

*DTRS13*

13<sup>th</sup> Design Thinking Research Symposium  
Technion – Israel Institute of Technology  
March 22-24, 2022

# **Expanding the frontiers of design: A blessing or a curse?**

**Program  
Abstracts  
Workshops**

22nd March 2022

## Tuesday

8:15	9:00	Registration
9:00	10:15	Opening ceremony
10:15	10:45	Coffee break
10:45	11:10	<b>Session 1:</b> <i>Pondering design 1</i>
11:10	11:35	
11:35	12:00	<b>Session 2:</b> <i>Pondering design 2</i>
12:00	12:25	
12:25	13:25	Lunch
13:25	13:50	<b>Session 3:</b> <i>Text analysis</i>
13:50	14:15	
14:15	14:40	
14:40	15:05	<b>Session 4:</b> <i>Cultural and social concerns</i>
15:05	15:30	
15:30	16:00	Coffee break
16:00	16:25	<b>Session 5:</b> <i>Design Thinking in professional training</i>
16:25	16:50	
16:50	17:15	
17:15	19:15	3D Printing workshops 1 & 2

23rd March 2022

## Wednesday

9:00	9:25	<b>Session 6:</b> <i>Design teams of diverse backgrounds</i>
9:25	9:50	
9:50	10:15	
10:15	10:45	Coffee break
10:45	11:10	<b>Session 7:</b> <i>Studio experiences</i>
11:10	11:35	
11:35	12:00	<b>Session 8:</b> <i>Expanding architectural design</i>
12:00	12:25	
12:25	13:25	Lunch
13:25	13:50	<b>Session 9:</b> <i>Empathic design beyond the mainstream</i>
13:50	14:15	
14:15		Round Table discussions
	15:30	
15:30	16:00	Coffee break
16:00		Stratasys + Visit to Printer lab
	18:30	
18:30	19:00	Free time
19:00	21:30	Conference dinner

24th March 2022

		<b>Thursday</b>	
9:00	9:25	<b>Session 10:</b> <i>Design Thinking: Methods, teaching and research</i>	
9:25	9:50		
9:50	10:15	<b>Session 11:</b> <i>Visual representation in design</i>	
10:15	10:40		
10:40	11:10	Coffee break	
11:10	11:35	<b>Session 12:</b> <i>Design interventions in industry and business</i>	
11:35	12:00		
12:00	12:25	<b>Session 13:</b> <i>Design contributes to transformation</i>	
12:25	12:50		
12:50	13:50	Lunch	
13:50	14:20	Remembering Ömer Akin	
14:20	15:00	Farewell – What next? <i>Introducing DTRS14</i>	
15:00	19:00	Optional Haifa tour	3D Printing workshops 3 & 4
19:00	21:30	Optional dinner in downtown restaurant*	

*\*Not covered by registration fee*

**Tuesday, March 22, 2022**

8:15-9:00

**Registration**

9:00-10:15

**Opening ceremony and session**

Chair: Ezri Tarazi

Dr. Arch. Einat Kalisch-Rotem

Mayor of Haifa

Prof. Jacob Rubinstein

Technion Executive vice president for research

Prof. Yasha Grobman

Dean, Faculty of Architecture & Town Planning

Gabriela Goldschmidt

**10:15-10:45**

**Coffee break**

10:45-11:35

**Session 1: Pondering design 1**

Chair: John Gero

**Christine Toh, Andy Dong, Mike Sharples**

*Designed to write*

**Jan Auernhammer, Chris Ford**

*What is design? The semantic core and periphery of design definition*

11:35-12:25

**Session 2: Pondering design 2**

Chair: Naz Börekçi

**Claudia Eckert, Chris McMahon, Martin Stacy**

*What counts as design?*

**Barbara Tversky (Invited talk)**

*Designing in and out of mind*

**12:25-13:25**

**Lunch**

13:25-14:40

**Session 3: Text analysis**

Chair: Linden Ball

**Newton D'Souza, Tilanka Chandrasekera**

*What design is not*

**Almila Akdag Salah, Senthil Chandrasegaran, Peter Lloyd**

*Analyzing storytelling in design talk using LIWC  
(Linguistic Inquiry and Word Count)*

**Senthil Chandrasegaran, Almila Akdag Salah, Peter Lloyd**

*A computational analysis of tentativeness and  
causation in design talk*

14:40-15:30

**Session 4: Cultural and social concerns**

Chair: Peter Lloyd

**Ariel Guersenzvaig, Jonathan Ventura**

*Design practice, professional responsibility, and self-  
enactment*

**Madhurima Das, Anastasia K. Ostrowski, Shelly Ben-David,  
Gillian J. Roeder, Kimberley Kimura, Catherine D'Ignazio,  
Cynthia Breazeal, Aditi Verma**

*Auditing design justice: The impact of social  
movements on design pedagogy at a technology  
institution*

