manufacturers". Suppliers predominantly focus on "profit maximization" and "specialized human resources." Automakers, with the highest overall scores, serve as the principal compass of

the industry. They occupy leading positions across all indicators, including "profit," "competitiveness," and even "data security." This concentration of power is consistent with Castells' Network Society theory (2010), which posits that the central nodes of a network control the greatest flow of data and resources. Banks constitute key players in financing large-scale AI projects. Their primary orientation toward "profit generation" and "infrastructure development" supports the premise presented by Kanani et al. (2023), who argued that without financial intermediary institutions, the transition from a traditional automotive industry to an intelligent one would face severe liquidity challenges. Technology companies, however, occupy a significantly lower-than-expected position within the ecosystem. Their limited emphasis on "infrastructure development" and "human resources" suggests that the technical sector has not yet been fully integrated into the value chain of large automakers. This finding markedly differs from the Karimlou & Zakeri (2020) model, in which technology companies (such as Tesla or NVIDIA) constitute the primary driving forces. Municipalities act as "urban infrastructure facilitators." Their balanced focus on "supporting innovation" and "infrastructure development" illustrates the strong dependence of autonomous vehicle implementation on the progress of smart city initiatives. This result aligns with Kanani et al. (2023), who emphasized that without physical urban infrastructure—such as smart traffic lights—automotive AI alone cannot be effective. The Traffic Police (Law Enforcement) shows the highest level of concern regarding "safety" (and "human resources"). The findings suggest that this institution views AI as a tool for enhancing traffic discipline, which corresponds with the results reported by Kanani et al. (2023). The Environmental Protection Organization achieves the highest score on the "environmental protection" indicator. This is consistent with Murphy & Navani (2024), who argued that AI, through route optimization and reduced fuel consumption, represents one of the few viable solutions for alleviating pollution in large metropolitan areas. The Supreme Council of the Cultural Revolution primarily contributes to "foresight" and "cultural impact assessments". Its emphasis on "human capital development" and "data security/privacy" reflects concerns about the ethical dimensions of advanced technologies. The Judiciary plays a vital role in "developing legal frameworks", and is expected to become the primary stakeholder in addressing legal cases related to autonomous vehicles. This finding corresponds with the challenges discussed by Kanani et al.

Acknowledgments
The authors gratefully acknowledge all individuals, institutions, and organizations that provided scientific, technical, administrative, or advisory support throughout this research and the preparation of this manuscript.

Conflicts of Interest
The authors declare that they have no financial or non-financial, personal, professional, or institutional conflicts of interest relevant to this work.

Conflicts of Interest
The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data Availability Statement
The data supporting the findings of this study are available from the corresponding author upon reasonable request.

AI Use Statement
The authors declare that no generative artificial intelligence (AI) or AI-assisted technologies were used in the preparation, writing, or editing of this manuscript.

Funding
The authors declare that no funds, grants, or other financial support were received during the conduct of this research or the preparation of this manuscript.

Ethics Approval
All procedures performed in this study were conducted in accordance with the ethical standards of the responsible institutional and national research committee.