VIRTUALLY HOSTED HACKATHONS FOR DESIGN RESEARCH: LESSONS LEARNED FROM THE INTERNATIONAL DESIGN ENGINEERING ANNUAL (IDEA) CHALLENGE 2022

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ABSTRACT

The International Design Engineering Annual (IDEA) Challenge is a virtually hosted hackathon for Engineering Design researchers with aims of: i) generating open access datasets; ii) fostering community between researchers; and, iii) applying great design minds to develop solutions to real design problems. This paper presents the 2022 IDEA challenge and elements of the captured dataset with the aim of providing insights into prototyping behaviours at virtually hosted hackathons, comparing it with the 2021 challenge dataset and providing reflections and learnings from two years of running the challenge. The dataset is shown to provide valuable insights into how designers spend their time at hackathon events and how, why and when prototypes are used during their design processes. The dataset also corroborates the findings from the 2021 dataset, demonstrating the complementarity of physical and sketch prototypes. With this paper, we also invite the wider community to contribute to the IDEA Challenge in future years, either as participants or in using the platform to run their own design studies.

Keywords: Prototyping, Hackathon, Design methods, Design practice, Design engineering

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Cite this article: Ege, D. N., Goudswaard, M., Nesheim, O., Eikevåg, S. W., Bjelland, Ø., Christensen, K. A, Ballantyne, R., Su, S., Cox, C., Timperley, L., Aeddula, O., Machchhar, R. J., Ruvald, R., Li, J., Figueiredo, S., Deo, S., Horvat, N., Čeh, I., Šklebar, J., Miler, D., Gopsill, J., Hicks, B., Steinert, M. (2023) 'Virtually Hosted Hackathons for Design Research: Lessons Learned from the International Design Engineering Annual (IDEA) Challenge 2022', in *Proceedings of the International Conference on Engineering Design (ICED23),* Bordeaux, France, 24-28 July 2023. DOI:10.1017/pds.2023.382

1 INTRODUCTION AND BACKGROUND

The International Design Engineering Annual (IDEA) Challenge is a virtually hosted hackathon for PhD and post-doctoral researchers working in the field of Engineering Design. Its aim are to i) generate open access prototyping datasets for design research; ii) foster community between researchers; and, iii) apply great design minds to develop solutions to real design problems.

These aims are aligned with the affordances of hackathons which include cultivation of team identity and learning opportunities (Pe-Than and Herbsleb, 2019), facilitating networking and cultivating new links (Briscoe and Mulligan, 2014). They also offer unique opportunities for studying design activity at the early stages of design, under time pressure, in reduced incubation times and across different levels of design expertise (Flus and Hurst, 2021).

The inaugural IDEA challenge was hosted in 2021 (Goudswaard et al., 2022) featuring four teams who were set the challenge of developing low-cost vaccine distributions systems. Design activity at the hackathon was understood by capturing and measuring prototypes which are considered to be highly important objects in the product development process (Wall et al., 1992). Prototypes were captured via means of Pro2booth (Giunta et al., 2022) which were then used to provide insights into the use of prototyping domains and their respective purposes (Ege et al., 2023). These insights were corroborated with interviews with each team to confirm that the as-captured prototypes were representative of the as-done prototyping activity.

This paper presents the 2022 IDEA challenge and elements of the captured dataset. It seeks to: i) provide insights into prototyping behaviours at virtually hosted hackathons; ii) compare the IDEA 2022 dataset to the 2021 dataset to explore similarities and differences in the prototyping data captured at each event; and, iii) provide reflections and insights from two years' running of the challenge to support future running of the IDEA challenge or similar events with consideration of the research utility of the platform. In doing this, the paper serves as an invitation for research groups to be involved with future iterations of the IDEA challenge as participants or take the lead and use the platform as a means to undertake their own design study.

2 THE IDEA CHALLENGE 2022 SET-UP AND DATA CAPTURE

2.1 Running the IDEA Challenge

Figure 1 shows a timeline of activities during the IDEA Challenge. The hackathon ran for 4 consecutive days, with online check-ins every morning and afternoon. MS Teams was used for video conferencing and sharing documents. Teams had access to a dedicated channel as well as a global one to connect with organizers and other participants throughout the challenge. Teams received the design challenge brief following an introduction on the morning of day 1. Final presentations and demos were scheduled on day 4.

