UNIVERSITY OF MISKOLC

FACULTY OF LAW

FERENC DEÁK DOCTORAL SCHOOL OF LAW

dr. Ibolya Stefán

NON-CONTRACTUAL LIABILITY FOR DAMAGES CAUSED BY HIGH-RISK AI SYSTEMS

(Theses of PhD dissertation)

MISKOLC

2026

Table of Contents

I. The subject and aim of the dissertation 3
II. The structure of the dissertation and the methods used in the research 7
III. Summary of the research results and its utilisation 9
IV. List of publications related to the dissertation 14

Dissertation closing date: 25 August 2026

I. The subject and aim of the dissertation

Artificial intelligence systems (hereinafter: AI systems) have become an essential part of our everyday life. The technology not only presents economic and social challenges, but also legal ones. Autonomous, self-learning systems question the applicability of traditional civil law liability doctrine, as tort law assumes conduct driven by human will. However, this is not a characteristic of AI systems. Therefore, the technology presents specific interpretative challenges regarding the conditions of non-contractual liability.

The objective of the dissertation is to examine non-contractual liability for damages caused by high-risk AI systems in the Hungarian legal system and EU law development. However, resolving liability issues cannot precede the civil law categorisation of the technology. Therefore, the premise of the research is whether AI systems can be classified as a subject of law (legal person) or an object of law (thing, product or service). Regarding this topic, several theories exist in the legal literature. Some argue in favour of creating an electronic personality, establishing legal status similar to legal persons. Others consider categorising the technology as a thing, product or service. I do not seek to establish a single, correct definition of AI systems but to define the conceptual and liability framework of the technology to resolve tort law issues. Another aim of the dissertation is to explore how the liability regimes in force – the general rule of non-contractual liability, liability for highly dangerous activities and product liability – can be interpreted in the context of AI systems; and to highlight where these regimes should be modified or complemented.

It should be noted that the research focuses on private law, namely tort law. However, the use of AI systems raises many legal issues in other branches of law; I do not analyse these issues to maintain the dissertation's focus. Therefore, I do not discuss criminal liability in relation to artificial intelligence. I examine public law issues only in the context of the provisions of the AI Act (Regulation (EU) 2024/1689) (hereinafter: AI Act).

The scope of the research must be narrowed. It should be mentioned that I do not analyse every AI system in my dissertation; instead, I focus on a specific category, namely high-risk AI systems. The concept of 'high-risk AI systems' is defined by two complementary criteria. First, the definition includes high-risk AI systems as defined in Article 6 and Annex III of the Artificial Intelligence Act (2024/1689) (hereinafter: AIA high-risk systems), which pose a significant risk to the health, safety or fundamental rights of natural persons. This criterion reflects the severity of potential harm and links the assessment of civil law liability to public law and product safety standards. Secondly, the concept contains highly autonomous systems

that are unpredictable – for engineers and developers – because of the technology's self-learning attribute. This criterion highlights the difficulty of allocating liability and the problem of 'the liability gap'. Therefore, the notion of high-risk is not a synonym of AIA high-risk. The notion of high-risk is a broader term and deliberately of mixed nature. This approach aims to link the rules of public law – under the AI Act – with the regulations of non-contractual liability.

The application of these two criteria – for different reasons – identifies systems that pose most of the challenges regarding civil law liability. Due to the high risks of causing harm and autonomous, self-learning operation, it is difficult to identify fault-based human behaviour. Thus, it undermines the application of the traditional civil law liability regime.

A typical consequence of high-risk AI systems is harm to others' life, physical integrity or property – irrespective of any contractual relationship with the party causing the harm – which is addressed by liability for highly dangerous activities and product liability. Therefore, the dissertation focuses on these forms of liability. In contrast, contractual liability presupposes an existing contractual relationship between the parties. In this context, the exclusion of parallel claims should be noted. According to Section 6:145 of the Hungarian Civil Code: *„The obligee may also enforce his claim for damages against the obligor in accordance with the rules on liability for damage caused by breach of contract, even if the damage gives rise to the obligor's extra-contractual liability."* This section defines the so-called 'non-cumul rule', which falls within the scope of doctrinal issues relating to contract liability. I do not study the non-cumul rule in the dissertation due to length restrictions.

