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CHAT-GPT: A CLEVER SEARCH ENGINE OR A CREATIVE DESIGN ASSISTANT FOR STUDENTS AND INDUSTRY?

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ABSTRACT
The intelligent design assistant has been an enduring interest for design research and industry. ChatGPT is an AI chatbot released in 2022 providing text-based responses to user queries, generating content, able to converse and improve; this different to finding static content like a search engine. ChatGPT has created a landmark surge in popular interest in Generative Artificial Intelligence, and given its non-prescriptive nature, it is timely to take a snapshot of its use in industry and design education. This paper presents survey results from industry and from undergraduate product design students. 61-65% of both groups utilise ChatGPT for project work, sometimes daily, but most commonly a weekly basis, indicating growing utility in industry and education. Tasks most commonly begin with ChatGPT and refined by users. Industry respondents commonly check human work too. The most common application was research, with free text responses highlighting idea generation, and coding as more creative endeavours. Industry commonly use it for refinement of written communication, while students employ it for CV and letter drafting, even potentially design folio content (less likely). Higher numbers of respondents agree that ChatGPT could enhance work scope, quality, and creativity, with potential need for training in industry and in embedding in university education. Daily or weekly use of ChatGPT for research tasks reminiscent of what one respondent termed a "clever search engine," yet new applications are emerging. Universities have the opportunity to prepare graduates for evolving industry practices, and indeed to influence those practices.

Keywords: Chat-GPT, text-based AI, language-based AI

1 INTRODUCTION
This paper reports on 2 complementary surveys on ChatGPT use. In August 2023 58% of industrial respondents (n=83) agreed ChatGPT should be integrated into university courses prompting a second product design engineering student focused survey. Within our industrial network snapshot, practicing engineers are not using ChatGPT to the systematic ends suggested by some (see Lausanne project described below). Early discussions with / observations of students have determined that some are using ChatGPT like industry, and potentially more creatively too. With the student survey we aimed to uncover the extent of the differences between industry and student ChatGPT use with implications for project-based learning and teaching in future curriculum. After setting the scene with a brief review, the paper will present and discuss results.

1.1 Generative AI
Artificial Intelligence (AI) is an enduring driver for design research and practice [1, 2]; the massive potential offset with concern for the future [3]. The ultimate Artificial Intelligence will be realised when human intelligence is replicated or exceeded by computer-based models. In the meantime, AI has trickled into many of the systems that designers and engineers use without significant concern e.g. generative CAD systems and suggestive web searching.
Increasingly sophisticated web search engines, such as Googlebot, improve at interpreting user prompts linking to complex metadata mined from the deepest parts of the internet including text, image and video content. The new Generative AI systems are also capable of understanding user supplied text/queries

and outputting text, image and video responses, but these are not retrieved from pre-generated content, rather these are uniquely developed in response to the user prompt and did not exist in advance.
At this level of description, it is difficult to appreciate the significance of these systems over what search engines like google have provided us for quite some time. Designers and design students have been using search engines like Googlebot to find critical specification data as well as descriptive and visual inspiration for ideation in their projects. The engines now even push information to users based on their online footprints and have arguably become more 'conversational'. Some search engines are now incorporating explicit "chatbots" moving users into a very similar environment as the famed ChatGPT. Language/text understanding/generation models which are able to train themselves are here; the first General Pre-Trained Transformer (GPT) models from 2018 and a new reality has dawned for practice and higher education with advent of ChatGPT in November 2022 [4]. Integrity in learning and assessment is an issue if generative AI is promoted in education. However, there is undoubtedly a need to consider how this technology will be productively used in practice.
The Q3 2023 Engineering Designer magazine (IED) reports 'How Artificial Intelligence is Transforming Engineering Design: Beyond CAD'. Distinct from research agendas for Generative Design [5] and image-based AI [6], the article highlights the 'world's first Chat-GPT designed robot'; Lausanne researchers are developing design specifications and concepts using a text-only chatbot. In the nascence of Chat-GPT, we want to understand the extent and differences between how our industrial networks and students have usefully leveraged text-only AI.

2 METHODOLOGIES

The initial study undertaken in July and August 2023 by a cross engineering faculty team, including a student intern, aimed to understand how engineering employers were using ChatGPT so as to inform teaching and learning practice. Following ethics approval, an anonymous, 18 question, Qualtrics questionnaire was distributed through an online networking platform aiming to sample across the 8 disciplinary networks of our engineering faculty, including Product Design and Manufacturing.
To understand our students' experience of ChatGPT an extended/modified version of the survey was approved for distribution to students of the Department of Design Manufacturing and Engineering Management (DMEM). The survey was distributed by email and classroom announcements 5 months after the original industry survey. We targeted early (1 and 2) and senior years (4 and 5) of 3 undergraduate product design courses.