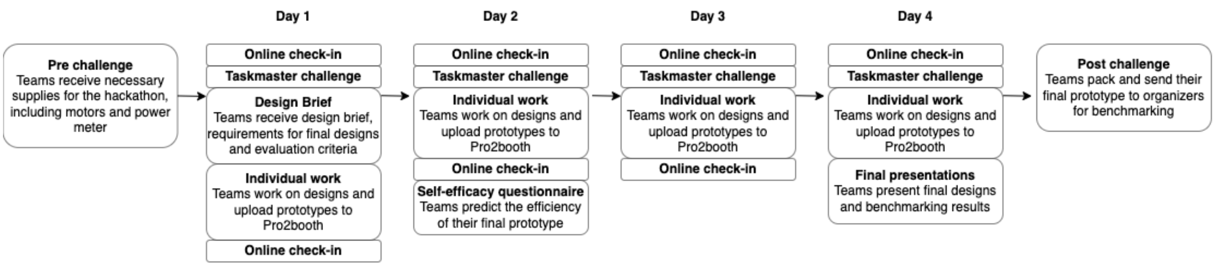

Figure 1. Timeline of the hackathon

Teams were assessed based on the following criteria: 1) quality of prototypes captured each day (30 %), 2) Physical performance (40 %), 3) Final design pitches (10 %) and 4) Bonus points (20 %). Bonus points were rewarded for daily "taskmaster challenges" during the morning check inns, fast-paced building challenges to get in a "prototyping mindset". Challenges included building the most impressive team mascot in 20 minutes or building a new piece of wearable technology to help designers work faster, as exemplified in Figure 2a.

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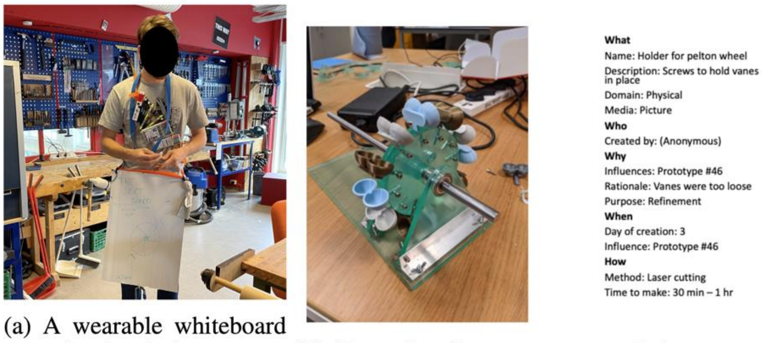

(a) A wearable whiteboard to make the designer more efficient

(b) Example of a prototype and data captured by Pro2booth

Figure 2. Taskmaster and pro2booth upload examples

The design challenge set was to develop a low-cost hydro-power generator to collect rainwater energy. Mandatory deliverables included a physical prototype that could be tested. Physical prototypes should be supported by digital prototypes, such as CAD, renders, or simulations. Teams were also required to provide a use case scenario for their conceptual prototype. Necessary supplies for comparing designs were sent in advance, consisting of a I) an Adafruit 12 V hybrid stepper motor, II) shaft coupler for the stepper motor, III) Diodes and capacitors for rectifying circuits, and IV) an Adafruit INA260 power meter.

The supplied parts were mandatory to use during the final prototype test. Final designs were required to be able to fit within a backpack and had to feature bespoke parts. The amount of potential energy teams could use when testing the physical performance of their final prototypes was limited to 1 kJ. Teams were, however, free to decide themselves how to utilize this energy, meaning that they could choose to have a 10L water reservoir located 10 meters above the generator providing high pressure for a short amount of time, or a 50L reservoir 2 meters above it for lower pressure over a longer time.

Five teams from universities across Europe consisting of with 3-4 participants each (15 male, 3 female) participated in the hackathon. They were between 23 and 35 years old (28 on average, SD= 3,6). 17 participants were PhD students, and one was a post-doc. 15 participants' field of study was mechanical engineering, one studied industrial design, one studied aerospace engineering and the last studied computer science. Participants had varied design experience, from less than two to 10+ years.

2.2 Data capture during the hackathon

Measuring this design activity could be carried out a number of different ways including protocol studies (Ericsson, 2017) or log-book studies (McAlpine et al., 2006) but these are deemed unsuitable for use at hackathons due to the loud and difficult to control settings (Flus and Hurst, 2021) and the low levels of formal documentation occurring in hackathons.

