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JOINT AND SEVERAL LIABILITY IN THE ALGORITHMIC CHAIN: A COMPARATIVE ANALYSIS OF DIRECTIVE 2024/2853 AND THE AI ACT (REGULATION 2024/1689) AND CONTRIBUTIONS TO THE DEVELOPMENT OF THE BRAZILIAN REGULATORY FRAMEWORK

RESPONSABILIDADE SOLIDÁRIA NA CADEIA ALGORÍTMICA: UMA ANÁLISE COMPARATIVA DA DIRETIVA 2024/2853 E DO REGULAMENTO DE INTELIGÊNCIA ARTIFICIAL (AI ACT) 2024/1689 E CONTRIBUIÇÕES PARA O DESENVOLVIMENTO DO MARCO REGULATÓRIO BRASILEIRO

RESPONSABILIDAD SOLIDARIA EN LA CADENA ALGORÍTMICA: UN ANÁLISIS COMPARATIVO DE LA DIRECTIVA 2024/2853 Y DEL REGLAMENTO DE INTELIGENCIA ARTIFICIAL (AI ACT) 2024/1689 Y CONTRIBUCIONES AL DESARROLLO DEL MARCO REGULATORIO BRASILEÑO

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ABSTRACT

This article examines whether passive joint and several liability within the suppliers' chain, under a consumer-protection logic, remains applicable when the defective product is an artificial intelligence system. The algorithmic chain poses three structural challenges absent from industrial chains: causal opacity, technical stratification into interdependent layers, and autonomous post-deployment behavioral evolution. Using the comparative method, the article analyzes the European instruments that seek to provide legal support on the issue—Directive (EU) 2024/2853 on liability for defective products and Regulation (EU) 2024/1689 (the AI Act). It concludes that joint and several liability exists within the European model but operates in a conditioned, graduated, and doubly instrumentalized manner: Directive 2024/2853 establishes horizontal joint and several liability among all responsible economic operators; the AI Act distributes compliance obligations vertically according to risk level and functional control, guiding the internal allocation of risk among co-obligors. The findings offer lessons for the development of Brazil's AI regulatory framework.

Keywords: Joint And Several Liability. Algorithmic Supply Chain. Product Liability. Artificial Intelligence Act. Defective Product. Comparative Civil Law.

RESUMO

Este artigo examina se a responsabilidade solidária passiva na cadeia de fornecedores, sob uma lógica de proteção ao consumidor, permanece aplicável quando o produto defeituoso é um sistema de inteligência artificial. A cadeia algorítmica apresenta três desafios estruturais ausentes nas cadeias industriais: a opacidade causal, a estratificação técnica em camadas interdependentes e a evolução comportamental autônoma após a implementação. Utilizando

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o método comparativo, o artigo analisa os instrumentos europeus que buscam oferecer suporte jurídico à questão — a Diretiva (UE) 2024/2853, relativa à responsabilidade por produtos defeituosos, e o Regulamento (UE) 2024/1689 (AI Act). Conclui-se que a responsabilidade solidária existe no modelo europeu, mas opera de forma condicionada, graduada e duplamente instrumentalizada: a Diretiva 2024/2853 estabelece a responsabilidade solidária horizontal entre todos os operadores econômicos responsáveis; o AI Act distribui verticalmente as obrigações de conformidade de acordo com o nível de risco e o controle funcional, orientando a alocação interna de riscos entre os coobrigados. Os resultados oferecem subsídios para o desenvolvimento do marco regulatório brasileiro de inteligência artificial.

Palavras-chave: Responsabilidade Solidária. Cadeia de Fornecimento Algorítmica. Responsabilidade pelo Produto. Regulamento de Inteligência Artificial. Produto Defeituoso. Direito Civil Comparado.

RESUMEN

Este artículo examina si la responsabilidad solidaria pasiva dentro de la cadena de proveedores, bajo una lógica de protección al consumidor, sigue siendo aplicable cuando el producto defectuoso es un sistema de inteligencia artificial. La cadena algorítmica presenta tres desafíos estructurales ausentes en las cadenas industriales: la opacidad causal, la estratificación técnica en capas interdependientes y la evolución autónoma del comportamiento después de la implementación. Mediante el método comparativo, el artículo analiza los instrumentos europeos que buscan proporcionar respaldo jurídico a esta cuestión —la Directiva (UE) 2024/2853, relativa a la responsabilidad por productos defectuosos, y el Reglamento (UE) 2024/1689 (AI Act). Se concluye que la responsabilidad solidaria existe en el modelo europeo, pero opera de manera condicionada, gradual y doblemente instrumentalizada: la Directiva 2024/2853 establece la responsabilidad solidaria horizontal entre todos los operadores económicos responsables; el AI Act distribuye verticalmente las obligaciones de cumplimiento de acuerdo con el nivel de riesgo y el control funcional, orientando la asignación interna del riesgo entre los coobligados. Los resultados ofrecen aportes para el desarrollo del marco regulatorio brasileño sobre inteligencia artificial.

Palabras clave: Responsabilidad Solidaria. Cadena de Suministro Algorítmica. Responsabilidad por Productos. Reglamento de Inteligencia Artificial. Producto Defectuoso. Derecho Civil Comparado.