I examine civil law liability issues within the framework of the general rule of non-contractual liability and two forms of strict liability: liability for highly dangerous activities and product liability. I do not analyse the liability for damage caused by another person or liability for damage caused by animals – regarding the latter, I only address the possibility of analogy – as the doctrinal issues raised by the technology are present prominently in the context of the general rule of non-contractual liability and the two forms of strict liability.

My dissertation does not aim to provide a comprehensive overview of all the damages that AI systems might cause. Therefore, I do not discuss compensation for non-pecuniary damages or financial loss resulting from destruction or damage to data (data corruption, data loss); assessing these would require a separate analysis reflecting the specific characteristics of digital assets. Therefore, I focus on the issues of compensation for traditional types of damages.

The examination of civil law liability cannot be separated from the broader question of how law allocates risks associated with the new technology. Legal instruments of risk management can be divided into ex ante and ex post measures. Ex ante, preventive measures – safety

regulations, standards and public law conditions of entering the market – are meant to prevent damage from occurring. Ex post measures – liability for damages – address damage that has already occurred. The focus of my analysis is on the ex post measures; however, I also examine ex ante preventive regulations – more specifically the product safety requirements of the AI Act. Ex ante and ex post mechanisms are complementary elements of the same system; therefore, linking them is one of the dissertation's aims.

The issue of risk allocation is inseparable from the functions of liability for damages, as well as from the legal policy considerations of allocating damages. I do not study these aspects separately but in the context of each form of liability. Regarding the fundamentals of non-contractual liability, I review the modern principles of compensation. Concerning strict liability, I examine its theoretical justification.

Based on these findings, I demonstrate how liability for damages might be allocated in the case of a high-risk AI system. I argue that the unpredictability arising from the opacity of autonomous systems does not justify the exemption from liability, but supports the allocation of risks to the operator. Finally, in the context of damages arising from the nature of the technology – where the traditional allocation of liability does not provide answers –, I examine a solution based on the logic of risk allocation: joint compensation by developers and operators. I outline the possible directions of this solution.

In accordance with the above, the dissertation seeks to prove the following theses:

1. Granting legal status – similar to natural or legal persons – to artificial intelligence systems under the provisions of the Hungarian Civil Code in force, is not an effective way to resolve liability issues.

2. In the case of high-risk AI systems, autonomy, opacity and the so-called 'black box effect' affect harmful conduct, causation and fault. As autonomy increases, the scope of human supervision and intervention decreases. Therefore, it shifts the focus of liability from fault to strict liability.

3. The operation of high-risk AI systems can be categorised as a highly dangerous activity. Therefore, the rules on liability for highly dangerous activities apply to any resulting damage. However, the court must determine whether an operation constitutes a highly dangerous activity.

4. In the case of high-risk AI systems, product liability and liability for highly dangerous activities are complementary forms of strict liability; their parallel application narrows the liability gap to some extent.

5. There is a narrow category of cases – because of the nature of the technology – where it is not possible to identify either a fault in conduct or a defect that would result in product liability. Strict liability cannot fully resolve these damages, but joint compensation by developers and operators may provide a long-term solution.

II. The structure of the dissertation and the methods used in the research

Following the Introduction, Chapter II begins with a civil law interpretation of artificial intelligence systems. In this context, I examine the technical and legal definitions of AI; different types of the technology according to their level of development, and possible categorisation under civil law, such as the subject of law (legal personality) or the object of law (a thing, a product or a service).

In Chapter III of the dissertation, I analyse the ethical and regulatory framework of trustworthy and responsible AI systems. Within this framework, I examine the significance of ethical standards and review international and EU guidelines from documents issued by the OECD, UNESCO, Council of Europe to the ethical principles of the AI Act.

In Chapter IV, I examine the legal regulation of AI systems. I review the development and key provisions of the AI Act, the New Product Liability Directive, the 2020 European Parliament resolution on the civil liability regime for artificial intelligence and the proposed Artificial Intelligence Liability Directive.

Chapter V of the dissertation focuses on analysing the general conditions of non-contractual liability. Following a brief overview of the fundamentals of liability law, I examine the issues of harmful conduct, causation and fault in the life cycle of AI systems. I also introduce the category of damages arising from the nature of the technology and develop a matrix for non-contractual liability for AI systems that provides the framework for further analysis.

In Chapter VI, I examine the rules of liability for highly dangerous activities, including the status of the operator and the issues of exemption and limitation period.

Chapter VII focuses on product liability as a specific form of liability. I analyse the provisions of the new Product Liability Directive and compare them with specific features of AI systems. Furthermore, I review the categories of defect, liable persons and the issues of the development risk defence.