An alternative to these methods is the measurement of design activity via means of capturing prototypes generated during the product development process. Existing systems in literature include Protobooth (Erichsen et al., 2021) and Archie (Nelson et al., 2019).

Measuring design activity in the IDEA challenge 2022 was carried out using Pro2booth (Giunta et al., 2022) - an online platform for capturing prototyping activities which builds upon the initial work of Protobooth. Participants continuously uploaded prototypes during the hackathon. Pro2booth captures the what, who, why, when and how of each prototype:

- **What:** Name, description (free text), domain (drop-down menu), media (picture, video, CAD files etc.)
- **Who:** Created by
- **Why:** Influences, rationale (free text), purpose according to Camburns' prototyping purposes (drop-down menu), Insights (free text)
- **When:** Influences, date of capture
- **How:** Method/machinery used (drop-down menu), time to create (drop-down menu)

Figure 2b shows an example of a prototype and its corresponding data captured by Pro2booth. Every prototype belongs to one of three possible domains; physical, digital or sketch. These were defined as follows: physical prototypes are considered any physical artefact (eg made of atoms) created during the hackathon, except as the result of a drawing process. This includes prototypes made using manual

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machining or hand tools, 3D printing, cardboard modelling or laser cutting etc. Prototypes created on a computer (eg made of 1s and 0s) are digital prototypes, for example, simulations, CAD models and code. Sketches are the result of any drawing process, such as hand-drawn sketches, schematics, hand-drawn diagrams and hand calculations. Prototyping purposes were defined according to (Camburn et al., 2017): **refinement** - the process of gradually improving a design; **communication** - the process of sharing information about the design and its potential use within the design team and to users; **active learning** - the process of gaining new knowledge about the design space; and, **exploration** - the process of seeking out new design concepts.

3 THE 2022 IDEA CHALLENGE DATASET

The 2022 IDEA Challenge dataset is summarised in Table 1. It contains a total of 240 prototypes with 1049 edges (connections to influential prototypes and creators). The table is sorted according to prototyping domains, purposes day of creation, time to make and manufacturing processes. Transitions under prototyping domains is a count of how many times teams moved between domains, e.g from making a physical prototype to a digital one.

Table 1. Overview of the IDEA Challenge 2022 prototype dataset

		#	%			#	%
Teams		5					
Prototypes		240					
Connections		1049					
Domain	**Physical**	141	58,8 %	**Method/ Machine**	**Sketching**	62	25,8 %
	Digital	40	16,7 %		**Technical drawing**	**1**	0,4 %
	Sketch	59	24,6 %		**Cad mock up**	**43**	17,9 %
	Transitions	78			**Cad detailed**	**17**	7,1 %
Purpose	**Refinement**	72	30,0 %		**Hand calculation**	**17**	7,1 %
	Communication	51	21,3 %		**Junking**	**26**	10,8 %
	Active learning	74	30,8 %		**Card/foam moddeling**	**4**	1,7 %
	Exploration	43	17,9 %		**Manual/ hand tools**	**19**	7,9 %
Day of creation	**Day 1**	68	28,3 %		**3D print**	**26**	10,8 %
	Day 2	58	24,2 %		**Laser cut**	**15**	6,3 %
	Day 3	63	26,3 %		**Moulding**	**2**	0,8 %
	Day 4	51	21,3 %		**Kits**	**10**	4,2 %
Time to make	**<10 min**	83	34,6 %		**Electrical**	**21**	8,8 %
	10-30min	85	35,4 %		**Coding**	**13**	5,4 %
	30-1hr	36	15,0 %		**Other**	**37**	15,4 %
	1-3hr	31	12,9 %				
	3-5hr	4	1,7 %				
	10hr+	1	0,4 %				

3.1 Investigating prototyping behaviors with regards to domains, purposes, day of creation and time to make

The following section contains an analysis of the relationships between prototyping domains, purposes, when prototypes are made, and how long it takes to make them, independent of teams. The plots in Figure 3 are normalised to 100 % to bring the attributes of each category of prototype to the same scale.