**15:30-16:00**

**Coffee break**

16:00-17:15

**Session 5: Design Thinking in professional  
training**

Chair: Kenny Segal

**Yvonne Eriksson, Katrin Skagert, Per-Erik Ekwall**

*Design process of live-action video instructions*

**Joana Alves dos Santos, Joana Moreira, Katja Tschimmel**

*Design thinking workshops for social workers*

**Anastasia Ostrowski, Cynthia Breazeal, Hae Won Park**

*How do older adults engage as robot co-designers?  
Rapid prototyping supported by lived experiences  
with technology*

17:15-19:15 Workshops

## Wednesday, March 23, 2022

9:00-10:15

### **Session 6: Design teams of diverse backgrounds**

Chair: Bo Christensen

**Xifan Ou, Gabriela Goldschmidt, Miriam Erez**

*Exploring the effect of team composition on creativity in design idea generation*

**Hernan Casakin, Gaetano Cascini**

*Multi-disciplinary design teamwork: Quality of collaboration and implications for extending the frontiers of design in education*

**John Gero, Julie Milovanovic**

*What is happening when designers from different disciplines work together: Characterization of the design behaviors and design spaces of mechanical and electrical engineers working in teams*

10:15-10:45

### **Coffee break**

10:45-11:35

### **Session 7: Studio experiences**

Chair: Haim Parnas

**Kenny Segal, Jonathan Ventura**

*Harnessing cultural empathy through design anthropology: An alternative design pedagogy approach*

**Naz Börekçi**

*Factors, strategies and criteria in design convergence*

11:35-12:25

### **Session 8: Expanding architectural design**

Chair: Dafna Fisher Gewirtzman

**Diana Osmólska, Alan Lewis**



*The impact of outsourcing and collaboration on the use of intuition and deliberation: A study of site analysis in the context of architectural design*

**Audrey Mertens, Yaprak Hamarat, Catherine Elsen**  
*Considering architects and clients' interactions through the Design Thinking framework*

**12:25-13:25**    **Lunch**

13:25-14:15    **Session 9: Empathic design beyond the mainstream**

Chair: Claudia Eckert

**Petra Ahde-Deal, Mette Laier Henriksen**

*Empathy goggles – The advantages of a physical empathy exercise when teaching design process and group work*

**Daniel Metcalfe**

*Empathic multispecies design – Using empathy to design with animal perspectives in mind*

14:15-15:30    Round Table discussions

**15:30-16:00**    **Coffee break**

16:00-17:15    **Special guest lecture**

Chair: Ori Levin

**Yariv Sade, Stratasys**

*Expanding the frontiers of design with full-color 3D printing technology*

17:15-18:30    Visit to Stratasys 3D printing lab in the Faculty of Computer Science (Prof. Gershon Elber)

18:30-19:00    Free time

**19:00-21:30**    **Conference dinner**

**Thursday, March 24, 2022**

9:00-9:50

**Session 10: Design Thinking: Methods, teaching and research**

Chair: Daniel Metcalfe

**Ezri Tarazi**

*7D – Nature centered design*

**Ana Thudichum Vasconcelos, Carla Paoliello, Ana Lia Santos**  
*Innovative teaching methodology: A learning process on how to translate DT knowledge and tools to non-designers*

9:50-10:40

**Session 11: Visual representation in design**

Chair: Yvonne Eriksson

**Janett Adler, Jea Hoo Na, Martyn Evans**

*Design communicating space tech innovation*

**James Andrew Self**

*Distributer design thinking: Understanding the role and use of design representation*

**10:40-11:10**

**Coffee break**

11:10-12:00

**Session 12: Design interventions in industry and business**

Chair: Yoav Sterman

**Lina Rylander, Magnus Eneberg**

*Designing for change in complex socio-technical systems*

**Fatma Demir, Irina Saur-Amaral, Daniel Ferreira Polóniac**

*Design thinking and innovation in SMEs: A systematic literature review in terms of barriers and best practices*

12:00-12:50 **Session 13: Design contributes to transformations**  
Chair: Andy Dong

**Bo Christensen, Kasper Arendt, Paul McElheron, Linden Ball**  
*The design entrepreneur: How adaptive cognition and formal design training create entrepreneurial self-efficacy and entrepreneurial intention*

**Hanna Lena Bogner, Anna-Sophia Rabe**  
*Design Thinking meets innovation management – A case study examining how Diplomatic Rebels manage design in organizations*

**12:50-13:50 Lunch**

13:50-14:20 Remembering Ömer Akin

14:20-15:00 **Farewell & What next?**  
*Introducing DTRS14*

---

15:00-19:00 Haifa tour / Workshops

19:00-21:30 Optional dinner in a restaurant in downtown Haifa (not included in registration fee)