3 RESULTS AND ANALYSIS

This section of the paper aims to convey the structure of the questionnaire design as well as present and contrast the results obtained from the separate industry and student distributions. The results are organised around: frequency of use; nature of tasks; types of tasks; enabled improvements; concerns and looking to the future.

Industry Sample Highlights:

- 83 Industry Respondents, across disciplines:
- 52% aged 18-20, 33% aged 31-45. (Q5)
- 25% Female, 71% Male, Other 4% (Q6)
- 65% have used ChatGPT for work purposes. (Q7)
- 59% aware of ChatGPT more than 6 months before survey. (Q9)
- 29% assume their employer unaware of their use. (Q11)

Solid % in chart differentiates ChatGPT users in each discipline.

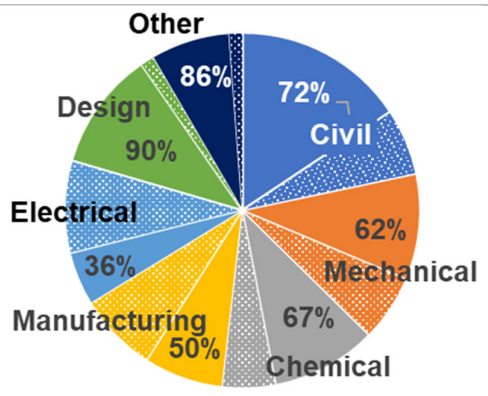

Figure 1. Key highlights of the Industry Sample

3.1 Response Profiles

Figure 1 shows the distribution of engineering disciplines in the industry sample. 'Other' includes low response rates from naval architecture, biomedical engineering and computer engineering. 'Design' includes product design, engineering design and architecture. Manufacturing has clustered technology and operations management with manufacturing engineers. Civil and environmental engineering was the most active network. Potential significance for "design" is highlighted in this paper where possible but given the sample size have mostly looked at all disciplines together as an "industry snapshot".

Student Sample Highlights:

- 74 Student Respondents, (see pie chart).
- 58% aged 18-20, 41% aged 21-30. (Q5)
- 35% Female, 65% Male overall. (Q 6)
- 61% have used ChatGPT for project work. (Q7)
- Only 14% of students heard of ChatGPT first through university or employment (Q9)
- 32%/41% aware of ChatGPT for more than 6/12 months. (Q10)
- 40% of users have used ChatGPT for CV/Folio content. (Q12)

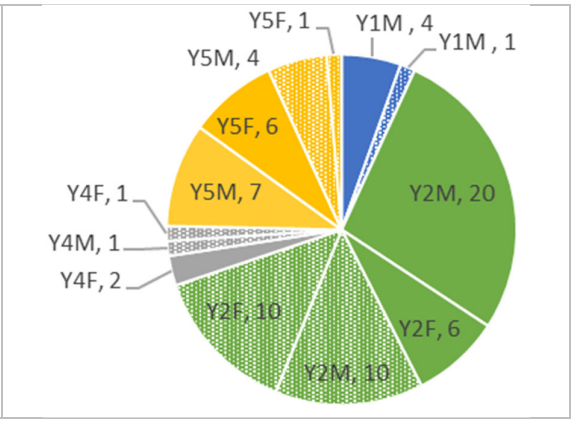

Figure 2. Key highlights of the Student Sample

Figures 1 and 2 show similar response rates for both distributions. It was perhaps surprising that so many respondents have not been active ChatGPT users but still motivated to participate. Non-users answered fewer questions and given it may also be a means to accelerate completion of the survey, we focused mainly on the responses of the 65% of industrialists and 61% of students who indicated they have used ChatGPT for project work. Table 1 shows results for an additional question that was asked to students showing some reasoning for not using ChatGPT in this way. Current plagiarism policy in our institution explicitly states AI is not allowed in assessed work, so may play a role in general abstinence, but it seems some students do not yet see a benefit of the tool to their efficacy.

Table 1. Student Survey Q8

Why you have not used ChatGPT for engineering or design work/project purposes: (select all that apply)	/29
I don't use ChatGPT for any purpose.	37.9%
I don't really know what ChatGPT is.	17.2%
I have never considered it a useful thing to try.	37.9%
I don't trust ChatGPT.	27.6%
I don't believe I am allowed to use ChatGPT for these purposes.	26%

3.1.1 Gender

It was not expected that gender would play role in the ways ChatGPT is used and seemed unlikely any such patterns would be evident in the sample size/balance. The pie chart in figure 2 shows the gender distribution across the 4 years of study highlighting users (solid colour) and non-users (dotted colour).

