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PARADIGMATIC FOUNDATIONS OF MARKETING IN THE MACHINE-TO-MACHINE (M2M) MARKET

Machine-to-machine interactions increasingly mediate economic exchange: connected devices and software agents can identify needs, evaluate offers, and initiate transactions with minimal human intervention. These shifts challenge marketing theory that presumes human motivation as the primary driver of choice. This article synthesises evidence on digital transformation and M2M infrastructures and proposes a paradigmatic framing of marketing in the M2M market as a cyber-physical, utility-centred form of marketing. A comparative analysis of classical, industrial, relationship and digital marketing logics is used to derive key assumptions, constructs and implications for strategic planning and operational marketing.

Keywords: marketing paradigm, machine-to-machine marketing, digital market transformation, economic relations system, agentic AI, cyber-physical systems, machine customers, utility-based decision-making, cyberbrand.

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Introduction . Over the last decade, economic interaction has increasingly incorporated autonomous technical systems that monitor conditions, evaluate alternatives, and execute actions within connected infrastructures. In such settings, exchange is initiated and completed not primarily through human perception, persuasion, or interpersonal negotiation, but through digitally mediated rules, protocols, and optimisation procedures embedded in cyber-physical systems. The relevance of this transformation is evidenced by the expanding scale of connected device ecosystems and cellular IoT connectivity forecasts, which imply a continuing rise in machine-initiated interactions and transactions [4]. This development creates a practical task for firms and public institutions: to ensure that products, services, and procurement offers remain "legible" and competitive within algorithmic decision environments. When purchasing and operational choices are increasingly delegated to machine agents, marketing can no longer be treated solely as a discipline of human-oriented influence and communication.

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Instead, it must be reconsidered as a function that shapes market accessibility, comparability, and preference formation under algorithmic evaluation, including requirements for data quality, interoperability, service-level guarantees, security, and verifiable performance. The practical implication is that firms that fail to adapt may soon face non-obvious market exclusion, not because their value proposition is weak in human terms, but because it is suboptimal or non-interpretable under machine evaluation criteria.

The conceptual starting point is the broader literature on digital transformation, which frames digital technologies as drivers of disruptions that trigger strategic responses and reshape value creation paths [10]. In parallel, Industry 5.0 research and policy framing emphasise that connectivity, automation, and cyber-physical integration should be directed towards human-centricity, sustainability, and resilience, thereby reconfiguring production and exchange systems and strengthening the infrastructural basis for machine-mediated coordination across organisations [1]. From a standards and architecture perspective, the technical preconditions for machine interaction in networked environments are increasingly codified through reference architectures and interoperability frameworks that specify service enablement, connectivity, and security requirements. A conceptual clarification is offered by NIST, which explicates the relationship between cyber-physical systems and the Internet of Things and supports a unified perspective on connected, digitally enabled physical devices [3, 5].

Within marketing scholarship, several established paradigms provide essential foundations. Historically, Relationship Marketing argues for a shift away from transactional logic towards relational exchange, commitment, and trust as central constructs of market functioning [5]. Service-dominant logic further reframes marketing around value co-creation and the primacy of service provision rather than the exchange of goods alone [7]. Within the Digital Marketing paradigm, research contributes an integrative framework for understanding how digital technologies reshape marketing processes and strategy, including the role of connected products, data, and analytics [11].

The present argument also relies on the national scholarly contribution that systematises “fundamental changes” in the enterprise environment and conceptualises these changes as drivers of transformation in marketing activity. The study also builds on national scholarly work that systematizes the fundamental changes in the enterprise environment and interprets them as drivers of marketing transformation. The recent research offers a concise historical overview of systemic development from mechanisation to digital transformation which helps to situate M2M interaction within the broader trajectory of long-term productivity-driven change [9].
An important contemporary contribution to the conceptualisation of machine customers is provided in the work “When Machines Become Customers”. The authors argue that AI-powered agents will soon increasingly participate in market exchange and influence revenue structures [13].