# Abstracts



Tuesday, March 22, 2022

## Session 1

### Designed to write

Christine Toh<sup>a</sup>, Andy Dong<sup>b</sup> and Mike Sharples<sup>c</sup>

<sup>a</sup> University of Nebraska at Omaha

<sup>b</sup> Oregon State University

<sup>c</sup> The Open University

This article describes the cognitive and processual similarities between creative writing and designing. We have chosen to investigate this intersection as one way to address the expansion in the boundaries of design thinking. Evidence of this intersection is drawn from a book on the cognitive aspects of creative writing and an interview with the author. The article identifies four sets of similarities between creative writing and design: processes; cognitive structures and processes; methods; and social processes. Based upon our analysis, we find reason to conclude that writing is a form of design and that writers are *ipso facto* designers. Since the human faculty of language is the foundation for creative writing, and language is thus far considered the paragon of cognitive skills, we conclude that the proliferation of design thinking across disciplines should be expected. If writing is designing, then all forms of communication modes (mathematics, language, symbology) are all forms of design itself.

### What is design? The semantic core and periphery of design definitions

Jan Auernhammer and Chris Ford

Center for Design Research, Stanford University

This paper examines the shared semantics among diverse Design definitions to identify its semantic core and discusses several

dilemmas that make a clear boundary for defining Design difficult and multifaceted. The research provides evidence that there is a diverse understanding and usage of the term Design. However, shared word-groups inherent in the definitions provide a family resemblance or bundles of interpredictable attributes for a shared comprehension of Design. Furthermore, a thematic analysis revealed five dilemmas, including Complexity, Zeitgeist, Expertise, Identity, and Disciplinary Perspective, making defining Design multifaceted. While activities and practice differ in diverse disciplines, the fundamental human capacity of productive or design thinking of determining a purposeful and meaningful (end) design (means) is shared among diverse professional disciplinary practices.

## Session 2

### What counts as design? No one right answer

**Claudia Eckert<sup>a</sup>, Chris McMahon<sup>b</sup> and Martin Stacey<sup>c</sup>**

<sup>a</sup> The Open University, Milton Keynes, UK

<sup>b</sup> University of Bristol, Bristol, UK

<sup>c</sup> De Montfort University, Leicester, UK

What design *is* remains controversial. Views are shaped by people's different perspectives, which depend both on the particular design disciplines they practise or study, and on the concerns and the theoretical and methodological concepts and tools of the intellectual disciplines they bring to looking at design. This paper looks at just how different some alternative views are and argues that the different types of design are too diverse to make agreeing on a crisp definition of design a feasible enterprise. Instead, we should accept that design is a family resemblance concept, and that different and seemingly contradictory views on what design is, can be valid. What follows from this is that we should focus cross-disciplinary studies on understanding the patterns of similarity and difference that connect different design fields, but do not apply to all types of design.

Moreover, we should treat knowledge generation and problem-framing activities as legitimate and important parts of design.

## Designing in and out of the mind

**Barbara Tversky**

Stanford University and Teachers College, Columbia University

Designing is a way of thinking, or rather, many ways of thinking. Designers need ideas; ideas are associations to stimuli, in the case of design, the stimuli are design problems. “Problem” implies a need for new association, new solutions, breaking old ones that may be useful otherwise. New ideas can overwhelm the mind so they need to be put out of the mind and into the world where they can be played with and tested creating a feedback loop. Research from cognitive science will be brought to illuminate that feedback loop. What then, separates design in architecture and engineering from design of art or policy or business or the everyday designs of ordinary people in their daily lives? Content and skills which guide the thinking in and out of the mind.

## Session 3

### What design is not

**Newton D’Souza<sup>a</sup> and Tilanka Chandrasekera<sup>b</sup>**

<sup>a</sup> Florida International University

<sup>b</sup> Oklahoma State University

To bring disciplinary clarity to the boundaries of design, and to understand “what is design?” the study poses an antithetical question: “what is not design?” This negative question is examined through a semantic analysis of papers authored in the Journal Design Studies



over the past 30 years. The objective of the paper is to revisit the past debates on what one considers as the boundaries of design, describe them and let design researchers formulate their own interpretation of its meaning in the contemporary context. Results are outlined through ten major themes that reflect the nature, product and uniqueness of design.

## **Analysing storytelling in design talk using LIWC (Linguistic Inquiry and Word Count)**

**Almila Akdag Salah<sup>a</sup>, Senthil Chandrasegaran<sup>b</sup> and Peter Lloyd<sup>b</sup>**

<sup>a</sup> Department of Information and Computing Sciences, Utrecht University

<sup>b</sup> Faculty of Industrial Design Engineering, TU Delft

Design thinking concepts such as storytelling, framing, and co-evolution, have been established from close readings of design activity. The increase in easy-to-use computational methodologies provides an opportunity to validate these concepts more widely. Among these concepts, storytelling is already operationalised through various computational approaches. In this paper, we create one corpus of design activity data from the four shared-data DTRS workshops and use Linguistic Inquiry and Word Count (LIWC) in attempting to automatically detect components of stories. However, the conversational nature of the data indicates that further development in methodology is needed. The contribution of the paper lies both in outlining how an automated method for identifying stories could work and showing how the DTRS corpus can be compared with other large datasets outside of the design discipline. This represents a further step on the way to understanding design thinking in conversational contexts.