1 INTRODUCTION

The rise of artificial intelligence as a core infrastructure of contemporary economic and contractual relations imposes to civil law a question that cannot be resolved by mere analogical application of classical doctrines: when an artificial intelligence system causes harm to a consumer, liability does not necessarily is attributed to a single actor but to a stratified chain of technical suppliers. This question structures the present article: does the regime of passive joint and several liability apply to the algorithmic chain?

The problem of imputing liability in complex resource chains is, in itself, familiar to consumer law and comparative civil law.

In Brazil, the Consumer Protection Code delineates passive joint and several liability among the actors in the supply chain, shaping the regime of liability for defective products around three prerequisites: identification of the manufacturer, traceability of the defect, and demonstration of the causal nexus between the product and the damage.

What artificial intelligence introduces as novel is the algorithmic chain, which simultaneously challenges those three premises, identification, traceability, and causal nexus, thereby disrupting the traditional logic of attribution.

In this scenario this article seeks to investigate whether, and in what manner, passive joint and several liability is applicable to the algorithmic chain that supports artificial intelligence systems.

To address this question, the article adopts a qualitative, deductive approach of a doctrinal and hermeneutic nature, starting from the classical categories of civil law to apply the occurrences arising from algorithmic contracting.

The investigation is supported by bibliographic, documentary, and legislative research, articulating the Brazilian legal order, particularly the Civil Code and the Consumer Protection Code, with the European legal framework, notably the AI Act (Regulation 2024/1,689) and Directive 2024/2,853, guided by the technique of dialoguing sources in order to extract from the existing legal order a legal regime capable of protecting the user prior to the enactment of a specific AI regulatory framework.

In the comparative law dimension, the functional method is employed through the reception of functional equivalence, whereby distinct legal systems are compared based on the concrete problem they seek to solve, namely the attribution of harm resulting from opaque algorithmic systems, rather than on mere terminological identity of their institutions.

The argumentative trajectory unfolds in three stages: the first examines the structural characteristics that distinguish the algorithmic chain from the traditional industrial chain, highlighting causal opacity, technical stratification into interdependent layers, and the behavioral evolution of systems; the second analyzes how Directive (EU) 2024/2,853 and the AI Act address the algorithmic chain. The third confronts the central question: whether passive joint and several liability exists in the European model and how it operates.

The relevance of the topic for the Brazilian legal order is direct. Brazil is presently engaged in constructing its AI regulatory framework, with Bill 2,338/23 pending in the National Congress. Understanding how the European model structured passive joint and several liability in the algorithmic chain is a prerequisite for enabling Brazilian law to develop its own response that neither ignores the identified challenges nor uncritically reproduces solutions designed for different economic and institutional contexts.

In this context, the hypothesis guiding this article is twofold: first, it is maintained that passive joint and several liability remains an appropriate structuring principle for attributing harms arising from artificial intelligence systems in Brazilian law, provided it is reconceptualized in light of the algorithmic chain rather than merely the classical industrial chain; and second, it is argued that the articulation between Directive (EU) 2024/2,853 and the AI Act (Regulation 2024/1,689) offers not only a model of inspiration but also a repertoire of normative techniques, reconceptualization of "product," functional equivalence of operators to the manufacturer, presumptions of defect and causal nexus, and vertical distribution of compliance duties, that can and should be adapted to Bill 2,338/23 and reinterpreted in dialogue with the Consumer Protection Code, the Civil Code, and the General Data Protection Law[3].

2 THE ALGORITHMIC SUPPLY CHAIN: STRUCTURE AND ASYMMETRY

2.1 FROM INDUSTRIAL CHAIN TO ALGORITHMIC CHAIN

The concept of a supply chain is familiar to civil law and, in particular, to consumer law.

Regarding the traditional industrial chain, Brazilian law provides that, once a causal nexus between a supplier and the damage (a defect in a product or service) exists, supplier is deemed responsible for repairing the damage, as well as the suppliers who have jointly

[3] RCMD Santos. (2022), *A responsabilidade civil e os influenciadores digitais*. (2022) <https://core.ac.uk/download/564764784.pdf> acessed on 10 June 2026.

caused the damage, as joint and liable pursuant to Articles 13, 14, 18 and 25 of the Consumer Protection Code[4].

These concepts have been underscored in jurisprudence such as

> "all those who participate in placing a product or service on the market are jointly and severally liable for eventual defect or vice, pursuant to Articles 14 and 18 of the Consumer Protection Code (CDC)[5], without regard to their actual participation in the occurrence of the damage."

Or by doctrines such as that of Bruno Miragem, who states:

> “With regard to consumer civil liability, the theory of direct and immediate damage answers precisely the question of defect as a prerequisite for the supplier’s duty to indemnify. In other words, there is civil liability for the fact of the product or service only when there is a defect and it is the cause of the damages suffered by the consumer. (...) In matters of civil liability for the fact of the product or service, one must uphold the logical necessity relation between the defect of the product or service and the damage caused to consumers.”[6]

Although the Consumer Protection Code contains a sui generis regime of civil liability, essentially objective, as Sergio Cavalieri Filho[7] explains, with respect to passive joint and several liability arising from wrongful acts it followed the classical discipline provided in the Civil Code[8], pursuant to articles. 264 and 942, at the time of Article 25 of the CDC.