Finally, in Chapter VIII of the dissertation, I summarise my research findings.

The research is based on several complementary methods. The core of the thesis is a dogmatic analysis of the non-contractual liability provisions of the Hungarian Civil Code. The research is comparative in nature and vertically focused. Therefore, I compare the Hungarian legislation with relevant documents regarding the development of EU law – this limited focus is justified by the fact that the content of domestic law in this field is mainly determined by the adoption of EU law – such as the AI Act, the new Product Liability Directive and the draft proposals

concerning the liability regimes of AI systems. Furthermore, in certain parts, I also address the Principle of European Tort Law. The dissertation does not seek to provide a comprehensive, horizontal comparison of the solutions identified in national legal systems.

My research is based on the general conditions of non-contractual liability. I examine these conditions in the context of AI systems' life cycles: development, operation and use of the technology. This approach aims to link the public law framework of the AI Act and non-contractual liability under private law. As I assign the life cycles of AI systems to the central position of the AI Act: the development cycle for the provider and the operation cycle for the deployer. Another point of reference for the analysis is the level of autonomy of AI systems, as it directly affects the scope of human supervision and intervention; therefore, the allocation of liability.

Based on these approaches, I develop the matrix of non-contractual liability for AI systems. The matrix covers the technology according to the levels of autonomy, the risk categories of the AI Act and the harmful conduct. This matrix highlights the fact that the increasing autonomy of AI systems results in a shift in the focus of liability from fault to strict liability. The matrix serves as a basis for the chapters that examine liability regimes. I suggest proposals for future legislation, where the regulation in force may seem incomplete or insufficient for AI systems.

III. Summary of the research results and its utilisation

In accordance with the objectives set out, I have formulated five hypotheses. In the following, I evaluate these theses in light of the research findings:

1. *Granting legal status – similar to natural or legal persons – to artificial intelligence systems under the provisions of the Hungarian Civil Code in force, is not an effective way to resolve liability issues.*

I have examined the possible approaches to categorise the technology under civil law – specifically, its status as a subject of law (legal person) and as an object of law (thing, product, service). Concerning legal personality, I studied electronic identity, the extension of legal personality (Bayern), partial legal capacity (Schirmer), and robot-slave theories (Bryson, Pagallo). I concluded that legal personality similar to natural or legal persons cannot be extended to the technology. Regarding the classification as a service, an examination of the AIaaS value chain has shown that the technology cannot be categorised as intermediary services – such as hosting services – as defined in the Digital Services Act. As the service provider does not act as a passive, neutral intermediary but generates the output from the input data. Therefore, the application of exemption rules – by analogy – to intermediary service providers is not confirmed. These rules are not effective to resolve the issues of non-contractual liability. Finally, the analysis of the concept of thing – under the Hungarian Civil Code – and the possibility of analogy – similar to electricity – has shown that AI systems may be categorised as things by analogy or broad interpretation. However, categorising the technology is not necessary to settle the issues of non-contractual liability. The classification of AI systems as products is not derived from rights in rem, but from the new Product Liability Directive. The examination has confirmed that an AI system can be categorised as a product, as the new Product Liability Directive extends the concept of product to software; therefore, it also applies to AI systems. However, the taxonomy does not mean that the technology has the characteristic of tangibility – such as things – under the Hungarian Civil Code, as the concept of product – under the Product Liability Directive – is a separate category.

2. *In the case of high-risk AI systems, autonomy, opacity and the so-called 'black box effect' affect harmful conduct, causation and fault. As autonomy increases, the scope of human supervision and intervention decreases. Therefore, it shifts the focus of liability from fault to strict liability.*

