
Artificial Intelligence and Design: Innovation, Practical Applications, and Future Creative Horizons

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ABSTRACT

Artificial Intelligence (AI) is reshaping the design landscape, from product development to graphics, service and critical-speculative design. This paper explores how AI enhances efficiency and expands creative possibilities, offering insights into its applications, challenges, and opportunities. While AI excels in automating complex tasks, the designer's role is evolving towards "sense making" – the ability to infuse meaning and context into AI-generated outputs. In product design, AI-driven technologies such as generative design and machine learning enable optimised and personalised solutions, positioning designers as mediators between algorithmic precision and human needs. In graphic design, AI democratizes access to advanced tools, raising ethical concerns about skill displacement. In service design, AI improves user experiences through personalisation, though issues of transparency and fairness must be addressed. In speculative design, AI has become a fundamental support for processes of futures imagining and envisioning. Additionally, the paper highlights the transformative role of AI in education, requiring students, researchers, and professionals to adapt to the evolving technological landscape. Finally, the paper discusses the ethical challenges of AI, such as bias and automation's societal impact, presenting AI not as a replacement for designers, but as a tool that enhances creativity, fostering a collaborative future where human ingenuity and technology harmoniously coexist.

Keywords: AI, Design, Generative AI, Innovation, Smart manufacturing

INTRODUCTION

Artificial Intelligence (AI) in the world of design has caused a radical shift, enhancing the creation of meaning and context through technology. This transformation process has been accelerated by AI's ability to automate repetitive and technical tasks, allowing designers to focus more on conceptual and creative aspects, on sense-making design, and on the interdisciplinary nature of the themes addressed by designers. In an increasingly automated context, AI presents itself as a powerful tool to expand the boundaries of human creativity. On the one hand, it improves efficiency and reduces production times, while on the other, it offers new opportunities for experimentation and innovation, through tools that generate multiple project

interactions and predict outcomes based on previous data (Wang et al., 2023). In particular, in product design, AI is widely used to accelerate development, improve performance, and reduce production costs (Nozaki et al., 2017). However, despite the efficiency of automated systems, it is the designer who gives meaning to the generated solutions, ensuring that they meet human needs, desires, and requirements. Graphic design has also greatly benefited from the introduction of AI, which has made advanced creative tools accessible to a wider audience. However, this progress has raised concerns about the possible devaluation of the professional designer's role and the creation of an increasingly polarized labor market (Mustafa, 2023). While AI can automate processes such as color selection, image manipulation, and layout generation, the designer continues to play a crucial role in the visual and narrative coherence of projects. Despite changes in the technical tool, it is the designer who determines the final form of the visual artifact through the given command or code (Verhoeven et al., 2019). This situation echoes the concerns that arose with the introduction of digital technologies, which have transformed graphic design work over the past 20–30 years. On the one hand, software has sped up processes, while on the other, it has revolutionized workflows, changing paradigms without, however, replacing the designer's central role as the “architect” of the visual product.

In service design, AI can become a tool to improve the user experience through personalization and behavioral data analysis, helping the designer interpret data, create better analyses, generate hypotheses of “Personas,” and more quickly develop user maps and blueprints. However, the adoption of such technologies raises ethical questions, particularly regarding privacy management and data transparency. In this context, the designer's role is crucial in ensuring that AI is used equitably and responsibly, keeping inclusivity and respect for cultural diversity at the center (Zhu et al., 2023). The designer, therefore, becomes a guardian of transparency, ensuring that AI-assisted solutions do not compromise user trust and are ethically responsible. One of the areas where AI has had the greatest impact is storytelling. Through automatic image and text generation tools, this technology enables designers to create more complex and immersive narrative scenarios. This is particularly relevant in the context of user interfaces and interactive prototype creation, where AI facilitates the construction of visual narratives that enhance the overall product or service experience (Meron, 2022). In this way, it is possible to visualize, simulate, and optimize the interaction between user and product more realistically, contributing to the development of projects that better meet public expectations.

