HOW WILL THE EMERGENCE OF AI IN THE WORLD OF INDUSTRIAL DESIGN CHANGE THE TRAINING NEEDS OF OUR STUDENTS?

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ABSTRACT

In 2023, artificial intelligence (AI) emerged in various professional fields, including Industrial Design, sparking ongoing discussions about its impact. Many designers are experimenting with AI tools to assess their value in the design process. Academic research also surged, mapping AI tools applicable in different design stages and proposing new emerging roles for industrial designers. Beyond tools, the day-to-day challenges for Industrial Designers due to AI remain unclear. This contribution focuses on the perspective of professional designers, who are the prospective employers of our students. Through online questionnaires and the snowball technique, our team conducted exploratory research in which 48 professional Industrial Designers from eight different countries (Germany, Denmark, India, Italy, the Netherlands, Russia, Spain, and the US) participated. Their professional insights reveal the stages of the design process in which they are applying AI tools, the specific AI tools that they use, challenges that they face, and both benefits and risks that AI generates in their work. Professional input also highlights necessary changes in industrial designers' education to update the role of Industrial Designers to the AI impact. These findings serve as a foundation for updating Industrial Designer curricula, addressing training needs identified by professional designers who face all these challenges of AI today.

Keywords: Artificial Intelligence, industrial design, professional designers, skills, curriculum of universities

1 INTRODUCTION

It's evident that the year 2023 has seen the emergence of artificial intelligence in numerous professional settings, including the field of industrial design. Industrial design is the process of creating and developing new products, including their form, function, and aesthetics. The field of industrial design is constantly evolving, and new technologies are continually being developed to aid in the design process. AI tools, with their ability to analyse data and generate new ideas, have the potential to revolutionize the way products are designed. [1].

Across all professional forums and associations of Product Designers, discussions are ongoing about this technology and how it will impact the professional practice of Products Design. Many professional designers and their teams are experimenting with the new tools that incorporate this technology, exploring their possibilities and analysing how their application can add value at different stages of their design process, considering the strengths and weaknesses of their teams. In short, artificial intelligence is transforming product design in many ways. From using machine learning algorithms to analyse large data sets and extract useful information to using AI-based design tools and improving the efficiency of the design process itself, AI is helping designers create more innovative and efficient solutions.

In the academic sphere, there has been a proliferation of publications in recent years exploring the impact of AI in the design process. Some academics have identified and mapped AI-based tools that can be applied in different stages of the design process. Cautela et al. (2019) analysed twenty start-ups, investigating in which phases of the project and how often AI was implemented in the design process. Their results show the predominance of AI applications in the research, team building, and task management steps [2]. Isgró et al. (2021) conducted secondary research through literature review and web search, collecting and mapping existing AI-enabled design tools in the design process. Their

research work showed that only a few AI applications have taken hold in design so far, and many others only existed as research or concepts [3].

While AI serves as a valuable tool, academics highlight that it does not replace the designer [1,5]. Moreover, academics also delve into the practical implications of AI adoption exploring what is actually happening in the day-to-day professional practice of designers. To what extent is AI likely to change the way design is practiced? That is, which decisions are made, and which can be automated, and which ones cannot? What changes in competences are required? And which roles should lead this transition? [4].

AI tools, on one hand, require a certain level of expertise and knowledge to use effectively. However, this can pose a barrier for some designers who lack the necessary skills or resources. On the other hand, the market and clients are increasingly aware of the transformative impact of AI. As other professionals incorporate AI tools into design processes, their demands and requirements will evolve. This leads us again to consider the implications for training future industrial designers.

Preparing future designers for AI technologies involves equipping them with the necessary tools and knowledge to use these tools safely while maintaining responsible control over the design process. Recognizing that AI systems and human-AI collaboration are fallible, it becomes the designer's responsibility to assess the machine's output. They must decide whether to incorporate it into their work or discard it if it does not meet expectations. As operational tasks increasingly shift to AI, designers may transition into roles more focused on evaluation and supervision [5].