To understand the structural evolution of this regime and the subsequent rupture caused by the algorithmic chain, it is useful to resort to the analogy of the “fire piramid.” In chemistry, combustion requires the simultaneous presence of three essential elements: fuel (the material that burns), oxidizer (oxygen) and heat (activation energy). The absence of any one of them prevents or extinguishes the flame.

In classical civil law, the emergence of the duty to indemnify under subjective liability follows a similar architecture. For the “fire” of compensation to ignite, the legal order requires the conjunction of inseparable elements: conduct (action or omission that serves as fuel), damage, and causal nexus (the heat that connects the act to the result), and fundamentally

[4] Brasil, Lei nº 8.078, de 11 de setembro de 1990. Código de Defesa do Consumidor <https://www.planalto.gov.br/ccivil_03/leis/l8078compilado.htm> accessed 4 June2026.
[5] BrasiL, *REsp 1.058.221-PR,* Rel. Min. Nancy Andrighi, 3ª T., j. 4-10-2011.
[6] B Miragem, *Curso de Direito do Consumidor (*3rd edn, Revista dos Tribunais, 465).
[7] S Cavalieri Filho, *Programa de Responsabilidade Civil* (17th edn, Atlas, 2026, 584/585).
[8] Brasil, Código Civil. Lei nº 10.406, de 10 de janeiro de 2002, <https://www.planalto.gov.br/ccivil_03/leis/2002/l10406compilada.htm> accessed 4 June 2026.

fault or intent (the oxygen that sustains attribution of liability). Without proof of fault or intent, the duty to compensate does not endure.

However, the evolution of consumer relations required the development of a regime in which the “fire” of liability could exist without the need to prove its “oxygen.” Thus objective liability emerges. Founded on the enterprise risk theory, it focuses exclusively on conduct, damage and causal nexus, presuming that one who obtains the benefits of market exploitation must bear its attendant burdens.

In the traditional industrial chain, therefore, actors are relatively identifiable and their causal contributions, though sometimes complex, can be investigated by established technical methods. A defect in a product may be traced to the design phase, raw material selection or assembly process; whether manufacturer, builder, producer or importer, each stage is linked to an agent with defined responsibilities.

The complexity of artificial intelligence and machine-learning systems, however, often challenges the decision-making logic employed and complicates the application of civil liability behind that medium, as currently debated.

In this regard, the algorithmic chain[9] introduces characteristics that challenge the traditional logic, prompting the law to reassess the civil-liability structure previously applied.

The first characteristic is algorithmic opacity.

The traditional supply chain, in cases of a defective product, allows for identification of the defective item and the causal contribution of each actor, thereby establishing the causal nexus among them and fulfilling the three requisites of civil liability (cause, nexus, damage).

However, machine-learning systems, including deep-learning models, such as Alexa, Siri, Cortana, or personalized recommendations from social networks, operate through layers of artificial neural networks under complex learning regimes. The system’s output results from the interaction of pre-tuned parameters and the inputs provided during use; consequently, the so-called “black boxes” arise in which the decision-making logic becomes inaccessible.

At this point the shift from subjective to objective liability acquires urgency. If proof of fault was already difficult under subjective liability in industrial chains, in the algorithmic chain it becomes a veritable devil’s probatio. The autonomy and opacity of “black boxes” prevent the injured consumer from indicating where negligence or lack of skill occurred during

[9] J Cobbe, M Veale, J Singh, Understanding accountability in algorithmic supply chains, in *2023 ACM Conference on Fairness, Accountability, and Transparency (FAccT ’23)*, June 12–15, 2023, Chicago, ACM, New York, NY, USA <*https://doi.org/10. 1145/3593013.3594073*> <https://arxiv.org/abs/2304.14749> accessed 3 June 2026.

programming or training. Requiring the victim to prove a developer's fault would be equivalent to asking it to isolate and measure the oxygen molecules in an already-consumed fire. For this reason, the deployment of autonomous systems embodies an inherent risk: any failure that frustrates the safety legitimately expected and causes harm should give rise to objective joint liability of the chain that enabled it.

The second characteristic is technical stratification into interdependent layers.

In the traditional industrial chain, the causal contribution of each actor or supplier is fully accessible once the product flow is mapped.

By contrast, artificial learning systems operate according to a stacked, functional layering of interdependent layers. To illustrate the algorithmic logic, consider four actors: the system developer; the model integrator (responsible for integrating software and the AI via APIs); the fine-tuning process and Integration of the model by the deployer (the operating agent).

The example reveals at least four layers and actors that, individually, do not deliver a final product; for his purpose, the supplier logic traditionally applied is altered, since in this context a product defect may result from the interaction among all these actors.

The third characteristic is the system's post-deployment circulation.

The traditional chain follows a linear trajectory with a temporal marker specific at the moment the product is transferred to the consumer and performs the functions for which it was manufactured.

The algorithmic chain, by contrast, features continuous learning and may undergo behavioral mutation after systemic input, without intervention by any specific or identifiable actor.

For these reasons, the supply chain must be understood and debated as a central legal issue, so as to determine whether the classical legal framework of individual identification of the harm-causer remains sufficient and whether joint and several liability across the supply chain can and should still be applied.