Prototyping domains - Figure 3a shows that over 70 % of physical prototypes were either refinement or active learning prototypes. Physical prototypes were used the least for exploration. Digital prototypes were mostly refinement or active learning but were used more for exploration than physical prototypes. Only 10 % of digital prototypes were used for communication. This contrasts sketches, where 47 % were communication prototypes. Sketches were also used over 30 % for exploration, and only 5 % for refinement. Figure 3b shows that 43 % of physical prototypes took between 10 and 30 minutes to make. 24 % took less than 10 minutes, while only a few prototypes took more than 3 hours to make. Most digital prototypes took longer to make than physical, with 33 % taking between 30 minutes and an hour to make. 26 % took more than an hour to make. 75 % of the sketches took less than 10 minutes to make, and no sketch took longer than an hour to finish. Figure 3c shows that the highest amount of physical prototypes were made on day 3 (33 %), closely followed by days 2 and 4 at 28 % and 27 %, respectively. Most digital prototypes were made on the second day, 40 % in total. Sketches were primarily used on the first day, and 73 % were uploaded that day.

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Prototyping purposes - Figure 3d shows that 71 % of refinement prototypes took less than 30 minutes to make. Almost 50 % of communication prototypes took less than 10 minutes to make, and none took longer than 3 hours. Active learning prototypes generally took longer to create, with 47 % taking longer than 30 minutes to finish. Most exploration prototypes were quick to make, and 60 % took less than 30 minutes to create.

Day of creation - Figure 3e Show that refinement prototypes were uploaded the most on days 2 and 3. Communication prototypes were used the most on day 1 and the least on day 2. Active learning prototypes were used similarly across all the days. Exploration prototypes were used most on day 1, at 42 %, declining through days 2 and 3, and the least on day 4. Figure 3f show that 50 % of prototypes created on day 1 took less than 10 minutes to make. 34 % took less than 30 minutes to make, and no prototype took longer than 3 hours. On day 2, prototypes taking between 10 and 30 minutes to make were the most significant, with those taking less than 10 minutes and those between 30 minutes and an hour following next. This pattern is repeated for day 3. Prototypes created on day 4 generally took longer to make than on the previous days, with 27 % taking between 1 and 3 hours to make.