I studied the general conditions of non-contractual liability in accordance with the AI systems' life cycle structure (development, operation and use) regulated in the AI Act. Regarding harmful conduct, I highlighted that traditional non-contractual liability presupposes conduct driven by human will, which AI systems do not have. I assigned typical harmful conduct to the technology's various life cycles. As a result, I have identified a category, the damage arising from the nature of the technology. Concerning this category, it is not possible to identify either a fault in conduct or a defect that would result in product liability. The damage derives from the specific characteristics of the technology, such as autonomy, self-learning and the black box effect. Regarding causation, the black box effect may – in certain cases – make it impossible to restore the chain of causation, making the evidentiary situation almost 'unsolvable'. As a result of the examination of foreseeability, I have stated that the first two layers of opacity (intentional opacity and opacity arising from the lack of knowledge) are obstacles related to proof, while algorithmic opacity negatively affects, ends factual foreseeability. I also highlighted that certain errors in AI systems are unforeseeable; therefore, even diligent approach cannot guarantee prevention. In this context, I had a recommendation for law reform: where the type of damage and the group of potential victims can be identified and the party causing the damage has breached the risk management, documentation and record keeping obligations under AI Act or has failed to disclose evidence in its sole possession, the presumption of foreseeability – and the chain of causation – would apply as a rebuttable presumption. I have analysed the levels of autonomy; and demonstrated that the increasing autonomy reduces the scope of human supervision and intervention. Therefore, the focus of liability shifts – at higher levels: Levels 4–5 – from fault to strict liability, namely liability for highly dangerous activities and product liability. This shift occurs in systems characterised by high autonomy and high risk, which is concluded in the matrix of non-contractual liability for AI systems. This matrix is the core instrument of the research, linking three analytical dimensions: the level of autonomy, the level of risk under the AI Act and the 'typical' life cycle of harmful conduct. The matrix highlights that the increasing autonomy of AI systems results in a shift in the focus of liability from fault to strict liability. The 'turning point' is linked to high-risk, 'Level 4' AI systems, where the general rule of non-contract liability cannot be applied due to the decrease in human oversight.

However, the liability regimes in the matrix do not result in automatic classifications. It also shows that issues of damages arising from the nature of the technology – at the highest level of autonomy – are rather a compensation issue.

3. *The operation of high-risk AI systems can be categorised as a highly dangerous activity. Therefore, the rules on liability for highly dangerous activities apply to any resulting damage. However, the court must determine whether an operation constitutes a highly dangerous activity.*

I have compared the criteria for liability for highly dangerous activities with the concept of 'high-risk' included in the draft annex of the 2020 European Parliament resolution on a civil liability framework for artificial intelligence and have highlighted the parallels. Concerning AI systems, autonomy and opacity are the characteristics that can magnify a minor malfunction into serious damage (Zech, Karner). Therefore, opacity is the basis of liability allocation in strict liability. It should be noted that not the AI systems – algorithms or trained models – but their operation, execution that forms the basis of liability. Therefore, the operation of high-risk AI systems, especially operating at higher levels of autonomy (Levels 4–5), can be categorised as highly dangerous activity. At these levels, the scope of human supervision and intervention is reduced, but it is necessary to remain, as the operator should control the risk. Classifying the technology should always be the responsibility of the court, which is based on the examination of the tools and the entire process of the activity in question. On the other hand, the AIA high-risk category under public law product safety cannot be automatically classified as a highly dangerous activity under civil law. Given the 'general nature' of the provision of liability for highly dangerous activity, the classification of the technology is a matter of case law.

4. *In the case of high-risk AI systems, product liability and liability for highly dangerous activities are complementary forms of strict liability; their parallel application narrows the liability gap to some extent.*

Concerning the analysis of product liability, I determined that liability for defects during the development phase can be addressed on the basis of product liability at all levels of autonomy. As the development phase is the first one of the value chain and the most relevant in terms of human decision-making. While in the context of the operation, at high levels of autonomy,

liability for highly dangerous activities should be applied. These two forms of strict liability are complementary instruments. Therefore, the injured party may bring a claim against the developer on the basis of product liability and against the operator on the basis of liability for highly dangerous activities at the same time, if the damages fulfil the condition of both regimes. These two liability regimes narrow the liability gap – to some extent – and enhance the legal protection of the injured party.

5. *There is a narrow category of cases – because of the nature of the technology – where it is not possible to identify either a fault in conduct or a defect that would result in product liability. Strict liability cannot fully resolve these damages, but joint compensation by developers and operators may provide a long-term solution.*

Whilst examining non-contractual liability, I introduced the category of damage arising from the nature of the technology. This category covers cases in which damage derives from the characteristics of the technology, and it is not possible to identify either a fault in conduct or a defect that would result in product liability. These damages cannot be fully resolved even by strict liability regimes, because the damage cannot be attributed to the conduct of any party or to a defect in the product. I believe these damages would appear at the highest level of autonomy, as a result of a significant technological leap to which neither the law nor the practice is prepared. These types of damages are expected to remain limited as both developers and operators will be able to adapt the AI system after the first occasion. I believe that joint compensation of developers and operators may provide a long-term solution. The subsidiary AI compensation fund would consist of a basic fee – based on the developers' and operators' sales and volume of usage – and an additional payment in case of damage. This would ensure compensation for those affected and legal certainty for the developers and operators without serious negative effects.