2.2 FUNCTIONAL EQUIVALENCE BETWEEN THE INDUSTRIAL SUPPLY CHAIN AND THE ALGORITHMIC SUPPLY CHAIN IN BRAZILIAN LAW

Given these three characteristics—causal opacity, technical stratification into interdependent layers, and autonomous behavioral evolution — the Brazilian doctrinal framework requires a methodological shift. More than debating the "nature" of the algorithmic

chain, it is essential to acknowledge its functional equivalence to the traditional industrial chain for purposes of liability attribution. From the user's perspective, an AI system is experienced as a single product or service: it not important to the user, in the background, the outcome results from the interaction of the model developer, the data provider, the integrator responsible for fine-tuning, the infrastructure provider, and the operator who deploys the system.

From this standpoint, the regime of passive joint and several liability established by the Consumer Protection Code, particularly articles 7, sole paragraph, 12, 18 and 25, and by the Civil Code, Articles 264 and 942, may be reinterpreted to encompass the algorithmic chain as a supply chain in the broad sense, without the need to create an autonomous micro-system of "algorithmic liability."

The technique of functional equivalence permits the classical categories of manufacturer, supplier, producer, and merchant to be read in light of the roles performed in the development and operation chain of AI systems. In practical terms, the base model developer, the integrator who adapts the system to a specific use case, and the operator who markets the system may, depending on context, be characterized as manufacturers or their equivalents, answering jointly and severally to the injured party, without prejudice to their right of recourse among themselves.

3 THE EUROPEAN MODEL: TIERED AND FUNCTIONAL LIABILITY

3.1 DIRECTIVE (EU) 2024/2,853: EXPANSION OF "PRODUCT" AND OF THE CHAIN OF LIABLE PARTIES

Directive (EU) 2024/2,853 of the European Parliament and of the Council[10], of 23 October 2024, applicable as of 9 December 2026 pursuant to Article 22, on liability for defective products, constitutes the most significant reform of the European product-liability regime since Directive 85/374/EEC.

Although Directive 85/374/EEC has been an effective and important instrument, new technologies, including artificial intelligence, have given rise to novel models of global supply chains that generate legal uncertainty by operating in regulatory gaps, particularly regarding the meaning of the term "product."

[10] Parlamento Europeu e Conselho da UE, Diretiva (UE) 2024/2853, de 23 de outubro de 2024. JO L 2024/2,853, <https://eur-lex.europa.eu/eli/dir/2024/2853/oj> accessed 3 June 2026.

"Injured persons face difficulties in obtaining compensation due to restrictions on bringing claims and challenges in gathering evidence to establish liability, especially in light of increasing technical and scientific complexity. This includes indemnification claims arising from new technologies. Accordingly, revision of the Directive would encourage the deployment and uptake of these new technologies, including AI, while ensuring that claimants enjoy the same level of protection regardless of the technology involved, and that all companies benefit from greater legal certainty and a equality conditions"[11].

The Directive expressly incorporates free and open-source software in the context of commercial activity, AI systems, and digital manufacturing files, however, defining "product" to include *"all movable property, even if integrated or connected to another movable or immovable good; electricity, digital manufacturing files, raw materials and software."*

This expansion repositions the major part of doctrinal debate on whether software may be considered a product for defect-liability purposes, treating AI systems as products subject to objective liability.

Beyond the definition of "product," the Directive introduces other innovations.

Other central innovation is the broadened interpretation of the circle of economic operators, based on Article 8, identifying agents equally joint responsible to the figure of the manufacturer, including importer or the representative.

The provision goes further by treating as a manufacturer any person who substantially modifies a product outside the original manufacturer's control and subsequently places it on the market.

In the AI context, this clause transcends the traditional chain and encompasses the algorithmic chain described in Chapter 1, so that, for example, a model integrator responsible for fine-tuning may be reclassified as a manufacturer for liability purposes in the event of a defective product.

The Directive further establishes a presumption of lack of quality or defectiveness under Article 10 where the defendant fails to comply with evidentiary disclosure obligations, when the product does not meet mandatory national product-safety requirements, or when the damage was caused by an obvious defect during reasonably foreseeable or normal use.

Article 10 addresses the liability gap created by algorithmic opacity and scientific complexity by stipulating a causal nexus between the consumer-user and the manufacturer-agent, as well as protecting the consumer's vulnerability when the

[11] ibid.

agent/manufacturer possesses the technical and economic capacity to prove a product's defect, without imposing an impossible evidentiary burden on the weaker party in the consumer chain.

Finally, Article 11 provides the causes of exoneration of the economic operator and, simultaneously, offers partial response to opacity and algorithmic mutation, notably in its item 1(c) and item 2.

The Directive, however, excludes the defense when the supervening defect results from connected services, updates, or the absence of security updates, provided those elements remain under the manufacturer's control.

The decisive criterion is therefore control. This is precisely the structural limit of the model: liability endures while mutation results from elements manageable by the manufacturer.

A remaining grey area to which the rule offers no answer is genuinely autonomous mutation emerging from the system's continuous learning without any controllable intervention.

In that scenario, the defense in clause (c) regains force and the injured party's protection diminishes, revealing that the gap is not legislative omission but a conceptual limit: the construction revolves around "manufacturer control," a category conceived for static products and of still indeterminate application to self-evolving systems.