Although adjacent literatures collectively explain the enabling technologies, organisational implications, and methodological instruments of digital markets, they do not yet sufficiently formalise the paradigmatic shift implied by machine decision-makers as market actors. Relationship marketing and service-dominant logic emphasise relational exchange and value co-creation, but their foundational assumptions still primarily presuppose human cognition, trust formation, and interpretive behaviour. Digital marketing and analytics address algorithmic mediation and data-driven optimisation, but they typically conceptualise algorithms as instruments used by firms to influence human customers, rather than as autonomous buyers with their own evaluation logic and constraints. A further unresolved aspect concerns branding under machine selection. Existing branding research in digital environments highlights how brands function amid information overload and online interaction [15]. However, the increasing

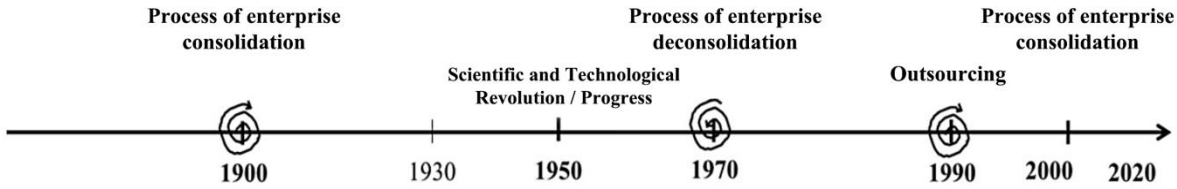
role of platforms and algorithms suggests that brand visibility, preference, and selection may be shaped by algorithmic assemblages rather than solely by human meaning-making [12]. Thus, the previously unresolved aspect of the overall problem lies in the insufficient conceptualisation of how marketing's fundamental categories transform within an emerging M2M marketing paradigm, where the decision-making subject is no longer a human actor but an algorithmic system operating through utility-like functions, constraints, and optimisation routines.

Aim and Objectives. The purpose of this article is to substantiate the need for a paradigmatic revision of marketing under M2M market conditions and to propose a conceptual formulation of an M2M marketing paradigm. This entails, first, linking the genesis of the M2M phenomenon to the long-run development of economic systems from mechanisation to automation and digital transformation. Second, comparing the foundational assumptions of classical marketing with those that characterise machine-mediated exchange. And third, synthesising relevant theoretical streams into a coherent definition that foregrounds algorithmic decision-making, utility maximisation, and data-driven optimisation as central principles of marketing in M2M markets.

Research Methodology. The study adopts a conceptual and theory-building design. Its methodological basis combines the systems approach, comparative conceptual analysis, historical-logical analysis, scientific abstraction, synthesis, and structural-logical modelling. Historical-logical analysis is used to position M2M interaction within the evolution from mechanisation and automation to digital transformation and cyber-physical systems. Comparative analysis examines how key marketing categories change when autonomous technical agents become immediate decision-makers. Scientific abstraction and synthesis integrate marketing concepts with decision theory, optimisation, and algorithmic systems to formulate the proposed M2M marketing paradigm. The systems approach and structural-logical modelling are applied to represent M2M economic relations and to synthesise technological, decision-making, and marketing foundations, while SIVA and the extended marketing mix are reinterpreted to demonstrate the practical implications of the proposed paradigm.

Presentation and Discussion of the Main Results. The emergence of the Machine-to-Machine market can be interpreted as the late outcome of a long productivity driven trajectory in which economic systems moved from mechanisation and automation towards comprehensive digital transformation. The logic of such systemic evolution, including its implications for marketing activity, is concisely represented in the Figure 1 providing an integrated view of the historical forces and transformation stages leading to contemporary market conditions [9].

Along this trajectory, technical systems gradually extended their scope from production tasks to coordination and decision-making, thereby reshaping the mechanism through which exchange is initiated and completed. With the advent of Agentic AI, this shift has intensified, as autonomous systems are becoming increasingly capable of initiating transactions, evaluating alternatives, and executing exchanges without direct human intervention. In this sense, comprehensive business digital transformation has not merely digitised existing marketing activities. It has also contributed to the emergence of M2M exchange as a distinct market phenomenon in which value propositions are assessed, selected, and enacted through machine-mediated routines. This development implies a need to rethink marketing not only as communication and relationship management with human customers, but as a strategic and operational system that functions in environments where the decision subject may be an algorithmic agent.