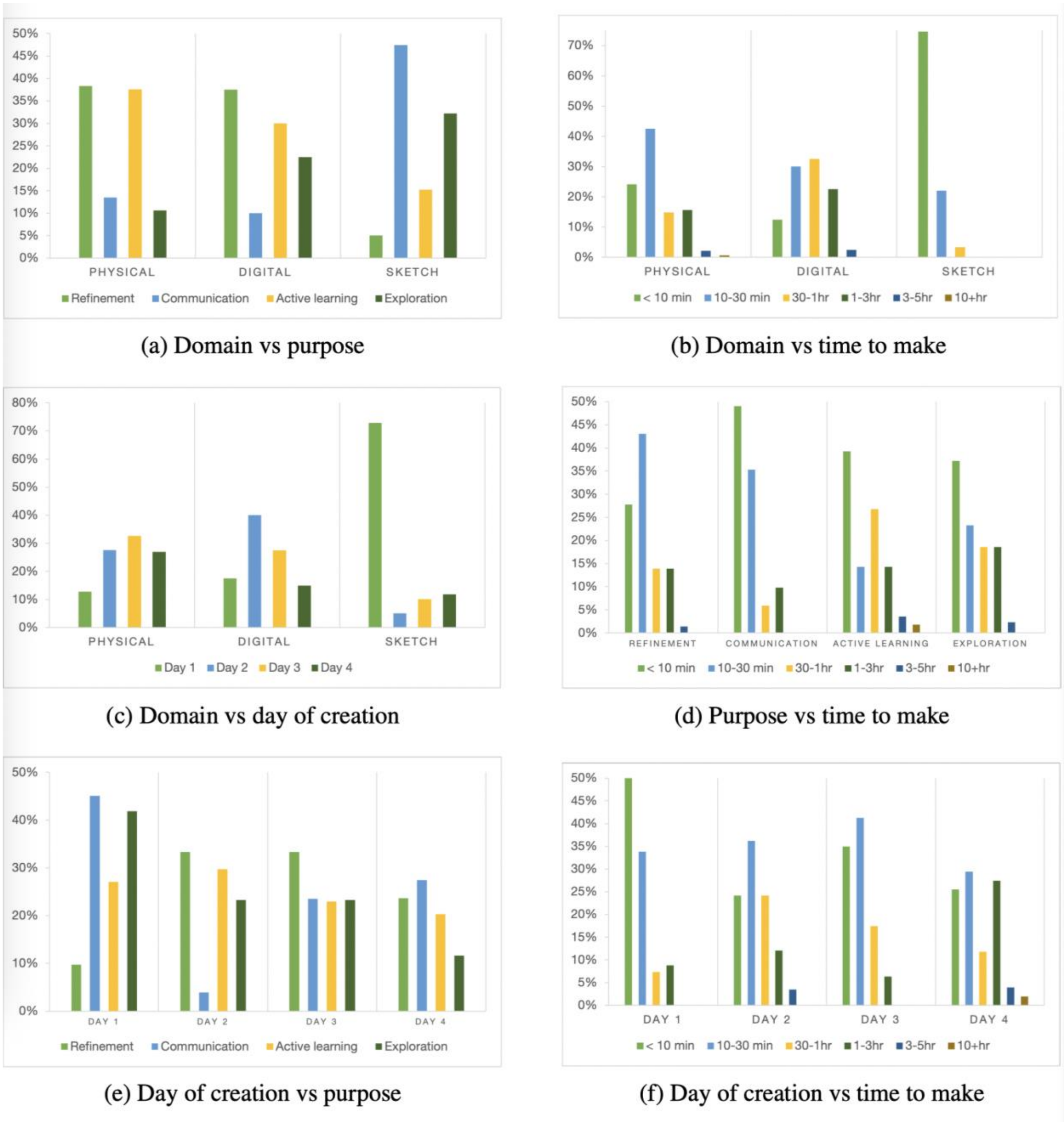

Figure 3. Relationship plots

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3.2 Time spent on prototyping in domains and purposes

As the time to make prototypes were recorded using pre-defined ranges, the total time spent prototyping in Table 2 are calculated from the mid-band of each range (eg. 1-3hr range would be 2 hours in the calculation). Teams each spent, on average, 19.9 hrs on physical prototypes, 7 hrs on digital and 1.7 hrs on sketches. Physical prototypes account for 59 % of uploaded prototypes and 70 % of time spent prototyping. On average, teams used 0.7 hrs to make a physical prototype. Digital prototypes took on average 0.88 hrs to make. 25 % of the prototypes in the dataset are sketches, taking on average 0,14 hrs to make, only 6 % of the total time spent prototyping. The time teams used to make each refinement, active learning and exploration prototype were similar, on average 0.57 hrs, 0.72 hrs and 0.69 hrs, respectively. Communication prototypes differ from the other purposes, with an average building time of 0.37 hrs.

Table 2. Time spent on prototypes in each domain and purpose

	Domain			Purpose			
	Physical	**Digital**	**Sketch**	**Refinement**	**Communication**	**Active learning**	**Exploration**
Time spent making (hrs)	99,6	35,2	8,4	40,9	18,8	53,6	29,8
Prototypes (#)	141	40	59	72	51	74	43
Time per prototype (hrs)	0,70	0,88	0,144	0,57	0,37	0,72	0,69

3.3 Chi-Squared test on the relationship between domains and purposes

A Chi-squared analysis of independence was undertaken to examine further the relation between prototyping domains and purposes in the dataset, revealing a significant relation and high association between domains and purposes ($\chi^2(6{,}240) = 61.915, p < .001,\ V = 0.36$). Results shown in Table 3 indicate that I) Physical prototypes are used more than expected for refinement and active learning and less than expected for communication and exploration; II) Digital prototypes are used less than expected for communication; and, III) Sketches are used less than expected for refinement and active learning but used more than expected for communication and exploration.

Table 3. Chi squared table for prototype domain and purposes, with arrows indicating higher, lower or as expected values

	Physical	**Digital**	**Sketch**
Refinement	↑ 52 (39.65) [3.85]	≃ 15 (12.08) [0.71]	↓ 3 (18.27) [12.77]
Communication	↓ 15 (26.62) [5.07]	↓ 4 (8.11) [2.08]	↑ 28 (12.27) [20.17]
Active learning	↑ 53 (41.35) [3.29]	≃ 12 (12.60) [0.03]	↓ 8 (19.06) [6.42]
Exploration	↓ 8 (20.39) [7.53]	≃ 8 (6.21) [0.51]	↑ 20 (9.40) [11.96]

4 DISCUSSION

4.1 Insights into prototyping behaviours at The 2022 IDEA Challenge

The 2022 dataset reveals insights into how prototypes were used, when and why they were used, and how much time designers spent on them during the IDEA Challenge. Prototype purposes as explored in Section 3.1 and the chi-squared analysis demonstrate the complementarity of sketches and physical prototypes with regard to purposes; physical prototypes were used for refinement and active learning, while sketches were used for communication and exploration. Their combination provides the full spectrum of prototyping purposes.