Accordingly, Directive (EU) 2024/2,853 advances on the main obstacles posed by the algorithmic chain: by redefining "product" to include new technologies and AI and subjecting them to objective liability; by expanding the circle of operators equated with the manufacturer, thereby reaching agents such as integrators responsible for fine-tuning; and by instituting presumptions of defect and causal nexus that neutralize the *probatio diabolica* imposed on consumers by opacity.

A conceptual limit remains, however: the exoneration regime, anchored in the notion of manufacturer control, addresses supervening mutation only while it remains manageable, but not genuinely autonomous mutation, in which the defense of supervening defect regains force and the injured party's protection is weakened. Thus the Directive provides a civil-liability structure, but does not exhaust the algorithmic chain.

For normative transplantation, the European experience offers concrete parameters for Brazilian legislators. Conceptually, the Directive's broad "product" clause, covering movable goods, electricity, digital manufacturing files, raw materials and software, including

AI systems, could inspire revision of Article 3 of CDC or the inclusion in Bill 2,338/23 of a functionally and technologically neutral definition of “algorithmic product.”

Such a solution would avoid recurring ontological debates about software and allow treating, under the same objective liability regime, both a defective toy and an AI system embedded in a credit, recommendation, or diagnostic platform.

On the subjective side of liability, the functional-equivalence technique to the manufacturer adopted by the Directive, treating as responsible those who substantially modify a product or relaunch it on the market under their brand, can be directly adapted.

A possible drafting, whether as a CDC reform or within Bill 2338/23, would equate, for all purposes of objective liability and passive joint and several liability, any person who: (i) substantially modifies an AI system or software outside the original developer’s control; (ii) integrates the system with other products or databases, conferring new or different functionality from that originally intended; or (iii) places on the market, under its own name or brand, an AI system developed by a third party.

Finally, the legal presumptions of defect and causal nexus in Article 10 inspire a specific solution to the *probatio diabolica* imposed by algorithmic opacity. Bill 2,338/23 could provide that failure to observe duties of transparency, documentation, impact assessment and system security, detailed in regulation or by the competent authority, gives rise to a rebuttable presumption of system defect and causal nexus in favor of the injured user. This technique aligns with the CDC’s evidentiary reversal in Article 6, VIII, but goes further: it transforms non-compliance with algorithmic governance obligations into a true evidentiary trigger, shifting the burden from proof of fault to proof of conformity.

3.2 AI ACT (REGULATION 2024/1,689)

While Directive (EU) 2024/2,853 structures product liability on the civil branch, the AI Act, Regulation (EU) 2024/1,689, in force since 1st August 2024 and applicable in a phased manner[12] under Article 113, organizes the supply chain through a system of compliance obligations allocated by functional roles.

[12] Parlamento Europeu e Conselho da UE, Regulamento (UE) 2024/1689, de 13 de junho de 2024 (Lei AI). JO L 2024/1689, <https://eur-lex.europa.eu/legal-content/PT/TXT/?uri=CELEX:32024R1689>. Article 113: Entry into force and application. This Regulation shall enter into force on the twentieth day following that of its publication in the Official Journal of the European Union. It shall apply from 2 August 2026. However: (a)Chapters I and II shall apply from 2 February 2025;(b)Chapter III Section 4, Chapter V, Chapter VII and Chapter XII and Article 78 shall apply from 2 August 2025, with the exception of Article 101; (c) Article 6(1) and the corresponding obligations in this Regulation shall apply from 2 August 2027.

The AI Act adopts a pyramidal and proportional approach, stipulating that the greater the potential risk of an AI system to fundamental rights, the denser the obligations imposed on actors in the chain.

Accordingly, Regulation 2024/1,689 defines four risk tiers: unacceptable risk, high risk, limited risk (transparency), and “minimal risk”[13].

Unacceptable risk, under Article 5, corresponds to AI systems which intrinsic characteristics violate fundamental rights or offend human dignity. For example, Article 5 prohibits: ‘(a) AI systems that employ subliminal techniques beyond a person’s awareness or deliberately manipulative or deceptive techniques’; (b) ‘AI systems that exploit any vulnerabilities of an individual or a specific group due to age, disability or particular socioeconomic circumstances’; and (c) ‘AI systems for the evaluation or classification of individuals or groups over a period of time on the basis of their social behavior or known, inferred or predicted personal or personality characteristic’”, among other provisions.

High-risk systems, in light of Articles 6 and 7, are those that may significantly affect product and user safety as well as fundamental rights.

To qualify as high risk, Article 6 establishes two cumulative requirements: systems intended to be used as ‘a safety component of a product, or where the AI system itself is a product”; and “a product which safety component is the AI system, or the AI system as a product, must be submitted to a third-party conformity assessment’.

The limited-risk tier introduces transparency obligations for AI systems that interact directly with users, which must inform the public users that content is artificially generated or that personal data are being processed (Article 50). Examples include customer-service chatbots or deepfake content.

Finally, general-purpose AI systems with systemic risk, under Articles 51–56, are those with high potential impact that utilize vast volumes of data, indicators and reference parameters—exemplified by GPT-4, Gemini, Claude (Anthropic) and Llama (Meta), which risk lies in unpredictable behavior or security failures.