In recent years, the use of facilitation tools, speculative design, and collective imagination has increased to build and nurture communities aiming for a deeper understanding of contemporary complex challenges and the related creation of desirable future visions. Recently, innovative practices have been using AI to enrich analysis, anticipation, and creative possibilities in these processes. AI integration offers new opportunities in creating future visions and understanding complex challenges, enhancing creativity,

data analysis, and idea communication. AI applications in speculative design can be articulated into three macro-areas: complex data analysis (identifying hidden patterns and trends in datasets to decode weak signals and predict possible futures); narrative generation (building imaginary worlds and expanding visions, contributing to the creation of future scenarios); and syntographic creation (AI can quickly generate complex images by transforming abstract concepts into tangible representations aimed at visualizing, understanding, and communicating concepts and ideas of possible future scenarios). These three macro-areas, intertwined, become powerful tools for critical and speculative design, essential for imagining, exploring, and communicating less dystopian and increasingly desirable futures (Monterosso & Schifano, 2024). The designer of the future, therefore, will not be just a technical expert, but a mediator between technology and humanity, capable of balancing the potential offered by AI with the need to maintain creative and cultural control over projects. Their function will no longer be exclusively linked to solving functional problems but will become increasingly oriented toward meaning-making, storytelling, and ethical reflection.

At this point, it is worth briefly looking to the past to better understand the present. Bruno Munari's enlightening reflection, more relevant than ever, comes into play here. With his usual provocative spirit, Munari overturns the idea that the use of technologies like computers might diminish human intervention. Criticizing those who reduce digital art to mere "computer art," he asserts that such logic, if applied to other art forms, would lead us to define painting as "brush art" and drawing as "pencil art." In this way, Munari reminds us that, beyond the tool used, it is always human creativity orchestrating the work, reaffirming the irreplaceable role of the designer as the director of the creative process (Munari, 1966). An observation that remains valid even in the age of AI.

In conclusion, the purpose of this work is to analyze how AI is redefining the role of the designer in various fields, including product design, graphic design, service design, and speculative design, showing how automation can be an opportunity to enhance creativity rather than a threat. In light of current research, reread through the lens of critical reflection from multiple perspectives, this article aims to highlight how AI does not replace the designer but supports them, freeing them from repetitive tasks and allowing them to focus on the more conceptual and strategic aspects of the creative process.

The ethical implications of AI usage will also be explored, with particular attention to transparency, privacy, and social responsibility. If our insights are correct, the future of design will be increasingly marked by collaboration between AI and designers, where technology can accelerate production, but it will be the designer who retains control over the narrative, aesthetics, and deep meaning of projects.

ETHICAL ISSUES AND THE DEMOCRATIZATION OF DESIGN THROUGH AI

The growing adoption of AI in design raises not only technical questions but also opens up a significant ethical debate. This technology is not merely a tool, but a force that can profoundly influence decision-making, creative, and social processes. Therefore, designers must be aware of the ethical and cultural implications associated with the use of such technologies, going beyond the mere technical dimension (Floridi, 2022). One of the most complex aspects concerns the authorship of works generated by AI. When automation becomes a central component of the creative process, it is legitimate to ask who the actual author of the work is. If an algorithm generates an image or project based on human input, who holds the authorship rights? This dilemma raises questions about the concepts of originality and creativity, which must be rethought in the era of intelligent machines. Despite the automatic intervention, the human contribution cannot be entirely eliminated, but the roles in the creative process must be reconsidered. At the same time, AI is democratizing design, making advanced tools accessible even to people without technical skills. Tools such as DALL·E and MidJourney allow high-quality visual projects to be created without requiring extensive professional training. However, this democratization raises other questions about the value of the professional designer's work and the potential standardization of design solutions. Creativity risks becoming homogeneous, with projects reflecting similar algorithmic choices (Prencipe and Sideri, 2023). Moreover, automation can perpetuate existing biases. Algorithms can reflect the prejudices present in training data, with the risk of producing solutions that are not inclusive or are discriminatory. In this context, the designer assumes the role of ethical guardian, responsible for ensuring that the generated solutions respect cultural diversity and are free from bias (Bucciantini, 2023). The automation of creative processes, in fact, poses the risk of standardizing results, making the critical use of AI essential to avoid reducing creative diversity. The integration of new technologies in design must therefore be considered not only from a technical perspective but also within a broader ethical framework. The designer's responsibility is not limited to designing artifacts but extends to adopting an ethic of technological civilization. This means that design today cannot focus solely on economic goals but must promote a program that unites innovation and sustainability, integrating respect for local traditions and the use of environmentally respectful processes. This approach contrasts with mere economic growth and promotes a production model that minimizes the ecological footprint and aims for social innovation. A crucial aspect is the need to reflect on how design can support technological development without compromising the environment and people's lives. The risk, in fact, is that without ethical regulation, businesses and designers themselves may become "pathogenic agents," causing irreversible harm to the environment and quality of life (Argentino, 2009). Authorship of works, democratization of access to technological tools, standardization of design solutions, and the risk of algorithmic bias are just some of the relevant issues related to the