Figoli et al. (2022) proposed that in the era of AI the role of industrial designers can shift to be a design arbiter, a role that combines the designer's skills and sensitivity with critical analysis expertise. The design arbiter evaluates outputs generated by AI systems and ensures their appropriate integration into the design process. The ability to effectively collaborate with AI systems, specifically designing for AI, becomes a crucial competence for the designer arbiter [6].

In the form of a position paper, this contribution main objective is to guide further discussions among academics based on the perspective of professional designers, who are the prospective employers of our students. These professionals at present can provide a more realistic view of what is happening in their professional practice and what profiles of young Product Designers can bring value to their teams and companies in the coming years.

2   METHOD AND CHARACTERISATION OF THE SAMPLE

This exploratory study was developed using an online questionnaire, distributed following the snowball technique through LinkedIn thematic groups of industrial design and also using alumni of the industrial design engineering degree from Tecnun, the School of Engineering of the University of Navarra (Spain), as starting contacts. The questionnaire had four different sections. The first section of the questionnaire collected general information about the designer's profile to determine if they fit into our research. The second section included questions to determine their interest and knowledge about AI. The third section explored their experience in using AI in their work, and the fourth section focused on gathering their opinion on the impact of artificial intelligence on the work of industrial designers and the training of future professionals.

The sample of designers participating in this study is balanced between young designers (46% have less than 5 years of experience) and experienced designers (17% have between 6 and 10 years of experience, and 38% have more than 10 years of experience). Considering the typology of companies in which they carry out their professional activity, the sample is also fairly balanced: 18 of the designers work in design studios, 10 in design consultancies, 13 in companies with their own products, and the remainder in other types of companies. In this sample, designers working in SMEs predominate, accounting for 75% compared to the remaining 25% who work in large companies. Asked about the geographical origin of their clients, 44% had clients of national origin and 56% of international origin.

Asked about the field of industrial design in which they carry out their professional activity, 81% of the participants engage in physical product design across various sectors such as consumer electronics, household appliances, industrial products, automotive and other means of transportation, biomedical products, lighting, furniture, etc. The remaining 19% are involved in other activities such as packaging design, UX/UI design, service design, and graphic design.

In the following sections, we present the results and conclusions of this research work obtained from the responses of the participants to our questionnaire. It is important to highlight the great interest shown by the participants in knowing the results of our research. In the final part of our anonymous

questionnaire, participants were invited to send us their contact details if they wished to receive a summary of the results obtained, and 35 out of the 48 participants provided us with their details.

3   RESULTS

In the first part of the questionnaire, we posed questions to understand the relevance that these professionals consider training in the application of AI to their professional field to have, and whether they have received training, and if so, by what means they have done so. The first question posed to professionals asked whether they considered it important to receive ongoing training on the use and applications of AI in the field of industrial design; an overwhelming majority of 94% responded affirmatively. However, when these professional designers are asked if they have received training in the use of AI for their professional field, only 44% of them respond affirmatively.

Of the professionals who had received training, 77% have self-taught using tutorials and online resources, while the remainder have been trained in courses offered by official institutions (universities and vocational training centres) or by software companies incorporating AI into their tools for the industrial design field.

In the second part of the questionnaire, we focused on the use of AI in their professional activity, the specific tools they have used, the phases of the design process in which they have applied them, and delved into their challenges, benefits, and risks. Most of the questions in this part of the questionnaire were open-ended, allowing the designers to explain their experiences in their own words. 65% of the designers reported having used AI tools in their work. In Table 1, we identified and classified the names of the AI tools that these designers are using in their work processes regularly, and in Figure 1, the stages of the design process in which they use these AI tools.

Table 1. Classification of the AI tools used by industrial designers participating in this research

Type of AI tools	Name of specific AI tools
Text generation	ChatGPT, Gemini/Bard, Bing, Copilot, Claude, ChatPDF, Gamma, Tome, Miro Assist
Image and sketch generation	Leonardo, DALL-E, Midjourney, Vizcom, Stable Diffusion, Firefly, Photosonic, Bing Image Creator
Automatic image editing and rendering	Photoshop Beta, Vizcom
Market trend analysis	Orange Datamining, Rapidminer

Q6: In which stage/s of the Design process has AI been useful to you?