In my dissertation, I concluded that Hungarian civil law in force – with the classification of AI systems as products, and the complementary, stricter regimes of liability for highly dangerous activities and product liability – is able to address the majority of damages caused by high-risk AI systems. Damages arising from the nature of the technology constitute a limited but specific category, for which the long-term solution might be the joint compensation by developers and

operators. I also formulated proposals for future legislation during the research, such as the presumption regarding foreseeability and causation and a longer – ten-year – limitation period for damages caused by high-risk AI systems.

IV. List of publications related to the dissertation

1) Stefán, Ibolya: A mesterséges intelligencia alkalmazása a közösségi platformokon. In: Koltay, András; Szikora, Tamás; Lapsánszky, András (szerk.) *A vadnyugat vége? Tanulmányok az Európai Unió platformszabályozásáról.* Budapest: ORAC Kiadó Kft., 2024, 212–228.

2) Pusztahelyi, Réka – Stefán, Ibolya: Improving Industry 4.0 to Human-Centric Industry 5.0 in Light of the Protection of Human Rights. In: Andrzej, Kot (ed.) *Proceedings of the 2024 25th International Carpathian Control Conference* (ICCC). Piscataway (NJ), Institute of Electrical and Electronics Engineers (IEEE), 2024, 1–6.

3) Stefán, Ibolya: Some Remarks on the Changing Product Liability Rules in Light of Artificial Intelligence. *Miskolci Jogtudó: Hallgatói Online Jogtudományi Folyóirat*, 2024/1, 151–159.

4) Stefán, Ibolya: A fokozott veszéllyel járó tevékenység megítélése a technológiai fejlődés tükrében. *Miskolci Jogi Szemle: A Miskolci Egyetem Állam- és Jogtudományi Karának Folyóirata*, 2023/3, 118–126.

5) Stefán, Ibolya: The Examination of Artificial Intelligence Systems in light of the Concept of Product and Service. *Studia Iurisprudentiae Doctorandorum Miskolciensium,* 2023/1, 135–150.

6) Stefán, Ibolya: A mesterségesintelligencia-rendszerek polgári jogi megítélésének vizsgálata a termék és a szolgáltatás fogalmára tekintettel. *Infokommunikáció és jog*, 2023/1, 27–31.

7) Stefán, Ibolya: Examination of Ethical Issues Regarding Intelligent Cars. *Miskolci Jogtudó: Hallgatói Online Jogtudományi Folyóirat*, 2022/3, 45–58.

8) Stefán, Ibolya: A mesterséges intelligencia-rendszerek felelősségi kérdései az uniós dokumentumok és a magyar szabályozás tükrében. *Publicationes Universitatis Miskolcinensis Sectio Juridica et Politica*, 2022/2, 367–384.

9) Stefán, Ibolya: Possible Regulatory Solutions for Intelligent Cars in light of EU Documents. *Studia Iurisprudentiae Doctorandorum Miskolciensium*, 2022/2, 211–230.

10) Stefán, Ibolya: A mesterséges intelligencia alkalmazásával kapcsolatos erkölcsi-etikai kérdések vizsgálata, különös tekintettel a tervezési létszakra. *Infokommunikáció és jog,* 2020/2., 23–28.

11) Stefán, Ibolya: A mesterséges intelligencia fogalmának polgári jogi értelmezése. *Pro Futuro – A jövő nemzedékek joga*, 10(1), 2020, 28–41.

12) Stefán, Ibolya: Examining the Issues of Legal Personhood of Artificial Intelligence and Robots. *Publicationes Universitatis Miskolcinensis Sectio Juridica et Politica*, 2020/1, 467–486.

13) Stefán, Ibolya: A mesterséges intelligencia jogi szabályozásának egyes kérdései. *Miskolci Jogi Szemle: A Miskolci Egyetem Állam- és Jogtudományi Karának Folyóirata*, 2020/3., 184–191.

14) Stefán, Ibolya: Definition of Artificial Intelligence from the Civil Law Aspect. In: Jámborné, Dr. Róth Erika (szerk.) *Doktoranduszok fóruma*. Miskolc, Magyarország : Miskolci Egyetem, Állam- és Jogtudományi Kar, 2019, 122–126.