

The Interaction between Artificial Intelligence and Human Competencies

Dalma Lilla Dominek
Social Communication
Ludovika University of Public Service
Budapest, Hungary
Learning Institute
Mathias Corvinus Collegium
Budapest, Hungary
dominek.dalma.lilla@uni-nke.hu

Abstract

The study examines the complex interaction between artificial intelligence (AI) and human competencies through a multidisciplinary approach. It presents how AI transforms the labor market, education, and social structures, with particular emphasis on the reconfiguration of competency requirements. The paper analyzes the complementary and competitive dimensions of human-machine collaboration, as well as the skills—such as creativity, critical thinking, ethical awareness, and digital literacy—that are gaining importance in future job markets. It addresses the ethical and legal challenges of AI applications, including issues of autonomy, responsibility, and fairness, and presents a liability model applicable to weak AI. The author emphasizes that sustainable and value-driven human-AI collaboration requires the adaptive development of education, regulation, and organizational culture to ensure that AI does not replace but rather complements human capabilities for the benefit of social well-being.

CCS Concepts

• Law; • Artificial intelligence; • Sociology; • E-government;

Keywords

Artificial intelligence, Competency, Ethics, Responsibility

ACM Reference Format:

Dalma Lilla Dominek. 2025. The Interaction between Artificial Intelligence and Human Competencies. In *Central and Eastern European eDem and eGov Days 2025 (CEEeGov 2025)*, December 03–05, 2025, Bucharest, Romania. ACM, New York, NY, USA, 6 pages. <https://doi.org/10.1145/3773002.3773018>

1 Introduction

Artificial intelligence (AI) is one of the most rapidly developing and significant technological achievements of our time, fundamentally transforming various spheres of society, including the labor market, the education system, healthcare, and public administration. AI algorithms possess increasingly sophisticated capabilities that enable

them to perform complex tasks that were previously considered the exclusive domain of human intelligence. These include natural language processing [1], the recognition and interpretation of visual information, strategic decision-making, and the adaptive management of continuous learning processes [2]. Due to their advanced nature, AI technologies are not only capable of automating static tasks but can also adapt to dynamic and changing environments—a skill that is crucial for addressing the complex challenges of the modern economy and society [3].

The rapid expansion of AI, however, represents not merely a technological breakthrough but also carries profound social and economic consequences. In parallel, it has become necessary to rethink human competencies, particularly in light of the fact that automation replaces human labor in certain fields, while in others, the importance of human skills continues to grow. Routine, repetitive, and rule-based tasks that once required substantial human effort are increasingly being transferred to algorithms, which, due to their speed and precision, can perform them more efficiently [4]. At the same time, aspects of human intelligence such as creativity, empathy, complex ethical considerations, and critical thinking—most of which cannot be formalized through algorithms—are gaining value and are becoming increasingly indispensable.

From this perspective, AI does not merely appear as a substitute for human labor but also as a potential partner, creating new forms of collaboration as well as new job and competency profiles. The success of human-machine collaboration largely depends on how AI systems are integrated with human expertise, and on how the structure of these interactions can be consciously designed and optimized [5]. This also means that the jobs of the future will undergo significant transformation, making continuous learning, retraining, and the development of complex skills—complementing AI's capabilities while counterbalancing its limitations—essential [6] (OECD, 2019b).

Furthermore, the application of artificial intelligence brings ethical, legal, and societal issues increasingly to the forefront, as AI systems influence human decision-making, increase the demand for transparency and accountability, and create new challenges in the areas of data protection and fairness [7]. These issues require further research and multidisciplinary approaches to ensure that AI development and implementation are aligned with societal values and norms. In this article, attention is given to the implications of AI for public administration and e-government services. As governments



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ACM ISBN 979-8-4007-2197-7/2025/12

<https://doi.org/10.1145/3773002.3773018>

increasingly adopt AI technologies for service delivery, eligibility assessments, and decision support, questions of human competencies, accountability, and legitimacy become central. While automation can increase efficiency in bureaucratic procedures, human skills such as responsibility, ethical reasoning, and trust-building remain indispensable to ensure democratic legitimacy [8].

This study therefore aims to provide a comprehensive, scientific examination of the complex interactions between AI and human competencies. Special attention is given to the interactional domain where AI does not simply replace but complements human abilities, as well as to identifying those competencies that will play a decisive role in the labor market of the future. The study also seeks to contribute to the work of policymakers and educational institutions by promoting the maximization of the effectiveness of human–machine collaboration and ensuring sustainable social and economic development in a rapidly changing, technologically increasingly complex world.