3.2 Frequency of ChatGPT Use

The early year student group is bigger but has more respondents claiming to "rarely" use the tools. Overall, approximately "weekly" is the most common frequency for the students and for industry (Figure 4). However, there are more "daily" and "not intend to use it again users" and less "rarely" industry users. There are 9 more industry users in the study than student which may explain increases in any type of user, but the lower number of occasional users may be indicative of a difference between industry and student adoption levels.

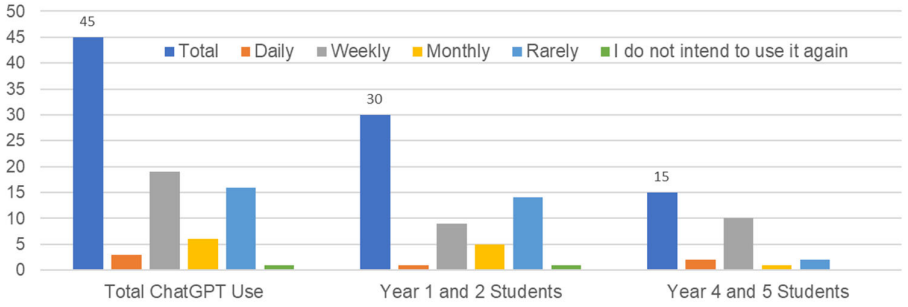

Figure 3. Frequency of ChatGPT use by students across years of study

29% of industry users do not think that their employers know they use ChatGPT at work. 3/7 students claiming to have used ChatGPT in employment (Q14), believed their employer was unaware (Q13).

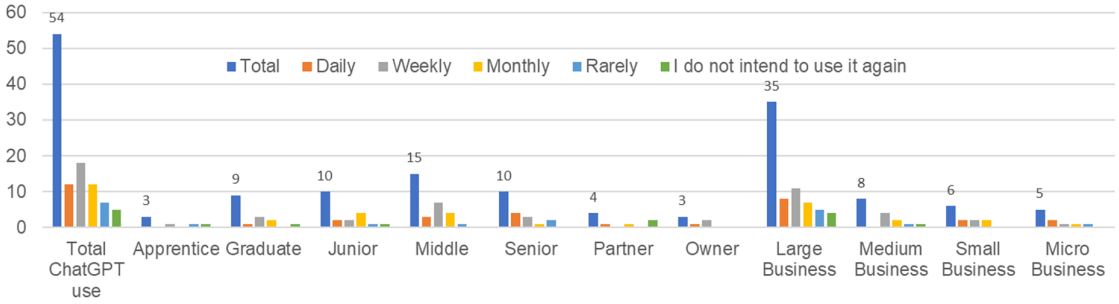

Figure 4. Frequency of ChatGPT across role levels (Q4) and business size (Q3)

3.3 Nature of the task

In table 2, students and industrialists are similar in most often using ChatGPT to start a task but finish as human endeavour. Industry respondents may be slightly more likely than students to do the reverse; review human work using ChatGPT. It is reassuring to see low figures for using ChatGPT verbatim. Fewer students offered insights into "other" applications, but interestingly were 'rearranging equations' and developing research interview questions. Industry respondents included uses classified under one of: "As a clever search engine for research and translations"; writing or rewriting communications/text; debugging and/or suggesting coding and idea generation.

Table 2. Industry Q12, Student Q16

I use ChatGPT to (select all that apply);	**Industry**	**Students**
provide a broad view of the landscape to assist task completion by a human.	68.5 %	62.2%
complete the task, then undertake a brief ˜ballpark" check.	13%	24.4%
check / review work already completed by a human- did I miss something.	29.6%	17.8%
complete the task alone without modification.	13 %	11.1%
other purpose not stated in options.	22%	11.1%

3.4 Task Types

In reflection the wording of the first option in table 3 is quite ambiguous for the student and may have been difficult to interpret in a study context. Research is unanimously the most common task type.
6 industrial respondents (11%) included other uses, some of which are arguably within the scope of the pre-defined answers, but also included: Automation of spreadsheet or word processing tasks, writing personal performance reviews, presentation structuring and support for using software packages. 2 students expanded AI use to image generation for folios (not ChatGPT) and similar to industry responses highlighted opportunities for coding development.

Table 3. Industry Q13, Student Q17

I use ChatGPT for (select all that apply):	**Industry**	**Students**
Core engineering tasks relating to my profession	33.3%	8.9%

Research purposes to support tasks	57.4%	77.8%
Communication between clients and colleagues	33.3%	11.1%
Organisation, prioritisation, or scheduling of tasks	16.7%	11.1%
other purpose not stated in options.	11%	4.4%

3.5 Use for Employment Application

Additional questions (Q12 and 13) were included for students. 40% (18) of the student users had used ChatGPT when applying for employment. Table 4 shows responses in this context, where it is perhaps not surprising there is less strong agreement that ChatGPT is useful for folio development.