Analysis of the time spent prototyping in each domain and purpose illustrates the importance of capturing this data, and not just prototype counts, as counts dont account for the vested effort in the activity. Physical prototypes in the dataset are, on average, quicker to make than digital prototypes, going against a typical motivator of going digital to permit iterating quickly - this prototyping dataset thus suggests the opposite- to prototype and iterate fast, you should use physical prototypes. The analysis also reveals communication prototypes to be the quickest, not surprising as most were shown to be sketches in Figure 3a. It is, however, apparent that the average lengths of each are to the same order of magnitude, and not significantly faster than physical or digital prototyping in this dataset. Teams used most time on active learning, followed by refinement, which could be due to the challenge requiring physical testing to learn what worked, and iterations to improve them. The least time was spent on communication prototypes, which could indicate the need for communication prototypes in

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events such as the IDEA Challenge is less important with small co-located teams working over a (relatively) short time period.

Purposes per day are as one would expect through the IDEA challenge, with the first days having peaks of communication and exploration likely related to ideation and discussion. Active learning peaks on day two but stays relatively consistent throughout, indicating that learning about the problem and solution spaces is important throughout design activities. Refinement peaks on days two and three when teams would have been making and iterating their concepts.

4.2 Similarities and differences in the prototyping datasets

Though the 2022 IDEA dataset captures more details for each prototype, we can compare the 2022 and 2021 IDEA datasets with regard to the details that are equivalent. Table 4 shows a high-level statistical comparison of the datasets. Values under the Difference column are comparisons of percentages between datasets. Positive percentages indicate an increase from the 2021 to 2022 datasets, negative percentages indicate a decrease.

Table 4. High-level statistical comparison of the 2021 and 2022 IDEA Challenge datasets

	2021		2022		Difference
	#	%	#	%	
Teams	4		5		**25,0 %**
Prototypes	203		240		**18,2 %**
Connections	1300		1049		**-19,3 %**
Physical	116	57,1 %	141	58,8 %	**1,6 %**
Digital	25	12,3 %	40	16,7 %	**4,4 %**
Sketch	62	30,5 %	59	24,6 %	**-6,0 %**
(Transitions)	51		78		
Refinement	74	36,5 %	72	30,0 %	**-6,5 %**
Communication	25	12,3 %	51	21,3 %	**8,9 %**
Active learning	90	44,3 %	74	30,8 %	**-13,5 %**
Exploration	82	40,4 %	43	17,9 %	**-22,5 %**
Day 1	37	18,2 %	68	28,3 %	**10,1 %**
Day 2	79	38,9 %	58	24,2 %	**-14,7 %**
Day 3	63	31,0 %	63	26,3 %	**-4,8 %**
Day 4	24	11,8 %	51	21,3 %	**9,4 %**

Even though design briefs differed, with dissimilar requirements and evaluation criteria, Table 4 shows similarities in the number of prototypes created per team (approx. 50) and a similar number of connections. We observe similar use of prototyping domains between datasets with a slight increase in digital prototypes in 2022, indicating that the challenge itself doesn't greatly affect what domain teams prototyped in. The increase in use of digital prototypes could be due to the 2022 challenge requiring precision parts to a larger degree than that of the 2021 challenge, necessitating digital models that could be 3D printed or laser cut. Sketching being used less in 2022 could be the result of some teams learning from previously participating in the challenge that making physical prototypes early was beneficial (Ege et al., 2023).