2 The Conceptual Framework of Artificial Intelligence

The concept of AI has long since surpassed the initial theoretical models developed in scientific laboratories and has moved to the center of economic, social, and political discourse. This technological innovation is not merely the subject of research in computer science and artificial systems but fundamentally transforms the functioning of modern society, influencing the labor market, governmental decision-making, as well as ethical and legal norms. In its classic definition, AI refers to the set of computer systems capable of imitating or modeling certain aspects of human intelligence. These include perception, learning, reasoning, and decision-making processes [9]. This definition highlights that AI is not merely an automated data processor but a complex cognitive system capable of responding adaptively to environmental stimuli in a manner similar to humans.

Stuart Russell and Peter Norvig [2] further refine the concept of AI by distinguishing four different approaches, each illuminating the operation of AI from a different perspective. The first approach is the category of systems that think like humans, aiming to model and simulate human cognition, i.e., thought processes. The second category comprises systems that act like humans, striving to imitate human behavior as authentically as possible based on the principle of the Turing Test. The third group is rational-thinking systems, which aim to optimize decision-making primarily through logical inference. Finally, the fourth approach is rational-acting systems, designed to solve problems effectively to achieve predetermined goals [2]. These categories fundamentally determine the directions of AI development and help to understand the complex nature of artificial intelligence.

Furthermore, AI systems are often classified into weak and strong categories, a distinction attributed to Searle [9]. Weak AI refers to systems specialized in solving a specific, well-defined task—such as image recognition or language translation—without possessing general, human-like cognitive abilities. In contrast, strong AI denotes a hypothetical group of systems that would be capable of performing

any human cognitive task, including independent thinking, emotional understanding, and general problem-solving; however, such a level of intelligence has not yet been achieved [2] [9].

From a technological perspective, the fundamental building blocks of current AI systems are machine learning, deep learning, and natural language processing. Machine learning algorithms allow AI systems to automatically recognize patterns and improve performance without human intervention by analyzing large volumes of data. Deep learning—a specialized branch of machine learning—uses multilayer neural networks capable of identifying and processing complex, nonlinear relationships [3]. Natural language processing enables computers to interpret, analyze, and generate human language, forming the basis of applications such as machine translation, speech recognition, or chatbots. Together, these technological components enable AI systems to learn and adapt autonomously, making them increasingly efficient and applicable across a wide range of industries.

In the domain of e-government, applications of artificial intelligence are currently confined to so-called weak AI systems, which are designed to carry out narrowly defined tasks without exhibiting general cognitive abilities. Typical examples include customer service chatbots assisting citizens with frequently asked questions, predictive analytics models that detect patterns of potential fraud in taxation or welfare programs, and algorithmic systems that streamline administrative case handling by automating repetitive checks.

A particularly illustrative case is Estonia’s digital state model, often referred to as e-Estonia. Here, AI and machine learning techniques have been incorporated into core public services. For instance, the Estonian Unemployment Insurance Fund has piloted AI systems that predict the risk of long-term unemployment and recommend personalized interventions, while the Tax and Customs Board has used anomaly-detection algorithms to improve compliance and fraud prevention [10] [11]. Moreover, the national AI program Krat (also known as Bürokratt) is envisioned as a virtual assistant that will enable citizens to interact seamlessly with multiple government agencies through natural language processing interfaces [12].

While these initiatives demonstrate the efficiency gains and innovative potential of AI, they also highlight an essential condition: human oversight and discretionary judgment remain indispensable. Automated recommendations must be reviewed, validated, or overridden by civil servants when they conflict with legal principles, fairness considerations, or citizens rights. This is not only a matter of technical accuracy but of democratic legitimacy, as accountability for public decisions cannot be delegated to algorithms [13].

In the public sector, current AI applications are examples of so-called weak AI, designed for specific tasks such as automated chatbots, fraud detection, or predictive analytics in taxation and social welfare. A notable case is Estonia’s e-government infrastructure, often referred to as e-Estonia, where AI systems are employed to support tax declarations and social insurance processes. While these tools enhance efficiency, human oversight remains crucial to maintain accountability and citizen trust.

3 The System of Human Competencies in the 21st Century

The rapid technological development of the digital age and the swift spread of AI applications are fundamentally transforming labor market expectations and the system of required competencies. Alongside traditional notions of knowledge and skills, the understanding of competencies as complex and dynamic interconnections is becoming increasingly important. This perspective incorporates knowledge, skills, attitudes, and values as an integrated system that enables the effective functioning of an individual [14]. Such a holistic approach is particularly vital in today's rapidly changing social and work environments, in which the emergence of AI is redefining the role and requirements of human labor.