## **A computational analysis of tentativeness and causation in design talk**

**Senthil Chandrasegaran<sup>a</sup>, Almila Akdag<sup>b</sup> and Peter Lloyd<sup>a</sup>**

<sup>a</sup> Faculty of Industrial Design Engineering, TU Delft, Delft, The Netherlands

<sup>b</sup> Department of Information and Computational Sciences, Utrecht University, Utrecht, The Netherlands

Analysing records of design activity such as transcripts or documents have typically involved close reading of transcripts and manual identification of concepts and behaviours. We explore the applicability of a machine-learning based computational tool—called *Empath*—in identifying high-level patterns in design talk. Specifically, we use it to examine the datasets from the Design Thinking Research Symposium (DTRS) workshops for two contrasting aspects of design talk—the expression of tentativeness that characterises designers’ exploration of the problem-solution space, and the expression of causal reasoning that characterises designers’ analytical thinking. We find that such a tool can be effectively used as a means of “distant reading”. However, the lack of design relevance in the tool’s training data results in ambiguities and miscategorisations that still need resolution through close reading.

## Session 4

### Design practice, professional responsibility, and self-enactment

**Ariel Guersenzvaig<sup>a</sup> and Jonathan Ventura<sup>b</sup>**

<sup>a</sup> Elisava Barcelona School of Design and Engineering, Spain

<sup>b</sup> Hadassah Academic College, Israel

This paper argues for a reconsideration of what it means to be a responsible professional designer, all while steering away from examining ethics in terms of obligations and facing the fact that current professional design often involves working *in, with, and for* the industry. While lenient in its understanding of design, it presents a normative framework that conceptualizes professional design as a *practice*, i.e., as a coherent, complex, socially established, and

cooperative activity with its specific intrinsic rewards and standards of excellence. By discussing responsibility as a virtue, the paper makes the case that a designer's personal investment in the design profession can be seen as a way of self-enactment, which provides strong motivating reasons for responsible action. The thrust of the argument retains the notion of responsibility understood as the readiness and willingness to convert care into design and to work on the constraining conditions of a design situation or process.

## **Auditing design justice: The impact of social movements on design pedagogy at a technology institution**

**Madhurima Das<sup>a</sup>, Anastasia K. Ostrowski<sup>a</sup>, Shelly Ben-David<sup>a</sup>, Gillian J. Roeder<sup>a</sup>, Kimberley Kimura<sup>b</sup>, Catherine D'Ignazio<sup>a</sup>, Cynthia Breazeal<sup>a</sup> and Aditi Verma<sup>c,1</sup>**

<sup>a</sup>Massachusetts Institute of Technology

<sup>b</sup>Wellesley College

<sup>c</sup>University of Michigan/Harvard Kennedy School

The purpose of engineering is to solve consequential, real-world problems in service of society. To be effective problem-solvers in societal contexts, engineers and designers ought to be trained to conceptualize and operationalize ethics, equity, and justice in their practice. Our work develops a methodology for an ethics, equity, and justice audit of design pedagogy that can also be extended to design practice. We develop this methodology by drawing on and extending the Design Justice framework, which we then use to assess design pedagogy at a technology institution – the Massachusetts Institute of Technology. In addition, we explore how design and critique courses engage with ethics, equity, and justice content in course syllabi and examine the impact of social and racial justice movements on design pedagogy. Our audit of design pedagogy, the largest such audit of its

kind, serves as a proof of concept of how this methodology can be applied more broadly to design education and practice.

## Session 5

### Design process of live-action video instructions

**Yvonne Eriksson<sup>a</sup>, Katrin Skagert<sup>b</sup> and Per-Erik Ekwall<sup>c</sup>**

<sup>a</sup> School of Innovation, Design and Engineering, Mälardalen University, Sweden

<sup>b</sup> Division Material and Production, Department Method for Product Realization, RISE Research Institute of Sweden, Gothenburg, Sweden

<sup>c</sup> Faculty of Media Studies, Dalarna university, Falun, Sweden

The aim of this design project is to explore ways of co-designing instructional videos, together with representatives from the elderly care sector, that show how to use Personal Protective Equipment (PPE) and how to follow basic hygiene routines. We have used a Design Thinking (DT) and Research through design (RtD). The results show that the main improvements derived from using a co-design process were input on the details needed to make the video more realistic and more reflective of real-world scenarios.