Eras	Modern						Postmodern	
Technological wave	**I**	**II**	**III**	**IV**			**V**	**VI**
Type of Technological Processes	Manual production	Mechanisation of production		First computing machines	Automation	Robotisation	Computerisation	Fully automated systems
Type of Industry	Industry 2.0				Industry 3.0			Industry 4.0
Innovation And Organisational Aspect	Traditional enterprises			Scientific-production associations, Venture companies			Technology parks, Technopolises	Science parks, Startups
Quality Control	Raw material control			Statistical quality control			TQM (Total Quality Management)	
Production model	Detroit model					Hollywood model		
Economic Logics	I					II		III
Economic Policy	Colonial system					Neocolonial system (GATT/WTO)		
Competition	National monopolies	Regional monopolies		TNCs (Transnational Corporations)			Global monopolies formation	
Production	Detroit model production			Core competency concentration trend			Outsourcing	OEM companies
Product	Product			Integrated product			Service	Function
Basis of Value Proposition				USP			UVP	UTP
De-facto Competitor	Enterprise			Innovation production associations			Inter-organisational alliances	Ecosystems

Figure 1 – Fundamental Changes in the Development of Industrial Enterprises and Their Impact on Marketing Activity. Source: [9]. Marketing activity in the context of fundamental changes. *Economic Bulletin of NTUU "KPI"*, 24

At the strategic level, this requires an adaptation of marketing planning and market strategy formation to conditions of algorithmic evaluation, constrained optimisation, and automated coordination. Core strategic questions such as segmentation, positioning, competitive advantage, and channel design must be reframed around machine-relevant criteria. These criteria include interoperability, verifiability, reliability, latency, and data governance. They do not replace human-facing value, but they increasingly shape whether an offer is discoverable, comparable, and executable within automated decision pathways. Competition also shifts towards ecosystem architecture, because firms increasingly compete through their ability to embed offerings into machine-executable workflows, standards, and platform interfaces that structure selection and repeated transactions.

At the operational level, implementing an M2M marketing strategy requires a reconfiguration of functional marketing instruments. Communication is supplemented, and in

some contexts displaced, by machine-readable representations of value, including technical documentation, metadata, schemas, service descriptions, and performance signals that enable automated comparison and selection. Customer relationship management extends to the governance of machine interactions. This includes monitoring algorithmic decision pathways, ensuring compliance with protocol requirements, maintaining trust through security and auditability, and designing feedback loops through telemetry and usage data. As a result, marketing execution becomes more tightly coupled with product architecture, data infrastructure, and service operations. This coupling blurs established boundaries between marketing, engineering, and governance functions.

To make this transition more concrete, Figure 2 illustrates how machine-mediated exchange reshapes economic relations among actors in the consumer market. Rather than treating M2M as a purely technical layer, the scheme shows how consumer motives and goals are translated into formal objectives, criteria, and rules that are implemented in algorithms operating within cyber-physical and computer-aided systems. The figure therefore offers a simplified process view of how economic relations in a consumer M2M context are formed and coordinated through interacting human and machine decision components.