The three main dimensions of human competencies—cognitive, socio-emotional, and digital/technological—are of fundamental importance in the age of AI [15]. Cognitive competencies include problem-solving abilities, creativity, critical thinking, and analytical skills, which are essential for understanding and addressing complex and rapidly changing problems [15] [16]. These abilities support adaptation to new situations and foster innovation, which is indispensable for competitiveness in the digital economy. The second dimension, socio-emotional competencies, includes cooperation skills, empathy, effective communication, and emotional intelligence. These competencies promote collaborative work and the successful management of complex social interactions [14] [17]. In AI-enhanced work environments, they are irreplaceable, as algorithms cannot replicate the depth and diversity of human emotional and social interactions [5]. Finally, digital and technological competencies are playing an increasingly defining role. These include information management, data analysis, algorithmic thinking, and the ability to interpret AI systems [3]. Such skills enable the workforce to effectively apply and supervise new technologies while critically assessing their impacts and ethical implications [15].

The meta-competencies identified by the World Economic Forum [16] include learning ability, complex problem-solving, and interdisciplinary thinking, which can be applied horizontally across numerous professional fields and are essential for remaining competitive in the future labor market. The prominence of these competencies is a dynamic consequence of digital transformation, which demands not only technical knowledge but also adaptive, creative, and integrative ways of thinking [16]. The OECD Future of Education and Skills 2030 program emphasizes that in the social and work environments of the future, a successful citizen will possess not only technical or digital abilities but also moral and social competencies [15]. This comprehensive competency system supports individuals in participating responsibly and ethically in a complex, global, and technologically advanced society, thus contributing to sustainable development and social cohesion [5] [15].

For civil servants, the introduction of AI requires the addition of new competencies to traditional legal and administrative skills, including digital literacy, data protection expertise and citizen-centric communication. These competencies can be described along three interrelated dimensions. Cognitive competencies include the ability to critically interpret algorithmic outputs, identify potential errors

and balance automated recommendations with legal and ethical considerations. Socio-emotional competencies include empathy, communication and trust-building, which are essential when citizens interact with AI-mediated services that may otherwise appear impersonal or opaque. Digital and technological competencies include algorithmic awareness, data literacy and the ability to evaluate and monitor the performance of AI systems in administrative processes. Together, these dimensions highlight a set of transversal skills – adaptability, accountability and interdisciplinary collaboration – that span all areas of public administration. These competencies are not only technical requirements, but also social and ethical capabilities that maintain citizens' trust in e-government and ensure that the introduction of artificial intelligence strengthens, rather than undermines, democratic legitimacy [18].

4 The Interaction between Artificial Intelligence and Human Competencies

The interpretation of the relationship between AI and human competencies goes far beyond the simplified dichotomy that describes it as competition between humans and machines. Recent scholarly discourse increasingly directs attention to the possibilities of complementarity and collaboration, where AI and human capabilities contribute to higher-level problem-solving and decision-making in a synergistic way [4] [5]. This interaction can be described along three main dimensions: complementarity, competition and displacement, and the reconfiguration of competencies. Complementarity is most visible in work environments where AI offers technical advantages—such as the rapid and accurate processing of large volumes of data—while human intuition, experience, contextual sensitivity, and ethical considerations remain essential. A classic example of this is in medical diagnostics: while AI can quickly identify pathological patterns in medical images, it is the physician's role to make clinical decisions, which require empathy, complex risk assessment, and consideration of the patient's individual needs [5] [19]. A similar form of synergy can be observed in education, where AI-based adaptive learning systems offer personalized content to learners, while the teacher's role is to maintain motivation, provide social and emotional support, and foster critical thinking [20] [21]. This type of human-machine collaboration not only enhances efficiency but also creates new value in the world of work and learning.

At the same time, however, some AI applications generate significant competition in the labor market. The rise of machine learning and automation threatens occupations built on routine, rule-based, and easily algorithmizable tasks. These include, for example, basic customer service activities, standard administrative tasks, or assembly-line work, where machine systems operate more reliably, quickly, and cost-effectively than human labor [22] [23]. As a result of these developments, some workers may be displaced from traditional employment structures. It is important to emphasize, however, that the emergence of AI also creates new types of jobs, particularly in areas where technological oversight, development, and ethical and societal governance are necessary. Such positions typically require higher levels of cognitive, social, and digital skills and contribute to the qualitative transformation of the labor force structure [6] [24]. A similar complementary division of roles can

be observed in e-government. For example, in tax authorities, algorithms are capable of quickly checking large amounts of data and flagging suspicious cases, but the final decision must be made by a civil servant, taking into account the legal environment and the citizen's situation. In this way, AI and human officials create value together: the machine provides efficiency, while humans ensure legitimacy and fairness [8].