### Design Thinking workshops for social workers

**Joana Alves dos Santos<sup>a</sup>, Joana Moreira<sup>a</sup> and Katja Tschimmel<sup>b</sup>.**

<sup>a</sup> Mindshake

<sup>b</sup> Mindshake / University of Porto / ID+

Design Thinking has been gaining significant attention as a potential approach to addressing organisational problems, including those of social institutions. This paper provides a theoretical and practical approach to Design Thinking as a method for social workers. The

starting point of this research is based on the hypothesis that Design Thinking can make a significant contribution to social workers' mindset and skills for developing innovative projects, by providing a design methodology set of tools. To answer the main research question, if and how social workers can become Design Thinking practitioners, we conducted a qualitative study through the realisation of 3 training workshops supported by questionnaires and interviews. The results indicate that social workers are motivated to learn DT skills and to work more creatively in teams, but that a 5-day workshop is not enough to give them the basic competences to apply the DT process by themselves.

## **How do older adults engage as robot co-designers? Rapid-prototyping supported by lived experiences with technology**

**Anastasia K. Ostrowski, Cynthia Breazeal and Hae Won Park**  
Massachusetts Institute of Technology

Co-design is a powerful methodology to incorporate older adults into the design of new technologies. It has been less commonly used in robot design processes, especially with older adults. Embedded in our work of a year-long co-design process with older adults, 28 participants between the ages of 70 and 94 engaged in a rapid-prototyping session to design social robot interactions using a flow-based programming interface. In this paper, we explore the rapid-prototyping session investigating how older adults design robot interactions supported by lived experiences with technologies, and how older adults relate to being robot interaction designers after the rapid-prototyping session. Results demonstrate the impact and value of incorporating co-design rapid-prototyping methods that empower users to design and program social robots. Our results strongly advocate for co-design methodologies that empower users, such as older adults, and expand the boundaries of technology design.

**Wednesday, March 23, 2022**

**Session 6**

**Exploring the effect of team composition on creativity in design idea generation**

**Xifan Ou<sup>a</sup>, Gabriela Goldschmidt<sup>b</sup> and Miriam Erez<sup>b</sup>**

<sup>a</sup> University of Shanghai for Science and Technology

<sup>b</sup> Technion – Israel Institute of Technology

Team composition affects the performance, including creativity, of teams in design tasks as in other tasks. Existing research presents mixed results on the impact of team composition on creativity. In this paper, we conduct an empirical study to investigate the impact of three different team categories on creativity: teams composed of designers only, teams composed of designers and non-designers, and teams of non-designers only. 18 volunteer dyads completed a short design ideation task by generating solution ideas, expressed through quick freehand sketches and/or texts. Three expert judges scored the ideas in terms of originality, usefulness, compliance with requirements, and in addition assigned an independent subjective creativity score to each team. Fluency and rareness of ideas were also calculated. Findings indicate that mixed teams got the highest scores in almost all variables, thereby adding to the literature that favors mixed teams for increased creativity.

# **Multi-disciplinary design teamwork: Quality of collaboration and implications for extending the frontiers of design in education**

**Hernan Casakin<sup>a</sup> and Gaetano Cascini<sup>b</sup>**

<sup>a</sup> School of Architecture, Ariel University, Israel

<sup>b</sup> Department of Mechanical Engineering, Politecnico di Milano, Milano, Italy

Design is a complex activity requiring disciplinary areas working in collaboration. However, how multi-disciplinary design teamwork affects the quality of collaborations from a social and task-related perspective, and how it can inform about extending the frontiers of design should be investigated. An empirical study comparing multi- with mono-disciplinary teams was conducted in the context of project-based education. Participants were students from two master's courses: one involving different disciplines, and the other mechanical engineering only. A series of semi-structured interviews was carried out, and the produced transcripts were analyzed qualitatively. Multi-disciplinary teamwork was found to enable a comprehensive understanding of the design task. However, this requires skills and competences different than those from mono-disciplinary teams, what challenges team dynamics and collaboration. Implications for extending the frontiers of design in higher education are discussed.

## **What is happening when designers from different disciplines work together: Characterization of the design behaviors and design spaces of mechanical and electrical engineers working in teams**

**John Gero and Julie Milovanovic**

College of Computing and Informatics, University of North Carolina at Charlotte, USA

Multidisciplinary teams are key in tackling the complexity of the artifact designed. In this article, we study multidisciplinary teams' design behaviors by combining protocol analysis, Natural Language Processing and network science. We analyzed three teams composed of professional mechanical and electrical engineers. Teams engaged in designing with similar processes and spend more cognitive effort on evaluating their design when collaborating. Creating a network of the concepts explored based on designers' disciplines produces their design spaces and illustrates the influence of context knowledge on the design situation. Mechanical engineers tend to tackle user-centered issues while electrical engineers focused more on product related one. But, for most of the concepts covered (e.g., end users, technological aspects) we observed collaboration between disciplines. Using networks to represent design spaces could become a tool to support team design collaboration.