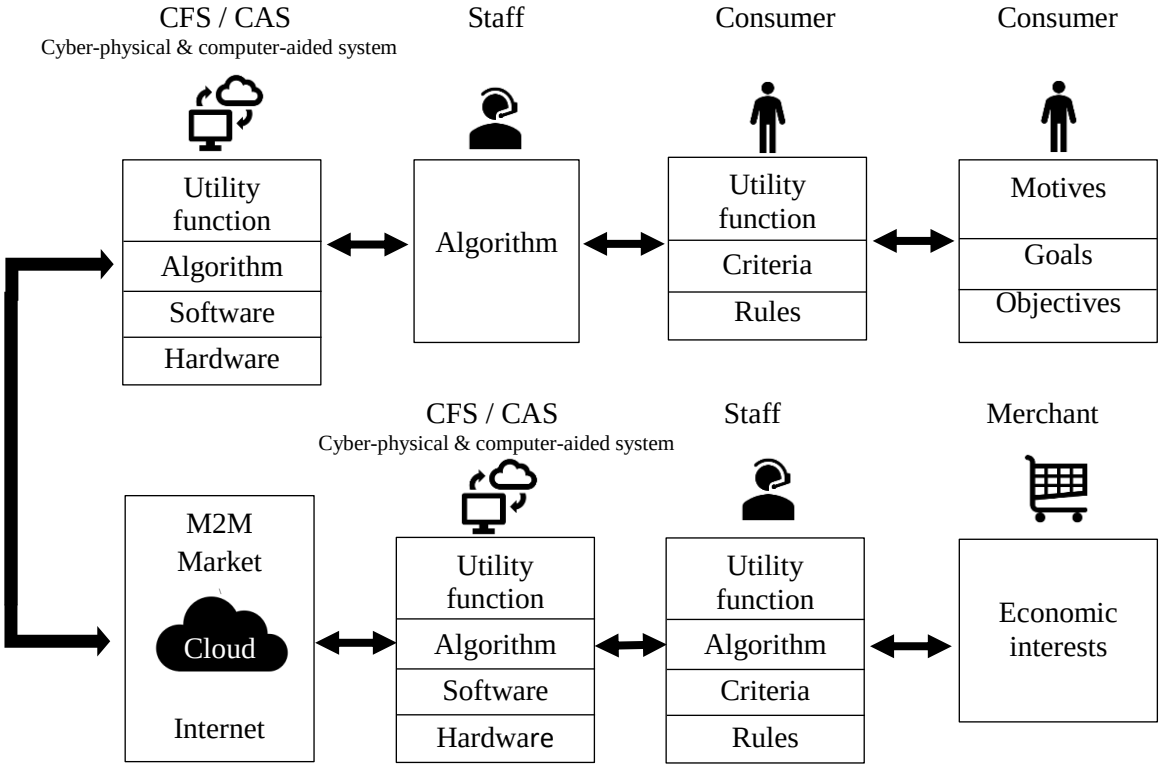


Figure 2 – Process of economic relations formation in the consumer M2M market
Source: Authors' own elaboration.

Taken together, these shifts support the view that the M2M market is associated with an emerging paradigm change in marketing. The central task becomes no longer to influence human choice but to design market-facing systems that remain selectable and actionable under machine-mediated decision-making, where value must be legible to both humans and

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autonomous agents, and where strategic advantage increasingly depends on participation in the technical and institutional structures that coordinate exchange. In Table 1, a comparative analysis of classical marketing and marketing in the M2M market is undertaken to demonstrate how core marketing assumptions change when the immediate decision-maker shifts from a human to an autonomous technical agent.

Table 1 – Comparative conceptual profile of marketing paradigms and the M2M case

Dimension	B2C marketing	B2B marketing	Relationship marketing	Digital marketing	M2M marketing (proposed)
Immediate decision subject	Individual consumer	Buying centre	Interdependent partners	Human decision maker supported by digital systems	Autonomous technical agent operating through embedded algorithms
Dominant evaluative basis	Motivations, attitudes, perceived value	Multi criteria performance, risk, and cost	Continuity value, trust, commitment	Data driven relevance and experience optimisation	Utility oriented optimisation under constraints over time
Information environment	Communication, experience, and interpretation	Specification contracts, performance evidence	Relational signals and governance	Platforms, data, analytics, automation	Machine readable attributes, interfaces, telemetry, verification signals
Mechanism of choice	Psychological and behavioural processes	Organisational process and negotiation	Governance and relational mechanisms	Algorithmic mediation of human attention and conversion	Algorithmic selection, negotiation, and execution by agents
Role of brand	Meaning and differentiation	Reputation and reliability	Trust signal and relational asset	Digital identity and multi-channel equity	Machine identifiable long run performance and risk signal, cyberbrand

Source: Authors' own elaboration.