Comparing prototype purposes between datasets reveal large percentage differences, where except for communication, all the other purposes were used significantly less than in 2022 than in the 2021 dataset. This could be due to the manner in which prototyping purposes were coded. The 2021 IDEA dataset was coded by researchers with the possibility of having multi-purpose prototypes. The 2022 dataset had teams coding manually, only allowing participants to choose one purpose, which would hopefully yield more accurate recorded purposes with respect to what the prototype was actually for.

when prototypes were made also differ between datasets. The increase in prototypes on the first day might be due to some teams having participated previously and knowing that they got points in the challenge for uploading prototypes, thus incentivising uploading more prototypes. The different challenges also likely affected when prototypes were made, as prototyping for the hydro-power challenge was more complex, and prototypes took longer to manufacture and test, compared to the more straightforward vaccine distribution challenge from 2021.

Ege et al., (2023) previously performed a chi-square test of independence to examine the relation between prototyping domains and purposes in the 2021 IDEA Challenge dataset, and found similar results to those in Section 3.3 corroborating the results of findings from the IDEA 2021 dataset. Both

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analyses found that: I) Physical prototypes were used more than expected for active learning and less for communication and exploration; II) Digital prototypes were used as expected for exploration, and; III) sketches were used more than expected for communication and exploration, and less than expected for refinement and active learning.

4.3 Reflections and insights from two years' running of the IDEA Challenge

After running the IDEA Challenge for two consecutive years, a number of insights and reflections have arisen that could support the future running of similar events. The two captured datasets are comparable in size (203 (2021) vs. 240 (2022) prototypes) with the former having already demonstrated research utility through multiple publications (Ege et al., 2023; Giunta et al., 2022; Goudswaard et al., 2022; Kent et al., 2022), thus reflecting the usefulness of the datasets for conducting design studies. A number of changes were incorporated when planning the 2022 IDEA Challenge. Most significant were changes made to Pro2booth that removed the need for post- hoc coding of domains and purposes. These were coded by participants themselves in the 2022 dataset by choosing a purpose and a domain from a drop-down menu for each prototype uploaded to Pro2booth. Participants also provided information on how long prototypes took to make and the equipment used to make them, allowing for analysis of the affordances of different prototypes. In the 2021 dataset, prototype instances had to be treated as equal, without evaluating the time and cost benefits of prototyping techniques. The 2022 hackathon also saw the inclusion of daily taskmaster challenges to get participants into a "prototyping mindset" at the beginning of each day. The teams' final designs were shipped back to the organisers after the challenge, in order to benchmark physical attributes objectively.

Following both IDEA Challenges, a survey was sent out to participants to comment on the IDEA challenge and answer a Likert-scale questionnaire (1-strongly disagree, 5- strongly agree). Questionnaire answers for both challenges are compared in Table 5 showing similarities in most respects. Positive differences indicate an increase from 2021 to 2022, negative differences indicate a decrease.

Table 5. Questionnaire results from 2021 to 2022 showing averages and standard deviations. (1-strongly disagree, 5- strongly agree)

Question	2021 (N=8)	2022 (N=12)	Difference
The challenge was appropriate	4,0 (0,77)	4,1 (0,86)	0,1
I enjoyed the IDEA Challenge	4,5 (0,67)	4,2 (0,90)	-0,3
The IDEA Challenge took too much time	3,0 (0,89)	3,2 (1,28)	0,2
The IDEA Challenge was an appropriate length to do some great designing	3,7 (0,64)	3,9 (0,86)	0,2
The virtual hosting was engaging	3,5 (0,92)	3,8 (0,92)	0,3
I enjoyed meeting other engineering design researches	4,1 (0,70)	3,8 (1,07)	-0,3
I would have preferred IDEA to be hosted in person	4,0 (0,77)	4,2 (1,07)	0,2
I had the tool necessary to tackle the design task	4,1 (0,70)	3,6 (1,44)	-0,5
I would be interested in participating in IDEA again	4,1 (0,70)	4,1 (0,76)	0,0
I would recommend others to be involved in IDEA	4,4 (0,49)	4,5 (0,50)	0,1

Most participants enjoyed taking part in the IDEA Challenge, and 11 of the 12 survey respondents from the 2022 hackathon responded that they would like to be involved in the future of it. All participants in both IDEA Challenges either agreed or strongly agreed that they would recommend others to be involved in IDEA. When asked what participants liked about the challenge, responses included: *"I am really inspired by the combination of design and research. This is a good way to collect data and proceed with research. Also, it's good to have opportunities to design. This journey makes us realize what to improve"* and *"It was a great exercise for us in a way of applying knowledge we are reading about"*. Participants also seemed to appreciate the daily taskmaster challenges, exemplified by the response *"I think that they put us in the mindset of quickly creating something, and that mindset stayed throughout the day"*.