## Session 7

### **Harnessing cultural empathy through design anthropology: An alternative design pedagogy approach**

**Kenny Segal<sup>a</sup> and Jonathan Ventura<sup>b</sup>.**

<sup>a</sup> The Department of Inclusive Design, Hadassah Academic College, Jerusalem IL

What is a cultural object? For over a decade we have been teaching a unique practice-oriented course for product designers focusing on three distinct cultures of wood: classic Japanese carpentry, Western and Southern African wood cultures, and the ascetic design of the Shakers. Instead of working in a classic manner of presenting the students with a design brief describing our intended result, including a clear function and market-value, we drove the students to start



thinking about cultural philosophies, norms, and conventions, as well as religious principles. Mixing various Israeli cultures (Palestinian, Ethiopian, and more) with a contemporary interpretation of these three cultures created a new approach towards the essence of both empathetic design as well as vernacular design. Through the unique cultural traits of wood, and understanding the Other, empathy is embedded within design practice.

## **Factors, strategies and criteria in design convergence**

**Naz A.G.Z. Börekçi**

Middle East Technical University, Department of Industrial Design

A study was carried out for investigating design convergence in a 2-in-1 hand-held stick vacuum cleaner project conducted with graduate design students. The design process was composed of three stages, problem analysis, idea generation and evaluation, defining three sets of divergence-convergence activities. The study is mainly based on the responses of the students (n=30) to a survey distributed in class. The survey consisted of six open ended questions that inquired into the 2-step convergence carried out in the idea generation stage, 1) for the generation of six alternative design solutions from a morphological chart containing sub-solutions for product sub-functions, and 2) then for the development of one final design solution. The data was subjected to thematic and content analyses. The findings reveal five factors, five strategies, and eight criteria that explain how acts of design convergence have taken place for the students.

## **Session 8**

### **The impact of outsourcing and collaboration on the use of intuition and deliberation: A study of site analysis in the context of architectural design**

**Diana Osmólska and Alan Lewis**

University of Manchester

This study utilises dual-processing theory to explore the impact of outsourcing and collaboration on the use of intuition and deliberation during site analysis. At site analysis stage, information is gathered, synthesised, and applied by architects to test the feasibility of proposed construction projects. Architects might collaborate with different internal or external players or outsource information-gathering tasks. 21 semi-structured interviews were conducted with architects and architectural assistants. The findings show that while collaboration can prompt deliberation, it can also lead to the use of intuition when supported by collective confidence, in turn causing errors to be overlooked. Outsourcing facilitated efficiency and reduced complex reasoning associated with difficult problems, providing an appealing and sometimes problematic method of working. This study expands design thinking by exploring site analysis, a non-design activity essential to the design process.

### **Considering architects and clients' interactions through the Design Thinking framework**

**Audrey Mertens, Yaprak Hamarat and Catherine Elsen**

Université de Liège

As the quality of the relationship between designers and users highly contributes to the success of the design process, involving users in the design process is more than ever crucial to the project. This paper

argues that Design Thinking could help architectural routines evolve regarding the interactions between end-users and architects. Though the Design Thinking principles may serve as an inspirational framework, we claim they still need to be adapted to architects' needs and fields' constraints. This paper focusses on the Belgian housing design field, specifically questioning the posture architects tend to have towards their end-users through 5 narratives collected from on-field practitioners. The aim is to establish a parallel between day-to-day architectural practice and Design Thinking as a mindset and as a process, as to delineate the essential points architects might benefit from and as to question the role that end-users could furthermore play throughout housing design processes.

## **Session 9**

### **Empathy goggles - The advantages of a physical empathy exercise when teaching design process and group work**

**Petra Ahde-Deal and Mette Laier Henriksen**

Copenhagen School of Design and Technology

In this paper we will address the impact of empathy when designing for blind and partially sighted people and discuss our experiences on how to engage students in an eye-opening physical empathy exercise when entering a new project. We will also explore the impact of using an empathy experience in group work and in the design process. One way to get to know the users, is to visit their everyday life and to try to experience their joys and frustrations. We transformed ski goggles into empathy goggles with several eye deceases and blindness. The task was to produce a prototype of wearables for a concept inspired by blind and partially sighted people that would help them in their everyday life, yet which would also be of interest for anyone to use.

Our ambition was to teach empathy to better understand the everyday life of the end users of this interesting, yet vulnerable user group.