Table 1 makes the fundamental shifts visible across several dimensions, most notably the change in the decision subject, the evaluative basis, and the information environment. On this basis, a marketing paradigm for the M2M market can be formulated as a cyber-physical marketing paradigm in which machines and their embedded algorithms become the immediate decision-makers, shifting marketing logic from influencing consumer motivation to optimising the utility-based criteria that guide automated choice. Within this paradigm, marketing is oriented towards ensuring that an offering is discoverable, comparable, and executable under machine-mediated decision-making, where selection is driven by a programmed objective under constraints such as cost, risk, availability, performance, compliance, and lifecycle optimisation. This shift also motivates the notion of a cyberbrand. Earlier branding research

used “cyberbranding” to describe branding and brand equity formation in digital space. [2] In the context of M2M, the cyberbrand can be specified more narrowly as a machine-identifiable brand signal, meaning a set of measurable and verifiable attributes that an agent can use to rank alternatives and to select the option that maximises system utility over time. In other words, brand advantage increasingly depends not only on human meaning, but also on how strongly the brand is represented through machine-legible trust and performance signals. The increasing transition from generative AI towards agentic AI strengthens the practical relevance of the cyberbrand construct and the broader paradigm. Architectures such as ReAct demonstrate that language model based systems can combine reasoning and acting to execute multi step tasks in interactive environments [8]. Generative agent research further shows how agents can maintain memory, plan, and adapt through reflection, supporting sustained autonomous behaviour rather than one off responses [14]. In market terms, this implies that software agents may increasingly perform procurement, supplier evaluation, negotiation, and service selection as goal directed processes operating under explicit objective criteria.

From a practical perspective, brands already need to optimise for M2M conditions through machine-readable product data, stable identifiers, structured metadata, and transparent specifications, supported by API access, integration readiness, security, and service reliability. Certifications, telemetry-based performance evidence, and consistent reputation signals across platforms become increasingly important, in line with research showing that AI is reshaping search and competition in AI-mediated environments [6]. To clarify the theoretical basis of this shift, it is useful to outline the disciplinary foundations that underpin the proposed M2M marketing paradigm. In particular, the paradigm draws on established marketing concepts that explain value creation and exchange, while simultaneously relying on concepts from the design of automated information processing and control systems, where objectives, constraints, and algorithmic decision rules are operationalised in software and hardware. Figure 3 summarises this dual foundation and shows how marketing concepts and control-oriented system design jointly inform the emerging logic of marketing under machine-mediated selection.

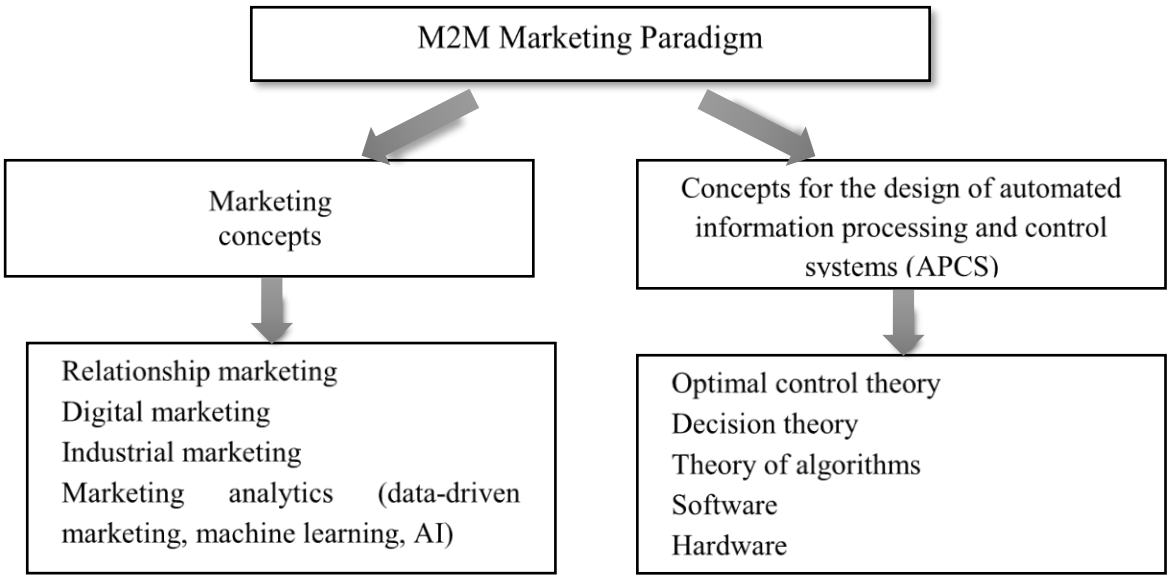

Figure 3 – Disciplinary Foundations of the M2M Marketing Paradigm
Source: Authors’ own elaboration.