Table 4. Student Survey Q13

Please indicate your agreement with the following statements: ChatGPT is useful for the purpose of:	strongly dis. %	somewhat dis. %	neither %	agree %	strongly agree %
developing CV contents.	0	0	16.7	55.6	27.8
ChatGPT is useful for the purpose of developing cover letter contents.	0	0	11.1	33.3	55.6
ChatGPT is useful for the purpose of developing portfolio contents.	16.6	16.7	22.2	33.3	11.1

Table 5. Student Survey Q19, industry Q13

What improvements do you see ChatGPT enabling in your work?	**Industry**	**Students**
Improved efficiency (more work completed in the same amount of time)	16.7%	6.7%
Improved scope (larger area of knowledge & easier access to information)	35.2%	53.3%
Improved quality (higher quality outputs completed at the same time)	37.0%	46.7%
Improved creativity (higher quality & quantity of ideas)	35.2%	28.9%
Other, not stated	3%	2%

3.6 Impact on work

From table 5 scope, quality and creativity impact divide the majority of responses. A number of respondents did select both “quality” and “creativity” but with no statistical correlation. “improved creativity” is one of more obvious interests for designers, but none of the industry respondents from the “product design”/Design discipline did select this option, and the student response is quite low.

3.7 Concerns

Industry users were more concerned (63% vs 53%) about mistrust/misuse of ChatGPT than students, and significantly more concern about Intellectual Property leaks (51.9% vs 15.6%). Student users were more concerned about diminished job satisfaction (37.8% vs 9.3%); perhaps those working are more reassured by seeing the impact of ChatGPT and less pessimistic about how these jobs will evolve?

3.8 The future

Table 6 shows the largest and final section for the survey. There seems relatively good alignment of student and industry responses on most points; generally, less “strong disagreement” on most items. More notable areas of variance have been highlighted in bold red outline. There is a relatively high level of agreement that training is required within organisations but less students feel strongly about that. Students may feel slightly less strongly that ChatGPT is going increase in capability over the next 2 years. Students seem to agree a bit more that ChatGPT could be purposed towards meeting UN SDGs; awareness of SDGs is quite high in universities and may be more variable in industry.

There is some variance in agreement over whether ChatGPT should be incorporated into engineering programme’s learning and assessment practices. In reflection, including AI in assessment is quite different to using it in learning and perhaps challenging to give a single answer to both.

Table 6. Student Survey Q18

I = Industry, **S** = Students. **Select the option which best describes your position on the following statements:**		Strongly dis %	Somewhat dis %	Neither %	agree %	Strongly agree %
UK engineering employers are under-utilising ChatGPT.	**I**	3.7	13.0	37.0	35.2	11.1
	S	2.2	4.4	55.6	37.8	4.4
ChatGPT can provide value to an engineering organisation/engineering employers.	**I**	1.9	5.6	9.3	46.3	37.0
	S	2.2	6.7	6.7	64.4	24.4
Training is required to best use ChatGPT in engineering organisations.	**I**	3.7	5.6	9.3	37.0	44.4
	S	4.4	13.3	28.9	42.2	15.6
ChatGPT is currently capable of producing useful outputs.	**I**	5.6	3.7	18.5	42.6	29.6
	S	4.4	4.4	4.4	60.0	31.1
The capabilities of ChatGPT will substantially increase in the next 24 months.	**I**	3.7	1.9	18.5	22.2	53.7
	S	2.2	6.7	11.1	46.7	37.8
ChatGPT will prove useful in achieving the UN Sustainable Development Goals.	**I**	5.6	9.3	42.6	29.6	13.0
	S	6.7	6.7	40.0	42.2	8.9
UK undergraduate engineering programmes should incorporate ChatGPT into learning & assessment practice.	**I**	14.8	9.3	14.8	27.8	31.5
	S	6.7	17.8	22.2	40.0	17.8

4 CONCLUSIONS

The study was limited in the small respondent numbers within some industry disciplines (not least design) and some course groups. However, survey perhaps does not have the resolution to unpick disciplinary rationale for the responses made. Focus groups are planned as a follow on.

Industry may be using the tool more frequently and finding more uses for language-based AI within their roles than the design students do in their day-to-day activities. Both students and industrial participants have mentioned coding as a significant application, and there are significant coding projects in years 3 and 4 of the courses where ChatGPT could have impact if it is not already. Our design teaching places a lot of emphasis of Product Design Specification, and it would be interesting to look deeper into the role of language-based AI for that. "A clever search engine or an intelligent design assistant"? There is certainly immediate evidence of search engine like activity and there is mention of idea and content generation which is arguably moving towards something more assistive and generative.

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