## **Empathic multispecies design – Using empathy to design with animal perspectives in mind**

**Daniel Metcalfe**

Technion – Israel Institute of Technology

Supporting a greater diversity of species within human-dominated habitats has been proposed as a way of achieving both conservation goals and addressing the growing alienation of people from nature. To advance the vision of more biodiverse human habitats there is a need for a design practice capable of understanding and addressing the needs of nonhuman species within human-dominated habitats. Here I explore the prospect of using empathic design when designing for nonhuman species, through analysis and reflection on a design exercise intended to help designers experience the world from the point of view of other animal species. The data gathered from interviewing participants in the exercise suggest that trying to perceive the world from the point of view of other species may have positive effects on the design process, including a deeper understanding and more holistic view of the animal, changes in sentiment and real-world interaction with the animal, and increased curiosity and motivation for designing for the animal.

### **Guest lecture**

## **Expanding the frontiers of design with full-color 3D Printing technology**

**Yariv Sade**

Stratasys

3D printing opens up a whole new world of possibilities for industrial designers. Geometries, textures, and colors can now be combined in a fully digital workflow from design to production. By integrating 3D printed CMF models into the product design process, designers can also make better data-driven design decisions and accelerate the design process. In this lecture, Yariv Sade will introduce Stratasys's full-color 3D printing technology and the value it can bring to industrial designers and design-oriented businesses.

**Thursday, March 24, 2022**

## **Session 10**

### **7D – Nature centered design**

**Ezri Tarazi**

Technion – Israel Institute of Technology

Decades after Design Thinking first emerged and developed, it is now detached from its theoretical core, where some of its aspects have become a buzzword, specifically the famous Double Diamond five-stage methodology. 7D is an attempt to bring more integrative thinking into the creative and innovative design process and expand the scope of the human-centered approach by placing the individual in the context of human society, nature, and the world. Based on a natural agricultural metaphor that has been used and tested in various contexts with thousands of participants and hundreds of organizations, 7D is an attempt to make Design Thinking more relevant, comprehensive, and viable. It is open-ended in its structure and can support the mindful shift to a new integrated design approach. It offers a nature-centered design framework of values and processes, critically needed to tackle the mammoth challenges currently faced by humanity.

### **Innovative teaching methodology: A learning process on how to translate DT knowledge and tools to non-designers**

**Ana Thudichum Vasconcelos, Carla Paoliello and Ana Lia Santos**

FBAUL - Lisbon University Fine Arts Faculty

This article presents an educational strategy to spread Design Thinking (DT) among non-designers (N-D). We challenged the

students from Product Design degree, at Fine Arts Faculty (Lisbon University), to create DT Workshops (WS) for N-D. This procedure was carried out over two semesters of the last two consecutive years. Repeating the process allowed us to obtain a set of representative WS and stabilize the following pedagogical practice: (1) Creation and development, (2) Testing and feedback incorporation, (3) Communication, and (4) Academic evaluation. The students were placed at the center of the problem, questioning the objectives of their intervention, and shaping the process communication tools. They switched from “creative way(s) of knowing, thinking and acting” as said by Alain Findeli to “creative ways of sharing”. The findings are based on identifying the likelihood for dissemination of DT to N-D, going far beyond the transfer of know-how.

## Session 11

### Design communicating space tech innovation

**Janett Adler, Jea Hoo Na and Martyn Evans**

Manchester School of Art, Manchester Metropolitan University

This paper explores the role of visual design in the high-tech sector in the UK. It presents a design thinking model suitable for communicating innovation values of UK based satellite and space tech organisations. It comprises findings from five case studies involving design-led brand development and creation. Research challenges were identified during the process of combining design with future technologies, including the development of an effective problem-solving approach that helps build business cases to enter new markets, enhancing communication with prospective funders, and establishing a professional level brand identity that is representative of innovative organisation culture. A new design thinking model was developed using a hybrid of case study and grounded theory methodologies through engagement with industry partners in the North West of England, UK. These together inform, generate and advocate solutions

for enhanced collaboration between design and the space tech industry.

## **Distributed Design Thinking: Understanding the role & use of design representation**

**James Andrew Self**<sup>ab</sup>

<sup>a</sup> UNIST (Ulsan National Institute of Science & Technology), Department of Design

<sup>b</sup> Brunel University London, School of Design

Due to the ill-defined nature of design problems, and resulting search for solution candidates, the embodiment of intentionality through design representation is important to design thinking. Design representations are employed as means to support designerly thinking between ill-defined design problems and coupled solution candidates. One way into developing further understanding of design representation, its role and use as scaffold for design thinking, is to adopt theory on distributed cognition. I offer a review and discussion of design representation as distributed cognition. I then position distributed cognition as a possible means to scaffold design research aimed at building general theory to explain design representation's role and use in design cognition.

going far beyond the transfer of know-how.