use of AI. The role of the designer goes beyond mere technical execution: they must be able to interpret, select, and guide the creative process toward a meaningful result. Their importance lies in the ability to contextualize and give meaning to creations generated through artificial intelligence (Hu et al., 2023). This requires a delicate balance between automation and human intervention, so that AI is used ethically and responsibly (Floridi, 2022). In the future, designers will not be able to ignore these challenges, as they are not only technical operators but social actors called to reflect on the implications of the technologies they adopt. This position is certainly not new, with roots in the design culture expressed by the great masters of Italian design, foremost among them Enzo Mari. In Mari's precious legacy, art, history, politics, ethics, philosophy, anthropology, and sociology blend into a cultural vision that, through design in its dimension as "reflective practice" and "knowledge in action" (Shön, 1993), profoundly impacts the surrounding reality. Mari's vision portrays the designer as an intellectual, a "cultural operator" (Quinz, 2020), who does not separate the professional from the person: "A multifaceted figure of thinker/philosopher, theorist/disseminator, promoter/teacher, brilliant communicator, but above all, a man of knowledge and conscience" (Favento, 2006).

SUSTAINABILITY AND ARTIFICIAL INTELLIGENCE

Sustainability is a central concept in the contemporary design debate, and the integration of AI is transforming the way designers approach environmental, social, and economic sustainability. In this context, sustainability is not limited to reducing environmental impact but also includes attention to social well-being and the efficient management of economic resources. AI offers advanced tools that allow for optimizing material use, reducing waste, and promoting a circular economy, with a direct impact on long-term sustainability. Generative design software, for example, analyzes millions of variations of a product, identifying the one that optimizes resource consumption and minimizes carbon emissions. In industrial design, AI is used to predict material behavior under real-use conditions, preventing design errors that could generate waste or scraps. A relevant example is topology optimization technology, which, thanks to AI algorithms, allows for lightening the structure of products, reducing raw material consumption and the energy impact of production processes (Karan et al., 2021). However, the adoption of AI in design, despite being presented as a sustainable strategy, is not without criticism. The use of powerful servers to process large amounts of data involves high energy consumption and a significant environmental impact, raising questions about the actual sustainability of AI. It is thus essential to strike a balance between employing advanced technologies and optimizing energy resources. Beyond environmental sustainability, another crucial issue concerns social well-being. In this area as well, the power of digital algorithms offers opportunities to identify accessible and inclusive solutions capable of meeting the needs of a wider audience. Thanks to advanced data analysis, designers can create products and services that better adapt to diverse cultural, economic, and social realities, thereby

promoting more equitable and conscious design. However, to achieve these goals, designers must work closely with local communities and use AI responsibly, avoiding the perpetuation of biases or social inequalities by algorithms (Zhang et al., 2023). Furthermore, these technologies are also revolutionizing economic sustainability in design, allowing for the development of more efficient business models oriented toward the circular economy. By automating repetitive processes and forecasting future scenarios, designers can reduce development and production costs, improve operational efficiency, and optimize resource use (Wang et al., 2021). In a circular economy context, for example, AI enables the design of products that are easily disassembled and recyclable, extending the lifecycle of materials and reducing costs associated with disposal and the production of new products. This approach, in addition to generating economic benefits, helps to reduce the environmental impact of design, promoting more conscious and sustainable use of resources.

Ultimately, sustainability in design goes beyond the environmental dimension and requires an integrated approach that also considers social and economic implications. AI can be a key tool in promoting sustainability in all its forms, but to do so, it is essential that designers maintain a critical and responsible vision. Their choices must take into account not only efficiency and costs but also the long-term impact on people and the environment.