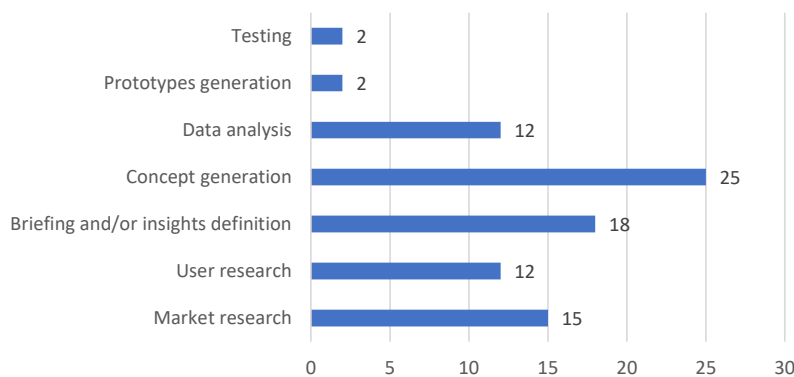| Stage	Value
Testing	2
Prototypes generation	2
Data analysis	12
Concept generation	25
Briefing and/or insights definition	18
User research	12
Market research	15

Figure 1. Participants' answers to the question: in which stage/s of the Design process has AI been useful to you?

Below, Tables 2, 3, and 4 present the challenges, benefits, and risks that these designers have identified when using AI tools in their work.

Table 2. Main challenges found when incorporating AI into their design processes

Challenges	Explanation	Number of designers that experiment this challenge
Few tailored for design	Training and/or numerous iterations are required for high-value output.	15
Large variety of tools	With such a wide range of AI tools available, it's hard to map and select them and decide which ones to train in, since we're unsure which ones will last.	7
Learning to give them the correct prompts	Creating the correct prompts to obtain a response close to the designer's expectations can be challenging.	6
Understanding of the context and the user	It's challenging to ensure that AI tools understand well who the user is and the context in which they need to respond.	2
None		2
Co-design with IA vs IA mastering design	Use them as tools and not give them the main role in the design.	1

Table 3. Main benefits that AI can bring to product design process

Benefits	Explanation	Number of designers that proposed this benefit
Efficiency and speed	Speeding up research and content generation to translate ideas into other materials useful for communicating ideas to clients (image, videos, sounds, etc.)	18
New inspirations	Getting preliminary design ideas and expanding ideation	15
Automatization of repetitive tasks	Fast processing of repetitive or non-creative tasks.	14
Better design decisions	Exploitation of data for better design decisions	6
Enhancement of visualisations	Refinement of design aesthetics while saving time/cost	4
Smarter products/services	Products/services that can anticipate their context (including the user), inform users, detect or predict events, and relieve human efforts during work	1

Table 4. Main risks that AI can bring in the Industrial Design professional field

Risks	Explanation	Number of designers that proposed this risk
Problems of privacy, Intellectual Property (IP) control and confidentiality	Use of the same data through AI tools can lead to similar solutions, or companies, due to the fear of losing control over their data, may develop their internal AIs and reduce their innovation capacity by relying on endogenous data.	11
People thinking that IA can replace/substitute designers	Some jobs will become obsolete because of increased intrusion, such as purely aesthetic designers, potentially resulting in a significant loss of quality in design.	11
Reduce creativity	AI can cause designer's block when a reference is available.	7
Loss ability for informed decision making	By skipping steps in the creation/design process and accelerating it, it's possible that we may overlook things along the way or neglect relevant factors in the process and critical reasoning, such as empathy.	5
Biased decisions and design solutions	Make decisions and generating solutions based on flawed or biased training data	4

Reduce skills of designer through visual representation	If design generation can be highly accurate through written commands, the motivation to develop a designer's skills in shaping an intangible idea through visual representation may begin to depreciate.	3
Waste of time	Too much time is wasted in getting tools to achieve what we want.	2
IA leading role	To give IA a leading role and let it guide the design.	1
Hallucinations of IA	This is a phenomenon wherein a large language model (LLM) perceives patterns that are non-existent or imperceptible to human observers, creating outputs that are nonsensical or altogether inaccurate.	1

Finally, in the last question of our questionnaire, the participating industrial designers shared their ideas about the changes they would like to see in the educational programmes of industrial engineering studies at universities to address the impact of AI on their professional activity. The results obtained are presented in Table 5.