After considering the risk classification provided by AI Act, it is possible to understand the regulation of the supply chain.

Article 25 is central to supply-chain analysis: it provides that any person (a) places its name or brand on a high-risk AI system already placed on the market; (b) makes a substantial

[13] European Commission, Shaping Europe’s digital future. AI Act <https://digital-strategy.ec.europa.eu/en/policies/regulatory-framework-ai> accessed 4 June 2026.

modification to the system; or (c) changes the intended purpose of a system not classified as high risk so that it becomes high risk, shall be regarded as a provider for the purposes of the Regulation, with the attendant obligations.

However, Article 25 does not apply to the entire supplier chain; its scope is limited, as its heading indicates, to high-risk AI systems. For other actors in the algorithmic chain, transparency obligations or general regulatory duties apply, such that the AI Act does not provide civil-liability rules among suppliers analogous to those set by Directive 2024/2,853.

This limitation has significant practical importance, since most consumer adhesion contracts for digital service, with access to streaming platforms, interaction with chatbots, use of recommender systems involve systems that are not classified as high risk under the AI Act. For those systems, Directive 2024/2,853 determines who is liable for product defects.

3.3 DIRECTIVE 2024/2,853 AND THE AI ACT: COMPLEMENTARY INSTRUMENTS WITH DISTINCT ARCHITECTURES

Directive 2024/2,853 and the AI Act proceed from distinct logics but converge on a common objective: to ensure that individuals harmed by an AI system have complementary access to components irrespective of the complexity of the chain that produced the harm.

Directive 2024/2,853 determines liability of the algorithmic supply chain, who is liable to the harm, under what conditions, and with which evidentiary burden. Its scope is therefore horizontal: it applies to any AI system placed on the market, irrespective of the risk level assigned by the AI Act.

By contrast, the AI Act operates at the regulatory level for AI systems. It allocates duties, obligations and risk management among actors in the supply chain. Thus, unlike Directive 2024/2,853, its scope is vertical: the greater the risk, the denser the layers of obligations and duties owed to users.

There is, accordingly, a connection and complementarity between the instruments. While Directive 2024/2,853 establishes civil liability upon defining who is liable for damage, under what conditions and with what evidentiary regime, and instituting passive joint and several liability of economic operators toward the injured individual; AI Act establishes regulatory compliance: the distribution of duties and obligations among supply-chain actors according to their functional role and the system’s risk level.

Their articulation between them operates at a precise juncture: non-compliance with the AI Act's conformity obligations may characterize the product defect for the purposes of the Directive, where failure to observe regulatory safety criteria undermines the legitimately expected level of protection.

In the Brazilian context, the AI Act's vertical logic directly dialogues with the duty-allocation model of the General Data Protection Law (LGPD). The distinction between controller and processor, coupled with joint liability under Article 42 of the LGPD and the right of recourse according to each actor's sphere of responsibility, anticipates for personal-data protection the same rationale the AI Act introduces for AI systems generally. This convergence suggests that Brazil's future AI framework need not start from a tabula rasa but may draw on the LGPD experience to coherently structure duties of documentation, impact assessment and algorithmic governance.

This architecture permits conceiving a two-tier regime. On the first, horizontal tier, the consumerist microsystem, Civil Code, Consumer Protection Code and LGPD enable the injured party to claim full compensation from any actor in the algorithmic chain qualified as a supplier or data-processing actor in the broad sense, in line with established passive joint and several liability. On the second, vertical tier, the AI regulatory framework distributes, through risk-graded conformity duties, objective parameters for internal allocation of responsibility among developers, integrators, infrastructure providers and operators. Joint and several liability thus ceases to be merely a victim-protection mechanism and functions also as an instrument to induce cooperation, corporate governance and algorithmic compliance among co-obligors.

4 PASSIVE JOINT AND SEVERAL LIABILITY IN THE EUROPEAN MODEL: DOES IT EXIST?

From the reading of the instruments under analysis, it is first observed that there are three conditioning factors for holding a supplying actor liable.

The first is conditioning by risk level: the AI Act imposes denser conformity obligations on high-risk systems (Article 25), whereas joint and several liability among operators stems from Directive 2024/2,853, irrespective of the system's risk classification.

The second is determined by the category of damage: Directive 2024/2,853 characterizes product defects and the potential harms arising from them.

Finally, the third conditions the identification of the responsible supplier, based on alteration, implementation or development of the system that gave rise to the defect and consequent harm.

This architecture demonstrates that passive joint and several liability exists in the European model, but in a conditioned, graduated manner articulated across two instruments operating on distinct ways.

At the regulatory level, the AI Act allocates duties and obligations among actors depending on functional role and system risk, so that the degree of responsibility among chain actors may vary.

At the civil-liability level, Directive 2024/2,853 guarantees the consumer-user passive joint and several liability of actors in the algorithmic chain for the entirety of the damage, irrespective of relative culpability for the product defect.

Thus, passive joint and several liability for the harm is secured by Directive 2024/2,853, which permits the claimant to demand full compensation from any co-obligor. The internal graduation of that liability is supported by both instruments: the Directive itself regulates the right of recourse among operators, while the AI Act, by distributing duties according to functional role and risk level, supplies objective parameters to measure each co-obligor's contribution in the ultimate apportionment of loss[14].