## **Session 12**

### **Designing for change in complex socio-technical systems**

**Lina Rylander<sup>a,c</sup> and Magnus Eneberg<sup>b</sup>**



<sup>a</sup> KTH Royal Institute of Technology, Integrated Transport Research Lab, Stockholm, Sweden

<sup>b</sup> KTH Royal Institute of Technology, Integrated Product Development and Design, Stockholm, Sweden

<sup>c</sup> Scania CV AB

The purpose of this paper is to increase our understanding of how designers perceive the development in the discipline. It explores the designer's role in working with system transformation and transition and exemplifies how design methods and processes may contribute. The research study builds on interviews and observations in a research project at the transport solution provider Scania. To contribute strategically, designers needed to work in a multidisciplinary manner, involving other disciplines in the client firm. Furthermore, the increased attention in design thinking made the client firms ask designers to facilitate interdisciplinary workshops. Today, the design offering has become more complex, and designers are involved in activities aiming for a change in complex socio-technical systems, which has led to a shift in the designer's role, from working in an intradisciplinary manner to becoming a stakeholder in transdisciplinary work applying methods from the system thinking

## Session 13

### **The design entrepreneur: How adaptive cognition and formal design training create entrepreneurial self-efficacy and entrepreneurial intention**

**Bo T. Christensen<sup>a</sup>, Kasper M. Arendt<sup>b</sup>, Paul McElheron<sup>c</sup> and Linden J. Ball<sup>d</sup>**

<sup>a</sup> Copenhagen Business School, Denmark

<sup>b</sup> Copenhagen Business School, Denmark

<sup>c</sup> VIA University College, Denmark

<sup>d</sup> University of Central Lancashire, UK

Why are design students more likely than other students to become entrepreneurs? The cognitive mechanisms underpinning design- and entrepreneurial thinking have been argued to be similar, suggesting relevance to business venturing. On the other hand, differential formal training in design vs business education suggests distinct types of “entrepreneurial self-efficacy”. We report a survey ( $N = 296$ ) of design versus business students that assessed how adaptive cognition and formal training drive distinct types of entrepreneurial self-efficacy and entrepreneurial intention. The study finds that design versus business students possess different types of entrepreneurial self-efficacy that are positively predicted by adaptive cognition, but differentially affected by type of education. Both types of entrepreneurial self-efficacy positively predict entrepreneurial intention to start up a new business. These findings advance an understanding of how design cognition overlap with other fields.

## **Design Thinking meets innovation management – A case study examining how *Diplomatic Rebels* manage design in organizations**

**Hanna Lena Bogner and Anna-Sophia Rabe**

Copenhagen Business School, Denmark

This case study introduces the unique concept of the *Diplomatic Rebel*: An innovation manager with the mindsets and skills of a Design Thinker (the rebel) as well as a manager (the diplomat). In doing so, a practice-based approach for managing design and innovation in organizations is presented. Studying the *Diplomatic Rebels* through the lens of literature, shortfalls in Design Thinking are advanced with management literature. While Design Thinking’s purpose is to overcome innovation barriers and drive idea generation, agreeableness and strategic thinking are needed to manage resistance and drive successful implementation in organizational settings. This contribution bridges the gap in academia and practice and consequently calls for a new stream of literature.



## Parallel workshops (optional)

**Tuesday, March 22, 2022**

17:15-19:15+

### **Workshop 1: Parametric knitting**

**Led by: Yoav Sterman and Dana Benshalom**

In this hands-on workshop, participants will be exposed to a basic workflow of parametric design for knitting.

The participants will experiment with generative sketching using Processing to produce a bitmap image that will be used as input for the knitting fabric.

The workshop will introduce some of the basic principles of knitting technology while demonstrating the translation of the generative sketch into a knitting program to produce a physical fabric. Textiles will be knitted using the Coded Matter Lab's Stoll ADF industrial knitting machine.

The workshop is limited to 8 participants.

### **Workshop 2: 3D printing in large scale**

**Led by: Rotem Ifrach**

Prototyping is a key element in Design Thinking, which is often limited to small-scale, using common 3D printers. This workshop will focus on bio-plastic large 3D printing (1 cubic meter) with a unique industrial-scale printer and its contribution to prototyping for design processes in various design fields such as furniture.

**Thursday, March 24, 2022**

15:45-18:00 +

### **Workshop 3: Parametric weaving**

**Led by: Yoav Sterman and Gali Cnaani**

The Coded Matter lab will host a hands-on workshop on parametric design tools for weaving.

The participants will experiment with generative sketching using Processing to produce a bitmap image that will be used as input for the woven fabric.

After a brief introduction to weaving, participants will generate a textile pattern by planning the weaving sequence using a custom design tool. Then, the participants will weave their designs using the lab's TC-2 digital weaving loom.

The workshop is limited to 5 participants.

### **Workshop 4: Save our reefs - print a bio-inspired artificial coral**

**Led by: Ofer Berman**

The Design-Tech Lab will host a hands-on workshop on designing a custom-made ceramic coral using a paste based 3d printing machine.

After a short introduction the participants will experiment with designing and fabricating an artificial coral and preparing the eco-ceramic material.

The workshop is limited to 5 participants.