Finally, the underlying concept of marketing also shifts. Marketing in the M2M paradigm can be interpreted as an optimisation-oriented discipline that combines established marketing foundations from industrial marketing, relationship marketing, and digital marketing with formal approaches from the theory of optimal control, decision theory, game theory, and data-driven marketing. In this framing, marketing activity is evaluated by how well it helps maximise the relevant utility objective under constraints, rather than by its persuasive impact on human choice.

Against this background, it is useful to reconsider applied marketing frameworks through an M2M lens. One practical starting point is SIVA (Solution–Information–Value–Access), since it is oriented to customer outcomes and decision processes. In M2M contexts, however, SIVA must be reframed for machine-mediated selection. "Solution" becomes an integration-ready capability embedded in workflows, "Information" becomes machine-readable evidence, "Value" becomes utility under constraints over time, and "Access" becomes interoperability and API-enabled reach within platforms and ecosystems (Table 2).

Table 2 – Short comparative view of SIVA in M2M marketing.

SIVA element	Classic meaning	In M2M marketing (evolved)
Solution	Product/service that solves a need	Capability packaged for automation, including interoperability, reliability, SLA, security, and integration readiness
Information	Messages that inform and persuade	Machine-readable descriptors and proofs, including metadata, schemas, certifications, telemetry, and audit trails
Value	Benefits versus price for the buyer	Utility under constraints over time, including cost, risk, performance, compliance, and lifecycle optimisation
Access	Channels and availability	Technical access and ecosystem placement, including APIs, standards compatibility, platform listings, and automated procurement pathways

Source: Authors' own elaboration.

This reframing of SIVA supports the paradigm-shift claim developed above. As autonomous agents increasingly act as immediate decision subjects, marketing is shaped less by persuasion and more by the design conditions that make an offer selectable in machine-mediated exchange. These conditions include machine-readable offer data, executable procurement and usage rules, and verifiable reliability and governance signals. As a result, marketing becomes more tightly coupled with product architecture, interoperability, and compliance, which increasingly determine whether an offering can enter and scale within automated ecosystems. In this context, the extended "12P" lens serves as a practical map of the emerging M2M marketing paradigm, translating the shift towards utility-oriented selection into concrete design and governance requirements (Table 3).

To consolidate the main argument, the foundations that jointly shape the emerging M2M marketing paradigm are synthesised in an integrative scheme. The aim is to show that the paradigm does not arise from a single technological driver, but from the convergence of marketing theory, formal decision and optimisation approaches, and the cyber-physical infrastructure that enables autonomous exchange. In this configuration, the **key trigger** is the change in the immediate decision subject, from human actors to algorithmic agents embedded in devices, platforms, and organisational workflows. Figure 2 summarises the theoretical scheme of the proposed paradigm.

Table 3 – The 12P Marketing Mix Adapted for Marketing in the M2M Market

"P" (12P)	M2M paradigm interpretation
Product	Integration-ready capability and measurable performance
Price	Lifecycle cost and machine-executable commercial rules
Place	Platforms, APIs, and automated procurement pathways
Promotion	Machine-readable information and verifiable signals
People	Technical stakeholders and ecosystem counterparts
Process	Automated service workflows and reliability routines
Physical evidence	Certifications, audit trails, and telemetry evidence
Personalisation	Context-aware configuration through policies and data
Privacy	Data governance, permissions, and compliance constraints
Protection	Security, identity, resilience, and trust mechanisms
Partnerships	Standards participation and alliance-based integration
Performance	Continuous monitoring against SLAs and utility outcomes

Source: Authors' own elaboration.

Figure 4 supports the claim that an M2M marketing paradigm is emerging by demonstrating a coherent reconfiguration of marketing's core assumptions under conditions of machine-mediated exchange. It links the technological feasibility of autonomous interaction to a distinct decision logic in which offers are evaluated through constrained, utility-oriented rules, and it shows why this logic cannot be accommodated within traditional persuasion-centred marketing categories.