Transposed to the Brazilian context, this dual instrumentalization suggests a fairly precise normative design. Passive joint and several liability toward the injured party may remain anchored mainly in CDC, Civil Code and LGPD, through interpretation that recognizes the algorithmic chain as a supply chain in the broad sense and expressly assimilates developers, integrators, data providers and operators to suppliers and manufacturers. Concurrently, the sectoral AI framework (Bill 2,338/23) should assume the role of allocating governance, transparency, impact-assessment and technical-documentation duties by functional roles and risk levels, providing objective criteria for recourse among co-obligors.

Legislatively, this means the Brazilian debate should not center on replacing passive joint and several liability with fragmented responsibility models, but on sophisticating it: (i) expanding, via assimilation clauses, jointly liable actors within the algorithmic chain; (ii) linking the scope of recourse liability to compliance with specific conformity duties; and (iii) articulating this regime with the already consolidated personal-data protection microsystem.

[14] V Reed Smith. *EU Product Liability Directive: What supply chain economic operators need to know now* (Feb.v. 2026) <https://www.reedsmith.com/articles/eu-product-liability-directive> accessed 5 June2026.

Thus redesigned, joint and several liability not only protects the individual but also internalizes, within the contract economy among chain actors, the costs of opacity, technical stratification and autonomous mutation of AI systems.

4.1 PASSIVE JOINT AND SEVERAL LIABILITY AS AN INSTRUMENT OF ALGORITHMIC GOVERNANCE

Passive joint and several liability, however, does not serve merely a compensatory function. Within the algorithmic chain, its significance transcends ensuring victim compensation and assumes a preventive and organizational role.

In traditional industrial supply chains, joint and several liability already creates incentives for manufacturers, distributors and suppliers to adopt minimum quality-control standards. In the context of artificial-intelligence systems, this effect is amplified by the very structure of the algorithmic chain. Because a defect may arise from the interaction of multiple technical agents and multiple development layers, no participant can assume it will be fully insulated from the risks inherent in the activity.

The possibility of being held liable for the entirety of the damage generates economic incentives for each participant to monitor the other actors in the chain. Developers will demand minimum quality standards for the datasets used to train models; integrators will audit providers of foundational models; operators will require technical documentation, certifications, human-oversight mechanisms and evidence of regulatory conformity.

Joint and several liability ceases to be merely a victim-protection mechanism and becomes an indirect instrument of private governance. The legal structure of liability induces preventive mechanisms of audit, monitoring and control among market participants themselves, thereby reducing the systemic risks inherent in AI systems.

From this perspective, passive joint and several liability approaches modern frameworks of regulatory compliance and technological accountability. The cost of oversight ceases to be borne exclusively by the state and is shared by economic actors, who are incentivized to prevent failures before they result in compensable harm.

For these reasons, joint and several liability should not be understood solely as a technique for allocating legal risk, but as a regulatory mechanism capable of fostering algorithmic-governance ecosystems compatible with the challenges posed by new technologies.

5 THE ALGORITHMIC CHAIN AS A STRUCTURAL CHALLENGE TO CIVIL RESPONSIBILITY LAW

After analyzing the European model, we return in summary to the structural problem that motivated this article: the algorithmic chain presents specific features that subject civil liability to challenges beyond classical instruments.

Causal opacity, the first identified feature, remains the most intractable obstacle. In the industrial chain, the defect is locatable: one traces the harm, identifies the manufacturer, and demonstrates the causal nexus. In the algorithmic chain, harm emerges from the interaction among multiple actors and multiple development layers.

Technical stratification into interdependent layers, the second feature, transforms opacity into a legal problem of imputing responsibility among actors.

Autonomous post-deployment behavioral evolution, the third feature, adds a temporal dimension. The defect that causes harm may not have existed when the product was placed on the market, it may have emerged subsequently and independently through the system's continuous learning.

In light of these three features, opacity, stratification and autonomous mutation, the European response, built on the complementarity of the two instruments (Directive 2024/2,853 and the AI Act), demonstrates both an update of the European legal order and its limits.

To the extent that passive joint and several liability exists and operates on the assumptions that chain actors are identifiable, harms are categorically classifiable, and each actor's degree of control over the system can be ascertained, it does not cover certain gaps and legal uncertainties: namely, when opacity prevents precise identification of each actor's causal contribution; harm results from the system's autonomous mutation; or the manufacturer cannot be identified.

5.1 REALLOCATION OF THE BURDEN OF PROOF IN THE ALGORITHMIC CHAIN

Algorithmic opacity produces effects that extend beyond material discussion of liability and directly affect procedural law. If consumer has no access to models, training parameters, operational logs or the internal decision-making mechanisms of a system, proving defect and causal nexus may become unduly onerous or practically impossible.

It is precisely in this context that Directive (EU) 2024/2,853 introduces evidentiary-facilitation mechanisms. Presumptions of defectiveness and causation do not

eliminate the need to prove damage, but they reduce the evidentiary burden on the injured party when the system's technical complexity renders proof production unfeasible.

From a functional perspective, the solution resembles instruments already present in Brazilian law, such as the reversal of the burden of proof under Article 6, VIII, of the Consumer Protection Code and the dynamic allocation of the burden of proof provided in Article 373, §1, of the Civil Procedure Code.