This year's hackathon aimed to level the playing field in terms of design by providing some essential equipment for benchmarking prototypes. Because of shipping delays, some teams didn't receive their packages in time for the start of the hackathon. This has likely affected to answer to the questionnaire question on having the necessary tools to tackle the design task.

Teams found the design briefs of the 2021 and 2022 IDEA Challenge to be appropriate for a 4-day hackathon, illustrated by the survey answers: *"The problem brief was well thought-out and suitable for the available timescale, and it was great to see the diversity in the solutions each team came up with"* and *"I liked that it was a real engineering challenge"*. There were, however, negative comments on the design brief: *"I guess the type of challenge limited our creative freedom a bit, resulting in a lot of existing turbine designs. But that is not necessarily a bad thing, because obviously there is a lot of design and prototyping possibility"*. This highlights one of the main challenges we have had to overcome when planning the challenge. The inaugural challenge was open-ended to comply with eventual Covid restrictions so that teams could participate no matter what facilities they had access to. This, however, made it difficult to objectively benchmark and compare designs which were required for analysis of design processes and outcomes. This year's challenge was therefore based on objectives that would allow each design to be benchmarked. Thus, there is a trade-off between creative freedom and objective comparability that needs to be addressed when suggesting design briefs for similar events.

A response that repeated itself after each IDEA Challenge was that participants would like it to be hosted in person: "*Make it in person (...) Everyone would be dedicated to the event and have the same tools"* and *"It would be great to have a conference track dedicated to this challenge in future years*". In-person hackathons have different research affordances. While they level the playing field between different groups they also prevent teams from truly working independently as ideas spill over between groups.

In summary, teams enjoyed participating in the challenge as it provided them the ability to engage in a real engineering design challenge whilst being part of real design research. A tension is identified between openness of task and objective evaluation options for benchmarking designs. The latter is useful for providing concrete recommendations on best practice but by closing the task it could be seen to reduce realism. Many participants wanted IDEA to be hosted in person which is under consideration for future years, although it brings with it a range of logistical and cost challenges.

4.4 Future of the IDEA Challenge

Following the inaugural IDEA Challenge hosted by the University of Bristol in 2021 with four participating institutions, the 2022 hackathon was hosted by the Norwegian University of Science and Technology featuring five participating institutions. The 2023 IDEA Challenge will be hosted during the spring by the University of Zagreb with a target of 8 participating universities.

IDEA challenges in 2021 and 2022 used a single design challenge over 4 days. Future design studies could explore multiple single-day challenges, permitting the exploration of multiple design conditions (eg specific design tools or virtual vs. in-person working) for each team during the course of the challenge. The current platform can capture prototypes' costs and purposes, but we still don't know yet what they contribute to the design process. Investigating the cost/benefit tradeoff of prototyping could be the aim of future IDEA Challenge studies to assist with good method selection during fast-paced design sprints such as those undertaken at events like the IDEA Challenge. Future studies on the presented dataset will further analyse the dataset to consider how individual team prototyping strategies vary and impact design, as opposed to the cohort level used in this paper, as well as how different team demographics impact output.

5 CONCLUSION

This paper has presented the 2022 IDEA challenge and elements of the captured dataset with the aim of providing insights into prototyping behaviours at virtually hosted hackathons, comparing it with the 2021 challenge dataset and providing reflections and learnings from two years of running the challenge. The dataset provides valuable insights into how designers spend their time at hackathon events and how, why and when prototypes are used during their design processes. The paper also corroborates the findings from the 2021 dataset and demonstrates the complementarity of sketches and physical prototypes with regard to purposes. Analysis revealed that I) Physical prototypes are used more than expected for refinement and active learning and less than expected for communication and exploration; II) Digital prototypes are used less than expected for communication; and, III) Sketches are used less than expected for refinement and active learning but used more than expected for

https://doi.org/10.1017/pds.2023.382 Published online by Cambridge University Press

communication and exploration. It also revealed that physical prototypes were quicker to make than digital prototypes, going against the typical motivator of going digital to permit quick iterations.

FUNDING

This research is supported by the Research Council of Norway (grant number 321386).

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