The scheme also clarifies that the practical expression of the shift is methodological and instrumental, as marketing increasingly depends on machine-readable value representations, reinterpreted frameworks such as SIVA and the extended 12P, and brand signals that are verifiable and usable by automated agents. In combination, these changes indicate a systematic transformation in how exchange is selected and executed, which is consistent with a paradigm-level development in marketing.

Conclusions and Directions for Further Research. The results of the study provide grounds to interpret the M2M market as a marketing domain in which the core logic of exchange is reorganised around machine-mediated selection and execution. The key empirical and conceptual implication is that, as purchasing and operational choices are increasingly delegated to autonomous technical agents, marketing analysis cannot be limited to models that treat human motivation and interpretation as the primary drivers of choice. Instead, the centre of gravity shifts towards how offers are represented, compared, and acted upon within algorithmic decision environments.

This finding supports the paradigm formation advanced in the paper. Marketing in the M2M market can be defined as a cyber-physical paradigm in which machines and their embedded algorithms become the immediate decision-makers, shifting marketing logic from influencing consumer motivation to optimising the utility-based criteria that guide automated choice. This formulation is consistent with the comparative evidence provided in Tables 1–3 and with the integrative scheme presented in Figure 2. Together, they show that the M2M case entails a simultaneous transformation of marketing categories, including the decision subject, the evaluative basis, the information environment, and the execution mechanism of exchange. These changes are not explained by a simple extension of digital marketing practices, because they alter the underlying assumptions of choice and the conditions of market participation.