Collaboration with AI also leads to a transformation of competences. So-called transversal or horizontal skills—which can be applied across various fields and work environments—are becoming particularly valued. These include critical thinking, ethical decision-making, human-centered design, and digital ethical awareness, all of which are essential for the responsible use of AI systems [25]. In addition, the content of digital and technological competencies is also transforming: the focus is no longer solely on tool usage but also on understanding how AI works, analyzing its social and economic impacts, and assessing its ethical implications [26]. In the age of AI, therefore, it is not only new technological knowledge that is needed, but also complex human competencies that ensure the active, critical, and ethical participation of individuals and communities in the digital society.

5 Ethical and social challenges in AI and human collaboration

The rapid development of AI is not only leading to technological and economic transformations, but also making it increasingly urgent to examine deeper ethical and social issues. As AI systems play an increasingly important role in various areas of life, including transportation, law enforcement, healthcare, and the labor market, greater attention must be paid to analyzing their social impacts and normative implications [27] [28]. Cooperation between AI and humans can only be sustainable and fair if technological developments take into account human rights, autonomy, responsibility, and the impact on social inequalities.

In e-government contexts, liability must be clearly assigned to avoid undermining democratic accountability. When an AI system produces an erroneous administrative decision—such as the wrongful denial of social benefits or an incorrect tax assessment—it must be evident whether responsibility lies with the software provider, the administrative authority, or the individual civil servant. This clarity is not only a matter of legal doctrine but also of preserving citizens' trust in public institutions. Without a well-defined liability regime, the opacity of algorithmic systems may result in a responsibility gap, in which no actor can be held fully accountable for harmful outcomes [29] [30].

Recent EU debates, particularly those surrounding the proposed Artificial Intelligence Act (AI Act), emphasize that accountability in public administration must remain firmly human-centered. Unlike speculative discussions on granting legal personhood to AI systems, the prevailing legal consensus is that administrative responsibility cannot be delegated to autonomous systems. Instead, liability should be structured along existing principles: the public authority retains primary accountability for administrative acts, while private software providers may bear contractual or product liability obligations in cases of defective AI systems [31] [32].

This approach reflects the broader risk-based regulatory philosophy of the AI Act, which classifies AI systems used in public administration as “high-risk” and subjects them to enhanced obligations for documentation, transparency, and human oversight. Such requirements aim to ensure that civil servants are not merely passive operators of automated tools but remain active decision-makers capable of overriding AI-generated outputs when necessary. In doing so, liability frameworks reinforce the principle that democratic accountability cannot be outsourced to algorithms, but must remain grounded in human institutions and actors [7].

One of the most critical ethical issues revolves around the concept of autonomy. Human autonomy—the ability to make individual decisions and act freely—is a fundamental value in democratic societies. However, when AI-based systems are involved in decision-making processes, the line between human and machine responsibility often becomes blurred. This is particularly problematic because some algorithms make decisions in areas that have a significant impact on people's lives, such as hiring, credit assessment, or criminal proceedings [34] [33]. In such cases, technological efficiency alone is not enough; transparency, explainability, and human oversight must also be ensured [7]. These requirements pose not only technical challenges, but also legal and philosophical ones.

Closely related to this is the issue of liability. Currently, legal regulations are unable to fully cover the risks arising from the autonomous operation of AI systems. Since algorithms and software do not have legal personality, operators, developers, or customers are usually held liable for any damage they cause—but this framework does not always ensure accountability, especially in the case of complex, learning systems [35]. One of the most important tasks for the future is to develop a responsibility structure that can take into account the technical complexity, adaptability, and partial autonomy of AI systems. Issues that straddle the boundary between law and ethics, such as algorithmic accountability or the moral agency of intelligent systems, require new normative and regulatory approaches [36].

Finally, one of the most pressing social challenges of AI application is the reproduction of structural inequalities. Algorithms typically learn from historical data, which often already carries social biases—whether based on gender, race, ethnicity, or economic status [37] [38]. This can result in AI systems—intentionally or unintentionally—reinforcing and preserving existing inequalities rather than remedying them. Eliminating unfair bias and ensuring algorithmic fairness and equity has become a key goal of responsible AI development [39]. Selecting appropriate data sets, ensuring model auditability, and assessing the social impact of decisions in advance are fundamental steps that are essential for the implementation of ethical AI applications.