THE DESIGNER OF THE FUTURE AND RESEARCH IN DESIGN

In the previous paragraphs, we have seen how the rapid acceleration induced by the integration of AI into creative and design processes is redefining the role of the designer in society, and how – consequently – the nature of the training required to address future challenges is changing. The designer of the future will no longer be just a technician or a creative, but will need to develop a hybrid profile, able to navigate between technological innovation, philosophy/ethics, and human-social sciences. This transformation demands not only new skills but also a rethinking of academic research and training (not just in the field of design!). As Edgar Morin reminds us, this will allow us to better respond to the great “challenge of complexity” of our time, which requires a paradigmatic shift towards a new way of thinking capable of reading, rearticulating, and organizing knowledge into a “complexus (that which is woven together)” (Morin, 2017) in order to connect – in a renewed and lasting balance – individuals, communities, society, the biosphere, and the cosmos. The training of designers, already based on a transdisciplinary approach, will indeed be increasingly so in the future. However, it is important to note that the ability to understand and use AI tools will need to be balanced with a deep understanding of social and cultural dynamics, so that designers can employ the most sophisticated and suitable technologies to meet the increasingly complex and changing needs of communities and social groups with different ethno-anthropological characteristics (Gasparini, 2021). Some design institutes are moving in this direction, developing educational programs aimed at combining technical skills with critical reflection, equipping designers to question the ethical and

social implications of their design choices (Zhang et al., 2023). Within the curricula, disciplines such as computational thinking, coding, data analysis, and design philosophy are increasingly present. Designers of the future will need to be able to read and interpret complex data, but also to understand how this data influences people and communities. The role of storytelling will be equally crucial, as design will no longer just be a way to create products and services, but to build meaningful experiences that engage users on a deeper level. Furthermore, the ability to analyze large amounts of data and generate predictive models allows designers to explore complex phenomena and develop new design approaches based on scientific evidence. The use of machine learning and big data tools enables the prediction of user reactions to specific products or services, providing insights that improve decision-making processes.

In this perspective, design research and practice will increasingly move towards a critical and speculative dimension, focusing on how emerging technologies will influence human behavior and social changes. Through AI, designers will be able to simulate future scenarios and imagine the impact of new technologies on sectors such as mobility, health, and the environment. In this sense, both researchers and designers will need to rely on a solid ethical foundation, ensuring that the products and services created are fair, inclusive, and respectful of cultural diversity (Wang et al., 2021). The designer of the future will thus become an interdisciplinary figure, capable of understanding and analyzing the world through data, intervening to improve the human experience with a vision attentive to ethical and cultural values (Aphirakmethawong et al., 2022). This vision of the future designer emphasizes the need for deep interaction with society. Data must not only be interpreted but also integrated into creative processes that take into account social and ethical implications. This approach will be the foundation of sustainable design, where AI becomes a tool to optimize the social impact of projects. The designer of the future, therefore, will be a data interpreter, a storyteller, and a technological expert capable of using AI to solve complex problems, but most importantly, to generate new meanings and create connections between people, communities, and products.

CONCLUSION

This paper has examined the transformative role that AI is assuming in the field of design, demonstrating how this technology tends to redefine creative processes in product design, graphic design, and service design. AI is not merely a tool for improving efficiency but represents a true accelerator of innovation and creativity, capable of expanding the boundaries of design experience by introducing new opportunities to create richer and more complex meanings, narratives, and contexts. The reflections have also highlighted that while AI automates numerous repetitive tasks, it cannot replace the role of the designer. The designer remains essential as a mediator between the precision of algorithmic solutions and human and cultural needs. The designer's ability to confer meaning and narrative coherence to projects,

leveraging AI's potential to personalize and make solutions more accessible and sustainable, remains central to the creative process.

However, this technological evolution also raises significant ethical concerns. Issues such as the authorship of AI-generated works, the risk of creative standardization, and the perpetuation of algorithmic biases are key challenges that require deep reflection. The designer will no longer be just a specialized technician but must assume the role of an ethical guardian, capable of overseeing automated processes and ensuring that they reflect principles of inclusivity, equity, and respect for cultural diversity.

In this context, our work emphasizes the need to rethink the training of future designers. It will be crucial to develop transdisciplinary skills that combine technology, sociology, ethics, and creativity. Designers will need to navigate a world dominated by data, where design decisions will increasingly be based on predictive analyses, without losing sight of the human and emotional value of the project.

Finally, this paper has explored how AI can foster sustainability, which includes not only environmental but also social and economic aspects. While these technologies provide advanced tools to optimize resource use, reduce waste, and promote a circular economy, ensuring these objectives are truly achieved will require a critical and responsible vision from designers, who must orient their work towards the well-being of people.

Thus, this paper proposes a vision of the future in which tomorrow's designer assumes the role of a multidisciplinary expert, capable of integrating technical, ethical, and cultural competencies to address the challenges of contemporary design. They will be able to translate data into profound meanings, while keeping ethical, cultural, and social values at the center of the creative process. Only by fully integrating technology with humanity can AI truly serve as a driver of positive innovation, not only technological but also—and above all—social.

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