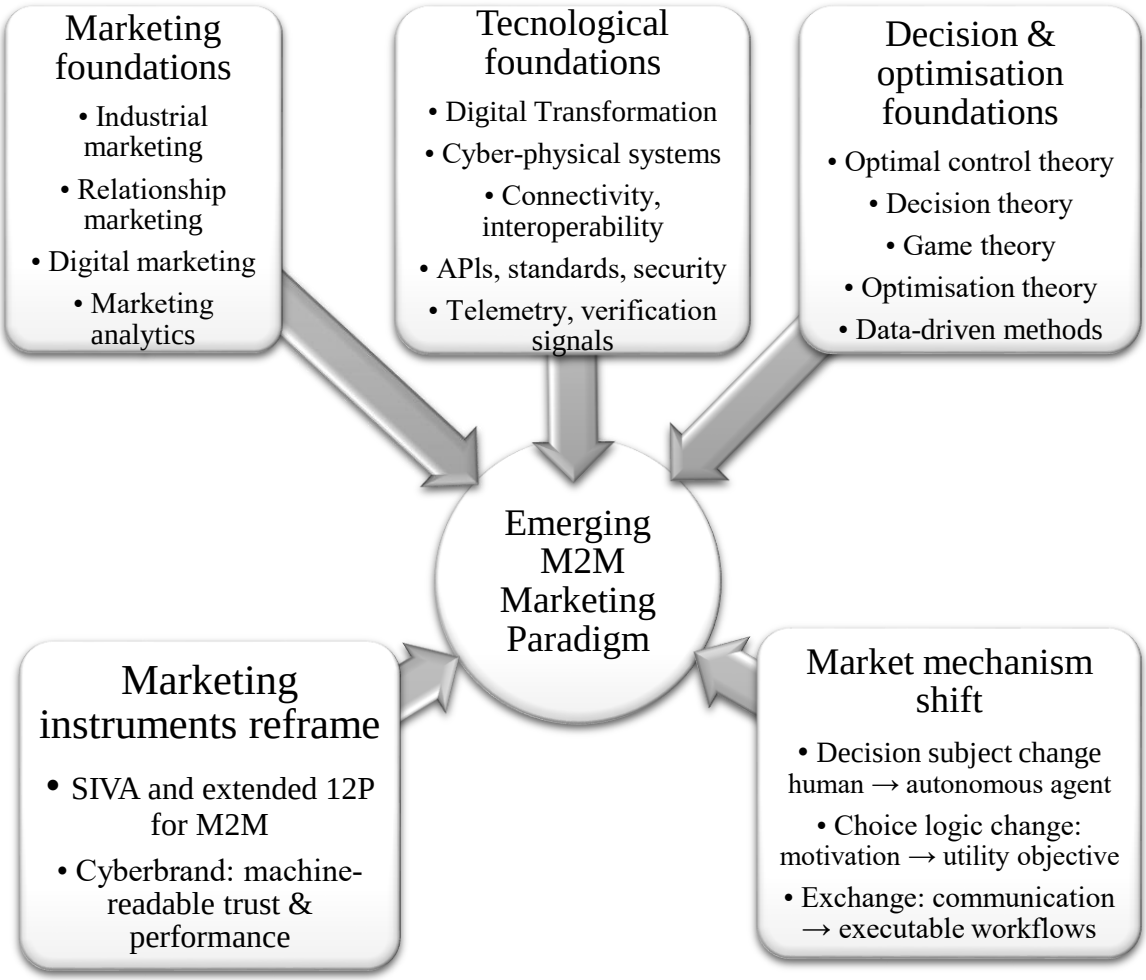

Figure 4 – Structural Model of the Emerging M2M Marketing Paradigm
Source: Authors' synthesis.

In this setting, marketing frameworks remain useful but require reinterpretation. SIVA and the extended 12P can be treated as operational maps for translating the paradigm shift into actionable requirements, where "information" becomes evidence and machine-readable descriptors, "access" becomes API-enabled ecosystem reach, and "value" is expressed as utility under constraints rather than as perceived value alone.

A further conclusion concerns branding. The paper argues that the cyberbrand construct follows as a necessary extension of branding theory to contexts of machine-mediated selection. Cyberbrand denotes not a general "online brand", but a specific brand function in which trust and differentiation are operationalised as measurable and verifiable attributes that influence automated ranking and repeated choice.

From a theoretical and methodological perspective, the overall conclusion is that the M2M market requires new approaches to implementing the marketing function, forming marketing strategies, and designing marketing mechanisms. Marketing becomes partly an optimisation-oriented discipline, where outcomes can be assessed by their contribution to the maximisation of the relevant utility objective under constraints, rather than primarily by persuasive impact on human choice. This calls for systematic integration of marketing theory

with formal approaches from the theory of optimal control, decision theory, optimisation, game theory, and data-driven modelling, while preserving marketing's focus on value creation and market coordination.

Prospects for further research follow from these conclusions. First, conceptual work is needed to formalise a typology of M2M decision contexts, distinguishing degrees of autonomy, delegation structures, and accountability regimes, and specifying when a machine agent is appropriately treated as the immediate decision subject. Second, strategy research should develop segmentation and positioning models grounded in machine-relevant criteria, including integration readiness, governance constraints, risk tolerance, and lifecycle optimisation objectives. Third, empirical studies are required to test and operationalise the proposed constructs, including measurement of how interoperability and verification signals affect automated procurement outcomes, and how cyberbrand indicators influence repeated machine selection in different industries. Finally, governance-oriented research should examine security, auditability, transparency, and compliance as market mechanisms that shape competition and selection under machine-mediated exchange, and that therefore become integral components of the emerging M2M marketing paradigm.

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Парадигматичні засади маркетингу на ринку міжмашинної взаємодії (M2M).

У статті обґрунтовано, що розвиток інформаційних систем, IoT-інфраструктури та агентського ШІ формує ринок міжмашинної взаємодії M2M, де вибір і транзакції здійснюються автономними технічними агентами без прямої участі людини. Показано обмеженість класичних підходів у маркетингу, що пояснюють вибір мотиваціями споживача, та доведено зсув логіки відбору до максимізації функції корисності за заданих обмежень. На основі порівняння основних маркетингових підходів запропоновано формулювання кіберфізичної парадигми M2M-маркетингу та визначено її наслідки для стратегічного й оперативного планування. Розкрито роль машинозчитуваних даних, сумісності та показників ефективності у формуванні ринкової пропозиції. Використано поняття «кібербренд» як машинозчитуваний сигнал довіри та ефективності.

Ключові слова: маркетингова парадигма; маркетинг на ринку M2M (міжмашинної взаємодії); цифрова трансформація ринку; система економічних відносин; агентській ШІ, кіберфізичні системи, машинні клієнти, оптимізація корисності, кібербренд.

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