Table 5. Changes proposed by professionals in the university education of industrial designers

Changes in the university education of industrial designers	Explanation	Number of designers that proposed these changes
Practice with AI tools to inform the design process in different existing courses of the curricula	Focus on practicality, use AI tools to inform the design process, and don't delve too much into academic theories to fully realise the potential of AI for impactful design work.	20
Understand how AI technology works	Set and teach methods that can support young designers in acquiring a critical evaluation mindset to use AI in a smart and meaningful way. Also, teach about ethical bases, biases, and risks of AI.	12
Specific courses on AI	Teach about different types of AI and their evolution.	4
Creativity in the era of AI	Give students the knowledge to know how to use AI correctly so that their designs are not alienated by AI and cultivate their creativity to develop their own style.	3
Learn to make the right questions or prompts	There is a mindset that needs to be acquired in order to master the use of AI, including what to do and what not to do with AI, as well as understanding its limitations and ethics.	1
Faculty and guest experts with professional experience in the use of AI tools	Firstly, it is necessary to train university faculty themselves and also to seek support from professionals and experts with professional experience in the correct use of AI.	1

4 CONCLUSIONS

We divide the conclusions of this work into two areas. The first set pertains to the current situation related to training, knowledge, and use of artificial intelligence tools by professional designers who participated in this study. The second set includes conclusions about how the education of our industrial design students should adapt in response to the emergence of AI in product design. Finally, we present our position as a starting point for an interesting discussion among conference participants and share ideas for future research.

In summary, 96% of the participants recognize the importance of AI in their professional field. However, less than half of them have received formal training in this area. They primarily acquire knowledge through self-study and practical tutorials or online resources. Regarding the AI tools they use, they apply them mainly in the initial stages of the design process, including market and user research, briefing, insights generation, concept development, and data analysis. These tools fall into four categories: text

generation, image and sketch generation, automatic image editing and rendering, and market trend analysis.

When asked about the challenges, benefits, and risks associated with using AI tools in their professional practice, designers identified several key issues. The main challenge is the wide variety of tools available and the time required to master them to achieve good results. This effort is compounded by the uncertainty of whether these tools will remain available in the market. On the other hand, AI technology offers significant productivity benefits, such as increased efficiency, speed, and the ability to automate repetitive tasks. However, opinions on the impact of AI on creativity are divided. Some professionals believe AI tools can help designers overcome the fear of a blank page, while others fear that these tools might lead to creative blockages. Finally, industrial designers identified two main risks related to AI: privacy issues, intellectual property control, and confidentiality on one hand, and the mistaken perception that AI can replace industrial designers, leading to professional intrusion, on the other.

Regarding the necessary changes in university curricula for future industrial designers, professional opinions are clearly divided. Some professionals advocate for a practice-focused approach, emphasising the use of AI tools in various design phases without extensive academic theory. Others believe it is crucial to understand how AI technology works to foster a critical mindset for its intelligent and relevant use. This division highlights the need for educational research to determine the most appropriate way to incorporate AI technology into the curricula for upcoming industrial designers.

Our position for opening discussion at this conference is that combining both approaches in our students' curriculum can greatly enhance their professional value. Practical experience with AI tools can make their design processes more efficient and potentially more creative. Meanwhile, a deeper understanding of AI—such as the types of data it uses, its algorithm families, and their capabilities—will enable them to visualize how AI technology and collaboration with AI experts can advance their product design projects, leading to the creation of smarter products.

To conclude, we want to emphasise the importance of continuing research in this field to clarify many of the uncertainties, such as the impact of using AI tools on designers' creativity or the benefits of more practical training versus training with a deeper theoretical understanding of AI, or a combination of both. One limitation of our work is the sample size, so we encourage our academic colleagues to conduct quantitative studies with larger samples to seek generalisable results, as well as qualitative studies to better understand the causes of these effects that AI is having on professional practice.

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