The underlying logic is similar: the proof burden should be attributed to the agent that has better technical and economic conditions to do so. In AI systems, such information is normally controlled by developers, integrators and operators of the technology, not by the user harmed by it.

The European model therefore does not abandon causation as a prerequisite for civil liability. Rather, it redistributes the burden of proving the causal nexus, adapting evidentiary rules to the technical reality of complex algorithmic systems.

5.2 FROM DEFECT LIABILITY TO RISK LIABILITY

Another relevant consequence of the algorithmic chain is the progressive transformation of the very notion of defect.

In the classical logic of product liability, a defect is conceived as an identifiable failure in manufacturing, design, or information. The product exhibits an objective nonconformity with the safety that a consumer is legitimately entitled to expect.

In artificial intelligence systems, however, certain harmful occurrences may arise even when no identifiable technical error exists. Phenomena such as emergent behavior, algorithmic drift, statistical biases undetected during training, or unforeseen interactions among distinct components can produce injurious outcomes without there being an attributable, individualized programming fault.

This circumstance partially shifts the focus of legal analysis. Beyond exclusively investigating the existence of a specific defect, it becomes necessary to assess the risks inherent in the very activities of developing, integrating, and deploying artificial intelligence systems.

The issue approaches contemporary formulations of risk theory, according to which certain activities, by reason of their nature and potential to cause harm, justify the imposition of strict liability for damages they produce. Artificial intelligence, especially when deployed in

contexts capable of affecting fundamental rights, exhibits characteristics consonant with this logic.

From this perspective, the algorithmic chain not only challenges traditional mechanisms of proof and causation. It also calls into question the classical conception of defect, requiring civil liability to engage more closely with legal categories grounded in the management and allocation of technological risks.

6 CONCLUSION

This article began by examining the classical supply chain and the doctrine of joint and several liability among suppliers , a classic institute of civil and consumer laws, and observed that the rise of new technologies and AI has produced a new supply paradigm, the algorithmic chain, which complicates traditional decision logic and the traceability of each actor's liability.

The analysis progressed in three stages.

First, it reviewed the classical industrial chain and demonstrated how civil liability precisely identifies harm, agent and causal nexus, then showed how the algorithmic chain gives rise to new scenarios across three dimensions: algorithmic opacity, technical stratification and behavioral evolution, challenging classical application.

Second, it examined two European instruments addressing civil liability in the algorithmic context, concluding that Directive 2024/2,853 reconceives "product" and defines civil-liability regimes among actors, while the AI Act constructs a regulatory architecture allocating duties and obligations among suppliers.

Third, it concluded that these instruments foresee passive joint and several liability within the algorithmic chain to protect the consumer-user, operating complementarily to delimit the degree of responsibility among co-obligors while ensuring full compensation to the injured party.

For Brazil's regulatory construction, the main lesson is that adopting this model of joint and strict liability transcends mere reparative protection. Aligned with logics already consolidated in the personal-data protection microsystem (such as joint liability of data-processing agents under Article 42 of the LGPD), imposing joint and several liability acts as a powerful driver of corporate governance. Aware of the risk of being held liable for the totality of damage, chain actors are compelled to develop robust *ex ante* algorithmic compliance programmes, require audits of partners and conclude contracts with rigorous recourse clauses, thereby organically raising market-wide safety standards.

In light of the foregoing, this article's main contribution to the Brazilian legislative debate on AI can be condensed into four normative criteria: (i) adopt a functional and technologically neutral concept of "product" that includes software, AI systems and digital artefacts, subjecting them to strict defect liability; (ii) expressly provide passive joint and several liability among actors in the algorithmic chain, with functional-equivalence clauses to the manufacturer/supplier for those who substantially modify the system, change its purpose, or place it on the market under their brand; (iii) institute legal presumptions of defect and causal nexus tied to breaches of duties of transparency, governance, security and technical documentation, particularly for high-risk systems; and (iv) integrate systematically with the LGPD, using the categories of controller, processor and data-processing agent to delimit spheres of recourse among developer, integrator, infrastructure provider and operator.

Beyond lessons drawn from the European experience, Brazil may leverage its existing regulatory achievements in complex technological ecosystems. The LGPD established a functional distribution of responsibilities between controllers and processors, coupled with duties of governance, accountability, security and risk mitigation[15]. Although designed for personal-data protection, the LGPD's architecture converges functionally with the AI Act's logic.

This proximity shows that Brazilian law does not start from a regulatory vacuum; rather, it already possesses normative instruments capable of inspiring future AI regulation, particularly regarding duty allocation among technological-chain participants, governance mechanisms and user protection in complex technical structures.

In this context, the principal lesson from the European model is the need to combine three complementary elements: objective liability *vis-à-vis* the victim, external joint and several liability among algorithmic-chain actors, and internal mechanisms for apportioning risk according to each actor's degree of control and participation.

Such an architecture simultaneously ensures full compensation of damages, reduces the evidentiary costs borne by users, and incentivizes preventive technological governance practices, producing a regulatory environment compatible with innovation and the protection of fundamental rights.

[15] Merenciano Advogados. *Lei Geral de Proteção de Dados* <https://www.merenciano.adv.br/lei-geral-de-protecao-de-dados> accessed on 2 June 2026.

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