Overall, it can be said that the future of cooperation between AI and human competencies requires thorough consideration and regulation not only in technical terms, but also in ethical and social dimensions. The embeddedness of AI systems in the social fabric necessitates the development of new norms, institutions, and collective values.

6 Theoretical outline of the artificial intelligence liability system

The increasingly widespread use of AI raises new legal challenges that go beyond the scope of traditional liability systems. While current European and domestic legislation only recognizes the legal personality of natural or legal persons, the operation of AI systems—especially autonomous, learning algorithms—creates a gray area where the precise definition of responsibility is often problematic [35] [40]. However, in the case of weak AI—i.e., systems designed for specific, well-defined tasks and lacking general consciousness—the traditional legal liability structure can still be applied. For these systems, a four-factor model provides a theoretical basis for the legal treatment of damage.

Firstly, the operation of AI can be classified as an activity involving increased risk, which, according to the Civil Code, entails objective liability, i.e. liability regardless of fault (Civil Code, Section 6:535 [41]). Due to the unpredictability and potential for error of AI systems and the opacity of their decision-making mechanisms, these activities carry increased risk, meaning that in the event of damage occurring during them, the party causing the damage can only be exempt from liability in exceptional cases, such as force majeure. Secondly, liability for damages usually lies with the person operating the AI system, who is responsible for its operation. This construct is analogous to the liability of motor vehicle operators, which declares the liability of the person operating the vehicle rather than the vehicle itself. The operator may be, for example, the service provider, the operator, or even the end user, depending on who exercises actual control over the operation of the AI. Thirdly, if AI is used as a means of committing a crime, the responsibility still lies with the human perpetrator. AI, even if it performs certain operations independently, cannot be considered a legal entity capable of acting in its current state, so criminal liability lies solely with the human user or developer [42]. Fourthly, when AI systems are used within a contractual framework, damages resulting from faulty performance can be dealt with using traditional contractual law instruments. The service provider—for example, a company offering AI-based decision support software—can be held liable under the general rules of warranty or breach of contract (Civil Code, Sections 6:157–6:174 [41]).

In e-government contexts, liability must be clearly assigned to avoid undermining democratic accountability. When an AI system produces an erroneous administrative decision, it should be clear whether responsibility lies with the software provider, the administrative authority, or the individual civil servant. Recent EU debates, particularly around the Artificial Intelligence Act, underline that accountability in public administration must remain firmly human-centered and cannot be transferred to autonomous systems [31].

It is important to emphasize that this set of rules applies only to weak AI. If systems appear in the future that already have partial self-awareness, autonomous moral judgment, and learning abilities, traditional models of responsibility may become inadequate. In this regard, the idea has already been put forward that certain advanced AIs should be given a kind of electronic personality that would enable them to assume partial legal responsibility. According to a

2020 resolution of the European Parliament, this new legal institution could provide an opportunity to ensure the accountability of intelligent systems, especially in the case of robotic and AI systems that operate with autonomous decision-making [12].

Nevertheless, the concept of electronic personality is the subject of significant philosophical and legal debate, as it fundamentally questions the traditional concept of legal personality. The regulation of future artificial systems is therefore not only a legal technicality, but also a profound ethical and social issue.

7 Summary

The rapid development of AI is not only a technological breakthrough, but also fundamentally reshapes the structure of the labor market, the objectives of education, the focus of competence development, and socio-economic relations. The study pointed out that although AI is increasingly capable of performing routine, algorithmic tasks with greater accuracy, human qualities such as creativity, empathy, ethical sense, critical thinking, and emotional intelligence remain indispensable in dealing with complex problems, social coexistence, and moral decision-making.

The relationship between AI and humans can be interpreted not only as competition, but increasingly as complementary cooperation. However, this cooperation does not happen automatically: it requires the adaptive and forward-looking development of education systems, legal regulations, and organizational cultures. Human competencies will therefore not lose their validity, but will be expanded with new meaning. Successful citizens of the future will need not only technological skills, but also ethical thinking, an interdisciplinary perspective, and the ability to cooperate.

Overall, the future will not belong exclusively to machines or humans, but to those who are able to cooperate with AI systems in a responsible, ethical, and value-based manner. The challenge, therefore, is not the technology itself, but how we develop the institutional, competency, and value systems through which AI truly serves human development—not replacing it, but complementing it.

Acknowledgments

Project No. TKP2021-NKTA-51 was realized with the support of the Ministry of Culture and Innovation from the National Research Development and Innovation Fund, financed by the TKP2021-NKTA tender program.

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